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Monitoring and Assessment of EU Habitats Directive Annex I Priority Habitat Petrifying Springs, 2025

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Front cover, from left to right and top to bottom:

A deep water fly trap anemone *Phelliactis* sp., Yvonne Leahy; **Common Newt** *Lissotriton vulgaris,* Brian Nelson; **Limestone pavement**, Bricklieve Mountains, Co. Sligo, Andy Bleasdale; **Garden Tiger** *Arctia caja,* Brian Nelson; **Violet Crystalwort** *Riccia huebeneriana*, Robert Thompson; **Coastal heath**, Howth Head, Co. Dublin, Maurice Eakin; **Meadow Saffron** *Colchicum autumnale*, Lorcan Scott

Bottom photograph: Joanne Denyer; **Petrifying spring,** Arroo Mountain, Co. Leitrim

Monitoring and Assessment of EU Habitats Directive Annex I Priority Habitat Petrifying Springs, 2025

Joanne Denyer

Denyer Ecology, Dublin

The NPWS Project Officer for this report was: Domhnall Finch; Domhnall.Finch@npws.gov.ie

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An Roinn Tithíochta, Rialtais Áitiúil agus Oidhreachta, 90 Sráid an Rí Thuaidh, Baile Átha Cliath 7, D07 N7CV

Department of Housing, Local Government and Heritage, 90 North King Street, Dublin 7, D07 N7CV

Contents

Executive Summary

This project involved the survey, review and Conservation Status Assessment of petrifying springs in Ireland. Petrifying springs with tufa formation (Cratoneurion) (EU Habitat code *7220) are listed as a priority habitat in Annex I of the EU Habitats Directive (92/43/EEC).

A field survey of 42 petrifying springs sites was undertaken in 2023-2024, of which 39 were located in SACs. The sites were selected to be a representative sample of petrifying springs in Ireland. They were located in 21 counties with 14 coastal sites and 28 inland sites. At each site, petrifying spring locations were mapped and detailed plots undertaken in a selection of petrifying springs. Data were collected on indicator species (vascular plants and bryophytes), water chemistry, tufa formation, water flow and potential impacts such as trampling, grazing and modifications to water flow. A review of recent literature, reports and other data sources was also undertaken to obtain additional data on new and existing petrifying spring sites in Ireland. The data included new locations for petrifying springs, updated information on known sites and data on petrifying spring condition.

Data from the project (field surveys and data review) added 237 new spring points to the database. This resulted in a dataset with 679 petrifying spring points, from 190 sites in Ireland. In the field survey, a total of 176 plots were recorded in petrifying spring flushes, seepages, springheads and streams. The most frequently recorded petrifying spring vegetation communities were Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades, which have high tufa formation and low species diversity, and Group 6 *Carex lepidocarpa* small sedge springs, which have low tufa formation and high species diversity. The High conservation value community, Group 8 *Saxifraga aizoides-Seligeria oelandica* springs, was recorded from three sites. A total of 10,4158 m^2 of petrifying spring habitat was recorded from the 42 field survey sites. The sites were ranked according to the Conservation scores of the petrifying springs present. Three sites have Outstanding ranking, these are Arroo Mountain SAC, Ben Bulben, Gleniff and Glenade Complex SAC and Black Head-Poulsallagh Complex SAC.

Area, Structure and Functions and Future Prospects were assessed for each field survey site. Water pollution was a major factor determining site condition, leading to low numbers of positive indicator species. Twenty-one sites (50%) had a Favourable overall conservation assessment; 14 sites (33%) had an Unfavourable-Inadequate assessment and seven sites (17%) had an 'Unfavourable-Bad' overall site assessment. The western sites tended to have higher petrifying spring area than the eastern sites (particularly in upland areas). Therefore although only 50% of sites were in Favourable condition, 77.38% (0.08km^2) of the total surveyed area was in Favourable condition. 0.02 km2 (18.42%) of the area was in Unfavourable-Inadequate condition and 0.004 km2 (4.2%) of the area in Unfavourable-Bad condition.

A National Conservation Assessment (NCA) was undertaken in 2024, using the 2023 field survey data and data from the petrifying spring data review. The overall NCA for petrifying springs is Unfavourable-Inadequate, with a Stable trend. Range and Area were assessed as being Favourable. Both have increased since the last assessment (2019), but this is due to more complete data being available. Whilst there have been small losses of habitat area within the reporting period, these are small in comparison to the overall Range and Area and the trend is reporting as 'Stable' for both. Structure and Functions are considered to be Unfavourable-Inadequate, with poor Future Prospects, as 33% of petrifying spring area was in Unfavourable condition. The most frequent criteria which failed the Structure and Functions assessment were: positive indicator species (10% plots); nitrate (8% plots); and, negative bryophyte species (6% plots). These are frequently linked, as elevated nitrate levels can cause an increase in negative bryophyte species and a decrease in positive indicator species. The key pressures recorded in the current assessment relate to water quality and changes to hydrology (groundwater pollution, groundwater abstraction, drainage and modification of hydrological flow). Another key pressure is lack of management, leading to petrifying springs

becoming overgrown with tall vegetation. Recommendations include hydrogeological investigations, further site surveys and the undertaking of conservation measures.

Acknowledgements

I am grateful to everyone who contributed to this project. This work was funded by the National Parks and Wildlife Service (NPWS), Department of Housing, Local Government and Heritage. Domhnall Finch, the NPWS project officer, and the NPWS GIS team provided essential advice and guidance. Melinda Lyons provided invaluable information on methodology, site access and water chemistry.

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A number of ecologists, organisations and NPWS staff provided valuable information on new and known petrifying spring sites for the conservation assessment: Claire Heardman (NPWS), Faith Wilson, BEC Consultants, Colm Clarke (Scott Cawley), Vincent Lang (River Moy Search and Rescue), Hannah Mulcahy (NPWS), Deborah Darcy, Declan O'Donnell (NPWS), Maurice Eakin (NPWS), Hazel Doyle (NPWS), Nick Merchant (NM Ecology), George Smith (Blackthorn Ecology), Maria Long (NPWS), Melinda Lyons (TU Dublin), Pat Roberts (MKO Ireland), Andrea Webb (NPWS) and Rory Hodd (Nimbosa Ecology).

Aerial imagery used in the site reports is from Tailte Éireann Aerial imagery: CYAL50446484 © Tailte Éireann – Surveying.

1 Introduction

1.1 Project rationale

Petrifying springs with tufa formation (*Cratoneurion*) (EU Habitat code *7220) is listed as a priority habitat in Annex I of the EU Habitats Directive (92/43/EEC). Priority habitats are habitat types in danger of disappearance and whose natural range mainly falls within the territory of the European Union. Ireland is obliged to undertake surveillance of Annex I habitats across their range under Article 11 of the EU Habitats Directive; and to report on their conservation status within the country every six years, under Article 17 of the Directive. This is the third round of reporting carried out under Article 17, for the period 2019 to 2024.

The National Conservation Status Assessment report requires information on four parameters: Range, Area, Structure and Functions, and Future Prospects, and also incorporates information relating to the pressures and threats operating on the habitats (DG Environment, 2023a). Field surveys are necessary to assess these parameters.

The first extensive survey of petrifying springs in Ireland was conducted in 2011-2013, as part of a PhD project 'The Flora and Conservation Status of Petrifying Springs in Ireland' (Lyons, 2015) funded by National Parks and Wildlife Service (NPWS) and the Irish Research Council. The results of this baseline survey are summarised in Lyons & Kelly, 2016. This informed the Article 17 report for the period 2007-2012 (NPWS, 2013). A desktop review of subsequent survey data was collated for the Article 17 report for the 2013-2018 period (NPWS, 2019; Denyer & Long, 2018).

The Department of Housing, Local Government and Heritage (DHLGH) commissioned Denyer Ecology to carry out monitoring and reassessment of Petrifying springs in Ireland for the Article 17 period 2019-2024 'National Petrifying Spring Survey 2023-2024'. This included field survey of 42 sites (2023-2024), review of current data on petrifying springs in Ireland, and collation of additional field data. For the previous reporting period of 2013-2018, the overall conservation status of Petrifying springs in Ireland was assessed as Unfavourable-Inadequate and was assigned a deteriorating trend (NPWS, 2019).

1.2 Petrifying springs

1.2.1 Tufa formation

Petrifying springs are a specialised habitat that forms where calcareous waters deposit tufa (a porous rock made of calcium carbonate). Springheads may be distinct point locations giving rise to small streams immediately below the point of emergence, or water may seep to the surface in a more diffuse pattern over a larger area (Lyons & Kelly, 2016.) Petrifying springs can occur in semi-natural habitats such as seepages on coastal cliffs, springs in upland fens and wooded springs, but are also found in artificial habitats such as quarries, water troughs, seepages on walls and in roadside ditches (Denyer *et al*., 2023).

The tufa formation may be small deposits around the bases of plants within the spring (paludal tufa), or can comprise very large mounds and cascades. The main tufa types occurring in Ireland are listed in Table 1 and example photographs shown in Figures 1 to 6.

Table 1 Summary of tufa formation types occurring in Ireland (from Lyons & Kelly, 2016)

Tufa category	Description
Cascade	Developing on steep slopes at varying distances from the water source; characterised by massive, frequently complex build-ups.
Dam	Similar to cascades but forming along streams and rivers and causing the impoundment of water behind a tufa crest.
Stream crust	Sheet-like deposits forming in streams of intermediate to low gradient; these may merge with cascades.
Paludal	Formed in low gradient mires where tufa accumulates around the bases of plants, often surrounded by carbonate muds.
Cemented rudites	Gravels etc. cemented by tufa; often found on coasts where spring water seeps onto shingle banks.
Oncoids/ooids	Unattached, coated grains (<1mm up to 30 cm); the cortex may consist of biotic or abiotic particles, such as stones or plant fragments.

Figure 1 Coastal cascade tufa extending onto beach, Spanish Point, Co. Clare. Photograph Joanne Denyer.

Figure 2 Tufa dam in stream, with water pooling behind dam, Belleek Woods, Co. Mayo. Photograph Joanne Denyer.

Figure 3 Stream crust tufa lining a stream in a woodland clearing, Glenasmole, Co. Dublin. Photograph Joanne Denyer.

Figure 4 Paludal tufa around the bases of bryophytes on flushed limestone pavement, Keelhilla Nature reserve, Burren, Co. Clare. Photograph Joanne Denyer.

Figure 5 Cemented rudites where stream crust tufa has formed around stones in woodland stream, Knocksink Wood, Co. Wicklow. Photograph Joanne Denyer.

Figure 6 Oncoids and ooids formed around vegetation fragments in petrifying spring vegetation within alkaline fen. Eskeragh, Co. Mayo. Photograph Joanne Denyer.

1.2.2 Vegetation communities

The ecological conditions within petrifying springs, with high pH, constant inundation by water and deposition of precipitated calcium carbonate, constitute a challenging environment for plants to colonise, and the communities associated with petrifying springs are therefore highly specialised (Lyons & Kelly, 2016). Irish petrifying springs are usually dominated by bryophytes (mosses and liverworts). They have been classified into eight plant communities (Lyons & Kelly, 2016). These groups encompass a broad range of variation within petrifying springs and include lowland, upland, wooded, unwooded and coastal springs (Table 2). See also Figures 7 to 14 for vegetation group examples.

The Irish Vegetation Classification (IVC (ref) also identifies a number of spring, fen and flush communities. Some of these have close affinity to petrifying spring habitat. For instance:

- FE4B *Philonotis fontana-Palustriella commutata* group*: Palustriella commutata-Bryum pseudotriquetrum* spring (IVC) and Group 2 *Palustriella commutata-Geranium robertianum* springheads (Petrifying spring vegetation group).
- FE1A *Schoenus nigricans-Campylium stellatum* group*: Schoenus nigricans-Campylium stellatum* fen (IVC) and Group 5 Schoenus nigricans springs (Petrifying spring vegetation group).
- FE1C *Schoenus nigricans-Campylium stellatum* group: *Carex panicea-Carex viridula* fen (IVC) and Group 6 *Carex lepidocarpa* small sedge springs (Petrifying spring vegetation group).

However, for other petrifying spring vegetation groups, there is no close correlation with the IVC. Lyons and Kelly (2016) petrifying springs vegetation classification was based on extensive data from petrifying springs only, and currently has a closer fit to Irish petrifying spring vegetation than the IVC.

Table 2 Petrifying spring vegetation groups (adapted from Lyons & Kelly, 2016; 2017)

Group	Name	Description
1	*Eucladium verticillatum-Pellia endiviifolia* tufa cascades	Bryophyte-dominated, strongly tufa-forming spring communities on steep slopes (both coastal and inland), often with low species diversity.
2	*Palustriella commutata-Geranium robertianum* springheads	Woodland springhead tufa cascades, dominated by *P. commutata*, on moderately steep slopes.
3	*Brachythecium rivulare-Platyhypnidium riparioides* tufaceous streams and flushes	Woodland communities with flowing water, typically forming in hydrological sequence below Group 2 springheads
4	*Palustriella commutata-Agrostis stolonifera* springheads	Usually on moderately steep slopes, with abundant *Palustriella commutata*. Similar to Group 2, but on open ground.
5	*Schoenus nigricans* springs	Springs on level ground forming paludal tufa amongst *Schoenus nigricans* tussocks, with an underlayer of bryophytes.
6	*Carex lepidocarpa* small sedge springs	Weakly tufaceous springs, with high species diversity, on level ground, associated with small-sedge fens.
7	*Palustriella falcata-Carex panicea* springs	Springs of level or gently sloping ground, especially characteristic of karst landscapes, and often with bare, unvegetated tufa or exposed bedrock; *Palustriella falcata* dominated.
8	*Saxifraga aizoides-Seligeria oelandica* springs	Species-rich springs with *Saxifraga aizoides* and a suite of rare bryophyte species; weakly tufa-forming, on steep slopes, centred on the Benbulbin Range of NW Ireland.

Figure 7 Coastal cascade tufa with Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades vegetation, Horn Head, Co. Donegal. Photograph Joanne Denyer.

Figure 8 Woodland petrifying spring with cascade tufa and *Palustriella commutata-Geranium robertianum* springheads vegetation, Knocksink Wood, Co. Wicklow. Photograph Joanne Denyer.

Figure 9 Tufa cascade waterfall with Group 3 *Brachythecium rivulare-Platyhypnidium riparioides* tufaceous streams and flushes vegetation, Louisa Bridge, Co. Kildare. Photograph Joanne Denyer.

Figure 10 Spring on coastal slopes with Group 4 *Palustriella commutata-Agrostis stolonifera* springheads vegetation, Rathcor, Carlingford, Co. Louth. Photograph Joanne Denyer.

Figure 11 Petrifying spring/flush with Group 5 *Schoenus nigricans* springs vegetation, Eskeragh, Co. Mayo. Photograph Joanne Denyer.

Figure 12 Group 6 *Carex lepidocarpa* small sedge springs vegetation, Louisa Bridge, Co. Kildare. Photograph Joanne Denyer.

Figure 13 Group 7 *Palustriella falcata-Carex panicea* springs vegetation, Arroo Mountain, Co. Leitrim. Photograph Joanne Denyer.

Figure 14 *Saxifraga aizoides-Seligeria oelandica* springs vegetation, Gleniff, Co. Sligo. Photograph Joanne Denyer.

1.3 Interpretation of Annex I priority habitat petrifying springs

Annex I priority habitat petrifying springs should be predominantly groundwater fed, tufa forming (petrifying) and support typical (*Cratoneurion*) vegetation (Lyons, 2015). Positive indicator species are ecologically significant species of petrifying springs and consist largely of mosses and liverworts (bryophytes), with a smaller number of vascular plants. These are *Aneura pinguis, Bryum pseudotriquetrum, Campylium stellatum, Didymodon tophaceus, Eucladium verticillatum, Fissidens adianthoides, Fissidens crassipes/F. rufulus, Hymenostylium recurvirostrum* var. *recurvirostrum, Jungermannia atrovirens, Mesoptychia turbinata, Palustriella commutata, Palustriella falcata, Pellia endiviifolia, Philonotis calcarea, Plagiomnium elatum, Scorpidium cossonii* and *Scorpidium scorpioides* (bryophytes); *Carex hostiana, Carex lepidocarpa, Carex panicea, Chrysosplenium oppositifolium, Crepis paludosa, Eleocharis quinqueflora, Equisetum telmateia, Equisetum variegatum, Eriophorum latifolium, Festuca rubra, Lysimachia tenella, Parnassia palustris, Pinguicula vulgaris, Selaginella selaginoides* and *Schoenus nigricans* (vascular plants); and, *Chara vulgaris* (algae) (Denyer *et al*., 2023).

High quality positive indicator species for *7220 are *Saxifraga aizoides, Mesoptychia bantriensis, Moerckia flotoviana, Catoscopium nigritum, Hymenostylium recurvirostrum* var. *insigne, Orthothecium rufescens, Seligeria oelandica, Seligeria patula* and *Tomentypnum nitens* (Denyer *et al*., 2023). These are largely restricted to western springs, particularly in the Ben Bulben, Gleniff and Glenade Complex SAC.

Good examples of petrifying springs are usually easy to identify as *7220 habitat because of high tufa formation or high numbers of positive indicator species. In some groundwater springs however, tufa formation may be found in the absence of typical petrifying spring indicator species. In addition, there are situations where a groundwater spring has low tufa formation, but supports positive indicator species. In these cases, it can sometimes be difficult to decide if a spring is an example of *7220 in poor condition, or whether it is not actually an example of *7220 habitat. Guidance on the identification of Annex I priority habitat petrifying springs is given (with examples) in Denyer *et al.* (2023) and the key criteria for assessment are summarised below.

1. The definition of a *7220 spring in Ireland includes springheads, groundwater seepage areas and watercourses (streams and rivers) which are predominantly groundwater fed. Note that tufa formation can occur in the absence of groundwater supply (*e.g*. when water flows through limestone gravel or similar) and hydrogeological investigation may be required to determine if there is significant groundwater input.
2. Tufa formation must be present for a spring to be considered to be an example of *7220 habitat. This excludes, for instance, springheads dominated by *Palustriella commutata* which have no tufa formation.
3. At least three positive indicator species must be present for a spring to be an example of *7220 habitat (but see point 6 below).
4. If a spring supports at least three positive indicator species and has at least patchy paludal tufa formation, then it is usually considered to be *7220.
5. A spring must have at least a 'Conservation Score' of three, which is a national ranking of 'Moderate' and above, to be considered as an example of *7220 habitat. This excludes springs that have a national ranking of 'Low' (but see point 6 below).
6. Expert opinion must be used in conjunction with these criteria. Examples where a spring may not follow the criteria above, but could still be considered an example of *7220 habitat include:
    a. Where a spring has high tufa formation but low number of positive indicator species as a result of groundwater pollution which may be reversible.
    b. Where a spring has experienced recent disturbance, which has temporarily reduced either tufa cover or number of positive indicator species.
    c. Where a stream section has significant tufa formation with less than three positive indicator species, but is part of a *7220 spring complex.
    d. Where a spring has low tufa formation or low number of positive indicator species but is located within a SAC for which 7220* is listed as a Qualifying Interest (QI).

1.4 Relevant publications

The following are key publications on the identification, survey and assessment of petrifying springs in Ireland:

- Denyer, J., Eakin, M., & Gill, M. (2023). Guidelines for the Assessment of Annex I Priority Petrifying Springs in Ireland. *Irish Wildlife Manuals*, No. 142. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.
- Lyons, M.D. & Kelly, D.L. (2017). Plant community ecology of petrifying springs (Cratoneurion) - a priority habitat. *Phytocoenologia:* 47 (1) 13-32.
- Lyons, M.D. & Kelly, D.L. (2016) Monitoring guidelines for the assessment of petrifying springs in Ireland. *Irish Wildlife Manuals*, No. 94. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Ireland.
- Lyons, M.D. (2015). *The flora and conservation status of petrifying springs in Ireland*. Ph.D. thesis, The University of Dublin, Trinity College, Dublin.

The National Conservation Status Assessments for petrifying springs for the previous reporting periods (NPWS, 2008; NPWS, 2013 and NPWS, 2019) are available with backing documents with additional relevant information (Denyer & Long, 2018; Kimberley, 2013). There is also a backing document which accompanies the 2024 National Conservation Assessment (NCA) (Denyer, 2024).

1.5 Conventions used throughout the report

The term ‘petrifying’ by definition denotes tufa formation and this habitat is often abbreviated to ‘petrifying springs’. The term ‘petrifying springs’ is used in this Wildlife Manual to refer to Annex I priority habitat Petrifying springs with tufa formation (*Cratoneurion*) (*7220).

The terms Range, Area, Structure and Functions, and Future Prospects are capitalised when they refer directly to the four parameters being assessed. The assessment outcomes of Favourable, Unfavourable-Inadequate and Unfavourable-Bad are also capitalised. The assessment outcomes are also referred to as ‘green’, ‘amber’ or ‘red’ (DG Environment (2022).

Vascular plant nomenclature follows that of the New Flora of the British Isles 4th Edition (Stace, 2019). Bryophyte nomenclature follows the updated Checklist for Britain and Ireland (Blockeel *et al*. 2021). Recent changes to indicator species names are highlighted in Denyer *et. al*. (2023).

1.6 Digital files accompanying this report

This report is accompanied by several digital files, as follows:

• ESRI-compatible shapefiles in ITM projection of spring locations, monitoring stops and habitat polygons and lines

• Microsoft Excel spreadsheet containing all data from the 2023-2024 monitoring survey

• Photographs (*.jpg) of petrifying spring habitat, monitoring stops and representative site photos, and Image catalogue (Microsoft Excel spreadsheet) detailing the photographs taken during this survey

2 Methodology

2.1 Petrifying springs data review

The Article 17 distribution data from the 2019 NCA assessment (period 2013-2018) was provided by NPWS as a point distribution shapefile. This lists all known petrifying springs points in Ireland. Individual springs are represented as a single point, rather than one point per site, as there are frequently multiple springs per site. The 2019 assessment included a total of 433 mappable points relating to petrifying springs in Ireland.

A review of recent literature, reports and other data sources was undertaken to obtain additional data on new and existing petrifying spring sites. This was used to inform the NCA, for GIS data compilation, and for assessing Pressures and threats, Structure and Functions and conservation measures. The data was also used to update the Article 17 distribution point data from the previous assessment (2013-2018). The majority of the new information was collected post 2019, but there was some older data from reports which were not included in the 2019 assessment. The data included new locations for petrifying springs, updated information on known sites and data on petrifying spring condition. The data sources are detailed in Denyer (2024) and included data from the National Fen Survey (2022-2023); planning reports and Ecological Impact Assessment reports; bryophyte datasets and consultation with ecologists.

Once the data was collated, a thorough review of every spring point in the database was undertaken. The data fields for each spring were checked and updated. Multiple sources of information were used to form an opinion on a particular feature. Decisions were made on whether to remove, add, or update features where new information had become available or where there was replication of information. Additional data such as survey mapping, site notes and photography were used to estimate and update an area for all points in the database.

2.2 Survey site selection

The site selection focussed on SACs, but included some non-SAC sites to ensure good geographical coverage and to include inland and coastal sites, different tufa types and all eight petrifying spring vegetation communities. In addition, sites were selected to include those with High and Low Conservation scores (where known) and a range of previous Conservation Status Assessments: Favourable; Unfavourable-Inadequate, Unfavourable-Bad and Unknown/not determined. Forty two sites were surveyed (Table 3; Figure 15). One site (34) was removed from the list due to access issues, therefore the sites are numbered from 1 to 43.

There are 20 SACs in Ireland which have the Annex I priority habitat Petrifying springs with tufa formation (Cratoneurion) 'Petrifying springs' [*7220] listed as a Qualifying Interest. These are shown in Appendix 1. Of these, 18 were surveyed in the current project (Table 3). In addition, there are a further 31 SACs from which confirmed or possible *7220 has been recorded (Appendix 1). Twenty of these SACs were surveyed (Table 3). An additional three non-SAC sites (Table 3) were included to ensure coverage of the current known range of petrifying springs (Figure 15). Two were located in counties that did not have SACs with confirmed *7220 (Site 11 and Site 21, Table 3) and one was the only inland site within a county (Site 25). Some of the SAC sites were not selected for survey as they do not have petrifying springs confirmed for the site and there is a low probability of it being present (Appendix 1). However, one site was not selected as it has had extensive recent survey data (Appendix 1). Some SAC sites are large and several different areas within the SAC were surveyed (Figure 15).

Table 3 Petrifying springs survey sites 2023-2024

Site no.	Site name	SAC code	County
1	Annaghmore Lough (Roscommon) SAC	001626	Roscommon
2	Ballyman Glen SAC	000713	Dublin, Wicklow
3	Ballynafagh Lake SAC	001387	Kildare
4	Bellacorick Bog Complex SAC	001922	Mayo
5	Ben Bulben, Gleniff and Glenade Complex SAC	000623	Sligo, Leitrim
6	Black Head-Poulsallagh Complex SAC	000020	Clare
7	River Boyne And River Blackwater SAC	002299	Meath
8	Caha Mountains SAC	000093	Cork, Kerry
9	Cuilcagh - Anierin Uplands SAC	000584	Cavan
10	East Burren Complex SAC	001926	Clare
11	Faughalstown	n/a	Westmeath
12	Glen of the Downs SAC	000719	Dublin
13	Glenasmole Valley SAC	001209	Meath
14	Horn Head And Rinclevan SAC	000147	Donegal
15	Howth Head SAC	000202	Dublin
16	Knocksink Wood SAC	000725	Wicklow, Dublin
17	Lough Derg, North-East Shore SAC	002241	Tipperary
18	Lough Eske and Ardnamona Wood SAC	002147	Donegal
19	Magherabeg Dunes SAC	001766	Wicklow
20	Malahide Estuary SAC	000205	Dublin
21	Rathcor, Carlingford	n/a	Louth
22	Rye Water Valley/ Carton SAC	001398	Kildare
23	Slieve Bloom Mountains SAC	000412	Offaly
24	Thomastown Quarry SAC	002252	Kilkenny
25	Beltany Mountain	n/a	Donegal
26	Hook Head SAC	000764	Wexford
27	Arroo Mountain SAC	001403	Leitrim
28	Carrowmore Point to Spanish Point and Islands SAC	001021	Clare
29	Clonaslee Eskers and Derry Bog SAC	000859	Laois
30	Cumeen Strand/Drumcliff Bay (Sligo) SAC	000627	Sligo
31	Fin Lough (Offaly) SAC	000576	Offaly
32	Lisduff Fen SAC	002147	Offaly
33	Lower River Shannon SAC	002165	Tipperary
35	Murvey Machair SAC	002129	Galway
36	Mweelrea/Sheeffry /Erriff Complex SAC	001932	Mayo
37	Ox Mountains Bogs SAC	002006	Sligo
38	Pollardstown Fen SAC	000396	Kildare
39	River Barrow and River Nore SAC	002162	Kildare, Kilkenny
40	Slieve League SAC	000189	Donegal
41	Bray Head SAC	000714	Wicklow
42	St John’s Point SAC	000191	Donegal
43	Slieve Tooey/Tormore Island/Loughros Beg Bay SAC	000190	Donegal

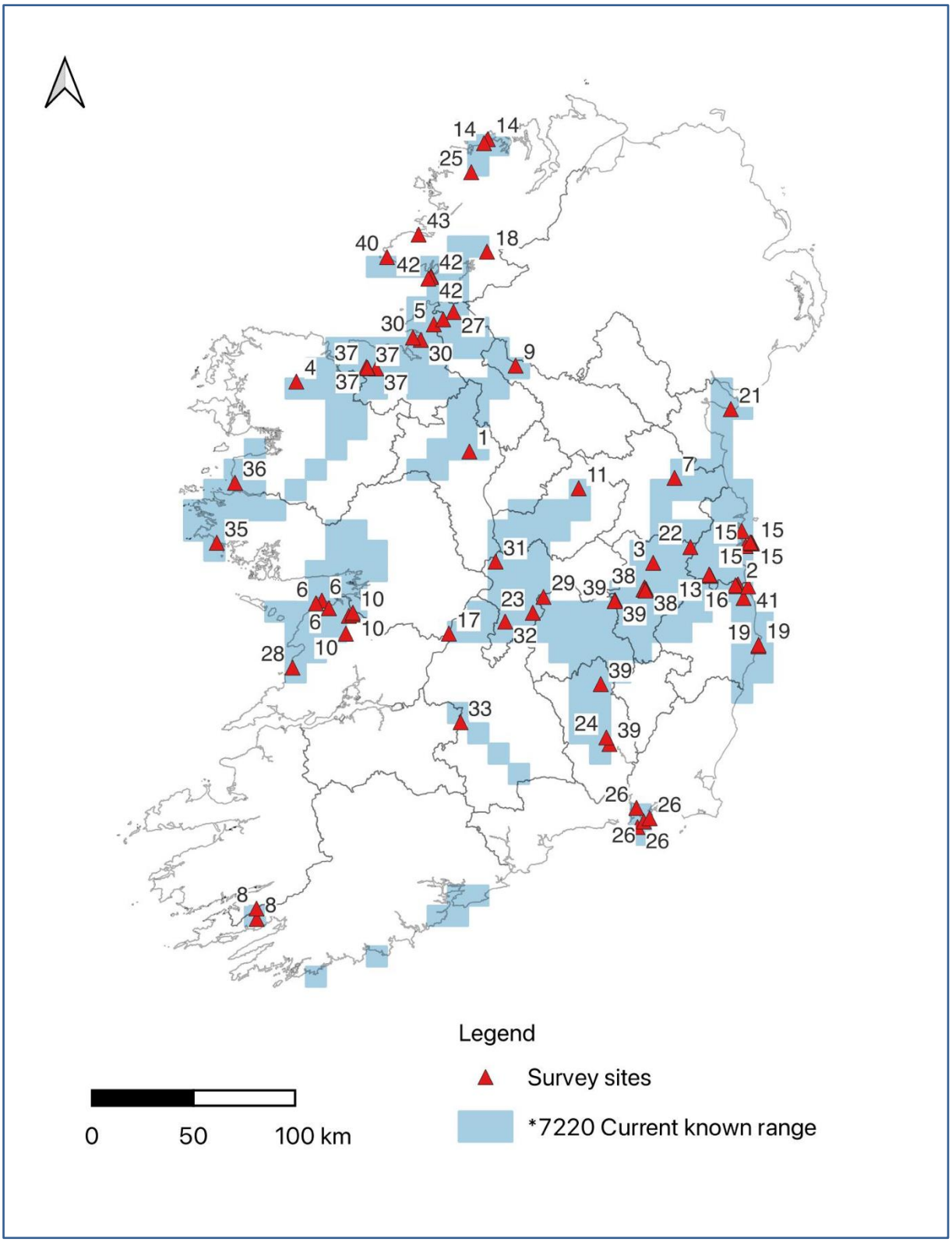

Figure 15 Location of the 2023-2024 *7220 monitoring sites. The 10 km distribution of *7220 habitat in the Republic of Ireland (NPWS, 2025) is also displayed. Some sites have several sub-sites and are represented by more than one point.

2.3 Field survey

2.3.1 Review of methodology

The baseline methodology used for petrifying springs in Ireland (Lyons & Kelly, 2016) was reviewed and updated in 2023 (Denyer *et. al*., 2023). This included required surveyor expertise, additions and nomenclature updates to the indicator species lists, identification of Annex I petrifying spring habitat and updates to petrifying spring evaluation and ranking. Some additional updates were made in the 2023-2024 surveys and these are included in the sections below.

2.3.2 Site access

Local NPWS staff were contacted to inform them that the survey was taking place and for assistance with gaining access to sites, where necessary. In total, 20 NPWS staff attended field surveys in their local area.

2.3.3 Indicator species

There are several groups of indicator species. These are vascular plants, bryophytes and one charophyte that can be used to indicate Favourable or Unfavourable spring status and conservation value. The current list (from Denyer *et al*., 2023) is shown in Tables 4 to 5 (positive indicators) and Tables 6 to 8 (negative indicators).

High quality indicator species are all relatively rare and often restricted to upland and north-western areas. These indicate highly ecologically significant examples of petrifying springs. Positive indicator species are generally common species and many will also be found outside of petrifying spring systems. Within petrifying spring systems however, they are typical of good condition spring habitat. Negative indicator species are grouped into general negative indicator species, invasive species and woody species in unwooded springs (these are not negative indicators in wooded springs).

Table 4 High quality indicator species of petrifying springs

Species name	Group	Comment
Saxifraga aizoides	Vascular plant	-
Mesoptychia bantriensis	Liverwort	Previously *Leiocolea bantriensis*
Moerckia flotoviana	Liverwort	Addition to list in 2023
Catoscopium nigritum	Moss	-
Drepanocladus lycopodioides	Moss	Addition to list in current project
Hymenostylium recurvirostrum var. *insigne*	Moss	-
Orthothecium rufescens	Moss	-
Seligeria oelandica	Moss	-
Seligeria patula	Moss	-
Tomentypnum nitens	Moss	-

Table 5 Positive indicator species of petrifying springs

Species name	Group	Comment
Carex hostiana	Vascular plant	Addition to list in 2023
Carex lepidocarpa	Vascular plant	-
Carex panicea	Vascular plant	-
Chrysosplenium oppositifolium	Vascular plant	-
Crepis paludosa	Vascular plant	
Eleocharis quinqueflora	Vascular plant	Addition to list in 2023
Equisetum telmateia	Vascular plant	
Equisetum variegatum	Vascular plant	
Eriophorum latifolium	Vascular plant	
Festuca rubra	Vascular plant	
Lysimachia tenella	Vascular plant	Previously *Anagallis tenella*
Parnassia palustris	Vascular plant	
Pinguicula vulgaris	Vascular plant	
Samolus valerandi	Vascular plant	Addition to list in current project
Selaginella selaginoides	Vascular plant	
Schoenus nigricans	Vascular plant	Addition to list in 2023
Chara vulgaris	Algae	[1]See note on other *Chara* species
Aneura pinguis	Liverwort	
Jungermannia atrovirens	Liverwort	
Mesoptychia turbinata	Liverwort	Addition to list in 2023 Previously *Leiocolea turbinata*
Pellia endiviifolia	Liverwort	
Bryum pseudotriquetrum	Moss	
Campylium stellatum	Moss	
Didymodon tophaceus	Moss	
Eucladium verticillatum	Moss	
Fissidens adianthoides	Moss	
Fissidens crassipes/ F. rufulus	Moss	Addition to list in 2023
Hymenostylium recurvirostrum var. *recurvirostrum*	Moss	Addition to list in 2023
Palustriella commutata	Moss	
Palustriella falcata	Moss	
Philonotis calcarea	Moss	
Plagiomnium elatum	Moss	Addition to list in 2023
Scorpidium cossonii	Moss	
Scorpidium scorpioides	Moss	

[1] If a *Chara* species other than *C. vulgaris* is recorded from a petrifying spring, then expert judgement should be used to decide whether to include it as a positive indicator (based on the species' ecology and distribution within the spring/fen system).

Table 6 Negative indicator species of petrifying springs

Species name	Group	Comment
Acer pseudoplatanus	Vascular plant	In wooded habitats only
Dactylis glomerata	Vascular plant	
Epilobium hirsutum	Vascular plant	
Helosciadium nodiflorum	Vascular plant	Previously *Apium nodiflorum*
Heracleum sphondylium	Vascular plant	
Juncus effusus	Vascular plant	
Phragmites australis	Vascular plant	
Rumex obtusifolius	Vascular plant	
Ulex europaeus	Vascular plant	In wooded habitats only
Urtica dioica	Vascular plant	
Brachythecium rivulare	Moss	
Cratoneuron filicinum	Moss	
Rhynchostegium riparioides	Moss	Previously *Platyhypnidium riparioides*

Table 7 Invasive species of petrifying springs

Species name	Group	Comment
Acer pseudoplatanus	Vascular plant	In unwooded habitats only
Cotoneaster species	Vascular plant	Added to list in current project
Epilobium brunnescens	Vascular plant	Updated from negative to invasive indicator in current project
Petasites pyrenaicus	Vascular plant	Previously *Petasites hybridus*; updated from negative to invasive indicator in current project
Prunus laurocerasus	Vascular plant	

Table 8 Negative woody species of open (unwoody) petrifying springs

Species name	Group	Comment
Calluna vulgaris	Vascular plant	
Fraxinus excelsior	Vascular plant	
Hedera hibernica	Vascular plant	Previously listed as *Hedera helix*
Heracleum sphondylium	Vascular plant	Addition to list in 2023
Lonicera periclymenum	Vascular plant	
Rubus fruticosus agg.	Vascular plant	
Salix cinerea	Vascular plant	
Ulex europaeus	Vascular plant	

2.3.4 Survey timing

Field surveys were undertaken between 28 July and 3 November 2023 and 16 May and 14 September 2024. The optimal time for surveying petrifying springs is April to September, inclusive. However, in the first survey year (2023) the survey period was extended to allow more sites to be surveyed. As petrifying springs are usually bryophyte dominated, they can sometimes be surveyed outside of the main field season (*e.g*. October/November). However, this must be taken into account when assessing ecological value and condition and comparing to baseline data.

2.3.5 Walk-over survey and mapping

For small sites, the whole site was walked over to map and update the locations of all petrifying springs. For larger sites (such as Ben Bulben, Gleniff and Glenade Complex SAC; Cuilcagh - Anierin Uplands SAC and Slieve Bloom SAC), or those with a high number of petrifying springs (*e.g*. Glenasmole Valley SAC), a walk-over area was planned pre-survey to target key areas.

Small springs were mapped with a single GPS point and an area (in metres) was estimated in the field. However, for more extensive spring/flush systems and coastal cliffs, it was sometimes possible to map a polygon or line in the field. A central point was take for any polygon or line to be used in the petrifying springs database. Target notes were made to map springs which were not included in the detailed plot survey.

2.3.6 Plot survey

There were three types of plots surveyed: baseline plot (where there was no baseline survey data); monitoring plot (where baseline data was available) and short survey plot (where a full plot was not required or not possible). A short survey plot could be done if sufficient plots had been undertaken at the sites for monitoring, but details of an additional petrifying spring(s) would be useful to record (*e.g*. on larger sites it was not possible to record a full plot in every petrifying spring). In addition, sometimes there were access issues (tides on the coast and inaccessible springs on cliffs and steep slopes) where a full plot was not possible.

The following data was recorded from the plots:

General spring and plot details:

- Recorder(s) and date(s) surveyed
- Grid reference
- Plot dimensions (2 m x 2 m where possible but some springs require 1 m x 4 m or smaller)
- Plot aspect, slope and altitude
- Spring type (springhead, flush, seepage, stream)
- Description of spring
- Petrifying spring vegetation community type (Section 1.1.2)
- Photographs of location (with landscape features), vegetation and tufa in plot
- Main habitat type in which petrifying spring occured (Fossitt, 2000)

Cover details (baseline and monitoring plots only):

- Tufa formation and cover: Cascade; Paludal (1, 2, 3); Stream crust; Dam; Oncoids/ooids; Cemented rudites; and non-tufa in plot. Total = 100%. Paludal cover 1 = weak/thin/discontinuous, 3 = strongly forming/continuous/conspicuous.

- Water cover: Flowing/trickling; Pool/standing water; Dripping; Damp; Dry, Not impacted by spring. Total = 100%.
- Surface covers: Living field/ground flora; Bare tufa (active/recent); Ancient/inactive tufa; Leaf litter/standing dead; Bare soil; Bare stone; Other (specify). Total = 100%.
- Canopy: total % tree canopy cover over plot

Species data:

- Baseline plots: % cover of all vascular plants, bryophytes and charophytes in plot. Separated into broadleaved herbs, graminoids, bryophytes, woody species, pteridophytes and algae. Recorded to nearest 5%. If <5%, then use: 3%, 1%, 0.5%, 0.1%. In Lyons & Kelly (2016), the total percentage cover was limited to 100% in a plot. As bryophytes are often underneath the vascular plant cover, this limit of 100% was removed in the current survey to reflect the actual percentage cover of each species in the plot, rather than relative cover.
- Monitoring plots: indicator species (positive and negative) recorded and the total percentage cover of positive indicator vascular plants and positive indicator bryophytes (separately). Percentage cover of negative indicator species or invasive species recorded for each species
- Short survey plots: positive and negative indicator species presence only.

In addition, the presence of additional positive negative indicator species located within the same spring, but outside of the plot, were recorded. This information was used to assess the Conservation score of the spring and taken into account in the condition assessment and change from baseline data.

Impacts:

- Vegetation height: Median vegetation height in cm
- Dung: Presence of animal dung in/adjacent to plot
- Trampling: Presence of trampling in/adjacent to plot
- Modification of water flow: note that historic impacts not always visible in the field
- Any other impacting activities: Any other notes not covered in the above.

2.4 Water chemistry

Where sufficient clean water was available within the spring, pH, electrical conductivity and temperature were recorded using a handheld device.

It is often very useful to have full water chemistry data for petrifying springs, for instance when assessing recharge zones (Denyer *et al*., 2023) and potential sources of pollution. For the baseline petrifying spring surveys by Lyons (2015), it was also important to have full water chemistry data so that the springs could be classified and thresholds for key nutrients determined. However, it can be difficult to obtain a large enough clean water sample for laboratory analysis and samples need to be kept cool and delivered to a laboratory for testing on the same day (as some key parameters have to be tested within 24 hours). This is not possible with some fieldwork locations. For monitoring and the assessment of petrifying spring condition, it is sufficient to have an estimate of nitrate and phosphate levels and pH, which can be measured in the field. Research has shown (Biggs *et al*., 2016) that field testing of nitrate and phosphate using ‘PackTest kits’ can detect ‘clean water’, with a level of 98% for phosphate, and 81% for nitrate, of freshwater sites correctly categorised (note that this investigation was using a lower threshold for nitrate than used by Lyons & Kelly, 2016). This study did include some very low nutrient waterbodies, but did not include groundwater fed springs.

In the current project, field testing of nitrate and phosphate was included. The aim was to assess whether this would provide information on which petrifying springs have possible elevated nitrates and phosphates, and therefore require detailed laboratory testing of water samples. PackTest field kits were used for a selection of petrifying springs on each site, where a clean water sample could be obtained. In addition, 10 water samples from petrifying springs were collected for laboratory analysis for comparison. These were in locations where the samples could be transported on the same day to an accredited laboratory. An additional 17 samples with water chemistry data from laboratory analysis were available from ecological surveys undertaken by Joanne Denyer in 2024, giving a total of 27 samples for comparison.

2.5 Site assessment

Each spring was assessed for Area, Structure and Functions and Future Prospects. The data from all plots was used for the site assessment. The criteria used were from Lyons & Kelly (2016), with updated specified where relevant.

2.5.1 Range

The Range (Figure 15) was calculated on a 10 km grid basis in TM75 Irish Grid projection, based on the national distribution. This distribution uses a combination of data from the 2023-2024 project, baseline data and additional information from the petrifying spring data review.

2.5.2 Area

Area was either estimated in the field (for small springs) or measured from a mapped polygon or line. For many sites there was no baseline data for comparison and therefore judgement had to be used in the field as to whether there had been any decrease or increase in area. In addition, some larger spring systems or upland springs had previously been estimated in the field or from site data. These were updated in the current survey and so may have changed (increased or decreased) without there actually being a change in the spring area.

2.5.3 Structure and Functions

Structure and Functions for individual springs were assessed using the criteria from Lyons & Kelly (2016) with some updates. These are listed in Table 9.

In Table 9, the threshold levels for nitrate and phosphate have been updated. In Lyons & Kelly (2016), these were <10 mg/l for nitrate and <0.015 mg/l for phosphate for a pass. It is important to note that phosphate and nitrate are sometimes quoted as phosphate-phosphorous and nitrate-nitrogen (referred to as phosphorous and nitrogen in this report, respectively). The conversion of nitrogen to nitrate is x 4.43 and the conversion of phosphorous to phosphate is x 3.066.

For the current project, the data from the baseline survey (Lyons & Kelly, 2016; Lyons, 2015) was reviewed. It was found that petrifying springs which failed the condition assessment on the number of positive indicator species and also had high cover of negative indicator species (likely to be an indicator of nutrient enrichment), could occur with levels above 2 mg/l of nitrate in some cases. For rivers, average levels of <4 mg/l nitrate (0.9 mg/l nitrogen) are required for high quality surface water and <8 mg/l nitrate (1.8 mg/l nitrogen) for good quality surface waters (EPA, 2024). Note that the accredited detection limit of nitrate for some laboratories (Level of Quantification, LOQ) is 4.4 mg/l. The nitrate threshold has therefore been updated to 2-4 mg/l as borderline fail and ≥4 mg/l as a fail. This is consistent with a recent review of Irish petrifying spring water chemistry data (Lyons & Kelly, in press). This threshold may be further reviewed in future as more information on water chemistry in petrifying springs becomes available.

For phosphate, the levels in rivers (EPA, 2024) for high quality are less than 0.025 mg/l phosphorous for high quality surface water and less than 0.035 mg/l phosphorous for good quality surface water. This is equivalent to 0.08 and 0.11 mg/l phosphate, respectively for high and good quality. The data from the baseline survey (Lyons, 2015) showed that phosphate levels above 0.015 mg/l had a negative impact on Irish petrifying springs and it is therefore likely that groundwater springs are much more sensitive than rivers to phosphate levels. Therefore, the phosphate threshold has not been changed. The accredited detection limit of phosphate for some laboratories is 0.03 mg/l,so the level of <0.015 mg/l for a pass may not always be possible to detect in laboratory analysis. Lyons (2015) found that 97% of petrifying springs which supported high quality positive indicator species had less than 0.03 mg/l phosphate, so even this higher threshold gives an important indication of petrifying spring water quality. In practice, any detectable phosphate in groundwater should be an indication that further investigation is required as phosphate levels may be exceeded.

Table 9 Assessment criteria for individual petrifying springs

Assessment criterion	**Target value for pass**
1) Species assessment criteria	
High quality indicator species	No loss from baseline number of species
Positive indicator species	3 species AND no loss from baseline number of species
Invasive species	Absent
Negative herbaceous indicator species	Total cover should not be dominant or abundant
Negative bryophyte indicator species	No one species dominant or abundant; if ≥2 species present, then fails if ≥2 are frequent or 1 is abundant
Negative woody indicator species	Absent (except in wooded springs)
2) Spring water composition and flow	
Nitrate level	No increase from baseline and ≥5 mg/l (≥2-5 mg/l = borderline fail)
Phosphate level	No increase from baseline and ≤0.015 mg/l
Water flow	No alteration of natural flow
3) Impacts of grazing and management	
Field layer height	Height between 10 and 50cm*
Trampling/dung	Impact should not be abundant/dominant
4) Overall Structure & Functions Assessment	
All pass or one minor/borderline fail AND, if some indicators are Not Determined, the number of passes is at least five AND there is a pass for Positive Indicator Species	Pass
>1 Fail (unless one minor/ borderline fail)	Fail

*Where vegetation is naturally bryophyte dominated, expert judgement may be used to pass a plot with lower vegetation height

For each site there was also a site level assessment. The criteria for assessing if a site is in Favourable, Unfavourable-Inadequate or Unfavourable-Bad condition are shown in Table 10. Other data may also be taken into account in the assessment. For instance, at site 21, all plots failed on nitrate levels and so according to the criteria in Table 10, the overall assessment should be Unfavourable-Bad. However, the petrifying springs passed all other criteria and had

good cover and number of petrifying spring positive indicator species. The overall assessment was therefore adjusted to Unfavourable-Inadequate, but the elevated nitrate levels was taken into account for the Future Prospects assessment. For some sites (*e.g*. Site 2 and Site 22), only a small area was surveyed in the 2023-2024 survey, as there was recent additional survey data and the sites are very sensitive. In the 2023-2023 assessment, all plots at Site 22 passed the condition assessment. Additional data for the SAC however shows that springs in other areas failed the condition assessment and therefore the overall assessment was Unfavourable-Inadequate.

Table 10 Site level assessment for Structure and Functions

Criterion	Site overall assessment
All assessment plots pass	Favourable
At least one plot fails and the number of fails < number of passes (if only one plot undertaken, or only a small part of site sampled then use additional information such as the condition of other springs noted on walk-over and desktop information to inform assessment)	Unfavourable-Inadequate
At least one plot fails and the number of fails > number of passes	Unfavourable-Bad

2.5.4 Future prospects

The Future Prospects assessment relates to the likely development and maintenance of Annex I petrifying spring habitat in Favourable condition for the foreseeable future. Information on pressures and threats at each site were recorded in the field and additional data was obtained from the petrifying spring data review. For each impact the timing (past/current/ongoing), scope (% of site impacted) and influence (Low/Medium/High) were recorded. A standardised list of pressures was used (DG Environment, 2023b). Conservation measures (both those in progress and required) were also listed (DG Environment, 2023c) and used to inform the Future Prospects assessment.

2.6 National Conservation Assessment

The assessment results for each of the four parameters (Area, Range, Structure and Function and Future Prospects) were combined to give the overall National Conservation Assessment (Table 11). Note that only data from the 2023 field survey was included in the NCA, as the Article 17 reporting for this habitat was completed in 2023 (prior to the 2024 field surveys).

Table 11 Evaluation matrix for the assessment of Conservation Status of Annex I habitats (adapted from DG Environment, 2023a)

	Conservation Status			
Parameter	**Favourable ('green')**	**Unfavourable – Inadequate ('amber')**	**Unfavourable – Bad ('red')**	***Unknown***
Range	Stable or increasing AND not smaller than the 'favourable reference range'	Any other combination	>1% decline in range per year over specified period OR More than 10% below 'favourable reference range'	No or insufficient reliable information available
Area	Stable or increasing AND not smaller than the 'favourable reference area' AND without significant changes in distribution pattern within range (if data available)	Any other combination	>1% decline in area per year over specified period OR With major losses in distribution pattern within range OR More than 10% below 'favourable reference area'	No or insufficient reliable information available
Structure & functions	Structure and functions in good condition and no significant deteriorations / pressures	Any other combination	> 25% of the area is unfavourable as regards its specific structures and functions	No or insufficient reliable information available
Future prospects	The habitat's prospects for its future are excellent / good, no significant impact from threats expected; long-term viability assured	Any other combination	The habitat's prospects are bad, severe impact from threats expected; long-term viability not assured.	No or insufficient reliable information available
Overall assessment of CS	All 'green' OR three 'green' and one 'unknown'	One or more 'amber' but no 'red'	One or more 'red'	Two or more 'unknown' combined with green or all 'unknown'

2.7 Conservation score and ranking

Conservation scores were calculated for each spring location, ranging from one (low conservation value for petrifying spring habitats) to ten (highest conservation value) (Denyer *et al*., 2023; Lyons & Kelly, 2016). The four criteria used to create a Conservation score for each particular spring/spring system have been updated and are shown in Table 12. It is important to note that these are calculated for the whole spring (not per plot) (Denyer *et al*., 2023), as springs are often very small and localised. The overall site score is taken as the highest score for any one petrifying spring at the site.

Table 12 Conservation score criteria and scores

Criteria	Value	Score
High Quality indicator species	List if present	1 per species
Species diversity	High quality and positive indicator species	0 to 4
Very high	15+ positive indicator species	4
High	10 – 14 positive indicator species	3
Moderate	5 – 9 positive indicator species	2
Low	1 – 4 positive indicator species	1
Absent	0 positive indicator species	0
Tufa Formation		
Very high	Massive, strongly consolidated deposits (usually cascade tufa)	4
High	Moderate cascade tufa Small to moderate consolidated deposits Strongly formed paludal tufa High cover of stream crust tufa High cover of oncoids/ ooids	3
Moderate	Small cascade tufa Patchy paludal tufa	2
Low	Sparse tufa formation	1
Absent	No tufa formation	0
Additional positive characteristics (see list below)	List if present	Score max.1 per spring

A list of example positive characteristics is provided below. Each positive characteristic scores one, with a maximum score of one per spring system (even if additional positive characteristics are present):

- Hydrogeological importance (*e.g*. two separate spring systems at one site).
- Geology (*e.g*. Lakes Marble bedrock in Connemara).
- Karst hydrology (*e.g*. in the Burren).
- Mineral-rich springs present.
- Spring supports, or is associated with, rare or protected flora not otherwise taken into account in the Conservation score calculation (rarely occurs in practice as most rare/ protected flora species associated with springs will be listed as high quality positive indicator species).
- Ancient woodland indicator species present (Perrin & Daly, 2010).
- Spring associated with (*e.g*. adjacent to/occurs in a mosaic with/or other hydrogeological connection to) another Annex I (*priority) wetland habitat *e.g*. Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* [*91E0}; Turloughs [*3180]; *Molinia* meadows on calcareous, peaty or clayey-silt- laden soils [6410]; Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430]; Transition mire and quaking bogs [7140]; Alkaline fen [7230] and blanket bog [*7130].
- Spring is part of a large spring complex (*e.g*. along a river valley).

The Conservation score is used to rank the conservation value of the spring at a national level (Denyer *et al*., 2023; Lyons & Kelly, 2016). The conservation value categories are shown in Table 13.

Table 13 National ranking of petrifying springs

Conservation Score	Ranking
1-2	Low
3-4	Moderate
5-6	High
7-8	Very High
>9	Outstanding

3 Data review results

The 2019 assessment included a total of 433 mappable points relating to petrifying springs in Ireland. In the current review, 33 points were removed and replaced with updated points, one point was removed as it could not be re-located in the field and one duplicate point was removed. In total, 89 points were updated with additional information, such as more precise grid references and area calculation. Six points which had been removed in the 2019 assessment were reinstated based on new information (such as field data) and 237 new spring points were added to the database. This results in a consolidated dataset with 679 mappable points, from 190 sites, relating to petrifying springs in Ireland. Note that this does not include the 2024 field survey data.

In the 2019 reporting round, 43 springs had no area assigned. To calculate the total area for the habitat, a subset of those points/polygons with known areas was used to help generate a median area (with confidence intervals) for those points with unknown area (via multiple imputation method, see Denyer & Long, 2018, for further details). In the 2024 data review, additional data such as survey mapping, site notes and photography was used to estimate an area for all points in the database (Denyer, 2024).

4 Field survey results

4.1 Site reports

Detailed site reports for the 42 sites surveyed in 2023-2024 are included in Appendix 2. These include maps of the survey area and petrifying spring recorded, number of plots undertaken, petrifying spring condition and Conservation score, vegetation communities recorded and key species (*e.g.* high quality indicator species).

4.2 Summary of field data

4.2.1 Distribution, area, type, tufa formation and vegetation

The 42 survey sites covered 21 counties, but no petrifying springs were recorded from the Co. Kerry site (part of Caha Mountains SAC). Petrifying springs are currently confirmed from 20 counties and at least one site was surveyed in each of these counties in the 2023-2024 surveys. Fourteen of the sites were coastal and 28 inland.

A total of 176 plots were recorded: 59 full baseline plots; 66 monitoring plots and 48 short survey plots. Four types of spring were recorded: flushes (39 plots), seepages (49 plots), springheads (82) and streams (6). The surveyed springs included all tufa formation types and each petrifying spring vegetation community (Table 14). The most frequently recorded vegetation communities were Group 1 and Group 6 (Table 14). Group 1 usually had high tufa formation and low species diversity and Group 6 had low tufa and high species diversity. Group

1 was often coastal and on steep ground. Group 6 was typical of slightly sloping or level ground and most frequently inland in a mosaic with alkaline fen. Group 8 had the highest conservation value and is known from only three sites (all of which were included in the 2023-2024 surveys). The total area of petrifying springs habitat at each site is included in the site reports (Appendix 2). A total of 10,4158 m^2 was recorded from the 42 sites and the area per site ranged from 3 m^2 (Bray Head SAC) to 28,886 m^2 (Bellacorick Bog Complex SAC).

Table 14 Vegetation groups recorded

Group	No. of sites	No. of plots
1. *Eucladium verticillatum-Pellia endiviifolia* tufa cascades	17	43
2. *Palustriella commutata-Geranium robertianum* springheads	10	25
3. *Brachythecium rivulare-Platyhypnidium riparioides* tufaceous streams and flushes	3	5
4. *Palustriella commutata-Agrostis stolonifera* springheads	4	8
5. *Schoenus nigricans* springs:	13	34
6. *Carex lepidocarpa* small sedge springs	15	32
7. *Palustriella falcata-Carex panicea* springs	7	16
8. *Saxifraga aizoides-Seligeria oelandica* springs	3	11

4.2.2 Indicator species

Nine high quality indicator species were recorded: *Catoscopium nigritum, Drepanocladus lycopodioides, Hymenostylium recurvirostrum var. insigne, Mesoptychia bantriensis, Moerckia flotoviana, Orthothecium rufescens, Saxifraga aizoides, Seligeria oelandica* and *Seligeria patula.* The high quality species were recorded from seven SAC sites: Arroo Mountain SAC, Ben Bulben, Gleniff and Glenade Complex SAC, Black Head-Poulsallagh Complex SAC, Caha Mountains SAC, East Burren Complex SAC, Mweelrea/Sheeffry /Erriff Complex SAC and Slieve League SAC. Additional records were made for *Orthothecium rufescens, Seligeria oelandica* and *Seligeria patula* in the current survey compared to the baseline survey (Lyons & Kelly, 2016; Lyons, 2015). The only high quality indicator species recorded in the baseline survey, but not recorded in the 2023-2024 survey was *Tomentypnum nitens.* This species had previously been recorded from one plot at Pollardstown Fen SAC but this area is now overgrown. However, it has been recorded elsewhere at this site recently.

Thirty-three positive indicator species were recorded in the 2023-2024 surveys (from 176 plots) sites) and 34 in the 2011-2013 surveys (from 186 plots) (Lyons & Kelly, 2016; Lyons, 2015). The baseline figures have been adjusted to take into account changes to the positive indicator species list since 2013. *Chara virgata* was recorded from one site in the baseline survey (Ballynafagh Lake SAC) but this was not refound in the 2023 survey and the plot location is overgrown. However, *Chara hispida* was recorded new to one site in 2023 (Thomastown Quarry SAC), so there is no overall reduction in charophytes recorded between the surveys. *Crepis paludosa* was not recorded in the 2023-2024 surveys but was recorded from nine sites in the baseline survey, three of which were re-surveyed in 2023-2024. All of the three re-surveyed sites were in good condition in the location where *Crepis paludosa* had previously been recorded so the reason for this reduction is unclear.

Nine negative indicator species were recorded from the 2023-2024 plots: the vascular plants *Dactylis glomerata, Epilobium brunnescens, Epilobium hirsutum, Helosciadium nodiflorum, Juncus effusus* and *Phragmites australis* and the bryophytes *Brachythecium rivulare, Cratoneuron filicinum* and *Rhynchostegium riparioides.* Of these, only five were recorded at cover of 5% or above in the plots: *Brachythecium rivulare, Cratoneuron filicinum, Juncus effusus, Helosciadium nodiflorum* and *Phragmites australis. Cratoneuron filicinum* had the

highest covers (up to 50%) and was most frequent (>5% in nine plots). This species usually indicates elevated nutrient levels in the spring groundwater.

Four 'invasive' species were recorded, each from one plot: *Acer pseudoplatanus, Buddleja davidii, Epilobium brunnescens* and *Petasites pyrenaicus.* In addition, *Cotoneaster* sp. was recorded from the vicinity of one plot.

4.2.3 Conservation score and national ranking

The Conservation scores for the surveyed plots ranged from 1 to 13. The number of plots and sites within each ranking category is shown in Table 15. The overall national ranking of each site is shown in Table 16 and in Figure 16. Two sites had Low ranking (Glen of the Downs SAC and Bray Head SAC), these are both located in the east of the country (Figure 16). Three sites have Outstanding ranking, these are Arroo Mountain SAC, Ben Bulben, Gleniff and Glenade Complex SAC in the north-west (Co. Sligo and Co. Leitrim) and Black Head-Poulsallagh Complex SAC in the west (Co. Clare) (Figure 16). Overall most sites (26) had a High national ranking and these are located across the country (Figure 16).

Table 15 Number of plots and sites within each national rank

Ranking	Number of plots	Number of sites
Low	3	2
Moderate	37	3
High	110	26
Very high	27	8
Outstanding	8	3

Table 16 Survey site Conservation score and ranking

Site no.	Site name	National ranking
1	Annaghmore Lough (Roscommon) SAC	High
2	Ballyman Glen SAC	High
3	Ballynafagh Lake SAC	High
4	Bellacorick Bog Complex SAC	High
5	Ben Bulben, Gleniff and Glenade Complex SAC	Outstanding
6	Black Head-Poulsallagh Complex SAC	High
7	River Boyne And River Blackwater SAC	High
8	Caha Mountains SAC	Very High
9	Cuilcagh - Anierin Uplands SAC	Very High
10	East Burren Complex SAC	High
11	Faughalstown	Low
12	Glen of the Downs SAC	High
13	Glenasmole Valley SAC	Very High
14	Horn Head And Rinclevan SAC	High
15	Howth Head SAC	Very High
16	Knocksink Wood SAC	Moderate
17	Lough Derg, North-East Shore SAC	High
18	Lough Eske and Ardnamona Wood SAC	High
19	Magherabeg Dunes SAC	High
20	Malahide Estuary SAC	High
21	Rathcor, Carlingford	Moderate
22	Rye Water Valley/ Carton SAC	High
23	Slieve Bloom Mountains SAC	Very High
24	Thomastown Quarry SAC	High
25	Beltany Mountain	Outstanding
26	Hook Head SAC	High
27	Arroo Mountain SAC	Outstanding
28	Carrowmore Point to Spanish Point and Islands SAC	Very High
29	Clonaslee Eskers and Derry Bog SAC	High
30	Cumeen Strand/Drumcliff Bay (Sligo) SAC	High
31	Fin Lough (Offaly) SAC	High
32	Lisduff Fen SAC	High
33	Lower River Shannon SAC	Moderate
35	Murvey Machair SAC	High
36	Mweelrea/Sheeffry /Erriff Complex SAC	Very High
37	Ox Mountains Bogs SAC	High
38	Pollardstown Fen SAC	Very High
39	River Barrow and River Nore SAC	High
40	Slieve League SAC	High
41	Bray Head	Low
42	St John’s Point SAC	High
43	Slieve Tooey/Tormore Island/Loughros Beg Bay SAC	High

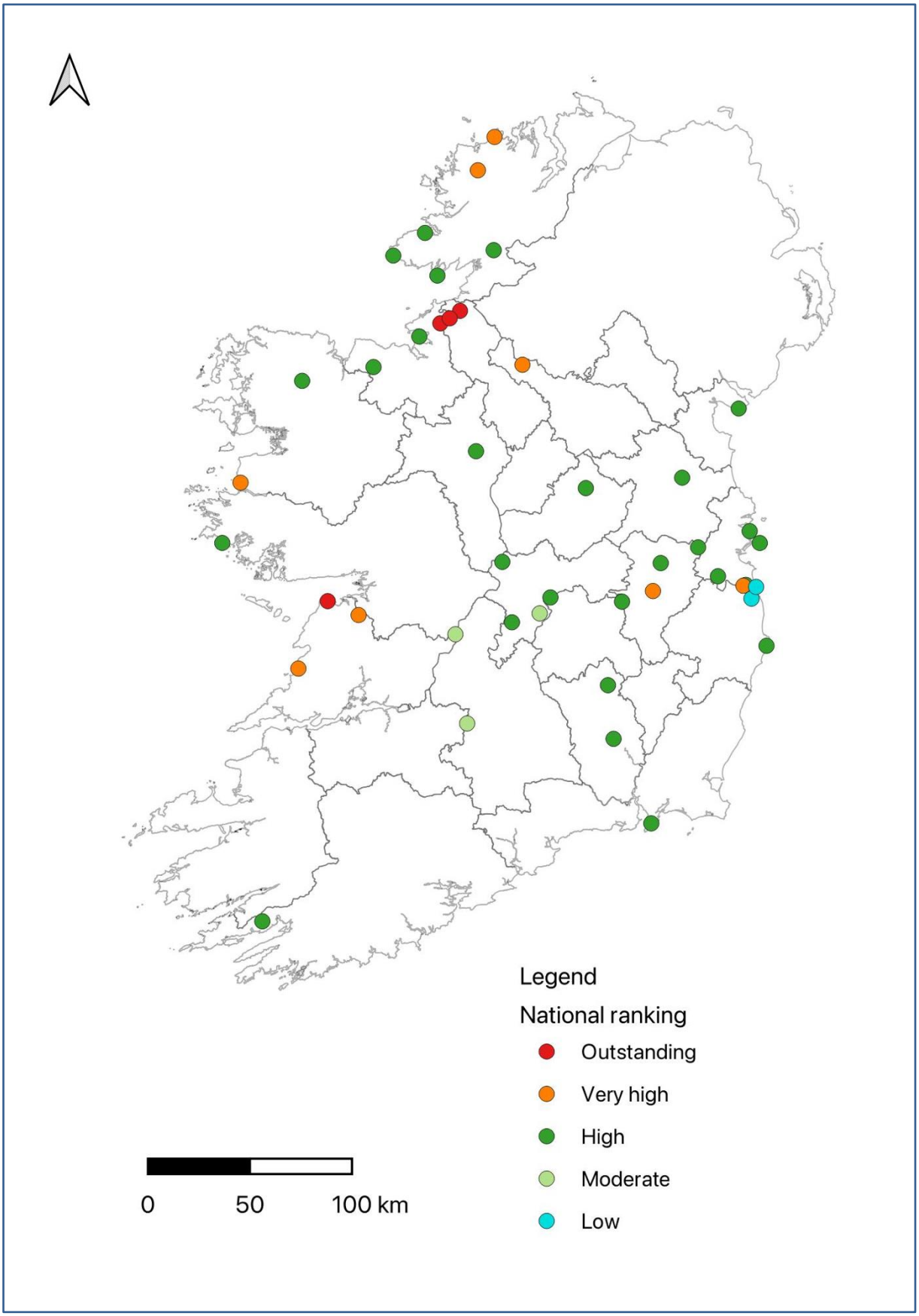

Figure 16 National ranking of 2023-2024 survey sites. Some sites have several sub-sites and are represented by more than one point.

4.2.4 Water chemistry

The results from the comparison of the field testing kit for nitrates and phosphates, compared to laboratory data, is show in Table 17 (nitrate) and Table 18 (phosphate).

In general, the field test kits gave a reasonable indication of when a petrifying spring may pass or fail the threshold level for nitrates for the Structure and Function assessment (Table 17). Fifteen samples tested by the laboratory failed the ≤5 mg/l nitrate threshold. Of these, 12 were shown to fail using the field kits, one was 'borderline' and one would have passed (no nitrate detected). Therefore, if the nitrate field kits are to be used, any value over '2' should be considered likely to fail the nitrate threshold. The elevated nitrate was not detected in only one sample. There was one sample where the field kit detected 2 mg/l nitrate ='borderline', whilst the laboratory sample did not detect nitrate (<4.4 mg/l = 'pass'). However, it is possible that this is due to the accredited detection limit of the laboratory. Whilst it is not fully accurate, the field kits did usually indicate when nitrate levels might be over the threshold level and that further investigation would be required.

The field kits were less accurate at detecting exceeded phosphate levels. The lower limit of detection of the field kits was 0.05 mg/l. Therefore, any colour change in the field kits (detectable phosphate) was considered a fail. Ten samples tested by the laboratory failed the ≤0.03 mg/l phosphate threshold (lower limit of accredited detection by laboratory). Of these, five were also shown to fail using the field kits. The samples that the field kits failed to detect had phosphate levels of 0.034-0.042 mg/l phosphate, which is below the detection limit of the field kits (0.05 mg/l). There was one sample where the field kit detected 0.2 mg/l phosphate ='fail', whilst the laboratory sample did not detect phosphate (<0.03 mg/l = 'pass'), which was clearly an error. The field kits were of limited use in detecting lower levels of phosphate, but did usually indicate when the level of 0.05 mg/l is exceeded so still provide some information when laboratory sampling is not possible.

Table 17 Comparison of nitrate data from field and laboratory testing

Sample	Field kit NO_3 mg/l	Pass/fail	Lab NO_3 mg/l	Pass/fail
1	10 to 20	Fail	33.7	Fail
2	10 to 20	Fail	36.3	Fail
3	2	Borderline	8.47	Fail
4	2 to 5	Fail	9.67	Fail
5	2	Borderline	<4.4	Pass
6	10 to 20	Fail	28.9	Fail
7	20 to 45	Fail	31.7	Fail
8	0	Pass	<4.4	Pass
9	0	Pass	<4.4	Pass
10	0	Pass	<4.4	Pass
11	10	Fail	31.4	Fail
12	10	Fail	26.8	Fail
13	20 to 45	Fail	29.5	Fail
14	>45	Fail	85.5	Fail
15	2 to 5	Fail	7.49	Fail
16	20 to 45	Fail	30.7	Fail
17	20	Fail	23.9	Fail
18	20 to 45	Fail	32.0	Fail
19	0	Pass	<4.4	Pass
20	0	Pass	<4.4	Pass
21	1 to 2	Pass	<4.4	Pass
22	0	Pass	<4.4	Pass
23	0	Pass	5.25	Fail
24	0	Pass	<4.4	Pass
25	0	Pass	<4.4	Pass

Table 18 Comparison of phosphate data from field and laboratory testing

Sample	Field kit $PO4^-$ mg/l	Pass/fail	Lab $PO4^-$ mg/l	Pass/fail
1	0	Pass	<0.03	Pass
2	0	Pass	<0.03	Pass
3	0	Pass	0.034	Fail
4	0	Pass	<0.03	Pass
5	0	Pass	<0.03	Pass
6	0.05 to 0.01	Fail	0.058	Fail
7	0	Pass	<0.03	Pass
8	0.2	Fail	<0.03	Pass
9	0	Pass	<0.03	Pass
10	0	Pass	0.034	Fail
11	0	Pass	<0.02	Pass
12	0	Pass	0.04	Fail
13	0	Pass	0.042	Fail
14	0.05	Fail	0.076	Fail
15	0.5 to 1.0	Fail	0.121	Fail
16	0	Pass	<0.03	Pass
17	0	Pass	<0.03	Pass
18	0	Pass	<0.03	Pass
19	0	Pass	<0.03	Pass
20	0	Pass	<0.03	Pass
21	0.5 to 1.0	Fail	0.780	Fail
22	0	Pass	0.0350	Fail
23	0.5 to 1.0	Fail	0.119	Fail
24	0	Pass	<0.03	Pass
25	0	Pass	<0.03	Pass

There is currently no threshold for ammonia (NH_3) or ammonium (NH_4^+) levels in petrifying springs in Ireland. Farr *et al.* (2014) recorded ammonia levels of 0.02 mg/l to 1.64 mg/l from petrifying springs in Wales. The Welsh petrifying spring sites were considered to be in good condition, with no signs of nutrient enrichment. The site with the highest ammonia value of 1.64 mg/l supported species-rich petrifying spring vegetation. Values recorded from Ireland in this project ranged from below detection (<0.01) to 0.748 mg/l ammonia. Ten of the petrifying springs failed the Structure and Functions condition assessment, these had ammonia levels of <0.01 to 0.035 mg/l. Thirteen of the petrifying springs passed the Structure and Functions condition assessment, these had ammonia levels of <0.01 to 0.807 mg/l. Therefore, there is currently no link between ammonia levels and poor condition of petrifying springs in Ireland. The sampled spring sites were in the east of Ireland and had some very high nitrate and phosphate levels and might be expected to be at the upper limit of ammonia levels in Ireland. Additional data available from petrifying springs in poor condition in Ireland (from Denyer Ecology surveys) have given values of 0.01 to 0.297 mg/l ammonia. Therefore, an upper limit of 1.0 mg/l ammonia is recommended until further information is available. It is not currently included as a criteria in the Structure and Functions assessment.

4.2.5 Structure and Functions

A summary of the Structure and Functions results for the 2023-2024 survey plots is shown in Table 19. The most frequent criteria to fail the assessment were the number of positive indicator species (*e.g*. less than 3 present or a reduction from the baseline value), nitrate level and phosphate level. These are strongly linked as elevated nutrients can lead to a decline in petrifying spring species, which are typical of low nutrient groundwater. There was only one plot where vegetation height was too low and this was because of pollution removing any vegetation cover. All other plots that failed this criteria had vegetation that was too tall due to undergrazing. High grazing levels typically caused trampling damage (10% of plots), rather than reducing vegetation height. As petrifying springs are bryophyte dominated, the vegetation can naturally be lower than the 5 cm threshold, without negative grazing impacts, and expert judgement was used to pass this criteria for 21 plots with vegetation lower than 5 cm in height.

Table 19 Assessment criteria for individual petrifying springs

Assessment criterion	% plots pass	% plots fail
Positive indicator species	86	14
Invasive species	97	3
Negative herbaceous indicator species	99	1
Negative bryophyte indicator species	96	4
Negative woody indicator species	93	7
Nitrate level[1]	74	26
Phosphate level[1]	79	21
Water flow[2]	98	2
Field layer height	94	6
Trampling/dung	90	10
Overall pass	76	24

[1]Nitrate and phosphate levels were not determined for 67 plots (*e.g*. because there was insufficient flow of clean water).
[2]In four plots it was not possible to determine if there had been historical impacts to water flow.

4.2.6 Pressures, threats and other activities

Impacts recorded from the 2023-20234 survey sites are summarised in Table 20. Negative impacts were recorded from 37 sites, positive impacts from seven sites and no impacts from five sites. The most frequently recorded impacts were water pollution (PA17 and PK01) impacting 20 sites and site management (usually a lack of grazing) (PA05) at 10 sites. Over-grazing (PA07) was less frequent than under-grazing, impacting six sites. Other key negative impacts were modification of hydrological flow (PL05), invasive alien species (PI02) and landslides (PM05). The latter were due to natural slippage of steep river banks and inland and coastal cliffs. Many impacts have a low influence or cover only a small area of the site (Table 20). The negative impacts which can impact a large area (>90%) of a site and/or have a high influence were lack of grazing (PA05), water pollution (PA17), water abstraction (PL01) and modification of hydrogeological flow (PL05). Over-grazing had a high impact on one site.

The main positive impact recorded was extensive grazing (PA08), which was recorded from five sites (Table 20) and maintains open petrifying spring vegetation in non-wooded sites.

Table 20 Summary of the impacts recorded in the survey sites

Impact code	Impact summary	No. of sites	Intensity			% habitat impacted			Timing		
			H	M	L	<50	50-90	>90	O	O&F	P
Negative impacts											
PA05	Abandonment of management e.g. grazing	10	2	4	4	4	5	1		10	
PA07	Overgrazing by livestock	6	1	2	3	5	1			6	
PA17	Pollution of groundwater from agriculture	5	1	4		2	2	1		5	
PA25	Other agricultural activities (e.g. tracks)	2		1	1	2			1		1
PD07	Oil and gas pipelines	1			1	1					1
PE01	Road creation	1			1	1				1	
PF02	Construction in existing built-up areas	1			1	1					
PF03	Development of sports infrastructure	1		1		1					1
PF05	Sports, tourism and leisure activities	2			2	2				2	
PF06	Deposition of waste/ rubbish	1			1	1				1	
PI02	Invasive alien species	5		1	4	5				5	
PI03	Problematic native species (deer)	3		2	1	1	2			3	
PI04	Plant and animal diseases (ash dieback)	1			1	1				1	
PK01	Mixed source pollution to groundwaters	15		8	7	8	7			15	
PL01	Abstraction from groundwater	3	1		2	3				2	1
PL05	Modification of hydrological flow	6	2	3	1	3	2	1		6	
PM05	Landslides and collapse of terrain	5		2	3	5				5	
PM07	Natural processes (vegetation succession)	1			1	1				1	
Positive impacts											
PA08	Extensive grazing	5			5		2	3		5	
PB09	Clear-cutting, removal of all trees	1		1			1				1
PL03	Old barriers or other obsolete infrastructures	1			1	1					1
No impacts											
PX04	No pressures or threats	5									

4.2.7 Conservation measures

Conservation measures were only recorded from two of the survey sites: Managing the impacts of converting land for construction and development of infrastructure (MF01) and Other measures related to agricultural practices (MA14). Additional recommended measures (not yet undertaken) are listed below:

- MA04 Reinstate appropriate agricultural practices to address abandonment, including mowing, grazing, burning or equivalent measures (six sites)
- MA05 Adapt mowing, grazing and other equivalent agricultural activities (e.g. burning) (five sites)
- MA10 Reduce/eliminate point or diffuse source pollution to surface or ground waters (including marine) from agricultural activities (six sites)
- MA13 Manage agricultural drainage and water abstraction (incl. the restoration of drained or hydrologically altered habitats) (two sites)
- MA14 Other measures related to agricultural practices (one site)
- ME06 Habitat restoration of areas impacted by transport
- MF01 Managing the impacts of converting land for construction and development of infrastructure (one site)
- MF04 Reduce/eliminate pollution to surface or ground waters from commercial, residential and recreational areas and activities, and from industrial activities and structures (one site)
- MG02 Management of hunting, recreational fishing, and the recreational or commercial harvesting or collection of plants and fungi (incl. restoration of habitats) (one site)
- MI03 Management, control or eradication of other invasive alien species (two sites)
- MI05 Management of problematic native species (two sites)
- MK01 Reduce impact of mixed source pollution (11 sites)
- MK02 Reduce impact of multi-purpose hydrological changes (six sites)

4.2.8 Survey site conservation assessment

The conservation assessment for each of the 2023-2024 survey sites is shown in Table 21 and in Figure 17. Twenty one sites (50%) had a ‘green’ Favourable overall conservation assessment; 14 sites (33%) had an ‘amber’ Unfavourable-Inadequate assessment and seven sites (17%) had a red ‘Unfavourable-Bad’ overall site assessment. Most of the sites with Unfavourable-Bad overall assessment were located in the midlands and the east (Figure 17). The majority of the western sites, except for two, were assessed as Favourable overall (Figure 17). None of the eastern sites were assessed as having a Favourable conservation assessment (Figure 17). As water pollution was a major factor determining site condition, it is likely that this distribution pattern is linked to lower water pollution impacts in the west of the country. The two sites in the west that had an Unfavourable-Inadequate assessment (Carrowmore Point to Spanish Point and Islands SAC) and Unfavourable-Bad assessment (Cumeen Strand/Drumcliff Bay (Sligo) SAC) were coastal sites with elevated nutrient levels.

The western sites tended to have higher petrifying spring area than the eastern sites (particularly on upland sites with extensive seepage areas). Therefore, the overall area of petrifying spring habitat in Favourable condition is 0.08 km2 (77.38% of the assessed habitat); 0.02 km2 (18.42%) was in Unfavourable-Inadequate condition and 0.004 km2 (4.2%) in Unfavourable-Bad condition.

Table 21 Survey site conservation assessment

Site no.	Site name	Area	Area trend	S&F	S&F trend	Future prospects	Overall assessment
1	Annaghmore Lough (Roscommon) SAC	Green	Unknown	Red	Unknown	Amber	Red
2	Ballyman Glen SAC	Green	Stable	Amber	Increase	Amber	Amber
3	Ballynafagh Lake SAC	Amber	Stable	Red	Decrease	Amber	Red
4	Bellacorick Bog Complex SAC	Green	Stable	Green	Stable	Green	Green
5	Ben Bulben, Gleniff and Glenade Complex SAC	Green	Stable	Green	Stable	Green	Green
6	Black Head-Poulsallagh Complex SAC	Green	Stable	Green	Stable	Green	Green
7	River Boyne And River Blackwater SAC	Amber	Decrease	Red	Stable	Amber	Red
8	Caha Mountains SAC	Green	Stable	Green	Unknown	Green	Green
9	Cuilcagh - Anierin Uplands SAC	Green	Unknown	Green	Unknown	Green	Green
10	East Burren Complex SAC	Green	Stable	Green	Stable	Green	Green
11	Faughalstown	Green	Stable	Green	Stable	Green	Green
12	Glen of the Downs SAC	Green	Unknown	Amber	Unknown	Amber	Amber
13	Glenasmole Valley SAC	Green	Stable	Amber	Stable	Amber	Amber
14	Horn Head And Rinclevan SAC	Green	Unknown	Green	Unknown	Green	Green
15	Howth Head SAC	Amber	Decrease	Amber	Stable	Amber	Amber
16	Knocksink Wood SAC	Green	Stable	Amber	Stable	Amber	Amber
17	Lough Derg, North-East Shore SAC	Green	Unknown	Red	Unknown	Amber	Red
18	Lough Eske and Ardnamona Wood SAC	Green	Unknown	Green	Unknown	Green	Green
19	Magherabeg Dunes SAC	Green	Stable	Amber	Stable	Amber	Amber
20	Malahide Estuary SAC	Green	Unknown	Amber	Unknown	Amber	Amber
21	Rathcor, Carlingford	Green	Stable	Amber	Stable	Amber	Amber
22	Rye Water Valley/ Carton SAC	Amber	Decrease	Amber	Stable	Amber	Amber
23	Slieve Bloom Mountains SAC	Green	Unknown	Amber	Stable	Amber	Amber
24	Thomastown Quarry SAC	Green	Stable	Green	Stable	Green	Green
25	Beltany Mountain	Green	Unknown	Green	Unknown	Green	Green

Site no.	Site name	Area	Area trend	S&F	S&F trend	Future prospects	Overall assessment
26	Hook Head SAC	Green	Unknown	Amber	Unknown	Amber	Amber
27	Arroo Mountain SAC	Green	Stable	Green	Stable	Green	Green
28	Carrowmore Point to Spanish Point and Islands SAC	Amber	Decrease	Amber	Stable	Amber	Amber
29	Clonaslee Eskers and Derry Bog SAC	Amber	Decrease	Red	Decrease	Amber	Red
30	Cumeen Strand/Drumcliff Bay (Sligo) SAC	Green	Stable	Red	Stable	Amber	Red
31	Fin Lough (Offaly) SAC	Green	Stable	Green	Unknown	Green	Green
32	Lisduff Fen SAC	Green	Stable	Red	Decrease	Amber	Red
33	Lower River Shannon SAC	Green	Unknown	Green	Unknown	Green	Green
35	Murvey Machair SAC	Green	Unknown	Green	Unknown	Green	Green
36	Mweelrea/Sheeffry /Erriff Complex SAC	Green	Stable	Green	Stable	Green	Green
37	Ox Mountains Bogs SAC	Green	Unknown	Green	Unknown	Green	Green
38	Pollardstown Fen SAC	Amber	Decrease	Amber	Stable	Amber	Amber
39	River Barrow and River Nore SAC	Green	Stable	Green	Stable	Green	Green
40	Slieve League SAC	Green	Unknown	Green	Unknown	Green	Green
41	Bray Head	Green	Unknown	Amber	Unknown	Amber	Amber
42	St John’s Point SAC	Green	Unknown	Green	Unknown	Green	Green
43	Slieve Tooey/Tormore Island/Loughros Beg Bay SAC	Green	Unknown	Green	Unknown	Green	Green

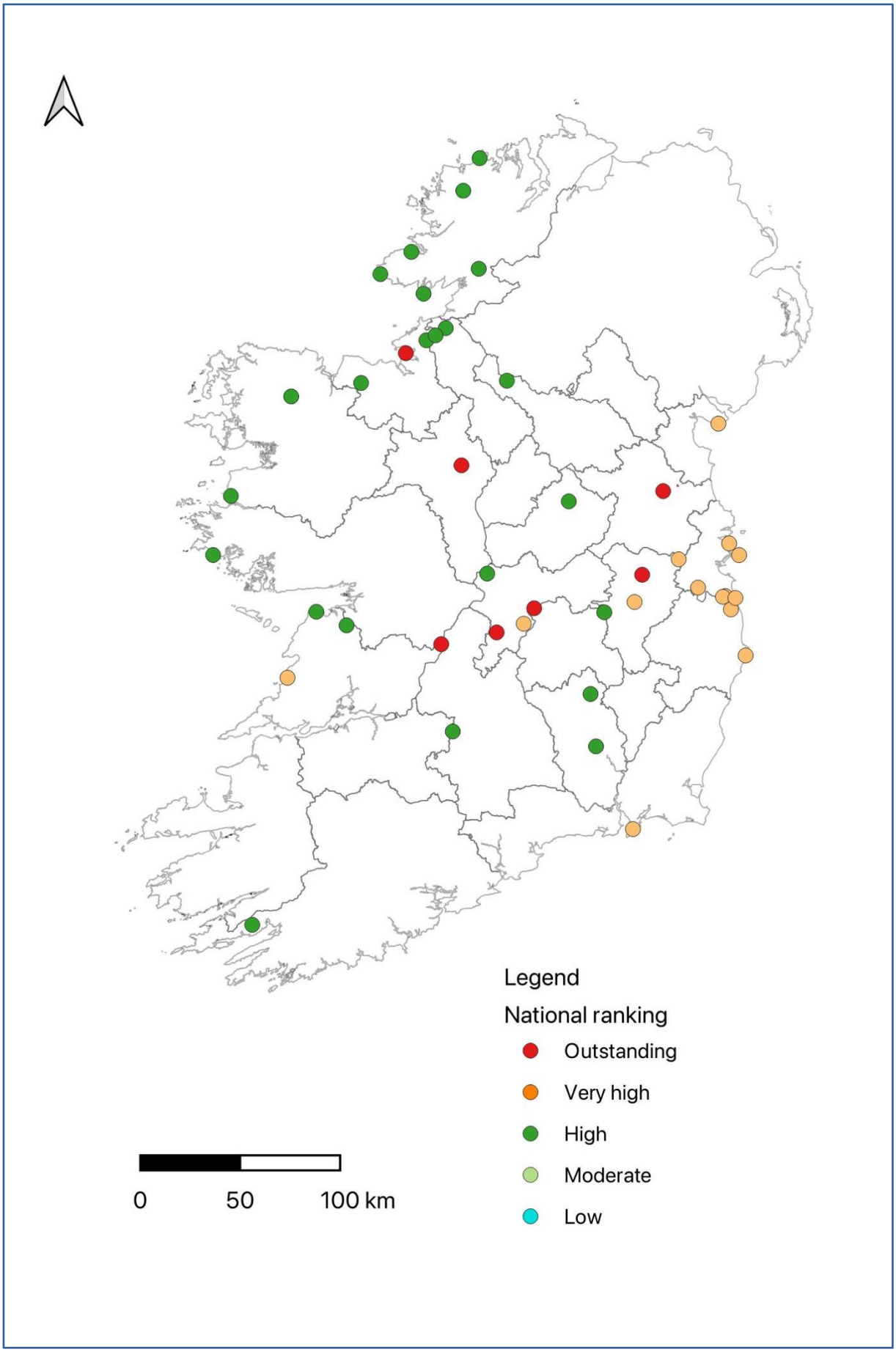

Figure 17 National ranking of 2023-2024 survey sites. Some sites have several sub-sites and are represented by more than one point.

5 National Conservation Assessment

The National Conservation Assessment was completed in 2024 and uses the 2023 field survey data and data from the petrifying spring data review (Section 2.1). The methods and data are detailed in the Article 17 report (NPWS, 2025) and backing document (Denyer, 2024). The overall National Conservation Assessment is shown in Table 22 and the key data supporting this is summarised in the sections below.

Table 22 Summary of the NCA for petrifying springs for the period 2019-2024

Parameter	Justification for assessment	Future prospects	NCA
Range	Stable, no loss recorded; equal to Favourable Reference Range	Good	Favourable
Area	Stable, no loss recorded; equal to Favourable Reference Area	Good	Favourable
Structure and Functions	18% habitat (<25%) not in favourable condition but stable short and long-term habitat condition trend	Poor	Unfavourable-Inadequate
Overall National Conservation Assessment		Stable	Unfavourable-Inadequate

5.1 Range

The 2019 Article 17 assessment (NPWS, 2019) included a total of 433 mappable points relating to petrifying springs in Ireland. The 2023-2024 field survey and data review resulted in an updated distribution of 679 mappable points from 190 sites (Figure 18).

In the latest assessment, the Range of petrifying spring habitat in Ireland is 218 x 10 km squares (Figure 18). This is an apparent increase in Range, both in the short-term (189 x 10 km squares recorded in 2019) and long-term (132 x 10 km squares recorded in 2013). However, this is due to improved knowledge and the addition of 238 new spring points in the current assessment. For instance, several new petrifying spring sites were recorded in the south-east of Ireland where there were previously no springs recorded.

While there have been some small losses of habitat area within the reporting period, these are small in comparison to the overall Range size, and this is an uncommon but relatively widespread habitat type in Ireland. The Range is not affected by such losses and the trend is reported as ‘Stable’.

The Favourable Reference Range (FRR) (21,800 km2) has been set as the current Range as it is based on more complete data being available on the distribution of petrifying springs across Ireland than was available in the last monitoring round. The FRR is considered to encompass all ecological and geographical variation of the habitat and is likely to be sufficiently large to allow the long-term viability of the habitat.

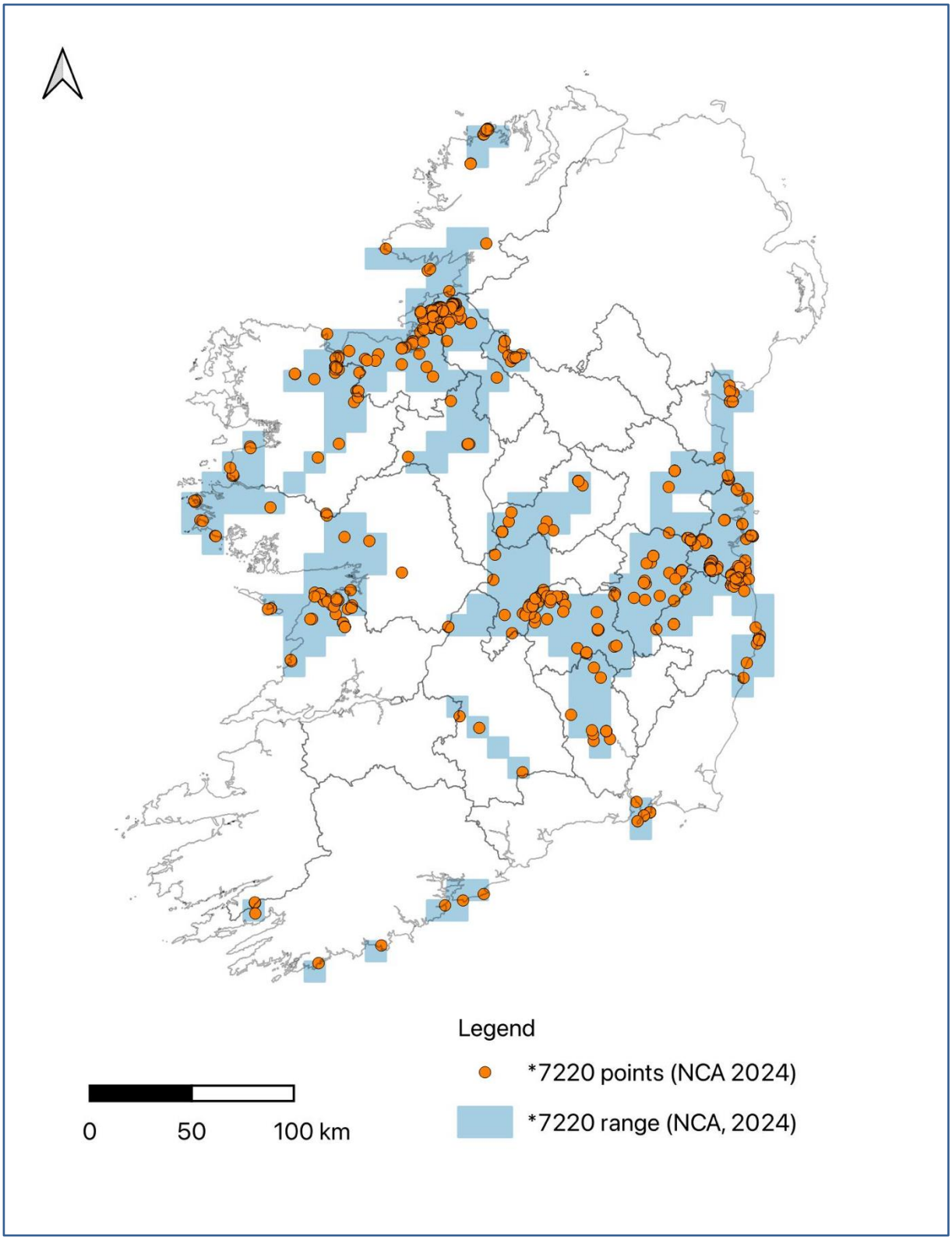

Figure 18 Range and distribution of petrifying springs in Ireland based on the National Conservation Assessment completed in 2024, using the 2023 field survey data and data from the petrifying spring data review (NPWS, 2025).

5.2 Area

The total area of petrifying spring habitat in 2024 was 0.1803 km^2. In the previous Article 17 reporting period (NPWS, 2019), petrifying spring area was estimated to be 0.1379 km^2 (minimum) to 0.1441 km^2 (maximum). This is an apparent increase of 16.5-28.8% in petrifying

springs habitat area. This is due to new information being available, with updated areas for many existing springs and the addition of 238 new spring points to the database.

The short-term trend direction was estimated as 'Stable' based on field survey data. Data sources show that there have been small losses at a few sites, but mostly the changes relate to condition rather than loss of area. Therefore, the Favourable Reference Area is set as the area in the 2024 reporting round, as many additional sites have been added.

5.3 Structure and Functions

Structure and Functions data were available for 24 sites from the National Petrifying Springs Survey 2023 field survey data, with a combined area of 0.0794 km^2 of petrifying spring habitat (Denyer, 2024). Additional data on Structure and Functions from relevant reports and datasets was available for a further 18 sites, with a combined area of 0.0023 km2 of petrifying spring habitat (Denyer, 2024). In total, Structure and Functions data was available from 310 plots at 42 sites, which is 22% of known petrifying spring sites, and from 0.082 km^2, which is 45% of the 2024 known petrifying spring area. In the petrifying spring areas for which Structure and Functions data was available for the reporting period, these were Favourable in 0.0629 km^2 (76.99%); Unfavourable-Inadequate in 0.0145 km^2 (17.75%); and Unfavourable-Bad in 0.0043 km2 (5.26%).

The most frequent criteria which failed the Structure and Functions assessment were: positive indicator species (10% plots); nitrate (8% plots); and, negative bryophyte species (6% of plots). These are frequently linked, as elevated nitrate levels can cause an increase in negative bryophyte species and decrease in positive indicator species. Trampling by deer failed in 4% of plots and elevated phosphate levels in 3% of plots. The least frequently failed criteria were invasive species (2% of plots), negative woody species (2% of plots), vegetation height (2% of plots), negative herbaceous species (1% of plots) and changes to water flow (1% of plots).

The Structure and Functions data was collected from a representative sample of petrifying springs in Ireland. It includes data from small and large spring complexes; urban and non-urban areas; covers a wide geographic spread; includes springs of Low to Very high Conservation Status; and, includes examples of all Irish petrifying spring vegetation communities (Lyons & Kelly, 2017). The results are also highly consistent with the full data from the 2023-2024 field survey site assessment (see Section 4.2.8): Favourable condition (77.38%); Unfavourable-Inadequate condition (18.42%); and Unfavourable-Bad condition (4.2%). Therefore, the results can be applied to the total known petrifying spring habitat, giving a total of 0.1388 km^2 in Favourable condition (77%) and 0.0415 km^2 in Unfavourable condition (23%).

In the 2019 National Conservation Assessment for this habitat, the proportion of habitat in Favourable condition was reported as 75% so there is an apparent 2% increase in area in Favourable condition in the current assessment. However, there was no corresponding increase in reported site condition compared to 2019. It is therefore considered that the apparent increase is due to more accurate assessment of spring areas in the current assessment.

Short-term trend direction was assessed as 'stable'. Where data was available from 2013-2024, 0.45% of the area had a 'decreasing' trend in structure and functions. There are ongoing issues and pressures at many spring sites, particularly in the east of the range. However, only a small number of these sites are continuing to decline in condition and so overall there is currently a stable short-term trend in structure and functions.

5.4 Future Prospects

5.4.1 Pressures

Pressures and threats data were available for 24 sites from the 2023 field surveys. Additional data on pressures and threats from relevant reports and datasets was available for a further 51 sites. In total, pressures and threats data was available from 75 sites, which is 39.46% of known petrifying spring sites; and from 0.1557 km^2, which is 87.63% of known petrifying spring area.

A total of 31 pressures and threats were recorded from the 75 sites (Denyer, 2024). These were ranked according to the number of sites they impacted. All impacts which were recorded at more than three sites, or which had a medium or high recorded impact affecting at least one site (ongoing) were selected as key impacts. This produced a list of 16 impacts which are listed in order of the number of sites impacted (in descending order) in Table 23.

All 16 selected pressures were recorded as '*ongoing and likely to be in the future*' (Table 23). In the full dataset there were 14 pressures listed as being in the past '*past*' at a number of sites:

- PL02 Drainage (three sites)
- PF01 Conversion from other land uses to built-up areas (two sites)
- PL05 Modification of hydrological flow (two sites)
- PA07 Intensive grazing or overgrazing by livestock (one site)
- PA25 Agriculture activities not referred to above (one site)
- PB09 Clear-cutting, removal of all trees (one site)
- PC05 Peat extraction (two sites)
- PD01 Wind, wave and tidal power (including infrastructure) (one site)
- PD07 Oil and gas pipelines (one site)
- PF03 Creation or development of sports, tourism and leisure infrastructure (one site)
- PF05 Sports, tourism and leisure activities (one site)
- PF13 Drainage, land reclamation and conversion of wetlands, marshes, bogs, *etc*. for built-up areas (one site)
- PL01 Abstraction from groundwater, surface water or mixed water (one site)
- PL03 Old barriers or other obsolete infrastructures (one site)

There were four 'threats' listed in the full dataset (*i.e.* pressures which were categorised as 'future' only):

- PA05 Abandonment of management/use of grasslands and other agricultural and agroforestry systems (*e.g*. cessation of grazing, mowing or traditional farming) (one site)
- PF01 Conversion from other land uses to built-up areas (two sites)
- PF05 Sports, tourism and leisure activities (one site)
- PI02 Other invasive alien species (other than species of Union concern) (one site)

The scope of the pressures was recorded for each site which had pressure and threats data available. This had been recorded as <50%, 50-90% and >90% for each pressure at each individual spring point. In order to assess the overall scope of each pressure across all springs,

the scope per area was calculated. The categories were converted to a percentage <50% = 25%, 50-90% = 75% and >90% = 95% (Denyer, 2024). The area of each site impacted by the pressure could then be estimated and combined to give an overall area for all sites assessed (Table 23).

For each pressure, the most frequently reported influence was selected (*i.e*. recorded at the most number of sites). However, where the most reported influence was 'Low' but there was a 'High' reported from at least one site, expert judgement was used to decide the overall influence level. Where there was an equal number of sites, *e.g*. two sites with 'Low' and two sites with 'Medium', the higher influence category was listed. If the combined number of sites with 'Low' was equal to those with 'Medium' and 'High', *e.g*. two sites with 'Low', one site 'Medium' and one site 'High', then 'Low' was not used and expert judgement was used to decide the overall influence level.

The key pressures in the current assessment relate to water quality and changes to hydrology. PK01 (mixed source pollution to groundwater) is the highest ranked impact, recorded at 15 sites. In addition, PA17 (agricultural pollution to groundwater), PF07 (residential and commercial pollution to ground water), PE05 (transport activities generating pollution to ground water), PL01 (groundwater abstraction), PL02 (drainage) and PL05 (modification of hydrological flow) are listed in the top 16 key pressures (Table 23).

The second key pressure is PA05 (abandonment of management) which was recorded at 12 sites. This can lead to springs becoming overgrown with tall vegetation or scrub and drying out. Conversely, over-grazing with associated trampling and dung was impacting some sites, either by intensive agricultural grazing (PA07) or deer (PI03).

Other impacts include the loss of springs, disturbance or other impacts from adjacent urbanisation (PF01) and recreational activities (PF05), invasive species (PI02) and dumping of waste (PF06). The category PA25 refers to damage to springs by use of agricultural vehicles (such as quad bikes) in and adjacent to petrifying spring habitat. Eight sites were subject to natural landslides, these were usually coastal or in river valleys.

Note that whilst all pressures affected a minority of the total petrifying springs area (<50%), the scope may be much higher at individual sites. For example, PA05, PA08, PA17, PE06, PF01 and PK01 were recorded as impacted over >90% of petrifying spring habitat in at least one site (Table 23).

Table 23 Summary of key impacts recorded in the NCA

Impact	No. of sites	Timing	Scope	Influence
PK01 Mixed source pollution to surface and ground waters (limnic and terrestrial)	15	ongoing and likely to be in the future	minority	Medium
PA05 Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming)	12	ongoing and likely to be in the future	minority	Medium
PA17 Agricultural activities generating pollution to surface or ground waters (including marine)	11	ongoing and likely to be in the future	minority	Medium
PI02 Other invasive alien species (other than species of Union concern)	8	ongoing and likely to be in the future	minority	Low
PM05 Avalanches, landslides and collapse of terrain	8	ongoing and likely to be in the future	minority	Low
PA07 Intensive grazing or overgrazing by livestock	8	ongoing and likely to be in the future	minority	Medium
PL05 Modification of hydrological flow	7	ongoing and likely to be in the future	minority	Medium
PF01 Conversion from other land uses to built-up areas	6	ongoing and likely to be in the future	minority	Medium
PF05 Sports, tourism and leisure activities	5	ongoing and likely to be in the future	minority	Low
PI03 Problematic native species	5	ongoing and likely to be in the future	minority	Medium
PL02 Drainage	5	ongoing and likely to be in the future	minority	Low
PF06 Deposition and treatment of waste/rubbish from built-up areas	4	ongoing and likely to be in the future	minority	Low
PA25 Agriculture activities not referred to above	2	ongoing and likely to be in the future	minority	Medium
PE05 Land, water and air transport activities generating pollution to surface or ground waters	2	ongoing and likely to be in the future	minority	Medium
PL01 Abstraction from groundwater, surface water or mixed water	2	ongoing and likely to be in the future	minority	Medium
PF07 Residential and commercial activities and structures generating pollution to surface or ground waters	1	ongoing and likely to be in the future	minority	Medium

Six invasive species were listed as a pressure (Table 24). Of these, five were ‘Other invasive alien species’ and this pressure was selected in the top 16 pressures as it impacted eight sites. In general, the impacts were low as the invasive species are often on the margins of the spring. There was one ‘Invasive species of alien concern’ recorded (Table 24). This was not selected as a key pressure as it was not having a Medium or High impact at any site and impacted a low number of sites overall.

Table 24 Invasive species listed as a pressure in the NCA

Species	Number of sites	Influence	Category
Cotoneaster sp.	3	Low	Other invasive alien species
Epilobium brunnescens	1	Low	Other invasive alien species
Fagus sylvatica	1	Medium	Other invasive alien species
Heracleum mantegazzianum	1	Low	Invasive species of alien concern
Petasites pyrenaicus	2	Low	Other invasive alien species
Soleirolia soleirolii	1	Medium	Other invasive alien species

5.4.2 Conservation measures

A number of conservation measures that had been undertaken were reported in the 2019 assessment (NPWS, 2019). The following are additional known conservation measures.

- Scrub clearance (MM01), treatment of invasive species (MI03) and removal of garden waste (MF04) from spring mounds within Moy Estuary undertaken in 2022 and 2024
- Scrub clearance (MA04) from petrifying spring/stream near Timahoe, Co. Offaly undertaken in 2024
- Habitat management plan (MM01; MF04) in preparation for an area of habitat with petrifying springs within Rye Water Valley/Carton SAC

5.4.3 Overall Future Prospects

The Future Prospects for the Range and the Area of the habitat were both assessed as good, because while there may continue to be some small losses of habitat area and/or habitat quality in the next 12 years, these are likely to be relatively small in comparison with the overall Range and Area, and so these parameters are unlikely to be affected by such losses/decreases in quality.

The Future Prospects for the Structure and Functions were assessed as Poor as 23% of the Area is in Unfavourable condition (Section 5.3), the pressures which are responsible for the Unfavourable condition were all categorised as 'ongoing and likely to be in the future' (Table 23) and there are few conservation measures being undertaken (Section 5.4.2).

5.5 Populations within and outside the SAC network

A list of SACs which contain petrifying spring habitat, both as a Qualifying Interest (QI) (20 sites) and non-QI (31 sites), are shown in Appendix 1. Five new SACs were added to the list in the current assessment due to increased knowledge (Denyer, 2024).

To calculate the area of SAC in good condition, the data from each individual monitoring plot located within the SAC network was used. Each spring point for which data was available, was ranked as 'Pass/Fail'. Each petrifying spring point had an area assigned and therefore for all SAC spring points it was possible to calculate the overall area in 'Pass/Fail' condition. This gave an area of 51761.3 m^2 in good condition ('Pass'). The overall area of SAC springs which was assessed was 60639.6 m^2. Therefore, the percentage of the assessed SAC sites in good condition was 85.36%. As the data was from a representative selection of SAC sites, this was extrapolated to the whole SAC network.

The trend was estimated using data from the 2023 field surveys and comparing with data on baseline SAC condition (Lyons, 2015). Comparison data was available for 14 sites (Denyer, 2024) There was an improvement in condition at one site (Ballyman Glen SAC), due to a

reduction in impact from clay pigeon shooting in the fen area south of the river. There was a decrease in condition in one site (Rye Water Valley/Carton SAC). This was due to the addition of survey data on springs within the SAC that had not previously been assessed, and does not reflect an actual change. The remaining 13 sites had no change in condition (Stable).

6 Conclusions and recommendations

Although the Range and Area of petrifying spring habitat in Ireland is considered Favourable, almost a quarter of petrifying springs have Unfavourable Structure and Functions. The key reasons for poor condition relate to water quality (elevated nitrate and phosphate levels) and water quantity (modifications to water flow, drainage and abstraction). In addition, some sites were impacted from low levels of management (*e.g*. grazing), leading to them becoming overgrown. A few sites were impacted by high levels of deer grazing, typically causing trampling damage. The larger coastal and upland western sites were often in Favourable condition with few negative impacts recorded. However, many smaller midland and eastern sites were found to be in Unfavourable condition, often due to groundwater pollution. Site-specific recommendations are included in the site reports (Appendix 2). These include:

- Hydrogeological investigations to determine sources of pollution (usually elevated nitrate and phosphate) and impacts to water quantity (*e.g*. drainage and abstraction). From this, site-specific measures can be determined to reduce impacts to water quality and quantity. The priority should be sites with higher Conservation scores or which support large areas of petrifying spring habitat
- Grazing measures at relevant sites including reintroduction of grazing at sites which are currently overgrown and protection from high deer numbers at sites which have deer trampling damage
- Survey of additional areas in large petrifying spring sites, particularly upland sites and those of High conversation importance such as Arroo Mountain SAC and Ben Bulben, Gleniff and Glenade Complex SAC. Because of the high number of petrifying springs supported at these sites and the site size, it was only possible to survey a small proportion of the sites in the 2023-2024 surveys
- Survey of additional sites not included in the 2023-2024 field survey, particularly important sites that are located outside of the SAC network

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Appendix 1 - List of SAC sites with *7220 recorded

Site name	Site code	QI	Selected*	Comment
Annaghmore Lough (Roscommon) SAC	001626		Y	No baseline survey but high certainty *7220 present. Only SAC with *7220 in Co. Roscommon.
Arroo Mountain SAC	001403	Y	Y	No recent survey data, additional springs to check, includes petrifying springs of very high ecological value
Ballyman Glen SAC	000713	Y	Y	No recent survey data in south of site, important *7220 site in eastern region
Ballynafagh Lake SAC	001387		Y	No recent survey data and spring may have become overgrown.
Bellacorick Bog Complex SAC	001922		Y	No recent survey data, supports a large area of *7220 habitat
Ben Bulben, Gleniff and Glenade Complex SAC	000623	Y	Y	No recent survey data and includes petrifying springs of very high ecological value
Black Head-Poulsallagh Complex SAC	000020	Y	Y	No recent survey data and includes petrifying springs of very high ecological value
Bray Head SAC	000714		Y	New petrifying spring site, no baseline data available
Caha Mountains SAC	000094		Y	No recent survey data. Only *7220 site in Co. Kerry and most SW *7220 site.
Carrowmore Point To Spanish Point And Islands SAC	001021	Y	Y	No recent survey data.
Clonaslee Eskers And Derry Bog SAC	000859		Y	No recent survey data and only esker site
Cuilcagh - Anierin Uplands SAC	000584	Y	Y	No recent survey data and additional springs to check
Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC	000627	Y	Y	No recent survey data
East Burren Complex SAC	001926	Y	Y	No recent survey data
Fin Lough (Offaly) SAC	000576		Y	No baseline survey but high certainty *7220 present.
Galway Bay Complex SAC	000268		N	Only one spring with some potential to be *7220 but not confirmed
Glen of the Downs SAC	000719		Y	New petrifying spring site, no baseline data available
Glenasmole Valley SAC	001209	Y	Y	No recent survey data and important *7220 site in in eastern region
Gortnandarragh Limestone Pavement	001271		N	Potential for *7220 but unconfirmed and little information
Hook Head SAC	000764		Y	New petrifying spring site, no baseline data available
Horn Head And Rinclevan SAC	000147		Y	No baseline survey but high certainty *7220 present
Howth Head SAC	000202		Y	No recent survey data
Inishmaan Island SAC	000212		N	Small areas of tufaceous springs and seepages - coastal springs well represented in survey data

Site name	Site code	QI	Selected*	Comment
Island Fen SAC	002236		N	Limited information and may not be *7220. Not included in 2024 Art17 distribution.
Knocksink Wood SAC	000725	Y	Y	No recent survey data, additional springs to check, important *7220 site in eastern region
Lisduff Fen SAC	002147	Y	Y	No recent survey data
Lough Carra/Mask Complex SAC	001774		N	Described as weakly tufaceous borderline habitat, small extent
Lough Corrib SAC	000297	Y	N	QI, but no data on *7220 within SAC except one inaccessible site in gorge
Lough Derg, North-East Shore SAC	002241		Y	No baseline survey but probable *7220 present
Lough Eske And Ardnamona Wood SAC	000163	Y	Y	QI but no baseline data or exact spring location known
Lough Gill SAC	001976		N	Several other sites surveyed in Co. Sligo
Lower River Shannon SAC	002165		Y	No baseline survey but high certainty *7220 present
Magherabeg Dunes SAC	001766	Y	Y	No recent survey data in very south and north of site. Large costal seepage area.
Malahide Estuary SAC	000205		Y	No baseline data available but *7220 present
Mamturk Mountains SAC	002008		N	Not QI and noted that 'no tufa' for this plot (likely to not be *7220)
Moneen Mountain SAC	000054	Y	N	Not possible to obtain access permission. Two other SACs surveyed in Burren region.
Murvey Machair SAC	002129		Y	No baseline survey but high certainty *7220 present
Mweelrea/ Sheeffry/ Erriff Complex SAC	001932	Y	Y	No recent survey data and additional springs to check
Omey Island Machair SAC	001309		N	No baseline survey data, but coastal which is well represented in survey data.
Ox Mountains Bogs SAC	002066		Y	No baseline survey but high certainty *7220 present although spring points not highly localised
Pollardstown Fen SAC	000396	Y	Y	No recent survey data but important eastern *7220 site with springs of high ecological value
River Barrow And River Nore SAC	002162	Y	Y	No recent survey data
River Boyne And River Blackwater SAC	002299		Y	No recent survey data. One of the largest known single cascade mounds of *7220 in Ireland.
River Moy SAC	002298		N	Extensive surveys undertaken 2021-2024 (Denyer Ecology)
River Shannon Callows SAC	000216		N	Described as 'weakly tufaceous seepages in pasture' with low conservation score.
Rye Water Valley/ Carton SAC	001398	Y	Y	Partial recent survey data only, important eastern *7220 site with springs of high ecological value

Site name	Site code	QI	Selected*	Comment
Slieve Bloom Mountains SAC	000412		Y	No recent survey data, upland area with many petrifying springs but limited *7220 within SAC.
Slieve League SAC	000189		Y	No baseline survey but high certainty *7220 present
Slyne Head Peninsula SAC	002074		N	Described as borderline *7220 habitat
St. John's Point SAC	000191		Y	No baseline survey but high certainty *7220 present.
Thomastown Quarry SAC	002252	Y		No recent survey data

*Selected for field survey 2023-2024

Appendix 2 - Site reports

Annaghmore Lough (Roscommon) SAC

Site details

PTRS23 Site code	PTRS23-001
County	Roscommon
Designations	SAC (001626)
Landscape	Lowland lake
Altitude	46 - 47 m

Survey details

Date(s) surveyed	03/11/2023		
Recorder(s)	George Smith		
Area surveyed	11.03 ha		
Subsites surveyed	Northern shore		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	2		
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figures 1a & 1b), as it is a large site. Survey area selected using aerial photography and local knowledge as most likely to support *7220.		

Site and petrifying spring description

Site description	Patchy tufa forming seepage zones on north shore of Annaghmore Lough with paludal tufa formation. Spring vegetation is *Schoenus* fen community. Substrate hard under bryophyte layer suggesting build-up of travertine but petrifying spring habitat limited in extent due to rank, unmanaged fen vegetation. In the main fen to the east of the lough, the northern side supports frequent patches of weak paludal tufa. Most of ground surface is pale marly mud.			
Site management	Spring areas along northern shore are unmanaged. Fen is extensively cattle grazed.			
Petrifying spring type(s)	Seepage			
Petrifying Spring vegetation communities	Group 5 *Schoenus nigricans* Springs			
Main tufa type(s)	Paludal; stream crust			
No. *7220 springs mapped	4			
Area of *7220	0.040 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	784 - 971	pH	7.12 - 7.41
	Nitrate mg/l	Not detectable	Phosphate mg/l	Not detectable
Other Annex habitats	7230			
Other Fossitt habitats	BL3; GS2; GA2; PF1			

Structure and functions

No. monitoring plots	2
% pass rate	0 %
Main criteria for failing S&F	Vegetation height (tall as ungrazed)

Impacts

Impact code	Description	Timing	Scope	Influence
PA05	Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming)	Ongoing & future	50-90%	Low
PF02	Construction or modification (e.g. of housing and settlements) in existing built-up areas	Ongoing & future	50-90%	Low

Change from baseline

No baseline data available

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Unfavourable-Bad	Unfavourable-Inadequate	Unfavourable-Bad

Conservation measures

Conservation measure code	Description
MA04	Reinstate appropriate agricultural practices to address abandonment, including mowing, grazing, burning or equivalent measures

Recommendations

Site management	Reinstate grazing/ encourage higher grazing of spring area
Survey	Survey of remaining area of SAC that was not surveyed in 2023
Hydrogeology	None

Photograph 1 North face shore of Annaghmore Lough (view to east) with *Schoenus* fen with petrifying spring seepages. Photograph George Smith.

Photograph 2 *Schoenus nigricans* petrifying spring vegetation community. Photograph George Smith.

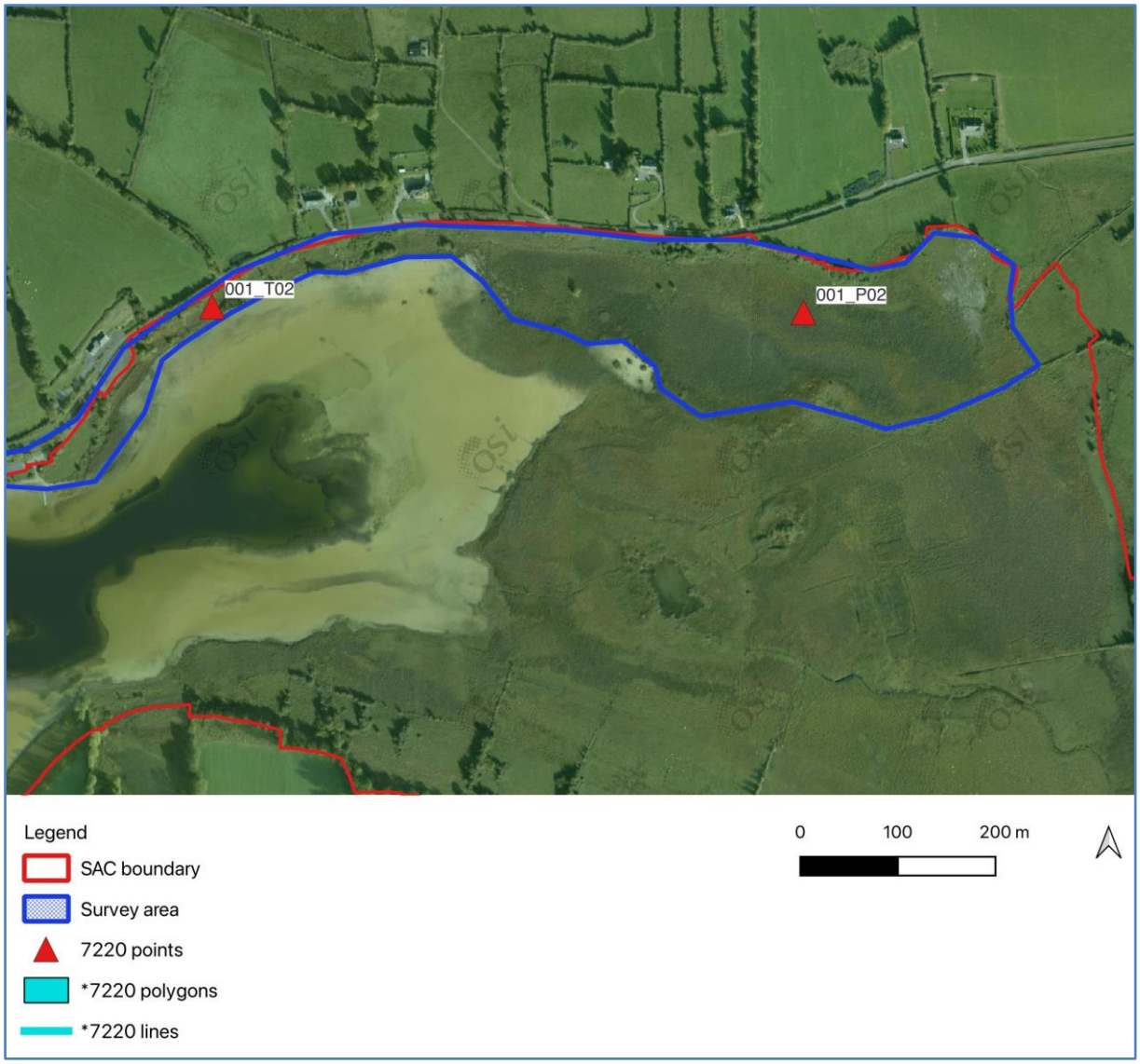


Figure 1a Annaghmore Lough (Roscommon) SAC survey area (east), *7220 locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Figure 1b Survey area (west), *7220 locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Ballyman Glen SAC

Site details

PTRS23 Site code	PTRS23-002
County	Dublin & Wicklow
Designations	SAC (00713)
Landscape	Lowland river valley
Altitude	83 - 85 m

Survey details

Date(s) surveyed	28/07/2023		
Recorder(s)	Joanne Denyer & Rory Hodd		
Area surveyed	0.72 ha		
Subsites surveyed	Fen south of river		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1	3	
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figure 1), there has been recent survey in other areas and the site is sensitive to trampling.		

Site and petrifying spring description

Site description	Alkaline fen with numerous iron staining and paludal tufa forming seepages south of river (Co. Wicklow). Extensive tufa forming seepages (cascade, paludal tufa and oncoids and ooids) within wet woodland north of river (Co. Dublin). Spring surface very wet and quaking in woodland and sensitive to disturbance.			
Site management	None recorded			
Petrifying spring type(s)	Springhead; flush			
Petrifying Spring vegetation communities	Group 2 *Palustriella commutata-Geranium robertianum* springheads Group 4 *Palustriella commutata-Agrostis stolonifera* springheads Group 6 *Carex lepidocarpa* Small Sedge Springs			
Main tufa type(s)	Paludal			
No. *7220 springs mapped	5 (26 mapped for whole site)			
Area of *7220	0.031 ha			
National ranking	High			
Species of note	*n/a*			
Water sample data	EC µS/cm	238 - 1010	pH	6.8 - 7.07
	Nitrate mg/l	Not determined	Phosphate mg/l	Not determined
Other Annex habitats	PF1			
Other Fossitt habitats	7230; *91E0			

Structure and functions

No. monitoring plots	4
% pass rate	75 %
Main criteria for failing S&F	Positive indicator species

Impacts

Impact code	Description	Timing	Scope	Influence
PA05	Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming)	Ongoing & future	<50%	Low
PF05	Sports, tourism and leisure activities	Ongoing & future	<50%	Low
PI03	Problematic native species (deer)	Ongoing & future	50-90%	Medium

Change from baseline

There has been an increase in area from the baseline (2012), this is because more of the SAC (particularly north of the river) has been surveyed, and many new springs mapped. There was no reduction in area in the springs M02, M03 and M04 which have baseline data. There was a large reduction in the number of positive indicator species in plot M02. This area has recovered from damage associated with previous clay pigeon shooting. However, the fen area is unmanaged and is becoming overgrown with tall *Molinia caerulea*. There was a reduction in tufa formation with 100% tufa in plot M02, M03 and M04 in the baseline survey and less than 10% in these plots in 2023. This may be related to past damage from trampling but could be due to changes in water quality which should be monitored.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate

Conservation measures

Conservation measure code	Description
MA04	Reinstate appropriate agricultural practices to address abandonment, including mowing, grazing, burning or equivalent measures
MG02	Management of hunting, recreational fishing, and the recreational or commercial harvesting or collection of plants and fungi (incl. restoration of habitats)
MI05	Management of problematic native species
MF01	Managing the impacts of converting land for construction and development of infrastructure

Recommendations

Site management	Extensive grazing in alkaline fen area, reduction of deer in woodland areas
Survey	Repeat survey of springs in fen area in next three years to assess if any further reductions in positive indicator species or tufa formation. Protection of sensitive habitats during surveys and investigations for adjacent planning applications – surveys only in consultation with NPWS to ensure minimisation of trampling damage.
Hydrogeology	Water sampling in alkaline fen area to investigate possible cause of tufa reduction.

Photograph 1 Alkaline fen with petrifying spring seepages, *Molinia caerulea* abundant. Photograph Joanne Denyer.

Photograph 2 Petrifying spring in wet woodland with iron staining, *Equisetum telmateia* and *Palustriella commutata* frequent. Cartridges from clay pigeon shooting present. Photograph Joanne Denyer.

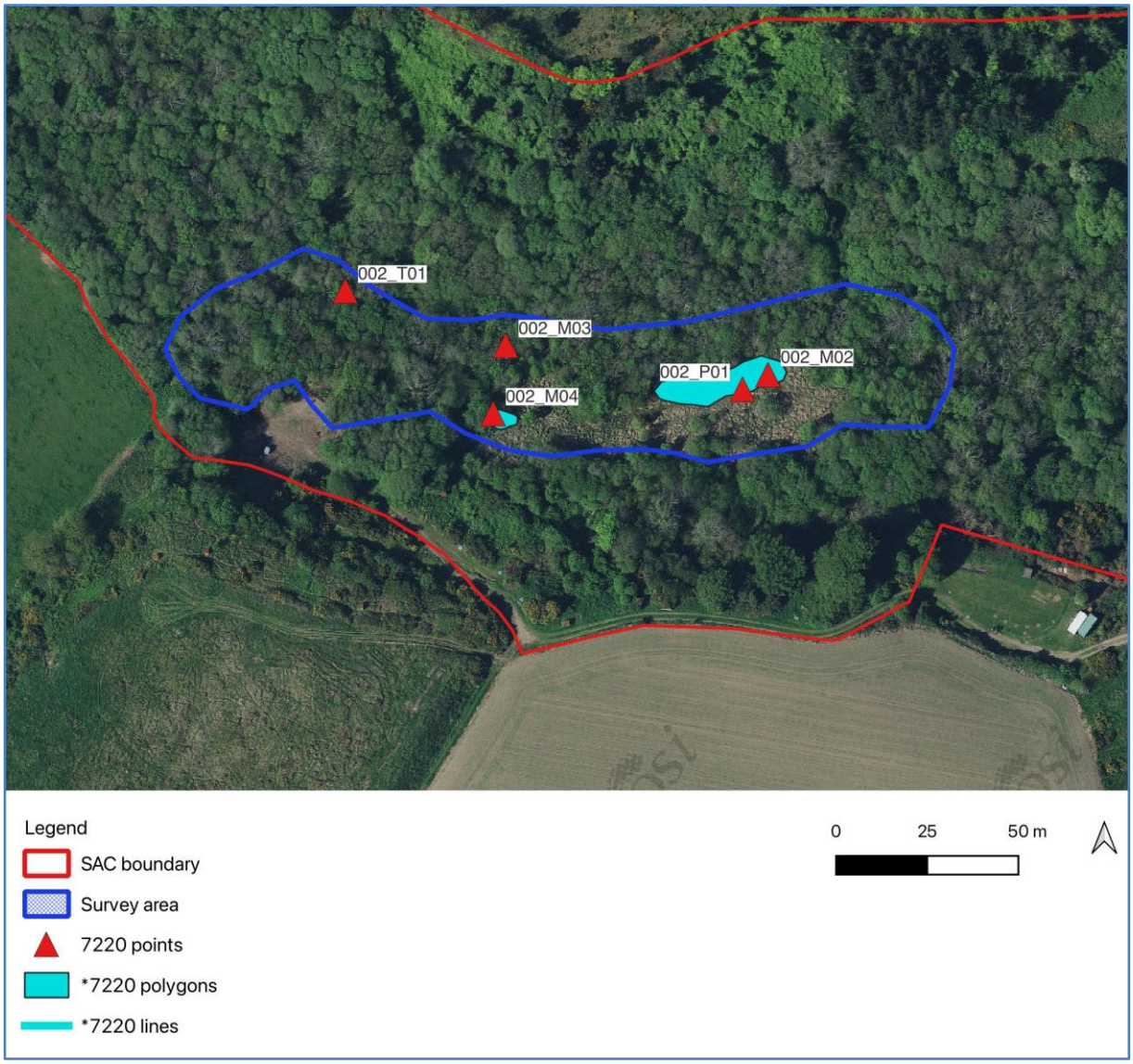


Figure 1 Ballyman Glen SAC survey area, *7220 locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Ballynafagh Lake SAC

Site details

PTRS23 Site code	PTRS23-003
County	Kildare
Designations	SAC (001387)
Landscape	Lowland lake and wetland
Altitude	86 m

Survey details

Date(s) surveyed	22/08/2023		
Recorder(s)	Joanne Denyer		
Area surveyed	5.55 ha		
Subsites surveyed	n/a		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
		2	
Water chemistry sampling	Field sampling and laboratory tested samples		
Survey limitations	Area where petrifying springs previously recorded surveyed (Figure 1).		

Site and petrifying spring description

Site description	Site supports bog, fen and transition mire. Spring arises in fen/ swamp near car park and flows to the southwest. Petrifying spring species and paludal tufa present from central area of spring line to the area of swamp/ pools in the south. Discharges to lake. Spring origin and flow line marked on old mapping. No other springs recorded from the site.			
Site management	None recorded			
Petrifying spring type(s)	Flush			
Petrifying Spring vegetation communities	Group 5 *Schoenus nigricans* Springs			
Main tufa type(s)	Paludal			
No. *7220 springs mapped	2			
Area of *7220	0.024 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	1250 - 1350	pH	7.34 – 8.01
	Nitrate mg/l	28.9 mg/l	Phosphate mg/l	0.058 mg/l
Other Annex habitats	7140; 7230			
Other Fossitt habitats	FS1; PF1			

Structure and functions

No. monitoring plots	2
% pass rate	0 %
Main criteria for failing S&F	Positive indicator species; negative woody species; nitrate and phosphate levels; vegetation height

Impacts

Impact code	Description	Timing	Scope	Influence
PA05	Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming)	Ongoing & future	50-90%	Medium
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	50-90%	Low

Change from baseline

There was a slight decrease in area from the baseline (2012) as the spring vegetation is becoming overgrown. One plot (M01) had a reduction in positive indicator species, but the second plot (M02) had an increased number. However, overall, the petrifying spring habitat had declined in condition due to becoming overgrown by tall vegetation. Nitrate and phosphate levels are both elevated. There may be some drying which is also allowing woody vegetation to invade. Paludal tufa had decreased in cover in both plots from the baseline. Phosphate levels were exceeded in the baseline survey but not nitrate (<0.07 mg/l).

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Unfavourable-Inadequate	Unfavourable-Bad	Unfavourable-Inadequate	Unfavourable-Bad

Conservation measures

Conservation measure code	Description
MA04	Reinstate appropriate agricultural practices to address abandonment, including mowing, grazing, burning or equivalent measures
MK01	Reduce impact of mixed source pollution

Recommendations

Site management	Introduce low level of grazing or other management to reduce vegetation height
Survey	Walk-over survey of remainder of site (particularly south of lake) to check for additional petrifying springs
Hydrogeology	Investigate pollution source and monitor water levels

Photograph 1 Petrifying spring line in tall *Schoenus* fen (view to NE). Photograph Joanne Denyer.

Photograph 2 Petrifying spring in overgrown reed swamp area. Photograph Joanne Denyer.

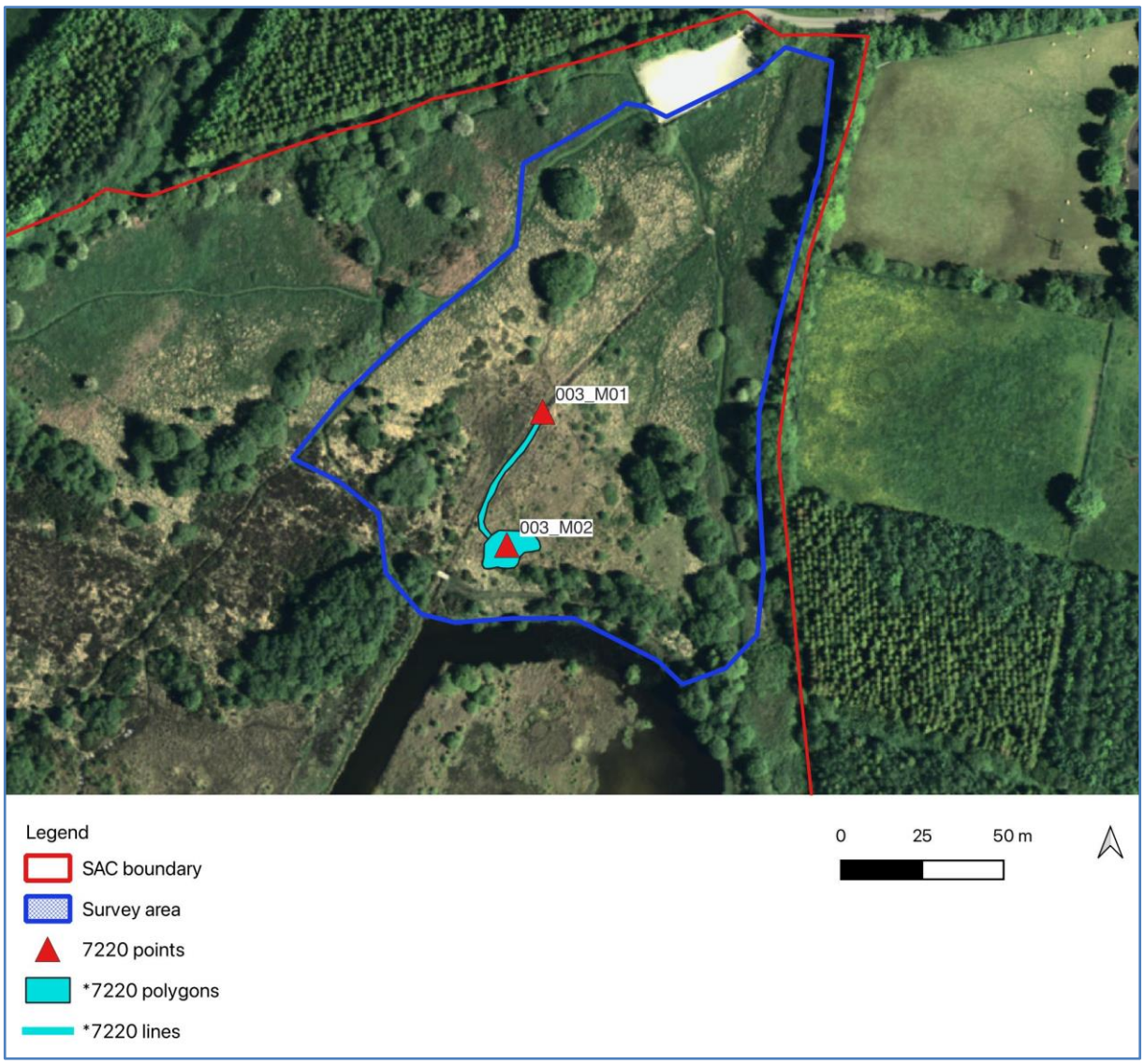


Figure 1 Ballynafagh Lake SAC survey area, *7220 locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Bellacorick Bog Complex SAC

Site details

PTRS23 Site code	PTRS23-004
County	Mayo
Designations	SAC (001922)
Landscape	Lowland fen
Altitude	61- 64 m

Survey details

Date(s) surveyed	22/08/2023		
Recorder(s)	Joanne Denyer & Rory Hodd		
Area surveyed	5.55 ha		
Subsites surveyed	Eskeragh		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1	2	
Water chemistry sampling	Field sampling		
Survey limitations	None		

Site and petrifying spring description

Site description	A large area of tufa-forming seepages within *Schoenus/ Cladium* fen. Strongly formed paludal tufa and species-rich vegetation. Springheads and pools present on the western edge of the fen and these areas have higher species richness. Owner reported very high-water flow in springs and formerly was used as a water source.			
Site management	Possibly grazed as area of improved pasture located in same field			
Petrifying spring type(s)	Springhead; flush			
Petrifying Spring vegetation communities	Group 5 *Schoenus nigricans* Springs			
Main tufa type(s)	Paludal			
No. *7220 springs mapped	3 spring points in one extensive flush area			
Area of *7220	2.889 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	486 – 663	pH	7.06 – 7.67
	Nitrate mg/l	Not detectable	Phosphate mg/l	Not detectable
Other Annex habitats	7210; 7230			
Other Fossitt habitats	PF1			

Structure and functions

No. monitoring plots	3
% pass rate	100 %
Main criteria for failing S&F	n/a

Impacts

Impact code	Description	Timing	Scope	Influence
PD07	Oil and gas pipelines	Past	<50%	Low
PL01	Abstraction from groundwater, surface water or mixed water	Past	<50%	Low

Change from baseline

There has been no change in actual area from the baseline (2012) but the actual area of petrifying springs is now mapped as a polygon, rather than estimated in the field. One plot had lower species richness than the baseline plot. However, it was difficult to locate the exact area for the plot and the missing species were present adjacent to the plot. Tufa cover was slightly lower to that recorded in the baseline, but still high in both monitoring plots. Overall the petrifying springs were extensive and species-rich with locally strong tufa formation.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
n/a	

Recommendations

Site management	No change to current grazing
Survey	Survey adjacent areas of SAC to see if further petrifying spring vegetation is present
Hydrogeology	None

Photograph 1 *Schoenus* fen with petrifying spring flushes throughout. Photograph Joanne Denyer.

Photograph 2 Extensive strong paludal tufa formation in petrifying spring flush areas. Photograph Joanne Denyer.

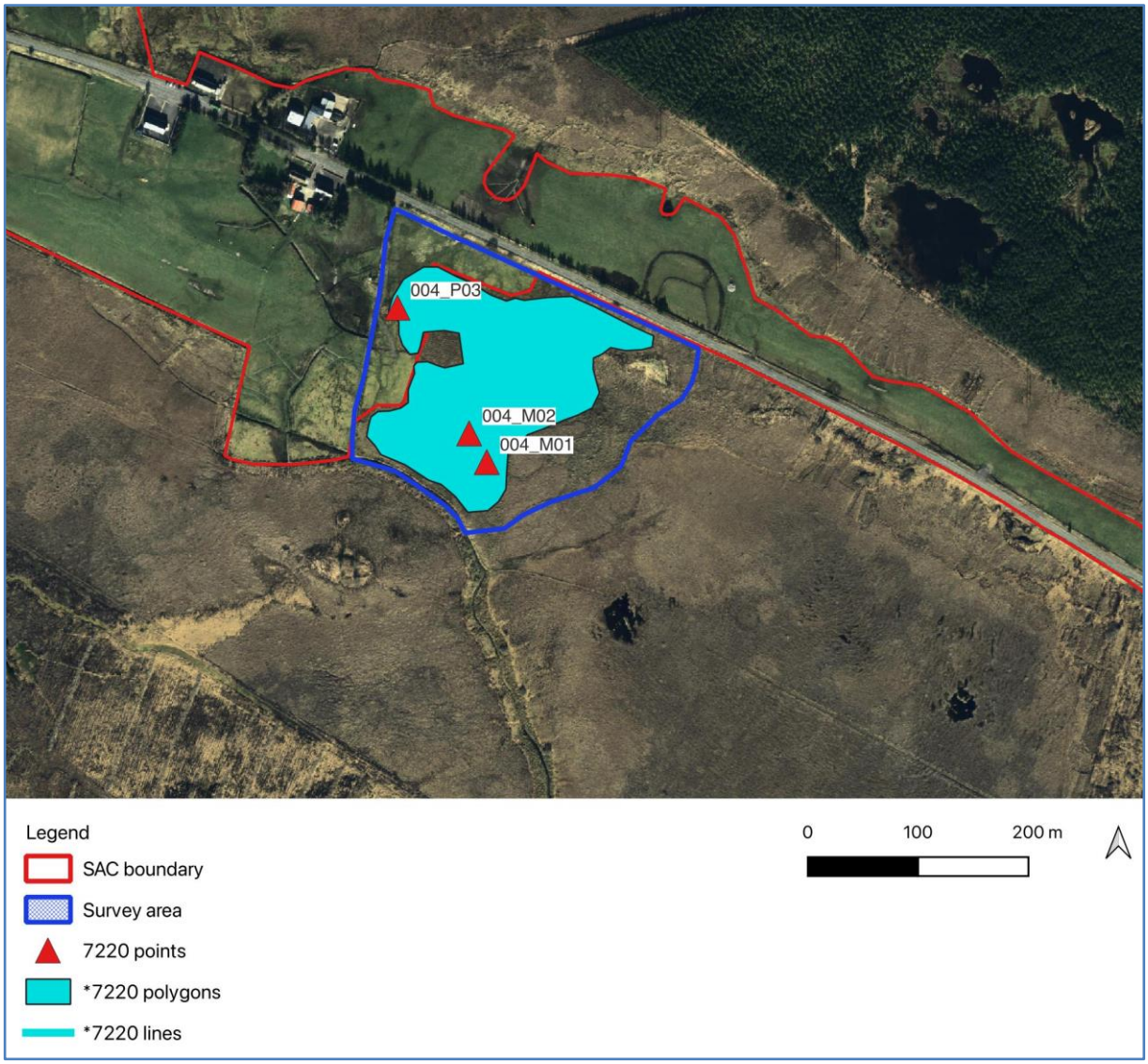


Figure 1 Bellacorick Bog Complex SAC survey area, petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Ben Bulben, Gleniff and Glenade Complex SAC

Site details

PTRS23 Site code	PTRS23-005
County	Sligo & Leitrim
Designations	SAC (000623)
Landscape	Upland
Altitude	180 – 368 m

Survey details

Date(s) surveyed	26/09/2023		
Recorder(s)	Joanne Denyer, Rory Hodd & Maurice Eakin		
Area surveyed	88.36 ha		
Subsites surveyed	Gleniff; Glenade		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1	7	2
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figures 1a & 1b), as it is a large upland site		

Site and petrifying spring description

Site description	This is a large site with a number of sub-sites. The petrifying springs on the cliffs support rare vascular plants and bryophytes and have the highest conservation scores in Ireland. In addition to the petrifying springs and seepages on the cliffs there are sedge dominated springs on lower, flatter ground. In general, the petrifying springs are highly species-rich, but have low to moderate tufa formation. However, some areas (e.g. Glencar waterfall) have high tufa formation.			
Site management	High levels of sheep grazing			
Petrifying spring type(s)	Springhead; flush			
Petrifying Spring vegetation communities	Group 7 *Palustriella falcata-Carex panicea* springs Group 8 *Saxifraga aizoides-Seligeria oelandica* springs			
Main tufa type(s)	Cascade; paludal			
No. *7220 springs mapped	15 spring points mapped in this survey, but much larger number recorded from whole SAC			
Area of *7220	0.634 ha			
National ranking	Outstanding			
Species of note	*Hymenostylium recurvirostrum* var. *insigne, Mesoptychia bantriensis, Orthothecium rufescens, Seligeria oelandica, Seligeria patula, Saxifraga aizoides*			
Water sample data	EC µS/cm	245 - 609	pH	8.25 – 8.36
	Nitrate mg/l	Not detectable	Phosphate mg/l	Not detectable
Other Annex habitats	6430; 7230; 8210			
Other Fossitt habitats	ER2; GS1; GS4			

Structure and functions

No. monitoring plots	10
% pass rate	100 %
Main criteria for failing S&F	One plot had small amount of *Hedera hibernica* present but spring in good condition, so plot passed overall.

Impacts

Impact code	Description	Timing	Scope	Influence
PA07	Intensive grazing or overgrazing by livestock	Ongoing & future	<50%	Low
PA25	Agriculture activities not referred to above	Ongoing	<50%	Low
PI04	Plant and animal diseases, pathogens and pests	Ongoing & future	<50%	Low
PM05	Avalanches, landslides and collapse of terrain	Ongoing & future	<50%	Low

Change from baseline

There were some slight changes to tufa recorded from the baseline (2010 – 2012), but these are largely due to interpretation (e.g. cascade vs stream crust on rocks) and overall, there were no large changes to tufa formation in the plots and adjacent spring area. Most of the monitoring plots had an increase in the number of positive indicator species recorded compared to the baseline. In addition, new locations were recorded for high quality indicator species including the very rare *Seligeria oelandica* and *Seligeria patula.* Grazing levels are high in the surrounding area, but not currently impacting the springs as many are on steep slopes. However, continued high sheep grazing could lead to increased nutrients and damage from grazing and trampling over time. There was damage from quad bike tracks on the lower part of one spring on lower ground but not currently causing significant damage.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
MA05	Adapt mowing, grazing and other equivalent agricultural activities (e.g. burning)
MA14	Other measures related to agricultural practices

Recommendations

Site management	Reduce levels of sheep grazing; reduce use of quad bikes etc. in spring/ wetland areas on lower ground
Survey	Survey of remaining area of SAC that was not surveyed in 2023
Hydrogeology	None

Photograph 1 Waterfall at Gleniff, Annacoona, with cascade tufa formation and rare bryophytes. Photograph Joanne Denyer.

Photograph 2 Rare bryophytes *Selgiera patula* (green) and *Seligeria oelandica* (black) on tufa covered rocks in petrifying spring at Gleniff, Annacoona. Photograph Joanne Denyer.

Photograph 3 Species-rich petrifying spring flush below springhead, on lower ground below Eagle's Rock, Glenade. Photograph Joanne Denyer.

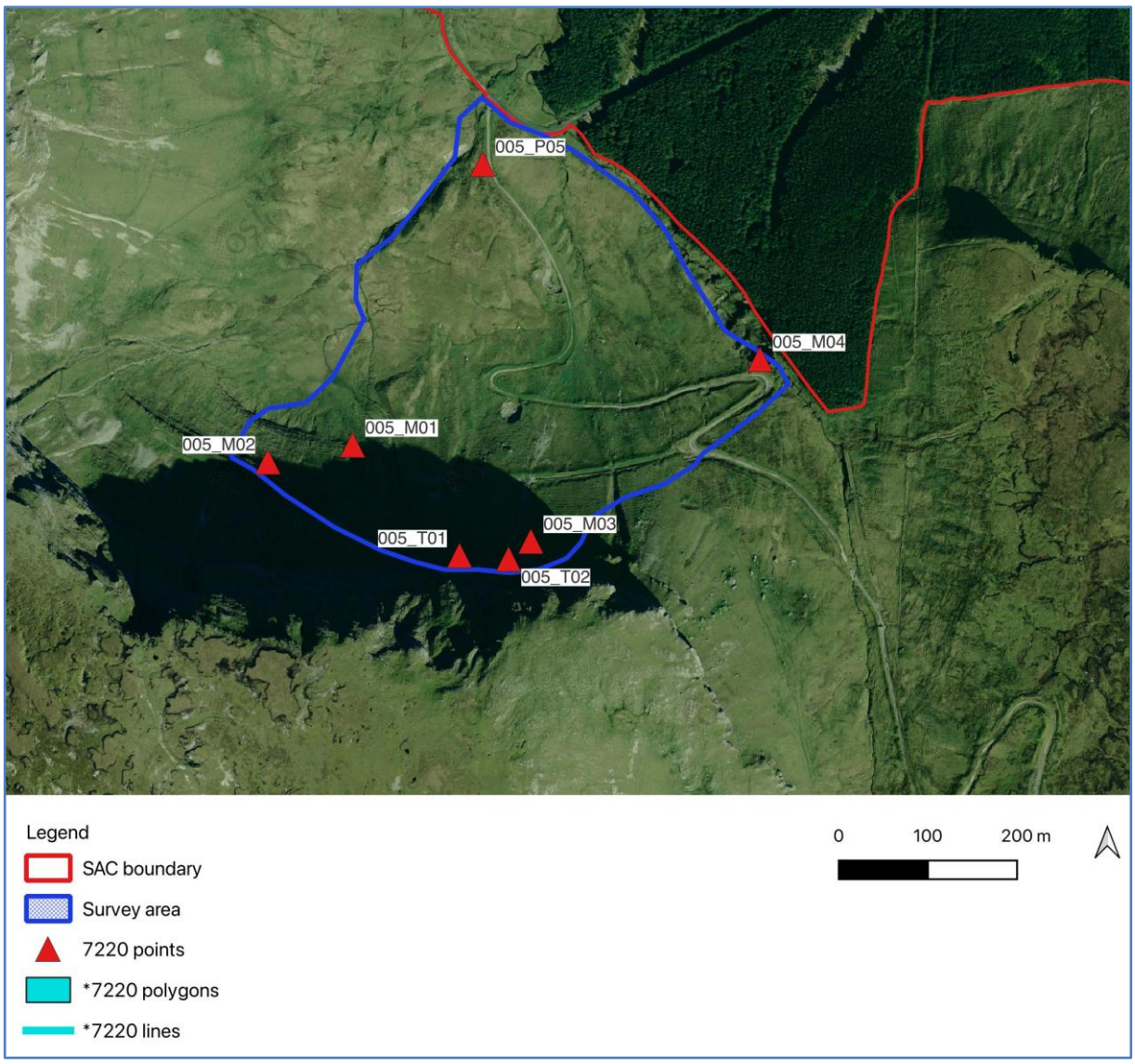


Figure 1a Ben Bulben, Gleniff and Glenade Complex SAC survey area (Gleniff), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

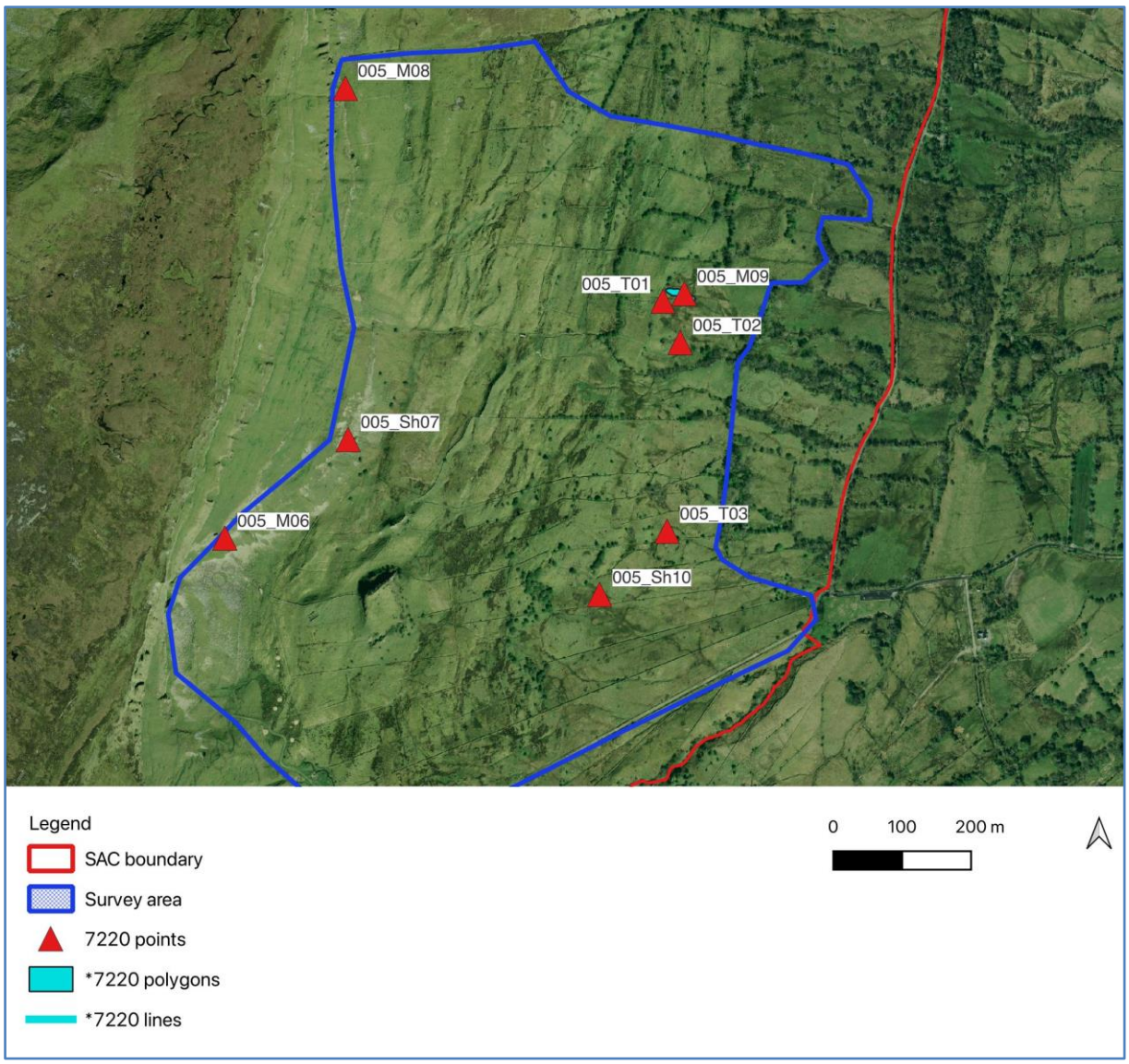


Figure 1b Ben Bulben, Gleniff and Glenade Complex SAC survey area (Glenade), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Black Head-Poulsallagh Complex SAC

Site details

PTRS23 Site code	PTRS23-006
County	Clare
Designations	SAC (000020)
Landscape	Lowland karst limestone
Altitude	44 – 110 m

Survey details

Date(s) surveyed	23/05/2024 & 28/09/2024		
Recorder(s)	Joanne Denyer		
Area surveyed	4.99 ha		
Subsites surveyed	Aghaglinny North, Black Head; Caher River, E of Fanore Bridge; Cappanawalla, above Newtown Castle		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1	4	3
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figures 1a-1c), as it is an extensive site.		

Site and petrifying spring description

Site description	A large SAC with several areas of petrifying springs. On the northern side of the SAC (Aghaglinny North) there are several large areas of species-rich flushed limestone pavement and steep limestone rock. This is the only site with Group 8 *Saxifraga aizoides-Seligeria oelandica* Springs and one spring with 'outstanding conservation score' outside of Aroo Mountain SAC and Ben Bulben, Gleniff and Glenade Complex SAC (Sligo/ Leitrim). The Caher River is unusual in having a high tufa formation within a seasonal large limestone river.			
Site management	Cattle grazing in several areas. Some water abstraction for livestock on the northern side of Black Head.			
Petrifying spring type(s)	Springhead; flush; seepage; stream			
Petrifying Spring vegetation communities	Group 3 *Brachythecium rivulare-Platyhypnidium riparioides* tufaceous streams and flushes Group 6 *Carex lepidocarpa* Small Sedge Springs Group 7 *Palustriella falcata-Carex panicea* springs Group 8 *Saxifraga aizoides-Seligeria oelandica* springs			
Main tufa type(s)	Paludal, stream crust			
No. *7220 springs mapped	17 (21 mapped for whole site)			
Area of *7220	0.488 ha			
National ranking	Outstanding			
Species of note	*Gentianella verna, Orthothecium rufescens, Mesoptychia bantriensis,*			
Water sample data	EC µS/cm	296 - 555	pH	7.3 – 8.21
	Nitrate mg/l	Not detectable to 2mg/l (1 plot)	Phosphate mg/l	Not detectable
Other Annex habitats	*8240			
Other Fossitt habitats	ER2; WS1			

Structure and functions

No. monitoring plots	8
% pass rate	100 %
Main criteria for failing S&F	n/a (borderline nitrate detected in one plot)

Impacts

Impact code	Description	Timing	Scope	Influence
PL01	Abstraction from groundwater, surface water or mixed water	Ongoing & future	<50%	Low

Change from baseline

All monitoring plots had an increase in the number of positive indicator species from the baseline (2011 – 2012). A new spring was recorded with the rare moss *Orthothecium rufescens*, which had 'outstanding' conservation rank. This was located to the east of the previous known location of *Orthothecium rufescens* (which was still present). There is some abstraction in the north of the SAC and this may have a long-term impact on the petrifying springs. However, they were all in favourable condition in the current survey. It is difficult to assess water flow from one visit as the water flow is variable in this karst landscape. Longer term water flow monitoring is therefore recommended.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
MA13	Manage agricultural drainage and water abstraction (incl. the restoration of drained or hydrologically altered habitats)

Recommendations

Site management	Maintain current low levels of cattle grazing
Survey	Survey of remaining area of SAC that was not surveyed in 2024
Hydrogeology	Monitor impact of abstraction on petrifying springs in northern part of SAC

Photograph 1 Species-rich petrifying spring vegetation with rare moss *Orthothecium rufescens* on flushed limestone pavement with paludal tufa. Photograph Joanne Denyer.

Photograph 2 Tufa formation and diverse algal communities in seasonal limestone river (Caher River). Photograph Joanne Denyer.

Photograph 3 Species-rich petrifying spring vegetation on flushed limestone pavement with paludal tufa. Photograph Joanne Denyer.

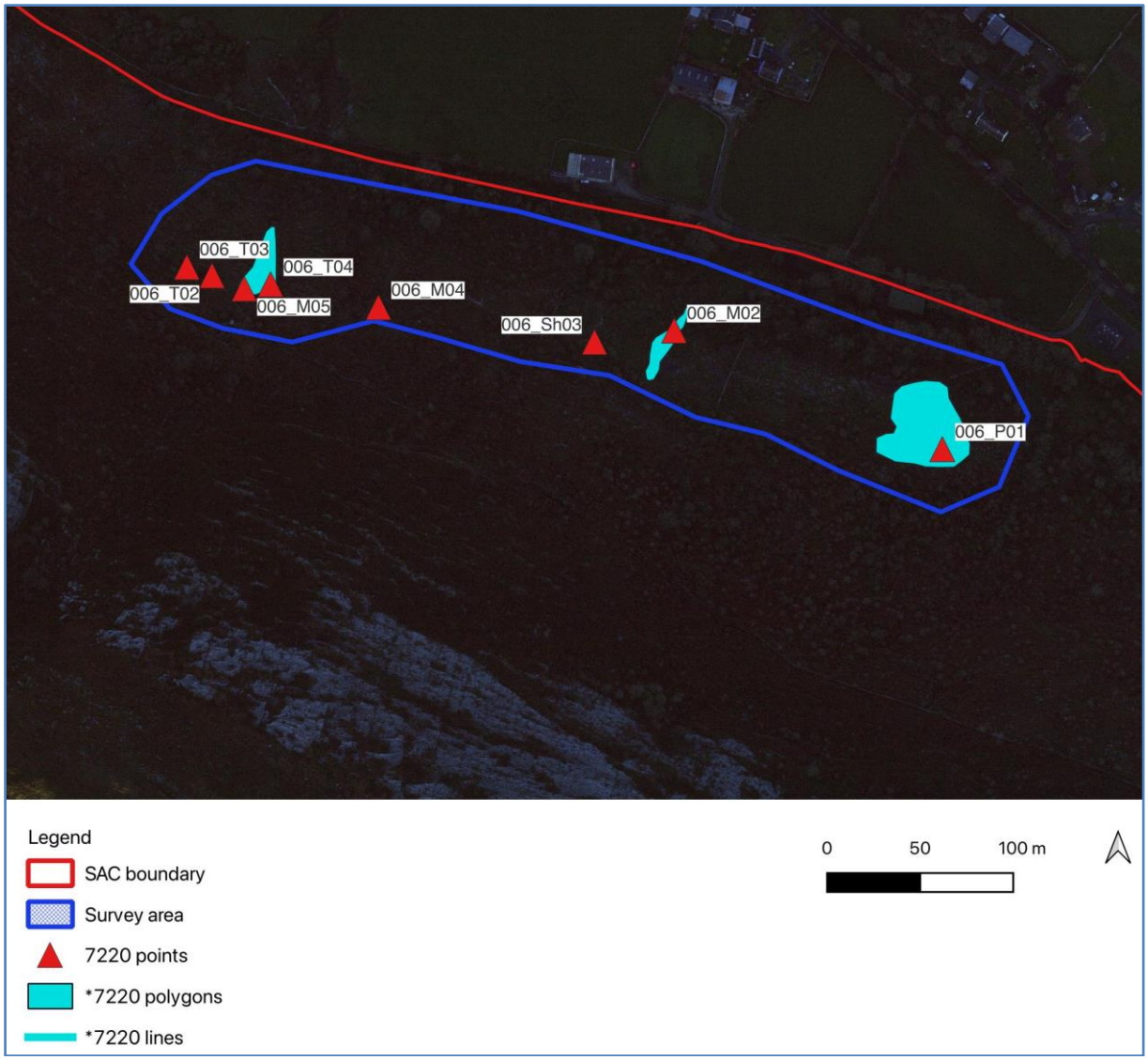


Figure 1a Black Head-Poulsallagh Complex SAC survey area (Aghaglinny North), petrifying spring locations and monitoring points
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

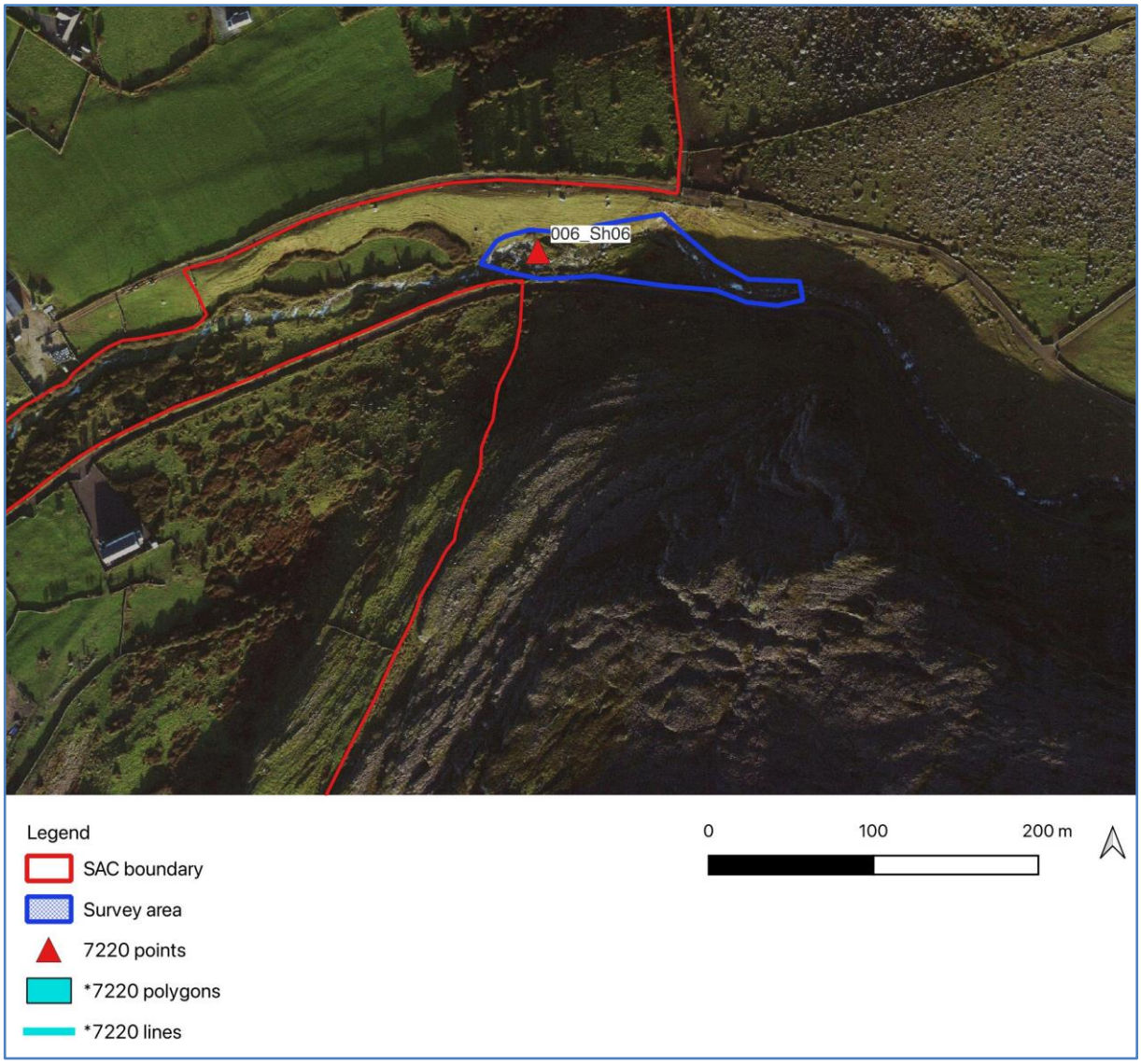


Figure 1b Black Head-Poulsallagh Complex SAC survey area (Caher River), petrifying spring locations and monitoring points
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

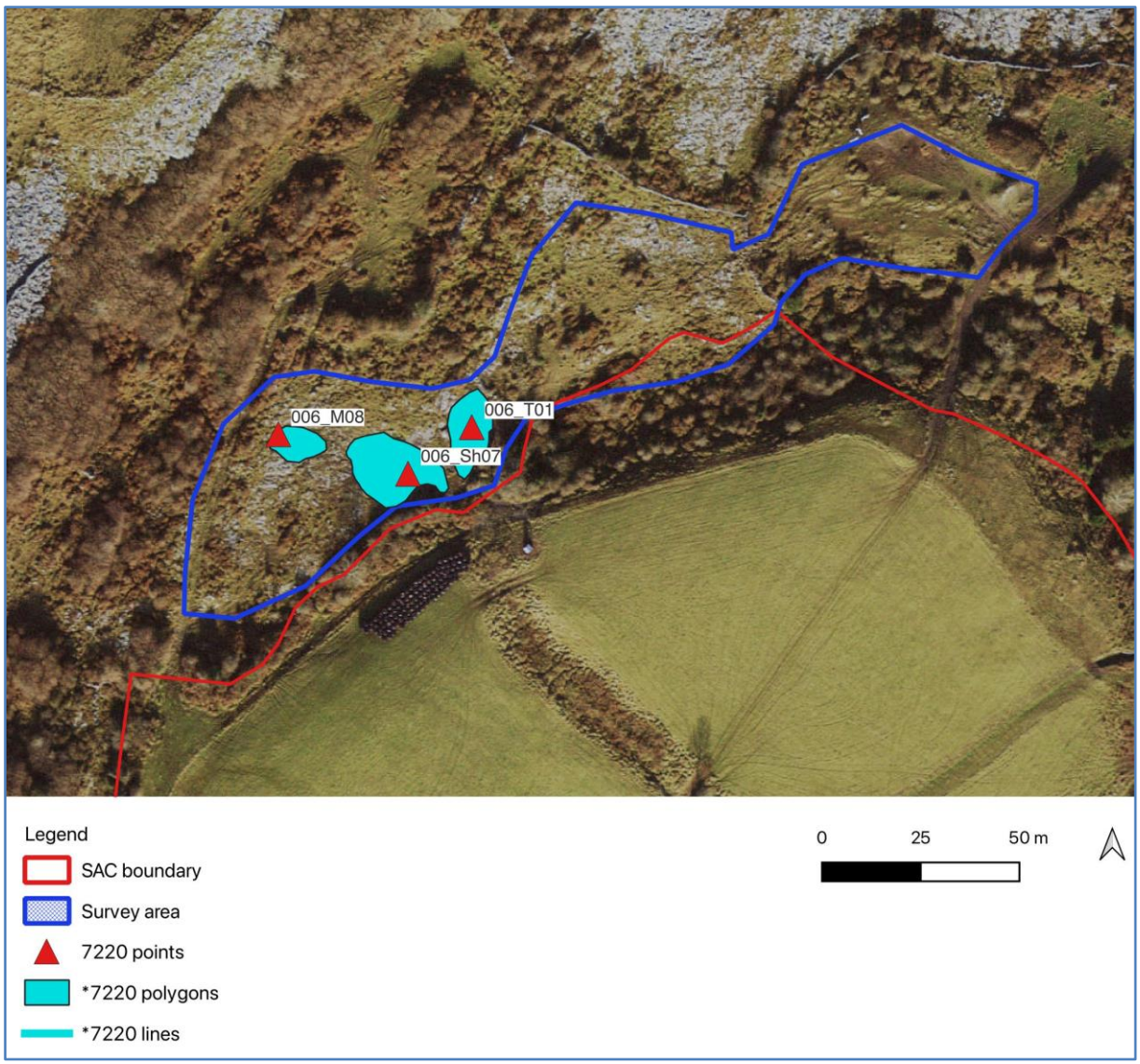


Figure 1c Black Head-Poulsallagh Complex SAC survey area (Capanawalla), petrifying spring locations and monitoring points
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

River Boyne And River Blackwater SAC

Site details

PTRS23 Site code	PTRS23-007
County	Meath
Designations	SAC (002299)
Landscape	Lowland river valley
Altitude	38 – 40 m

Survey details

Date(s) surveyed	05/09/2023		
Recorder(s)	Joanne Denyer		
Area surveyed	4.76 ha		
Subsites surveyed	Broadboyne Bridge		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
		3	
Water chemistry sampling	Field sampling		
Survey limitations	This site was the only known *7220 habitat within this SAC at the time of survey (additional petrifying spring habitat has subsequently been recorded at Crewbane Marsh pNHA to the east).		

Site and petrifying spring description

Site description	A single massive cascade mound, approx. 30m by 30m and up to 2m in height in the southern area. Fed by two springs which arise in woodland and scrub and then flow over and through the mound. Most of the mound (except the edges) are unwooded and there is a tall-herb fen at the base of the mound. There is nutrient (nitrate) enrichment, species diversity is low and negative indicator species are abundant on the mound.			
Site management	Light deer grazing			
Petrifying spring type(s)	Springhead			
Petrifying Spring vegetation communities	Group 3 *Brachythecium rivulare-Platyhypnidium riparioides* tufaceous streams and flushes			
Main tufa type(s)	Cascade			
No. *7220 springs mapped	4 (3 plots within the main cascade and one point to the west)			
Area of *7220	0.040 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	645 - 1108	pH	7.51 – 7.65
	Nitrate mg/l	10 mg/l	Phosphate mg/l	Not detectable
Other Annex habitats	n/a			
Other Fossitt habitats	FS2; WD1			

Structure and functions

No. monitoring plots	3
% pass rate	0 %
Main criteria for failing S&F	Positive indicator species; negative bryophyte species; nitrate level

Impacts

Impact code	Description	Timing	Scope	Influence
PA05	Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming)	Ongoing & future	<50%	Low
PA17	Agricultural activities generating pollution to surface or ground waters (including marine)	Ongoing & future	50-90%	High

Change from baseline

The baseline plots (2011) also failed on cover of positive indicator species, negative bryophyte species (*Cratoneuron filicinum* dominant) and nitrate level. Phosphate level was also exceeded in the baseline plots but not in the 2023 survey. The 2011 level was 0.066 mg/l, which should have been detected by the 2023 field kit test (limit of detection 0.05 mg/l). It is possible that there has been a reduction in phosphate levels, but laboratory testing is needed to confirm. The petrifying spring habitat to the west of the mound has become overgrown due to lack of grazing/ management.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Unfavourable-Inadequate	Unfavourable-Bad	Unfavourable-Inadequate	Unfavourable-Bad

Conservation measures

Conservation measure code	Description
MA10	Reduce/eliminate point or diffuse source pollution to surface or ground waters (including marine) from agricultural activities

Recommendations

Site management	Grazing of the vegetation at the base of the mount would open up the vegetation and increase diversity of the petrifying spring vegetation. However, this is a privately owned site and this may not be possible.
Survey	Survey of remaining area of SAC that was not surveyed in 2023 (Crewbane Marsh pNHA).
Hydrogeology	Investigate source of elevated nitrate and phosphate

Photograph 1 View of massive cascade mound, at least 2 m in height, dominated by negative bryophyte indicator species *Cratoneuron filicinum.* Photograph Joanne Denyer.

Photograph 2 Wooded stream with strong tufa formation (flows onto main tufa cascade). Photograph Joanne Denyer.

Figure 1 River Boyne And River Blackwater SAC survey area, petrifying spring locations and monitoring points
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Caha Mountains SAC

Site details

PTRS23 Site code	PTRS23-008
County	Cork
Designations	SAC (000093)
Landscape	Upland
Altitude	448 m

Survey details

Date(s) surveyed	13/09/2023 & 06/05/2024		
Recorder(s)	Joanne Denyer		
Area surveyed	24.1 ha		
Subsites surveyed	Eastern slopes of Nareera, Co. Cork		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
		1	
Water chemistry sampling	Field sampling		
	Only part of SAC surveyed (Figure 1), as it is an extensive upland site. Area within Co. Kerry checked in 2024, springs present but no tufa recorded.		

Site and petrifying spring description

Site description	Petrifying spring arising from rock outcrop on eastern slope of Nareera, below Toberavanagh Lough. Located during NSUH surveys (2014) and baseline data available. Bryophyte dominated species-rich short fen vegetation with sparse paludal tufa. Some iron staining where spring emerges and above on slope. No other known petrifying spring in Cork side of SAC.			
Site management	High sheep grazing			
Petrifying spring type(s)	Springhead			
Petrifying Spring vegetation communities	Group 6 *Carex lepidocarpa* Small Sedge Springs			
Main tufa type(s)	Paludal			
No. *7220 springs mapped	1			
Area of *7220	0.008 ha			
National ranking	High			
Species of note	*Mesoptychia bantriensis*			
Water sample data	EC µS/cm	494	pH	8.01
	Nitrate mg/l	Not detectable	Phosphate mg/l	Not detectable
Other Annex habitats	4010			
Other Fossitt habitats	ER1; HH3			

Structure and functions

No. monitoring plots	1
% pass rate	100 %
Main criteria for failing S&F	Invasive species *Epilobium brunnescens* present, but not currently affecting condition.

Impacts

Impact code	Description	Timing	Scope	Influence
PA07	Intensive grazing or overgrazing by livestock	Ongoing & future	50-90%	Medium
PI02	Other invasive alien species (other than species of Union concern)	Ongoing & future	<50%	Low

Change from baseline

There was a slight increase in the number of positive indicator species from the baseline survey (2014) but no other changes. Tufa cover was sparse in both surveys. The plot is heavily grazed but at present this is not causing the plot to fail the condition assessment.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
MA05	Adapt mowing, grazing and other equivalent agricultural activities (e.g. burning)

Recommendations

Site management	Reduce levels of sheep grazing
Survey	No further survey required in short-term
Hydrogeology	None

Photograph 1 Location of petrifying spring (bottom right corner of photograph). View to north. Photograph Joanne Denyer.

Photograph 2 Petrifying spring dominated by *Palustriella commutata*. Heavily grazed. Photograph Joanne Denyer.

Figure 1 Caha Mountains SAC survey area, petrifying spring locations and monitoring points
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Cuilcagh - Anierin Uplands SAC

Site details

PTRS23 Site code	PTRS23-009
County	Cavan
Designations	SAC (000584)
Landscape	Upland
Altitude	321 – 377 m

Survey details

Date(s) surveyed	07/09/2023		
Recorder(s)	Joanne Denyer & Maurice Eakin		
Area surveyed	88.95 ha		
Subsites surveyed	Eastern side of Cuilcagh		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	3	1	1
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figures 1a & 1b), as it is a large upland site		

Site and petrifying spring description

Site description	A number of petrifying springs are present in this SAC. There is one tufa mound within blanket bog on lower ground, but also seepages with sparse tufa arising from stream banks and slopes on higher ground. Many were located during NSUH surveys (2012), and not all have precise mapped locations. The petrifying spring vegetation is species-rich and the springhead within the blanket bog area is an unusual type of spring.			
Site management	Sheep grazing			
Petrifying spring type(s)	Springhead; flush			
Petrifying Spring vegetation communities	Group 6 *Carex lepidocarpa* Small Sedge Springs Group 7 *Palustriella falcata-Carex panicea* springs			
Main tufa type(s)	Cascade; paludal			
No. *7220 springs mapped	8			
Area of *7220	0.044 ha			
National ranking	Very high			
Species of note	n/a			
Water sample data	EC µS/cm	921 - 2042	pH	6.97 – 7.66
	Nitrate mg/l	Not detectable	Phosphate mg/l	Not detectable
Other Annex habitats	4010; *7130			
Other Fossitt habitats	FW1; GS4; HH3; PB2			

Structure and functions

No. monitoring plots	5
% pass rate	100 %
Main criteria for failing S&F	Trampling in two plots but not causing plots to fail.

Impacts

Impact code	Description	Timing	Scope	Influence
PA07	Intensive grazing or overgrazing by livestock	Ongoing & future	<50%	Low
PM05	Avalanches, landslides and collapse of terrain	Ongoing & future	<50%	Low

Change from baseline

One plot had baseline data from 2012. There was a reduction of one positive indicator species within the plot. However, three additional positive indicator species were present adjacent to the plot, so it is likely to be from plot positioning. There is sheep trampling, dung and heavy grazing in some of the plots but the plots still passed the condition assessment.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
MA05	Adapt mowing, grazing and other equivalent agricultural activities (e.g. burning)

Recommendations

Site management	Reduce grazing levels
Survey	Survey of remaining area of SAC that was not surveyed in 2023
Hydrogeology	None

Photograph 1 Large petrifying spring springhead in blanket bog on lower slopes. Photograph Joanne Denyer.

Photograph 2 Species-rich petrifying spring vegetation on riverbank, natural land slippage present. Photograph Joanne Denyer.

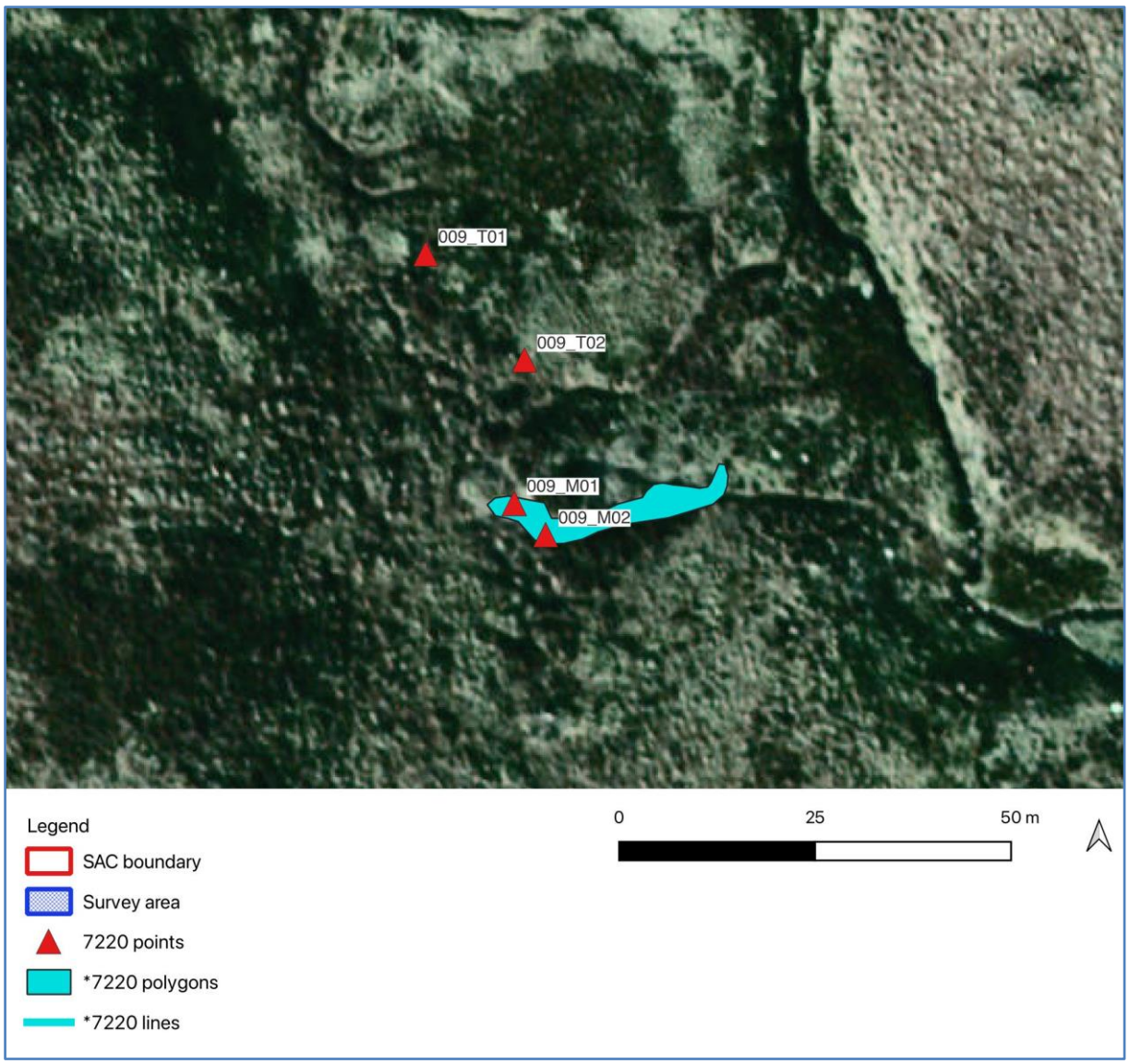


Figure 1a Cuilcagh - Anierin Uplands SAC survey area (east), petrifying spring locations and monitoring points
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

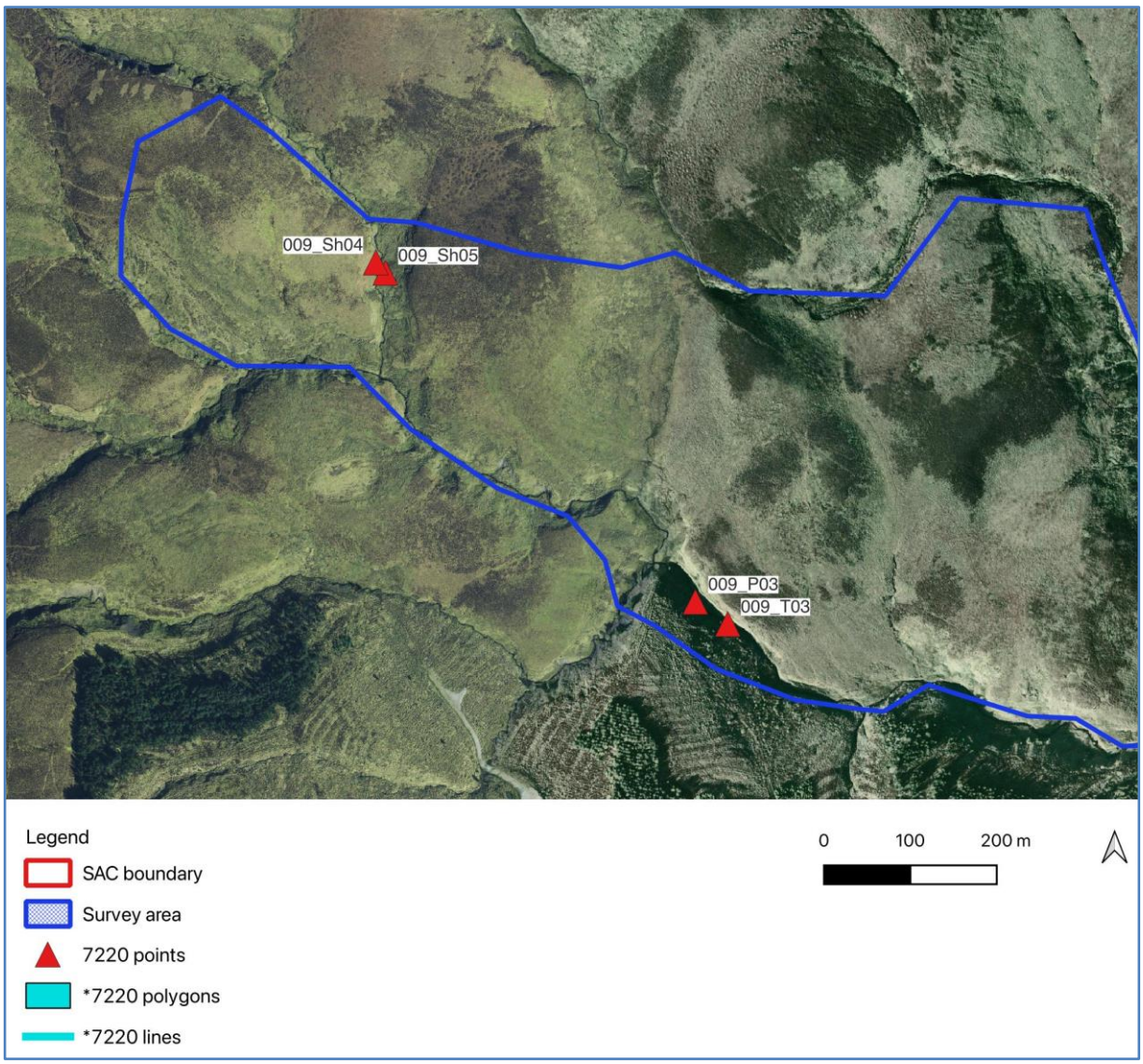


Figure 1b Cuilcagh - Anierin Uplands SAC survey area (west), petrifying spring locations and monitoring points
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

East Burren Complex SAC

Site details

PTRS23 Site code	PTRS23-010
County	Clare
Designations	SAC (001926)
Landscape	Lowland karst limestone
Altitude	39 – 195 m

Survey details

Date(s) surveyed	13/08/2023 & 17/10/2023		
Recorder(s)	Joanne Denyer		
Area surveyed	10.18 ha		
Subsites surveyed	Keelhilla Nature Reserve; Rinnamona Lough; Doomore		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	4	2	1
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figures 1a & 1b), two additional petrifying spring points known from Teeskagh.		

Site and petrifying spring description

Site description	Various springheads and flushes arising on limestone pavement. Includes species rich *Schoenus* and small sedge vegetation, with relatively sparse paludal tufa. The Rinnamona Lough petrifying springs are associated with a turlough.			
Site management	Winter cattle grazing evident in some areas			
Petrifying spring type(s)	Springhead; flush; stream			
Petrifying Spring vegetation communities	Group 5 *Schoenus nigricans* Springs Group 6 *Carex lepidocarpa* Small Sedge Springs Group 7 *Palustriella falcata-Carex panicea* springs			
Main tufa type(s)	Cascade; paludal, oncoids & ooids			
No. *7220 springs mapped	8			
Area of *7220	0.082 ha			
National ranking	Very high			
Species of note	*Drepanocladus lycopodioides, Mesoptychia bantriensis*			
Water sample data	EC µS/cm	240 - 780	pH	
	Nitrate mg/l	Not detectable to <1 mg/l	Phosphate mg/l	Not detectable to 0.05 mg/l
Other Annex habitats	*3180; 7230; *8240			
Other Fossitt habitats	ER2; FL6; GM1; GS4; PF1; WS1			

Structure and functions

No. monitoring plots	7
% pass rate	86 %
Main criteria for failing S&F	Positive indicator species; woody vegetation; phosphate levels

Impacts

Impact code	Description	Timing	Scope	Influence
PA07	Intensive grazing or overgrazing by livestock	Ongoing & future	50-90%	Low
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	<50%	Medium

Change from baseline

One plot (M01, Keelhilla Nature Reserve) had a decrease in positive indicator species from the baseline (2012) and a decrease in tufa formation. This plot was becoming overgrown and also had elevated phosphate levels. The baseline water sample did not have elevated phosphate. All other plots either had the same number or more positive indicator species recorded in the current survey. One plot in a stream at Rinnamona Lough (P06) had previously had 60% tufa formation recorded, but this was only 10% in the current survey. However, there were no obvious impacts to this spring, and it may be that the plot location was not accurate.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
MA10	Reduce/eliminate point or diffuse source pollution to surface or ground waters (including marine) from agricultural activities

Recommendations

Site management	Most of the site has suitable grazing levels. However, the spring/ fen area at Keelhilla Nature reserve is under grazed and the grazing levels at this site should be reviewed.
Survey	Survey of remaining area of SAC that was not surveyed in 2023
Hydrogeology	Investigate source of elevated phosphate in two springs

Photograph 1 Species-rich *Schoenus nigricans* petrifying spring on flushed limestone pavement, Keelhilla Nature Reserve. Photograph Joanne Denyer.

Photograph 2 Abundant oncoids and ooids in woodland petrifying spring/ stream at Keelhilla Nature Reserve. Photograph Joanne Denyer.

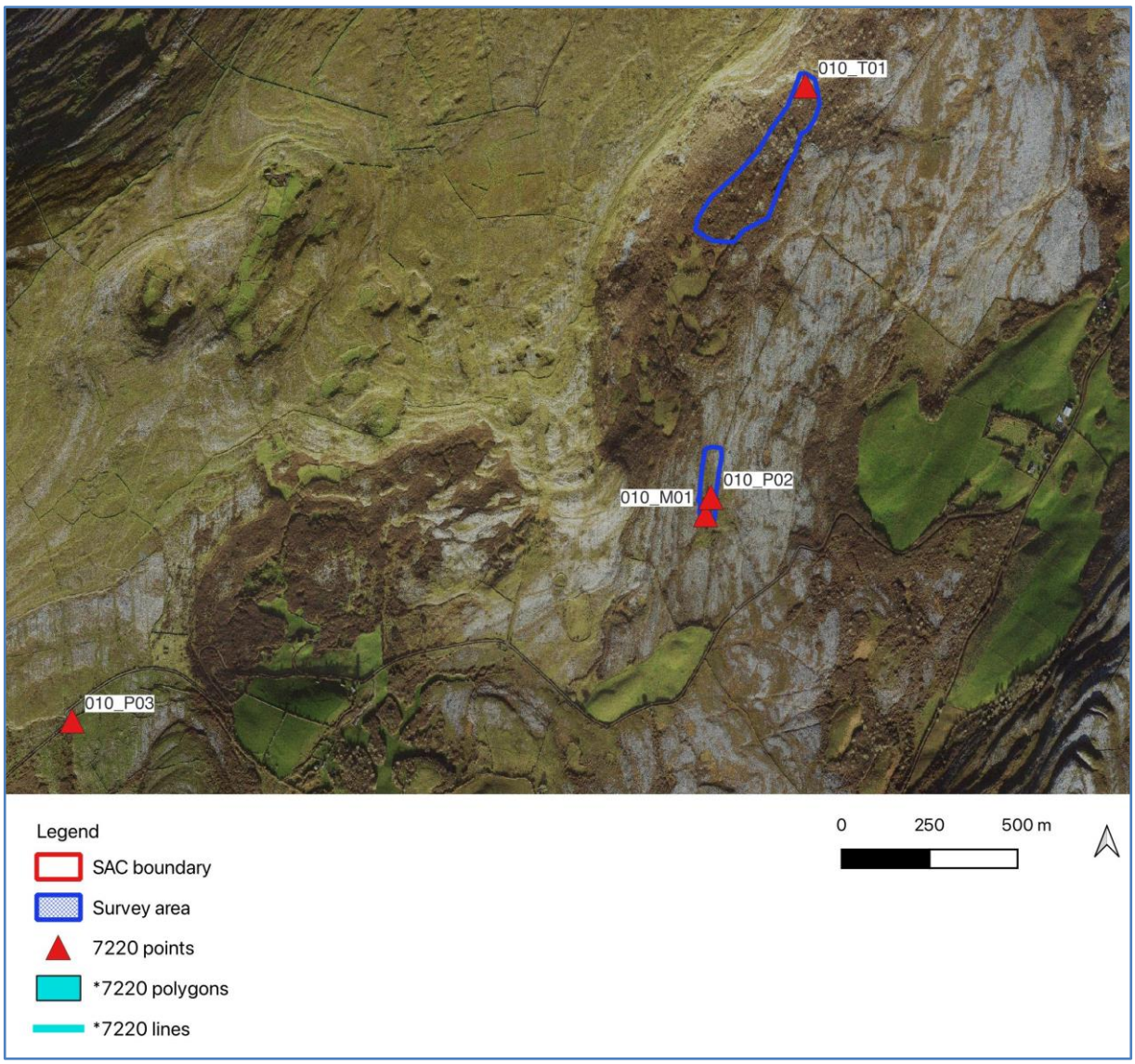


Figure 1a East Burren Complex SAC survey area (Keelhilla Nature Reserve & Doomore), petrifying spring locations and monitoring points
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

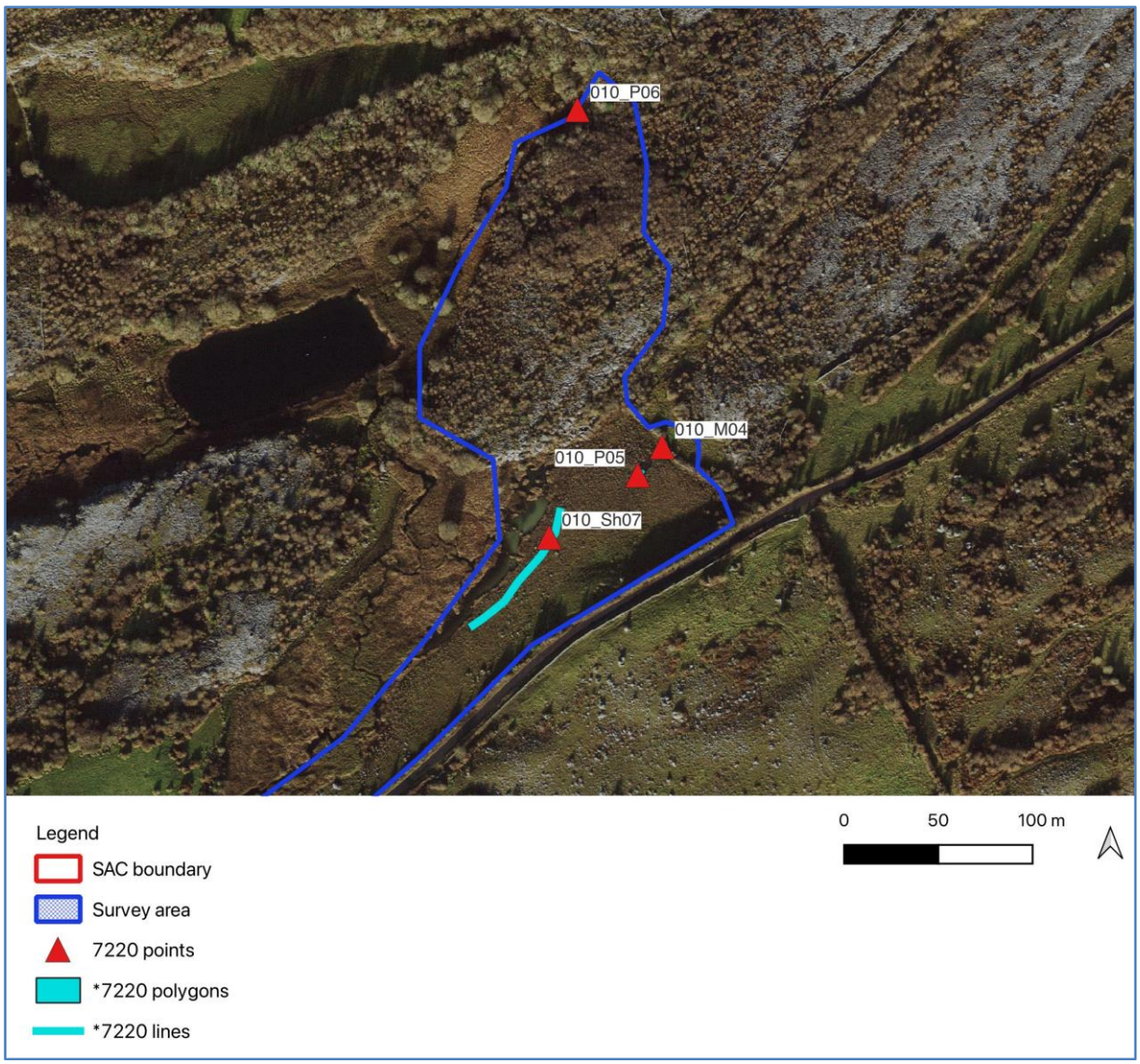


Figure 1b East Burren Complex SAC survey area (Rinnamona Lough), petrifying spring locations and monitoring points
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Faughalstown

Site details

PTRS23 Site code	PTRS23-011
County	Westmeath
Designations	n/a
Landscape	Lowland lake
Altitude	60 – 64 m

Survey details

Date(s) surveyed	25/09/2023		
Recorder(s)	George Smith		
Area surveyed	5.97 ha		
Subsites surveyed	n/a		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1	2	
Water chemistry sampling	Field sampling		
Survey limitations	All known extant petrifying spring locations surveyed.		

Site and petrifying spring description

Site description	Seepage zone with moderate to strong paludal tufa formation on slope beside Lough Derravarragh. The main spring is in the west of the site, is dominated by *Carex panicea, Carex viridula* and *Palustriella commutata*, and contains a holy well. More moderate slopes in the area support more fen-like vegetation with *Menyanthes* and *Equisetum fluviatile.* A smaller, similar seepage zone is to the east, bisected by a modified stream and hedgerow. The stream substrate is a firm tufa crust, and the stream cuts through 30-40 cm deep tufa deposits.			
Site management	Cattle grazed earlier in year			
Petrifying spring type(s)	Seepage; stream			
Petrifying Spring vegetation communities	Group 6 *Carex lepidocarpa* Small Sedge Springs			
Main tufa type(s)	Paludal; stream crust			
No. *7220 springs mapped	4			
Area of *7220	0.666 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	60 - 64	pH	7.82 – 7.94
	Nitrate mg/l	Not detectable	Phosphate mg/l	0.05 mg/l
Other Annex habitats	n/a			
Other Fossitt habitats	GS4; WL1			

Structure and functions

No. monitoring plots	3
% pass rate	100 %
Main criteria for failing S&F	2 plots have elevated phosphate, but no impact on plot condition

Impacts

Impact code	Description	Timing	Scope	Influence
PA07	Intensive grazing or overgrazing by livestock	Ongoing & future	<50%	High
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	<50%	Low

Change from baseline

There has been a decrease in paludal tufa formation from the baseline (2010 & 2013). This may be related to trampling by cattle present in the current survey. Phosphate was 15 mg/l in the baseline survey (at the threshold) and exceeded the threshold in the current survey. This may be an actual increase or due to differences in water chemistry testing methods. One plot had higher species richness than the baseline and one had higher so there was no overall change in positive indicator species within the site.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
MA05	Adapt mowing, grazing and other equivalent agricultural activities (e.g. burning)
MK01	Reduce impact of mixed source pollution

Recommendations

Site management	Cattle stocking rate suitable to maintain vegetation but significant poaching in spring area. Investigate options to reduce poaching.
Survey	No further survey required in short-term
Hydrogeology	Investigate source of elevated phosphate

Photograph 1 Small sedge dominated petrifying spring vegetation on the lake shore. Photograph George Smith.

Photograph 2 Stream with abundant stream crust tufa. Photograph George Smith.

Glen of the Downs SAC

Site details

PTRS23 Site code	PTRS23-012
County	Wicklow
Designations	SAC (000719)
Landscape	Lowland wooded valley
Altitude	127 m

Survey details

Date(s) surveyed	04/08/2023		
Recorder(s)	Joanne Denyer & Rory Hodd		
Area surveyed	3.19 ha		
Subsites surveyed	n/a		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1		
Water chemistry sampling	Field sampling		
Survey limitations	Only one known petrifying spring (Figure 1).		

Site and petrifying spring description

Site description	Small tufa forming stream in north-east of site. The spring is mostly under scrub and hard to access. Petrifying spring species largely confined to upper section of spring, near springhead.			
Site management	Some Cherry Laurel being undertaken. No management in vicinity of spring.			
Petrifying spring type(s)	Springhead			
Petrifying Spring vegetation communities	Group 2 *Palustriella commutata-Geranium robertianum* springheads			
Main tufa type(s)	Paludal; oncoids & ooids			
No. *7220 springs mapped	1			
Area of *7220	0.007 ha			
National ranking	Low			
Species of note	n/a			
Water sample data	EC µS/cm	510	pH	7.77
	Nitrate mg/l	5 – 10 mg/l	Phosphate mg/l	Not detectable
Other Annex habitats	91AO			
Other Fossitt habitats	WD1			

Structure and functions

No. monitoring plots	1
% pass rate	0 %
Main criteria for failing S&F	Nitrate level

Impacts

Impact code	Description	Timing	Scope	Influence
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	50-90%	Medium

Change from baseline

No baseline data available as recently recorded petrifying spring

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate

Conservation measures

Conservation measure code	Description
MK01	Reduce impact of mixed source pollution

Recommendations

Site management	Consider removal of dense vegetation over stream (in consultation with petrifying spring ecologist).
Survey	No further survey required in short-term
Hydrogeology	Investigate source of elevated nitrate

Photograph 1 Densely shaded petrifying spring vegetation in stream. Photograph Joanne Denyer.

Photograph 2 Stream crust tufa in petrifying spring. Photograph Joanne Denyer.

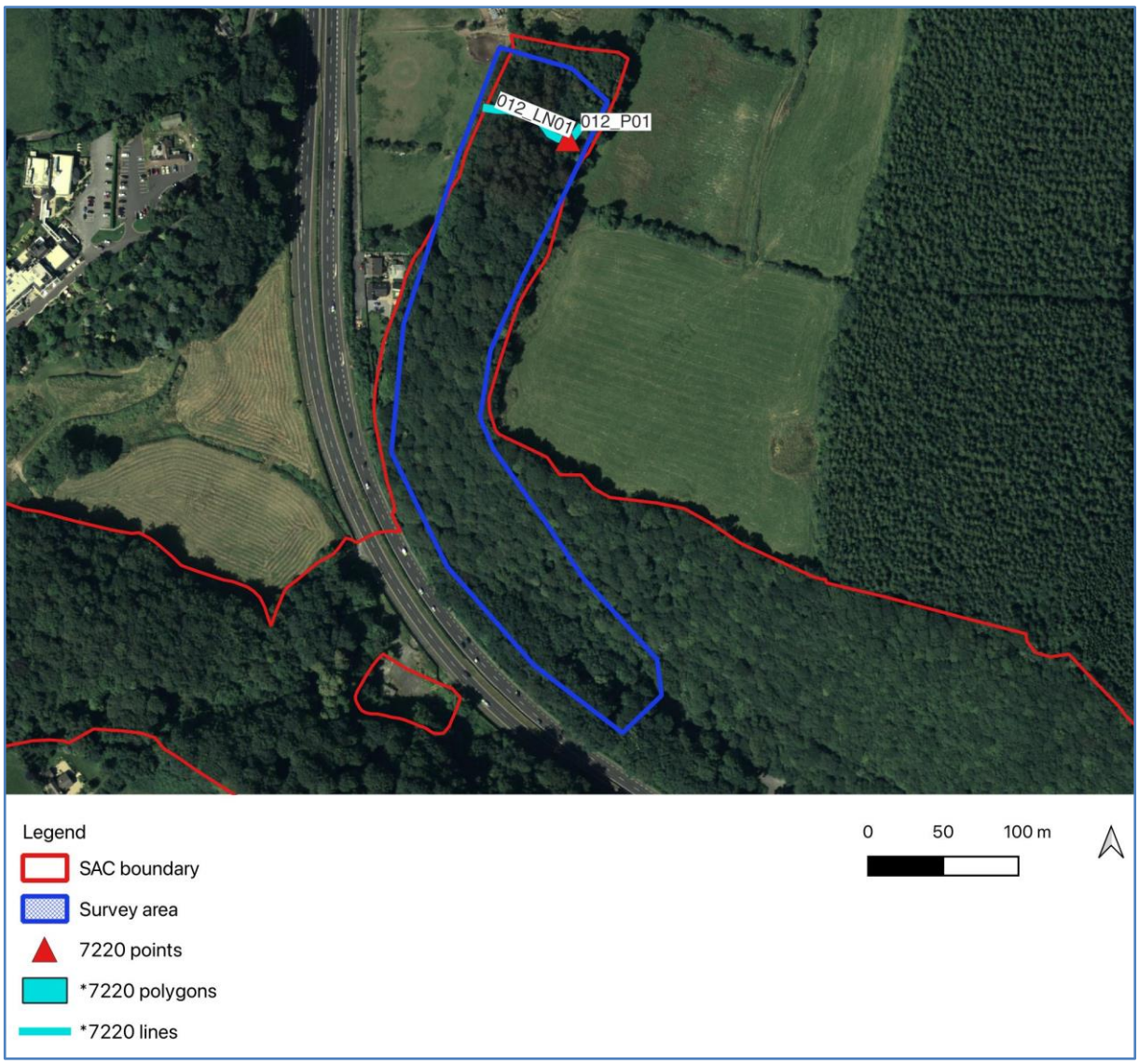


Figure 1 Glen of the Downs SAC survey area, petrifying spring locations and monitoring points. Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Glenasmole Valley SAC

Site details

PTRS23 Site code	PTRS23-013
County	Dublin
Designations	SAC (001209)
Landscape	Lowland river valley
Altitude	159 – 200 m

Survey details

Date(s) surveyed	01/09/2023		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	14.16 ha		
Subsites surveyed	Woodland to east of lower reservoir		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
		5	7
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figures 1a & 1b), as it is an extensive site with many petrifying springs.		

Site and petrifying spring description

Site description	Large number of highly petrifying springs, mainly in the north-east side of the site. The main springs arise on the steep wooded slopes to the east of the lower reservoir. Most are very strongly tufa forming spring/ streams with some fen/ flush areas associated with them in open areas. The steep slopes are prone to landslips in the upper parts which has affected some springs in the past. Additional springs are present in by the upper reservoir on open ground and less strongly tufa producing springs are present in the woodland to the west of the reservoirs.			
Site management	Some areas used as pasture. Most woodland unmanaged. Moderate deer grazing. Recreational use but no formal path to main springs.			
Petrifying spring type(s)	Springhead; seepage; stream			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades Group 2 *Palustriella commutata-Geranium robertianum* springheads Group 4 *Palustriella commutata-Agrostis stolonifera* springheads			
Main tufa type(s)	Cascade; paludal; stream crust			
No. *7220 springs mapped	13 (21 springs mapped for whole site)			
Area of *7220 (m^2)	0.386 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	140 - 813	pH	7.5 – 8.03
	Nitrate mg/l	Not detectable – 2 mg/l	Phosphate mg/l	Not detectable
Other Annex habitats	6410; 7230; *91E0			
Other Fossitt habitats	ED3; FS2; GS4; WN2; WN6			

Structure and functions

No. monitoring plots	12
% pass rate	77 %
Main criteria for failing S&F	Trampling and grazing (deer) (8 plots); positive indicator species and nitrate (one plot)

Impacts

Impact code	Description	Timing	Scope	Influence
PA17	Agricultural activities generating pollution to surface or ground waters (including marine)	Ongoing & future	<50%	Medium
PA25	Agriculture activities not referred to above	Past	<50%	Medium
PI03	Problematic native species	Ongoing & future	<50%	Medium

Impact code	Description	Timing	Scope	Influence
PM05	Avalanches, landslides and collapse of terrain	Ongoing & future	<50%	Medium

Change from baseline

There was no change in tufa cover from the baseline surveys (2011 – 2013). One plot (M07) had previously been recorded as being dominated by cascade tufa, but in the current survey it had cascade, paludal and stream crust tufa. This may be a different interpretation, or the plot may not have been in the exact same position (as the valley is wooded, GPS signal can be poor). There was little change in the number of positive indicator species from the baseline, some plots had one more and others one less species. Only one plot (M04) had 2 species less than the baseline. This plot had significant deer trampling and nitrate levels were elevated (also elevated in the baseline survey).

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate

Conservation measures

Conservation measure code	Description
MA14	Other measures related to agricultural practices
MI05	Management of problematic native species

Recommendations

Site management	One plot at the top of the valley slope had had track works undertaken close to the plot. Avoid future track works without consultation. Management of high levels of deer grazing and trampling.
Survey	Survey of remaining area of SAC that was not surveyed in 2023. Monitoring of petrifying springs which are on the SAC boundary to ensure no damage from track creation and other works.
Hydrogeology	Investigate source of elevated nitrate

Photograph 1 Petrifying spring vegetation in woodland with large cascade mound and cascade ‘steps’ with soft mud (deer trampled). Photograph Joanne Denyer.

Photograph 2 Stream crust tufa and cemented rudites in wooded petrifying stream. Photograph Joanne Denyer.

Figure 1a Glenasmole Valley SAC survey area (north), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

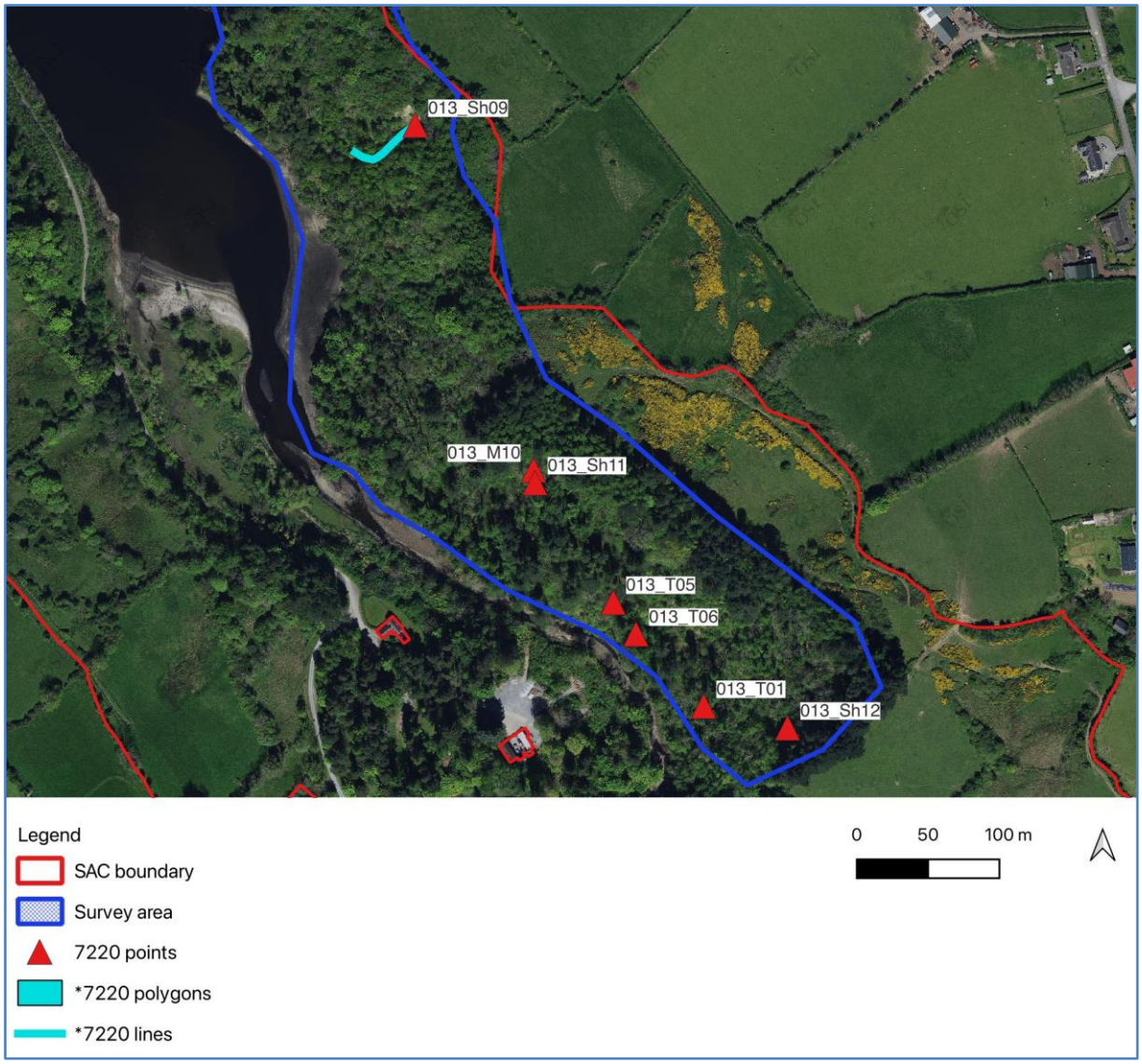


Figure 1a Glenasmole Valley SAC survey area (south), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Horn Head And Rinclevan SAC

Site details

PTRS23 Site code	PTRS23-014
County	Donegal
Designations	SAC (000147)
Landscape	Coastal
Altitude	0 – 79 m

Survey details

Date(s) surveyed	03/10/2023 & 04/10/2023		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	181.49 ha		
Subsites surveyed	Tramore Strand; Cloghernagh		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	3		5
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figures 1a & 1b), as it is an extensive site.		

Site and petrifying spring description

Site description	Two distinct areas of petrifying springs. Cascade tufa present on coastal cliffs at north and south of Tramore Beach. Some are highly species-rich for this vegetation type. Inland, mostly on the south facing slopes of Cloghernagh, there are many springheads and areas of seepage lines within wet grassland and *Schoenus* fen, with paludal tufa formation. These are also highly species rich.			
Site management	Locally high levels of sheep grazing			
Petrifying spring type(s)	Springhead; flush			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades Group 5 *Schoenus nigricans* Springs Group 6 *Carex lepidocarpa* Small Sedge Springs			
Main tufa type(s)	Cascade; paludal; stream crust; oncoids & ooids			
No. *7220 springs mapped	13			
Area of *7220 (m^2)	2.080 ha			
National ranking	Very high			
Species of note	n/a (*Catoscopium nigritum* known from site, but not recorded in this survey)			
Water sample data	EC µS/cm	411 - 556	pH	7.81 – 8.32
	Nitrate mg/l	Not detectable	Phosphate mg/l	Not detectable
Other Annex habitats	2130; 2170; 2190			
Other Fossitt habitats	CS1; GS4; LS2; PF1; PF3			

Structure and functions

No. monitoring plots	8
% pass rate	100 %
Main criteria for failing S&F	Five plots had high trampling or grazing, but still were in overall good condition

Impacts

Impact code	Description	Timing	Scope	Influence
PA07	Intensive grazing or overgrazing by livestock	Ongoing & future	<50%	Medium

Change from baseline

No baseline data as petrifying springs recently recorded

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
MA05	Adapt mowing, grazing and other equivalent agricultural activities (e.g. burning)

Recommendations

Site management	Reduce sheep grazing levels in northern part of site
Survey	Survey of remaining area of SAC that was not surveyed in 2023
Hydrogeology	None

Photograph 1 Species-rich coastal petrifying spring vegetation, with cascade tufa, southern end of Tramore Strand. Photograph Joanne Denyer.

Photograph 2 Species-rich small sedge petrifying spring vegetation, with paludal tufa, in north of site (Cloghernagh). Photograph Joanne Denyer.

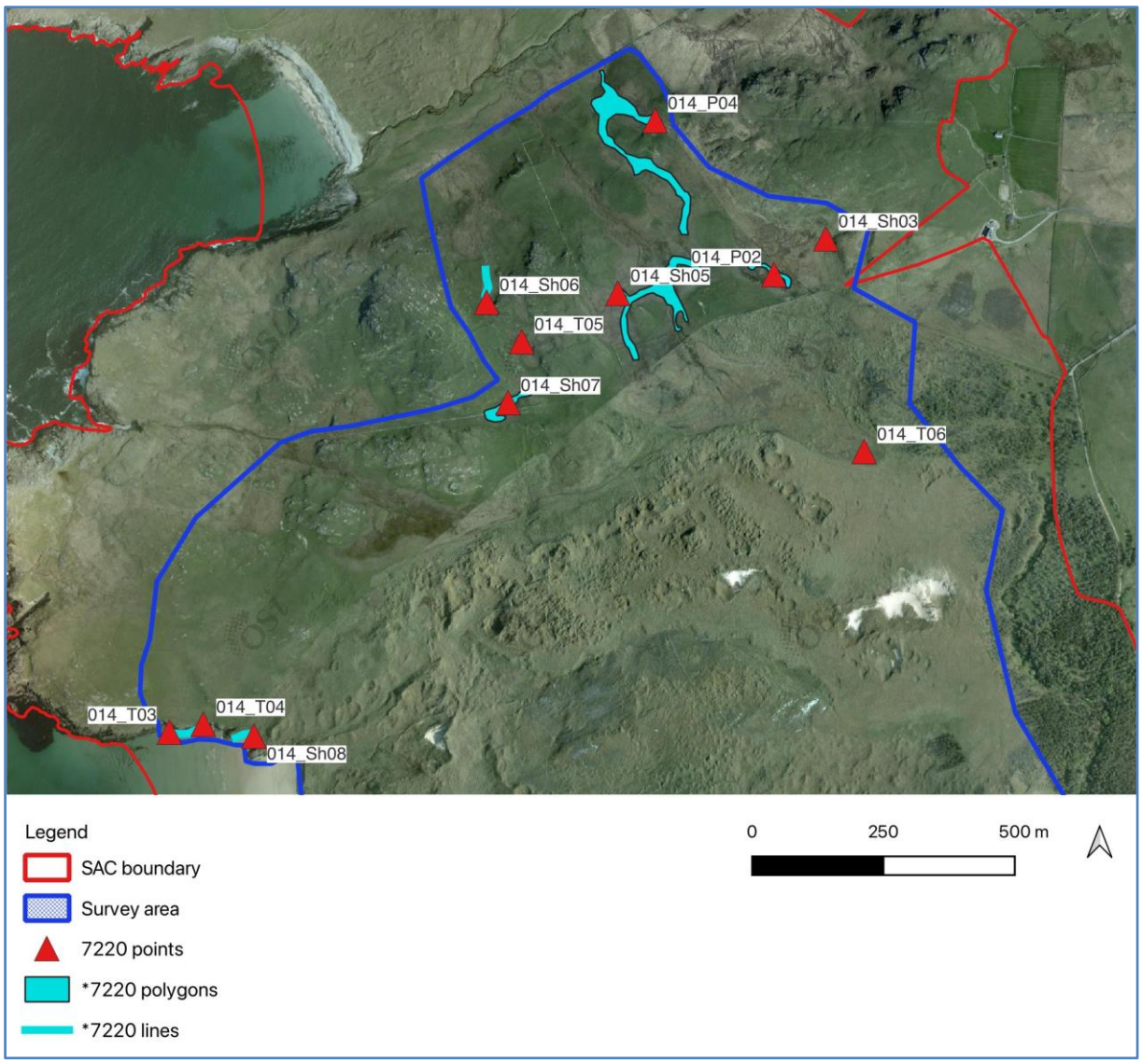


Figure 1a Horn Head And Rinclevan SAC survey area (north), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

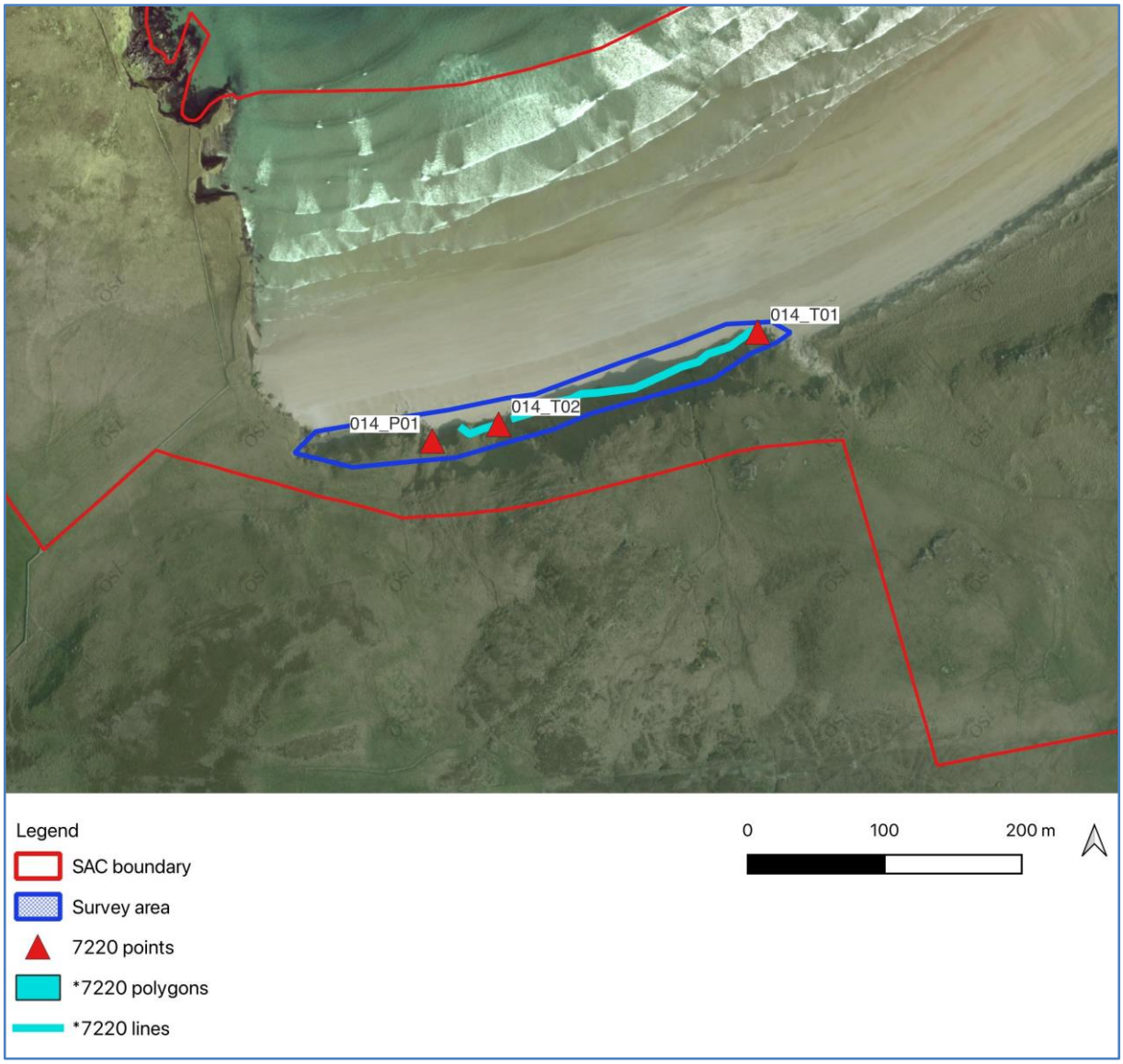


Figure 1b Horn Head And Rinclevan SAC survey area (south), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Howth Head SAC

Site details

PTRS23 Site code	PTRS23-015
County	Dublin
Designations	SAC (000202)
Landscape	Coastal
Altitude	2 – 73 m

Survey details

Date(s) surveyed	31/08/2023		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	0.76 ha		
Subsites surveyed	Kilrock Quarry; Balscadden Beach; Upper cliff path; Red Rock		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1	2	2
Water chemistry sampling	Field sampling		
Survey limitations	All known extant petrifying spring locations surveyed (Figures 1a & 1b)		

Site and petrifying spring description

Site description	Number of separate springheads and flushes including coastal tufa seepages and springheads and tufa flushes in quarry. One former inland tufa spring area no longer *7220, as tufa not present and only one positive indicator species present.			
Site management	None recorded. Inland hollow site was previously more open so may have been grazed but no grazing at present			
Petrifying spring type(s)	Springhead; flush; seepage			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades Group 6 *Carex lepidocarpa* Small Sedge Springs			
Main tufa type(s)	Cascade; stream crust			
No. *7220 springs mapped	7			
Area of *7220 (m^2)	0.010 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	378 - 1374	pH	7.14 – 8.02
	Nitrate mg/l	Not detectable	Phosphate mg/l	0.05 – 0.5 mg/l
Other Annex habitats	7230			
Other Fossitt habitats	CB1; CS1; ER1; FS2; GS4; HH1; WS1			

Structure and functions

No. monitoring plots	5
% pass rate	80 %
Main criteria for failing S&F	One plot fails on positive indicator species and is no longer considered to be *7220 as overgrown and possible hydrology changes. Three plots had elevated phosphate levels, and one had borderline elevated nitrate, but all still were in good condition.

Impacts

Impact code	Description	Timing	Scope	Influence
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	<50%	Medium
PL05	Modification of hydrological flow	Ongoing & future	<50%	Medium

Change from baseline

One plot (Sh03) had 7 positive indicator species present in the baseline survey (2012). In the current survey this area was overgrown and only one positive indicator species was present and no tufa formation. A stream had good water flow into the area, but water chemistry may have changed. In all other plots with baseline data, positive indicator species had increased slightly. The two plots in the quarry had higher tufa cover compared to the baseline. Phosphate levels were elevated here but not in the baseline survey. The plot at Balscadden Beach was moved slightly (as there was better quality *7220 habitat adjacent). This plot had higher tufa formation in the current survey, but this may be due to repositioning. Nitrate and phosphate levels were exceeded at Balscadden Beach in both periods.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate

Conservation measures

Conservation measure code	Description
MA04	Reinstate appropriate agricultural practices to address abandonment, including mowing, grazing, burning or equivalent measures
MK02	Reduce impact of multi-purpose hydrological changes

Recommendations

Site management	Consider grazing of overgrown inland petrifying spring area
Survey	No further survey required in short-term
Hydrogeology	Investigate changes to hydrology of inland former *7220; Investigate source of elevated phosphates and nitrates

Photograph 1 Petrifying spring seepage on back quarry wall, Kilrock Quarry. Photograph Joanne Denyer.

Photograph 2 Cascade tufa and petrifying spring vegetation at Balscadden Beach. Photograph Joanne Denyer.

Figure 1a Howth Head SAC survey area (north), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Figure 1b Howth Head SAC survey area (south), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Knocksink Wood SAC

Site details

PTRS23 Site code	PTRS23-016
County	Dublin & Wicklow
Designations	SAC (000725)
Landscape	Lowland wooded river valley
Altitude	62 – 122 m

Survey details

Date(s) surveyed	03/08/2023		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	10.84 ha		
Subsites surveyed	Bog meadow; main woodland		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	2	2	1
Water chemistry sampling	Field sampling and laboratory tested samples		
Survey limitations	Only part of SAC surveyed (Figures 1a & 1b), as it is an extensive site and most known petrifying springs are located in the east.		

Site and petrifying spring description

Site description	Bog meadow area in east includes large cascade tufa system linked by tufa forming stream to SAC and discharging to river. Large tufa formation where spring enters river (outside of SAC). Main woodland has highly tufa forming springheads, extensive flushing and streams with stream crust tufa (but low number of positive indicator species in the latter). Tufa formation high in most spring areas. Extensive tufa seepage area in wet woodland to north of bog meadow.			
Site management	None recorded			
Petrifying spring type(s)	Springhead; stream			
Petrifying Spring vegetation communities	Group 2 *Palustriella commutata-Geranium robertianum* springheads			
Main tufa type(s)	Cascade			
No. *7220 springs mapped	14 (17 mapped for whole site)			
Area of *7220 (m^2)	0.744 ha			
National ranking	Very high			
Species of note	n/a			
Water sample data	EC µS/cm	710 - 1220	pH	7.44 – 7.48
	Nitrate mg/l	Not detectable to 36.3 mg/l	Phosphate mg/l	Not detectable to 0.034 mg/l
Other Annex habitats	*91E0			
Other Fossitt habitats	FW1; WN2; WN6			

Structure and functions

No. monitoring plots	5
% pass rate	60 %
Main criteria for failing S&F	Positive indicator species; negative herbaceous species; nitrate; phosphate; tramping (deer). Invasive species present but not currently impacting spring condition.

Impacts

Impact code	Description	Timing	Scope	Influence
PF03	Creation or development of sports, tourism and leisure infrastructure	Past	<50%	Medium
PI02	Other invasive alien species (other than species of Union concern)	Ongoing & future	<50%	Low
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	<50%	Medium

Change from baseline

The woodland plot in the Bog Meadow (M02) had fewer positive indicator species from the baseline (2012). It had elevated nitrate, deer trampling and invasive species (Winter Heliotrope) on upper spring area. Both nitrate and phosphate exceeded the thresholds in the baseline survey in this plot but phosphate was not detectable in the current survey (laboratory tested sample). The main woodland monitoring plot (M03) had higher positive indicator species compared to the baseline. This had elevated nitrate and phosphate levels in the current and baseline surveys. No baseline data was available for other plots. Tufa cover was very high in both plots in the baseline and current survey.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate

Conservation measures

Conservation measure code	Description
MK01	Reduce impact of mixed source pollution
MI03	Management, control or eradication of other invasive alien species

Recommendations

Site management	Invasive species control on petrifying springs in Bog Meadow; Ensure recreational development at Bog Meadow and Education Centre at main woodland do not have any negative impacts on adjacent petrifying springs.
Survey	Survey of remaining area of SAC that was not surveyed in 2023
Hydrogeology	Investigate source of elevated phosphates and nitrates

Photograph 1 Large wooded cascade petrifying spring adjacent to Education Centre, main Knocksink Woodland. Photograph Joanne Denyer.

Photograph 2 Large wooded cascade petrifying spring north of Bog Meadow, open areas caused by deer trampling. Photograph Joanne Denyer.

Photograph 3 Massive tufa cascade with strong flow discharging to river, south of Bog Meadow. Outside of SAC but linked to petrifying stream within SAC. Photograph Joanne Denyer.

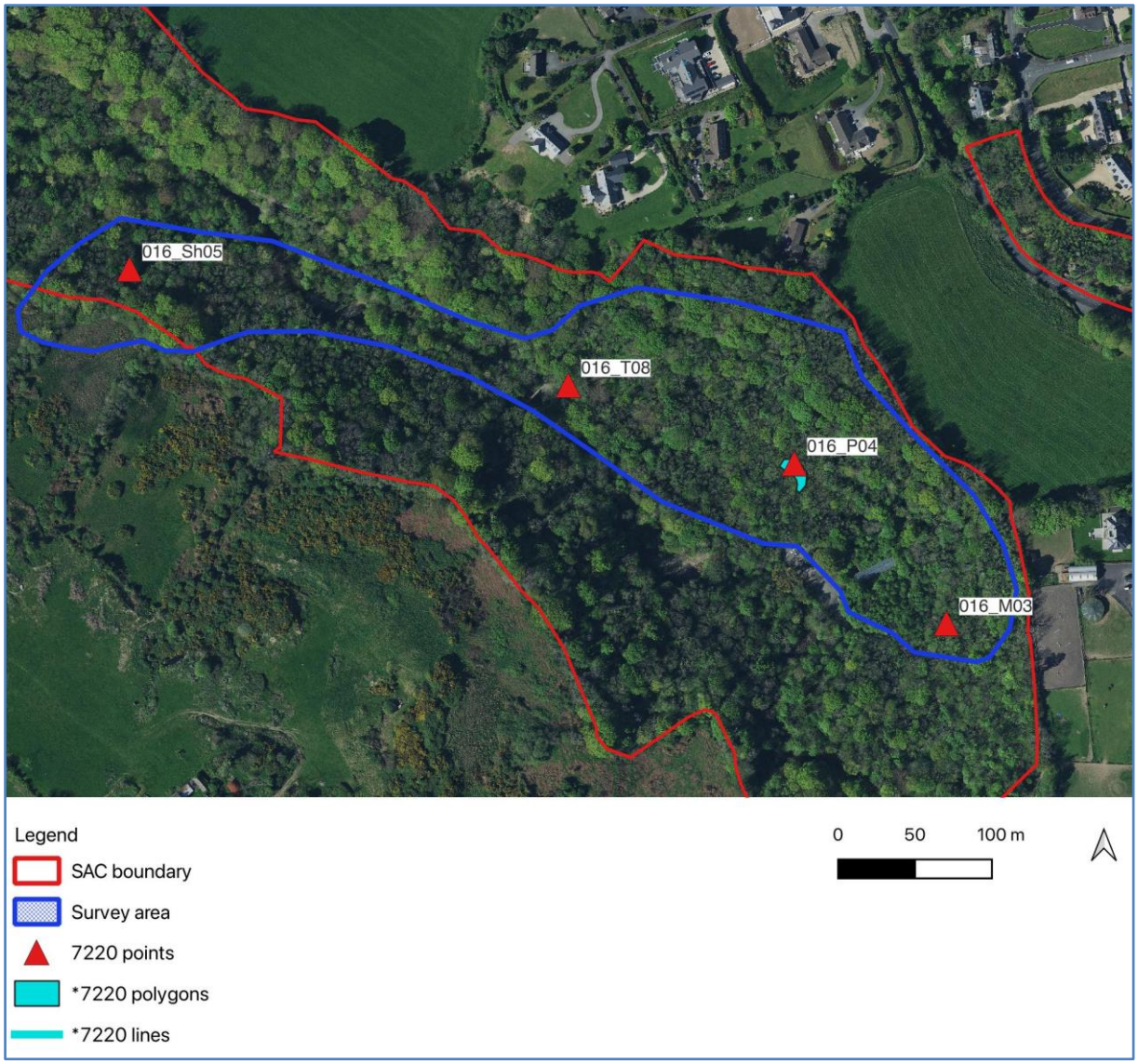


Figure 1a Knocksink Wood SAC survey area (Bog Meadow), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

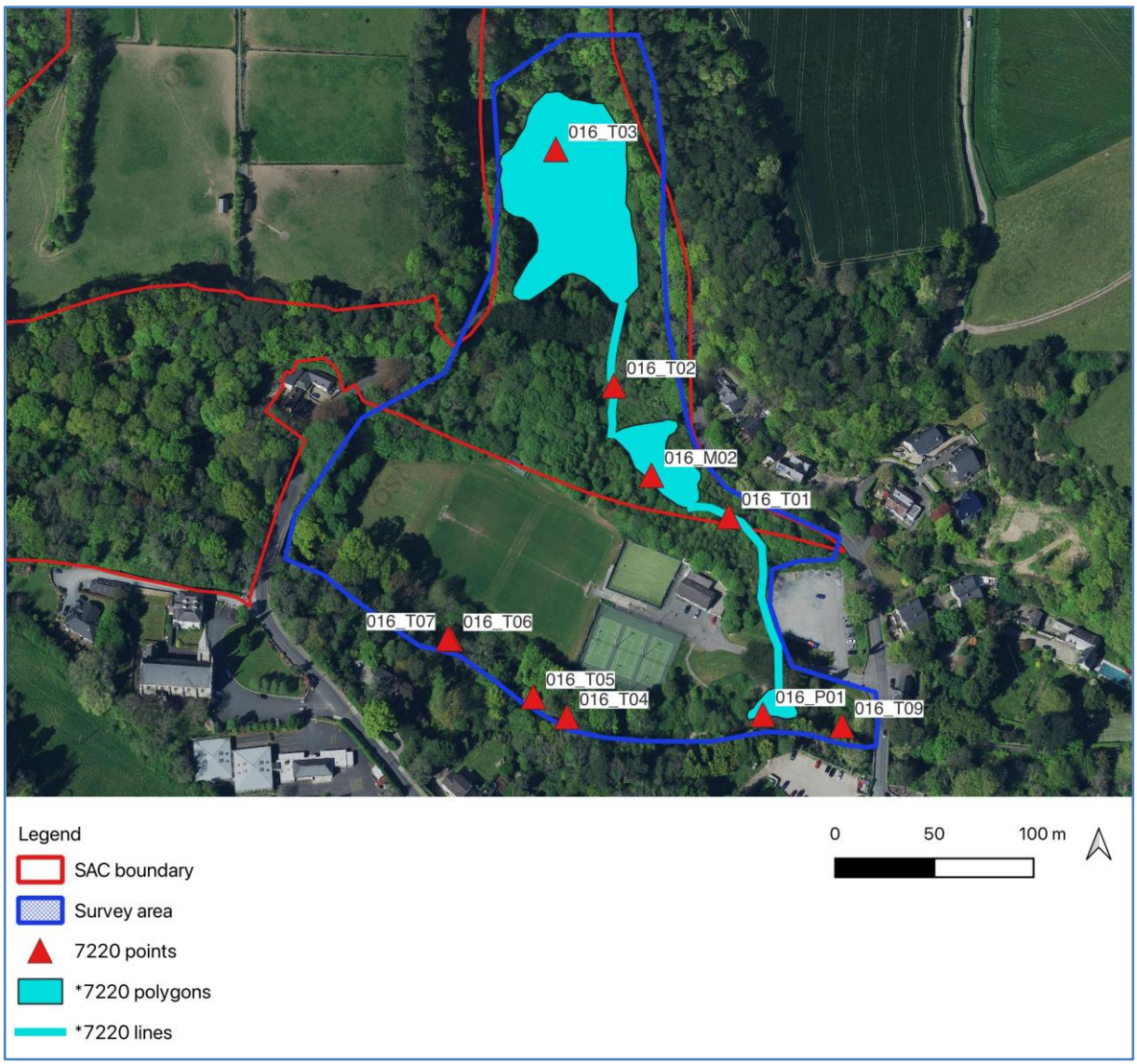


Figure 1b Knocksink Wood SAC survey area (main woodland), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Lough Derg, North-East Shore SAC

Site details

PTRS23 Site code	PTRS23-017
County	Tipperary
Designations	SAC (002241)
Landscape	Lowland lake
Altitude	40 m

Survey details

Date(s) surveyed	02/11/2023		
Recorder(s)	George Smith		
Area surveyed (ha)	0.53 ha		
Subsites surveyed	n/a		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	2	0	0
Water chemistry sampling	Field sampling		
Survey limitations	Only known location for petrifying springs within SAC surveyed (Figure 1).		

Site and petrifying spring description

Site description	Petrifying springs and associated alkaline fen on a moderate slope adjacent to Lough Derg. Upper slope is occupied by inactive tufa deposits dominated by bramble and encroached by young woodland. The largest cascade is at the south-western end, but there are smaller cascades and seepage zones throughout the lower parts of the site, which is dominated by alkaline fen vegetation. High algal cover in some areas from elevated nutrients.			
Site management	Badger and deer activity maintaining open vegetation, otherwise unmanaged.			
Petrifying spring type(s)	Springhead			
Petrifying Spring vegetation communities	Group 5 *Schoenus nigricans* Springs Group 6 *Carex lepidocarpa* Small Sedge Springs			
Main tufa type(s)	Cascade			
No. *7220 springs mapped	2 spring points mapped in one seepage and cascade area			
Area of *7220 (m^2)	0.287 ha			
National ranking	Moderate			
Species of note	n/a			
Water sample data	EC µS/cm	813 - 821	pH	7.22 – 7.44
	Nitrate mg/l	10 mg/l	Phosphate mg/l	0 – 0.05 mg/l
Other Annex habitats	7230			
Other Fossitt habitats	FS1; PF1; WS1			

Structure and functions

No. monitoring plots	2
% pass rate	0 %
Main criteria for failing S&F	Negative bryophyte and herbaceous species; nitrate; phosphate; vegetation height

Impacts

Impact code	Description	Timing	Scope	Influence
PA05	Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming)	Ongoing & future	>90%	Low
PA17	Agricultural activities generating pollution to surface or ground waters (including marine)	Ongoing & future	>90%	Medium

Change from baseline

No baseline data available

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Unfavourable-Bad	Unfavourable-Inadequate	Unfavourable-Bad

Conservation measures

Conservation measure code	Description
MA10	Reduce/eliminate point or diffuse source pollution to surface or ground waters (including marine) from agricultural activities

Recommendations

Site management	Consider grazing of overgrown petrifying spring/ fen vegetation
Survey	No further survey required in short-term
Hydrogeology	Investigate source of elevated nitrate and phosphate and possible changes to water flow.

Photograph 1 Petrifying spring vegetation on lakeshore. Photograph George Smith.

Photograph 2 Petrifying spring vegetation becoming overgrown with tall *Phragmites australis*. Photograph George Smith.

Figure 1 Lough Derg, North-East Shore SAC survey area, petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Lough Eske and Ardnamona Wood SAC

Site details

PTRS23 Site code	PTRS23-018
County	Donegal
Designations	SAC (002147)
Landscape	Lowland river gorge
Altitude	69 m

Survey details

Date(s) surveyed	24/07/2024		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	1.65 ha		
Subsites surveyed	n/a		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1		
Water chemistry sampling	Field sampling		
Survey limitations	Only known location for petrifying springs within SAC surveyed (Figure 1). Other areas of gorge not accessible.		

Site and petrifying spring description

Site description	Wooded riverbank in ravine. One tufa-forming stream was recorded on the northern bank of steep wooded gorge. There had been a rough historic location for this spring but little detail. No other petrifying springs were recorded, but the area is hard to access because of the steep rock gorge and fast running deep water in the river.			
Site management	None recorded			
Petrifying spring type(s)	Springhead			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades			
Main tufa type(s)	Cascade			
No. *7220 springs mapped	1			
Area of *7220 (m^2)	0.002 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	637	pH	8.04
	Nitrate mg/l	Not detectable	Phosphate mg/l	Not detectable
Other Annex habitats	91A0			
Other Fossitt habitats	WN1			

Structure and functions

No. monitoring plots	1
% pass rate	100 %
Main criteria for failing S&F	n/a

Impacts

Impact code	Description	Timing	Scope	Influence
PX04	No pressures or threats	Ongoing & future	>90%	n/a

Change from baseline

No baseline data available

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
n/a	

Recommendations

Site management	No change in management required for *7220 habitat
Survey	No further survey required in short-term
Hydrogeology	None

Photograph 1 View of petrifying spring in wooded gorge from opposite river bank. Photograph Joanne Denyer.

Photograph 2 Cascade tufa dominated by *Eucladium verticillatum* in the petrifying spring. Photograph Joanne Denyer.

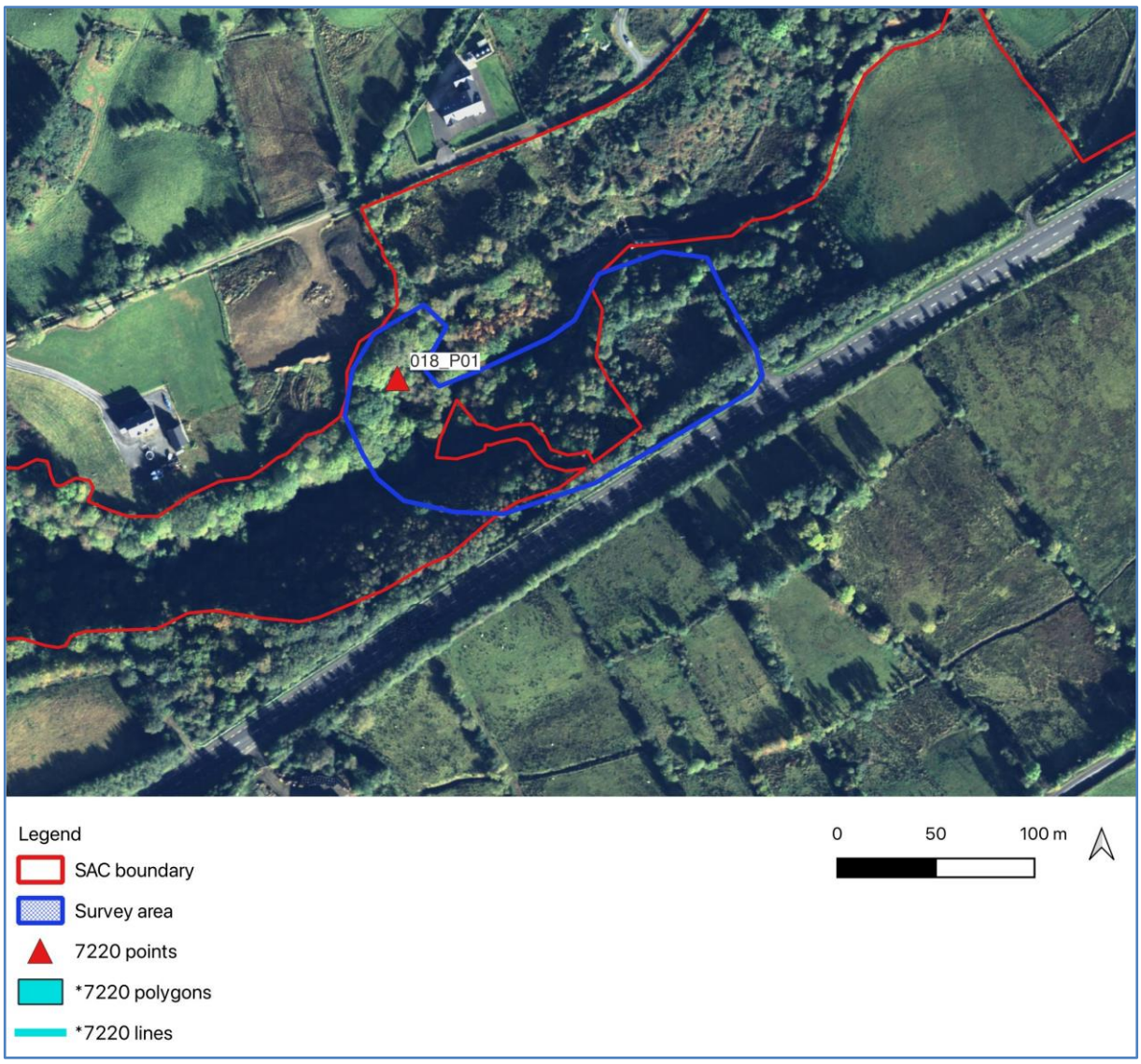


Figure 1 Lough Eske and Ardnamona Wood SAC survey area, petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Magherabeg Dunes SAC

Site details

PTRS23 Site code	PTRS23-019
County	Wicklow
Designations	SAC (001766)
Landscape	Coastal
Altitude	2 – 19 m

Survey details

Date(s) surveyed	13/10/2023 & 19/10/2023		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	5.17 ha		
Subsites surveyed	Ardmore Point; Magheramore Beach		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
		2	2
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figure 1a – 1c), there has been extensive recent survey.		

Site and petrifying spring description

Site description	Coastal petrifying springs. Massive cascade tufa in south and north of site on coastal cliffs. Extensive seepage lines with paludal tufa deposits on sedimentary slopes and cliffs. Seepages at level of high tide and in grassland above cliffs, particularly around Ardmore Point. Sigs of drying and inactive tufa in springs in north of Magheramore Beach.			
Site management	None recorded			
Petrifying spring type(s)	Springhead; seepage			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades Group 6 *Carex lepidocarpa* Small Sedge Springs			
Main tufa type(s)	Cascade			
No. *7220 springs mapped	4 (48 mapped for whole site)			
Area of *7220 (m^2)	0.084 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	567 - 933	pH	8.05 – 8.24
	Nitrate mg/l	0 – 10 mg/l	Phosphate mg/l	Not detectable
Other Annex habitats	2130			
Other Fossitt habitats	CB1; CS1; CS3; FS2			

Structure and functions

No. monitoring plots	4
% pass rate	75 %
Main criteria for failing S&F	Positive indicator species; nitrate; water flow

Impacts

Impact code	Description	Timing	Scope	Influence
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	<50%	Medium
PL05	Modification of hydrological flow	Ongoing & future	<50%	High

Change from baseline

Baseline data available for two plots: M01 (south of Ardmore Point) and M04 (northern end of Magheramore Beach). M01 had no change in positive indicator species from the baseline (2011). There was a slight reduction in tufa formation due to natural erosion, as part of this spring is at/ below the high tide line. Phosphate levels were very high in the baseline survey, but it was not possible to obtain sufficient water to test in the current survey. M04 also had no change in the number of positive indicator species from the baseline (2013). However, the main positive indicator species *Palustriella commutata*, which previously had 30% cover, was only present as dead tufa encrusted plants in the current survey. There appeared to be significant drying, and the plot vegetation has deteriorated since baseline survey. This may be due to changes to land management on the cliffs above this petrifying spring. Nitrate and phosphate were elevated in this spring in the baseline survey and nitrate in the current survey (phosphate may not have been high enough to detect with field kit).

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate

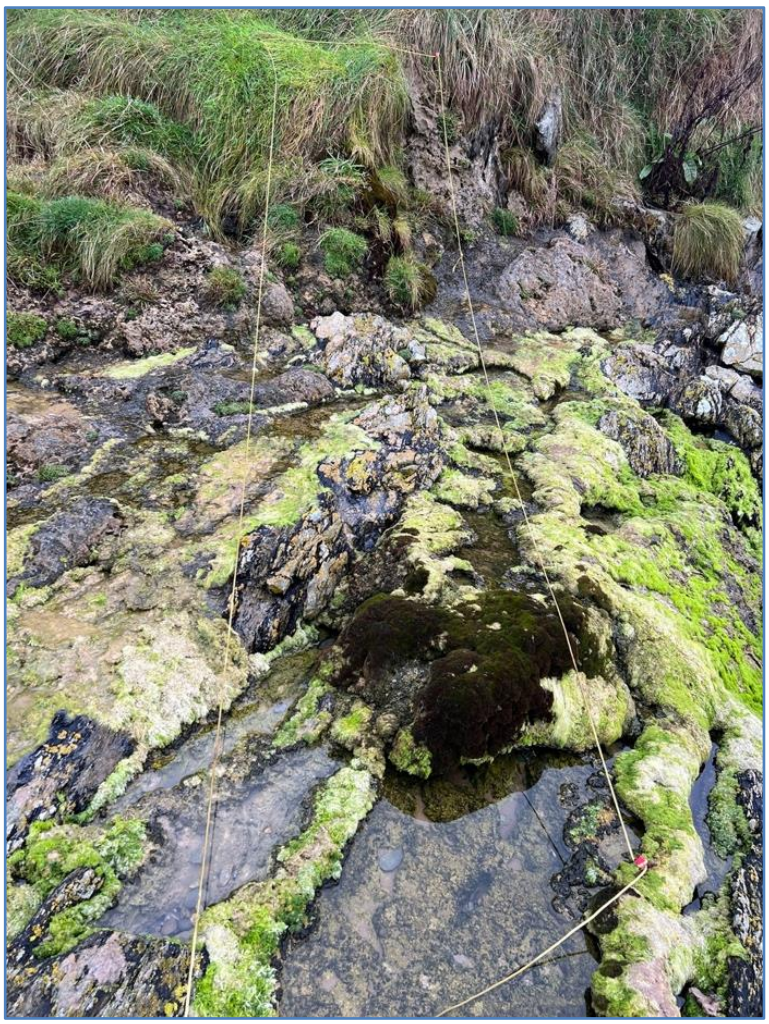
Conservation measures

Conservation measure code	Description
MA10	Reduce/eliminate point or diffuse source pollution to surface or ground waters (including marine) from agricultural activities
MK02	Reduce impact of multi-purpose hydrological changes

Recommendations

Site management	Protection from disturbance in south of site where adjacent to a path. Protect from ant potential development in the area which could impact hydrogeology or increase visitor pressure in this area. In northern part of SAC, consider an extensive buffer zone at the cliff edge above the springs, between the arable field and the petrifying spring vegetation. No ploughing or vegetation removal/ disturbance should be undertaken here.
Survey	No further survey required in short-term
Hydrogeology	Investigate source of elevated nitrates

Photograph 1 Coastal petrifying spring with massive cascade tufa formation, north of Magheramore Beach. Degraded with inactive tufa and low vegetation cover. Photograph Joanne Denyer.



Photograph 2 Coastal petrifying spring vegetation at high tide line, south of Ardmore Point. Photograph Joanne Denyer.

Photograph 3 Coastal seepage in slump area on Ardmore Point with species-rich small sedge petrifying spring vegetation. Photograph Joanne Denyer.

Figure 1a Magherabeg Dunes SAC survey area (northern beach), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

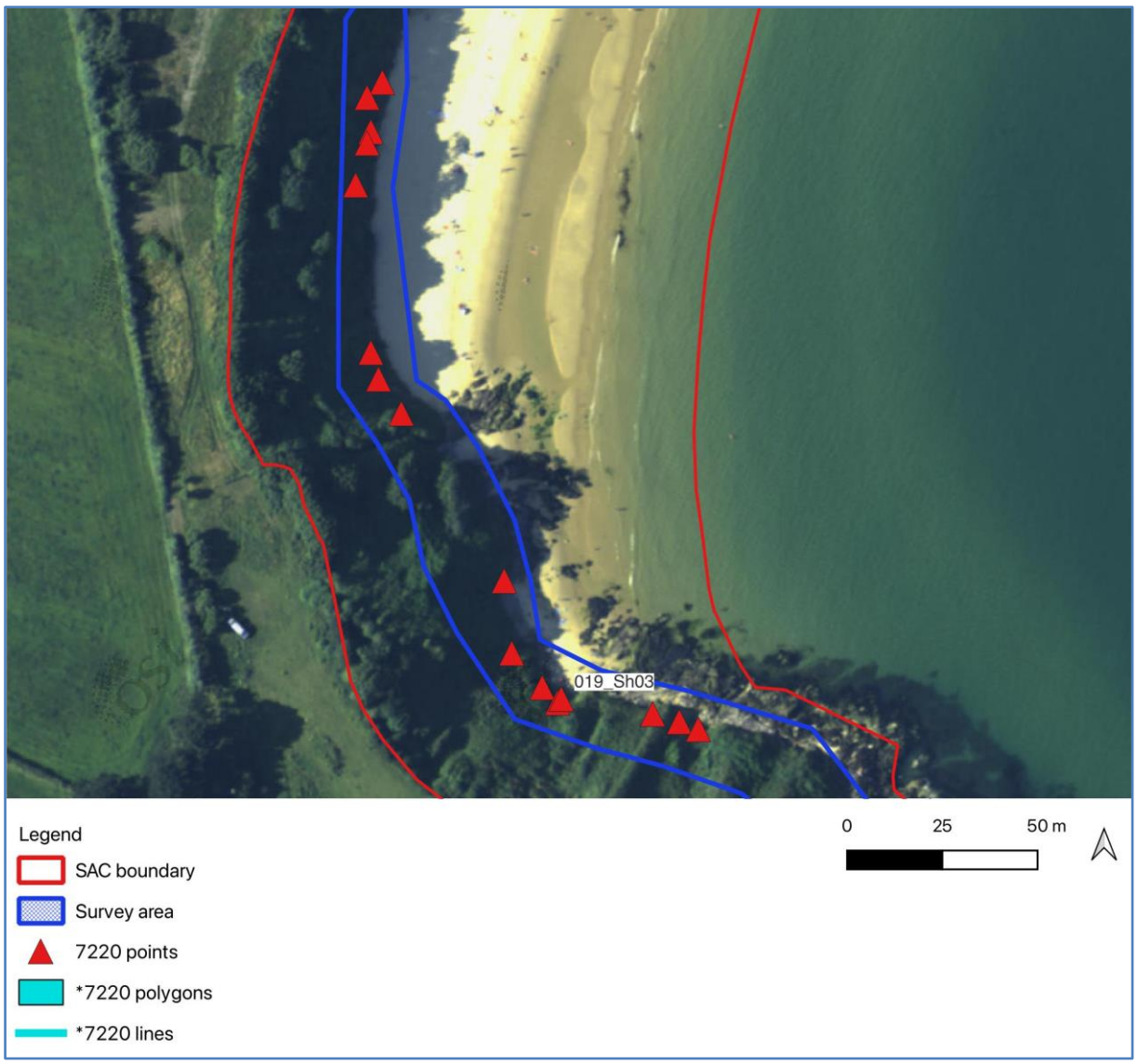


Figure 1b Magherabeg Dunes SAC survey area (southern beach), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

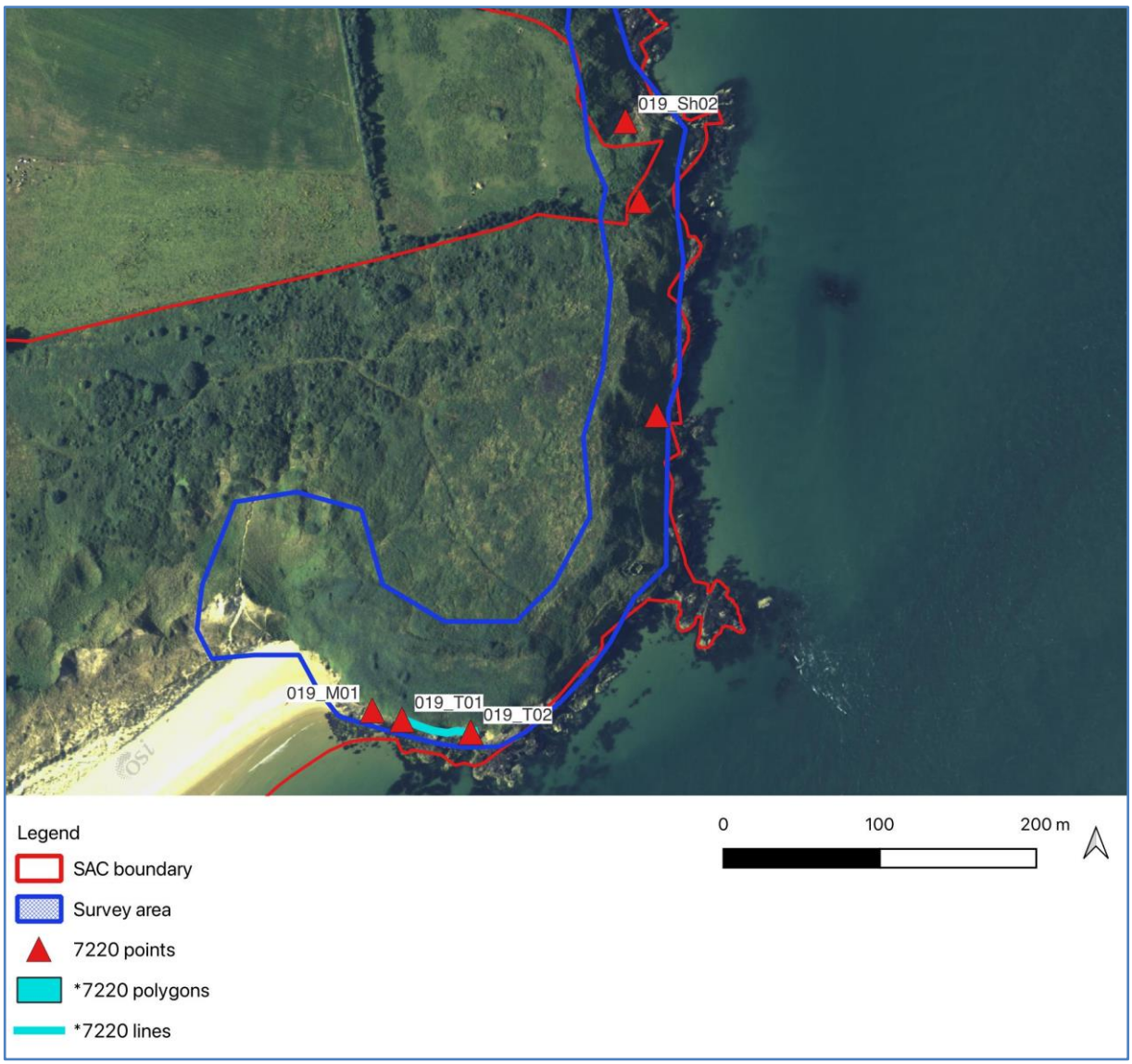


Figure 1c Magherabeg Dunes SAC survey area (Ardmore Point), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Malahide Estuary SAC

Site details

PTRS23 Site code	PTRS23-020
County	Dublin
Designations	SAC (000205)
Landscape	Coastal
Altitude	0 – 10 m

Survey details

Date(s) surveyed	15/08/2023		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	0.52 ha		
Subsites surveyed	n/a		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1		
Water chemistry sampling	Field sampling		
Survey limitations	Only known location for petrifying springs within SAC surveyed (Figure 1).		

Site and petrifying spring description

Site description	Section of cliff with numerous seepages with tufa formation, including two large cascade mounds. Not all seepages have tufa formation or positive indicator species.			
Site management	None recorded			
Petrifying spring type(s)	Springhead			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades			
Main tufa type(s)	Cascade			
No. *7220 springs mapped	2			
Area of *7220 (m^2)	0.006 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	1143	pH	7.22
	Nitrate mg/l	5 mg/l	Phosphate mg/l	0.2 mg/l
Other Annex habitats	n/a			
Other Fossitt habitats	CB1; CS1			

Structure and functions

No. monitoring plots	1
% pass rate	0 %
Main criteria for failing S&F	Nitrate; phosphate

Impacts

Impact code	Description	Timing	Scope	Influence
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	<50%	Medium

Change from baseline

No full baseline plot undertaken but assessed as 'Unfavourable-Inadequate' (2011). Described as small tufa cascades with inactive tufa. In current survey, tufa assessed as 'massive strongly consolidated deposits' so may have been an increase in tufa formation.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate

Conservation measures

Conservation measure code	Description
MK01	Reduce impact of mixed source pollution

Recommendations

Site management	No management required but monitor recreational disturbance (currently no issues)
Survey	No further survey required in short-term
Hydrogeology	Investigate source of elevated phosphates and nitrates

Photograph 1 Seepage zone along low cliffs above shoreline, view to north. Photograph Joanne Denyer.

Photograph 2 Cascade tufa with petrifying spring vegetation. Photograph Joanne Denyer.

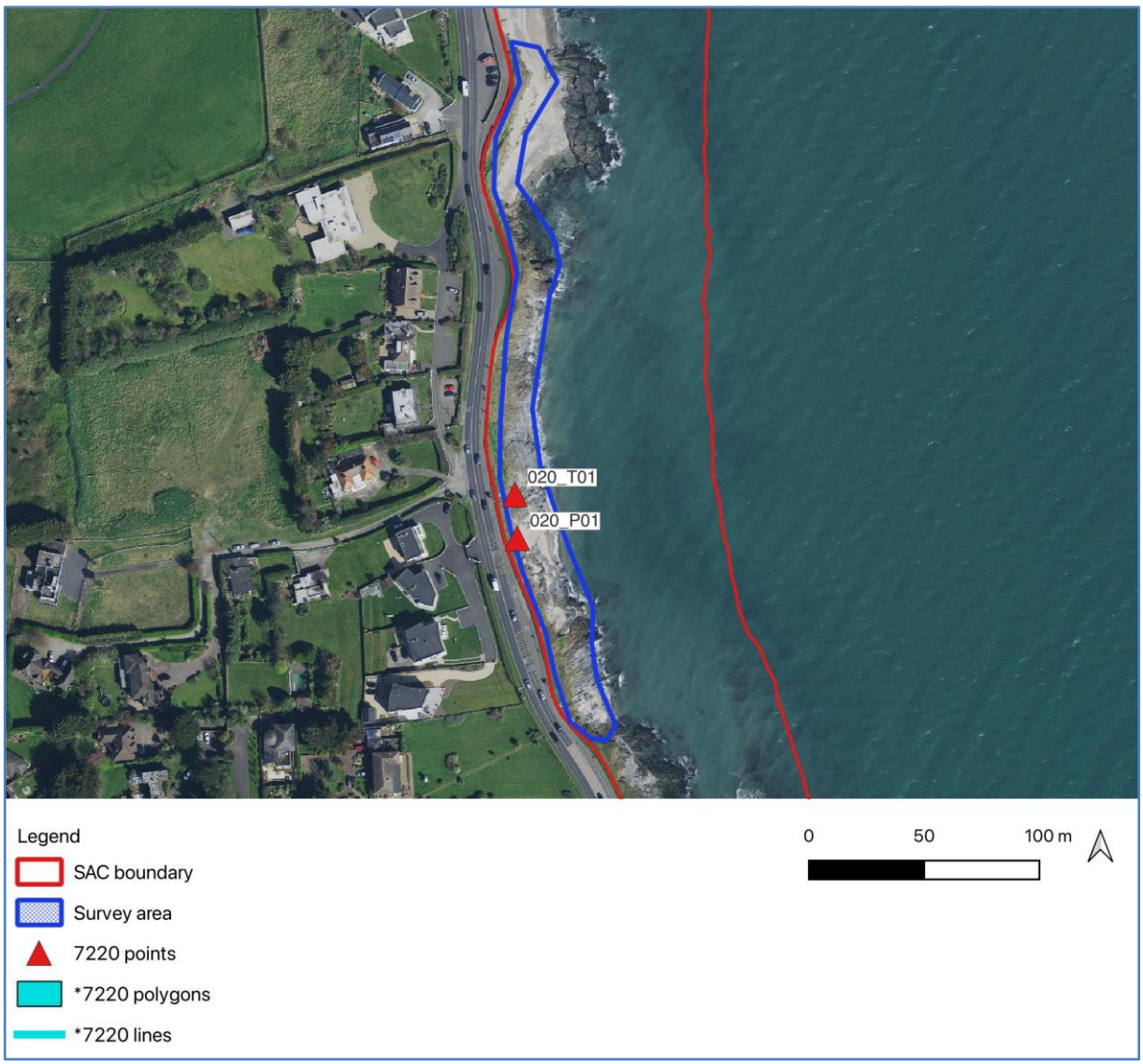


Figure 1 Malahide Estuary SAC survey area, petrifying spring locations and monitoring points. Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Rathcor, Carlingford

Site details

PTRS23 Site code	PTRS23-021
County	Louth
Designations	n/a
Landscape	Coastal
Altitude	5 – 12 m

Survey details

Date(s) surveyed	06/10/2023		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	2.28 ha		
Subsites surveyed	n/a		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
		3	1
Water chemistry sampling	Field sampling		
Survey limitations	None (survey area shown on Figure 1)		

Site and petrifying spring description

Site description	Coastal petrifying springs at west and eastern end of beach on sedimentary sea clifs. Seepages at eastern end are the largest with significant cascade tufa formed over a length of *c*. 100m of beach. Lumps of tufa have fallen onto the shore here.			
Site management	None recorded			
Petrifying spring type(s)	Springhead; seepage			
Petrifying Spring vegetation communities	Group 4 *Palustriella commutata-Agrostis stolonifera* springheads			
Main tufa type(s)	Cascade			
No. *7220 springs mapped	10			
Area of *7220 (m^2)	0.027 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	726 - 1287	pH	7.56 – 8.15
	Nitrate mg/l	5 – 10 mg/l	Phosphate mg/l	Not detectable
Other Annex habitats	n/a			
Other Fossitt habitats	CS3; LS; LR			

Structure and functions

No. monitoring plots	4
% pass rate	0 %
Main criteria for failing S&F	Nitrate

Impacts

Impact code	Description	Timing	Scope	Influence
PA17	Agricultural activities generating pollution to surface or ground waters (including marine)	Ongoing & future	50-90%	Medium
PM05	Avalanches, landslides and collapse of terrain	Ongoing & future	<50%	Medium

Change from baseline

Three plots have baseline data (2013). All three plots had an increase in positive indicator species in the current survey. There was a slight reduction in the recorded tufa in two plots and one was recorded as cascade tufa in the current survey and paludal tufa in the baseline survey. This may be due to plot positioning and tufa formation was still very high in all plots. Nitrate was also exceeded in the baseline survey.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate

Conservation measures

Conservation measure code	Description
MA10	Reduce/eliminate point or diffuse source pollution to surface or ground waters (including marine) from agricultural activities

Recommendations

Site management	No management required
Survey	No further survey required in short-term
Hydrogeology	Investigate source of elevated nitrates

Photograph 1 Petrifying spring vegetation below springhead, dominated by *Palustriella commutata* and with stream crust tufa present. Photograph Joanne Denyer.

Photograph 2 Cascade tufa at springhead with mounds of *Palustriella commutata.* Photograph Joanne Denyer.

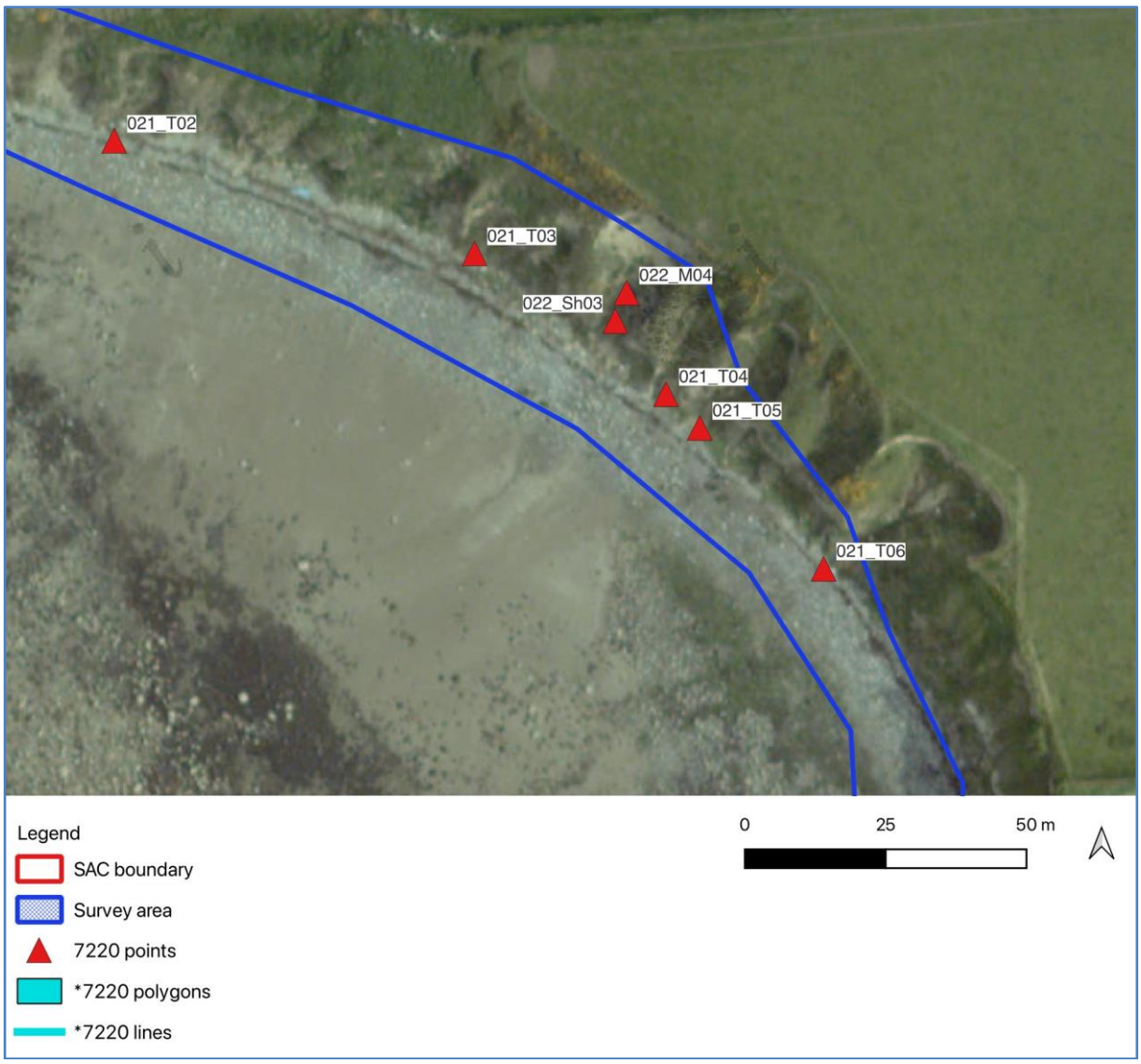


Figure 1a Rathcor survey area (east), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

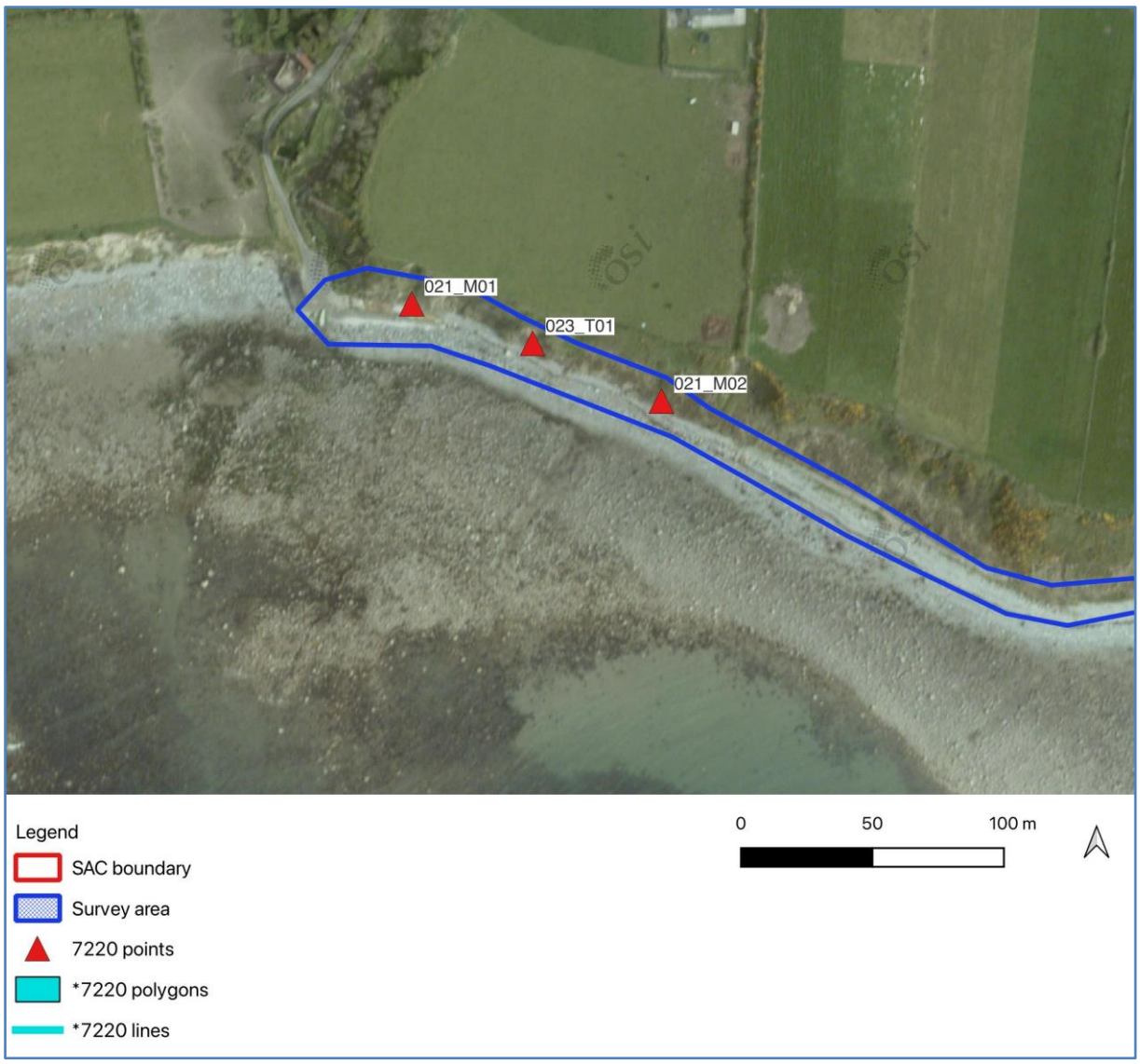


Figure 1b Rathcor survey area (west), petrifying spring locations and monitoring points. Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey

Rye Water Valley/ Carton SAC

Site details

PTRS23 Site code	PTRS23-022
County	Kildare
Designations	SAC (001398)
Landscape	Lowland river valley
Altitude	42 – 57 m

Survey details

Date(s) surveyed	24/08/2023		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	5.41 ha		
Subsites surveyed	Louisa Bridge (north and south of river)		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
		4	
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figures 1a – 1c), there has been extensive recent survey.		

Site and petrifying spring description

Site description	Series of springhead, flushes and pools in SAC area south of river. Species-rich vegetation with sparse paludal tufa on terraces and cascade tufa dominated by bryophytes on steep slopes (e.g. stonework within Roman Bath and steep bank above middle terrace). Waterfall to north of river (outside of SAC) has very high cascade tufa and stream below has high cover of stream crust tufa, with cascade tufa where it enters the Rye Water river.			
Site management	None recorded south of river. North of river there are steps and a path.			
Petrifying spring type(s)	Springhead; flush			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* Tufa Cascades Group 3 *Brachythecium rivulare-Platyhypnidium riparioides* tufaceous streams and flushes Group 6 *Carex lepidocarpa* Small Sedge Springs			
Main tufa type(s)	Cascade; paludal; dam			
No. *7220 springs mapped	12 (15 mapped from whole site)			
Area of *7220 (m^2)	0.255 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	586 - 1795	pH	7.58 – 8.41
	Nitrate mg/l	Not detectable	Phosphate mg/l	0 – 0.1 mg/l
Other Annex habitats	6210; 7230; *91E0			
Other Fossitt habitats	BL1; FW1; FP2; PF1; WN6			

Structure and functions

No. monitoring plots	4
% pass rate	100 %
Main criteria for failing S&F	Phosphates elevated in 4 plots and invasion of woody species. However, springs still species-rich and in good condition. M04 has low indicator species but is a waterfall with very strong flow which reduces species cover.

Impacts

Impact code	Description	Timing	Scope	Influence
PF06	Deposition and treatment of waste/rubbish from built-up areas	Ongoing & future	<50%	Low
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	50-90%	Low
PL05	Modification of hydrological flow	Ongoing & future	<50%	Low

Change from baseline

Baseline data available for plots south of the river (M01, M02, M03) from 2013 and 2013. All had elevated phosphates in the baseline survey and also elevated levels with the field testing kit in 2023. However, laboratory tested water samples in 2024 (two separate samples for each plot), did not detect elevated phosphates. Positive indicator species were high in all plots with slight reduction in M02, increase in M01 and no change in M03. Tufa cover was highly reduced in all three plots but may be due to interpretation of paludal tufa as the vegetation was more open in the baseline survey and tufa more visible. From photograph comparisons, there does not seem to be an actual decrease in tufa formation. Plot M04 has baseline data from 2021 and general survey data from 2011. This had no change in positive indicator species and tufa cover was 100% in both surveys. There is no baseline water chemistry data, but there is less filamentous algae cover on the spring in the current survey compared to 2021 and 2011. Water sample (laboratory testing) has shown both low and exceeded phosphate levels so these may vary temporally. Other plots in the SAC, not surveyed in detail in 2023, have poor condition due to high nitrate levels.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate

Conservation measures

Conservation measure code	Description
MK01	Reduce impact of mixed source pollution
MK02	Reduce impact of multi-purpose hydrological changes
MF04	Reduce/eliminate pollution to surface or ground waters from commercial, residential and recreational areas and activities, and from industrial activities and structures

Recommendations

Site management	Louisa Bridge south – removal of litter from Roman Bath and ensure that any restoration works to brick structures do not impact petrifying spring vegetation. Review of paths within this area to avoid petrifying spring vegetation and recreational trampling. Protection of sensitive habitats during surveys and investigations. Surveys only in consultation with NPWS to ensure minimisation of trampling damage.
Survey	No further survey required in short-term
Hydrogeology	Investigate source of elevated phosphates and nitrates and potential water flow reduction to upper terrace springs
Other	Extend SAC boundary to include petrifying springs at Louisa Bridge north and highly tufa forming stream with dams in wooded valley north of Rye Water (Hamwood Stream).

Photograph 1 Petrifying spring vegetation on upper terrace which has now infilled from open pools in 2011. Photograph Joanne Denyer.

Photograph 2 Petrifying spring vegetation and open pool on middle terrace. Photograph Joanne Denyer.

Photograph 3 Massive cascade tufa formation and extensive stream crust below waterfall, Louisa Bridge north. Photograph Joanne Denyer.

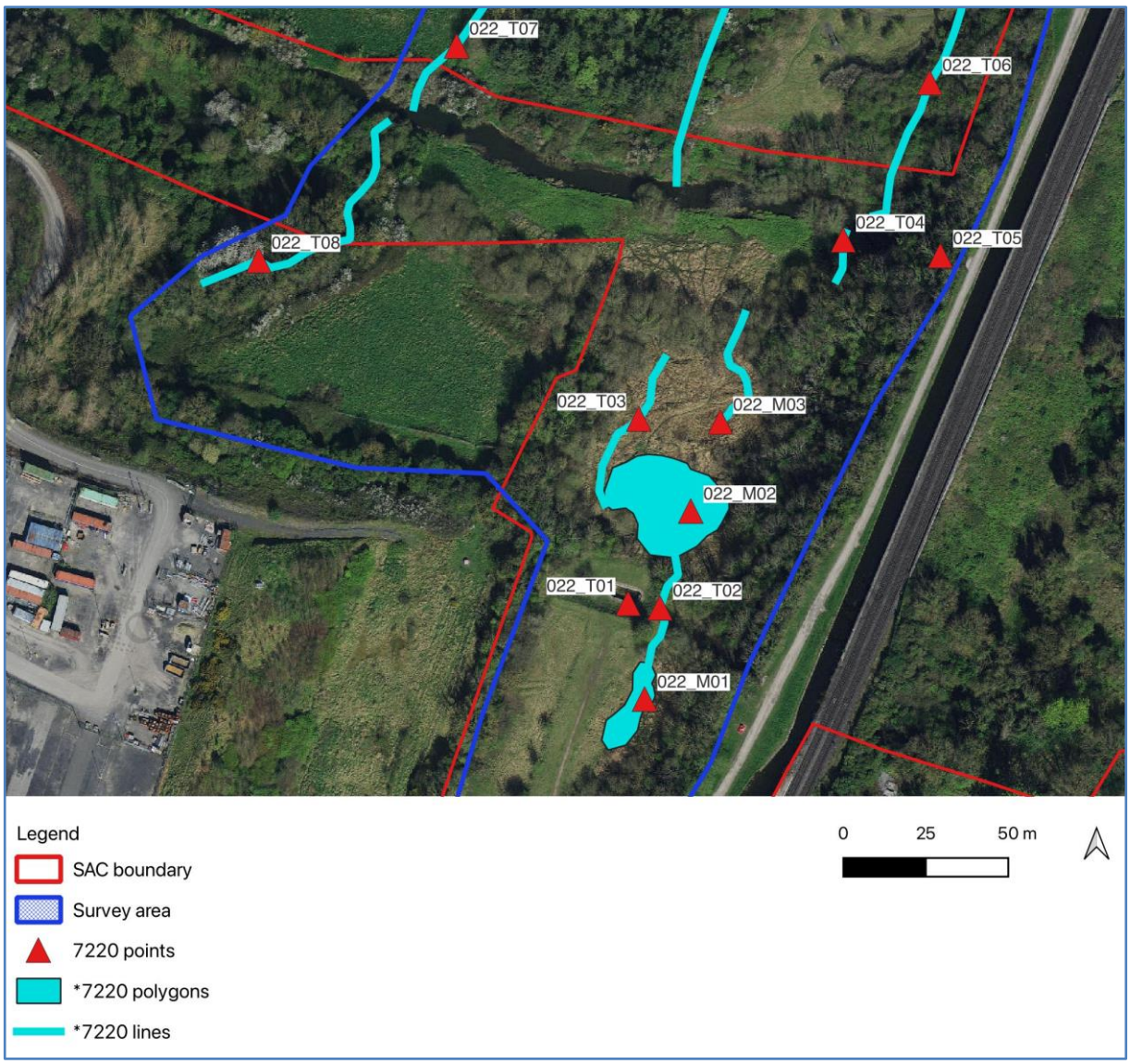


Figure 1b Rye Water Valley/ Carton SAC survey area (Louisa Bridge south), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

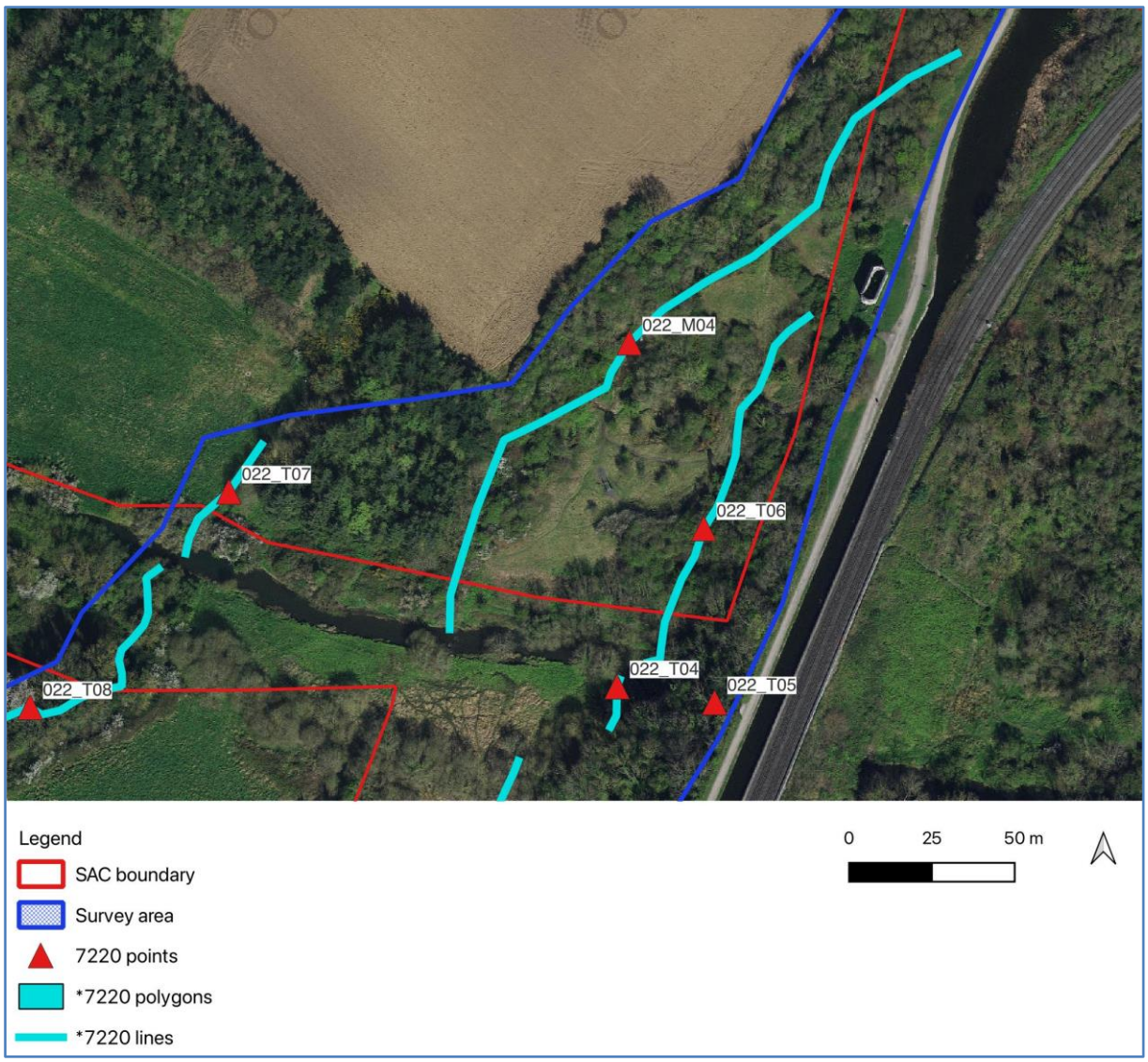


Figure 1b Rye Water Valley/ Carton SAC survey area (Louisa Bridge north), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

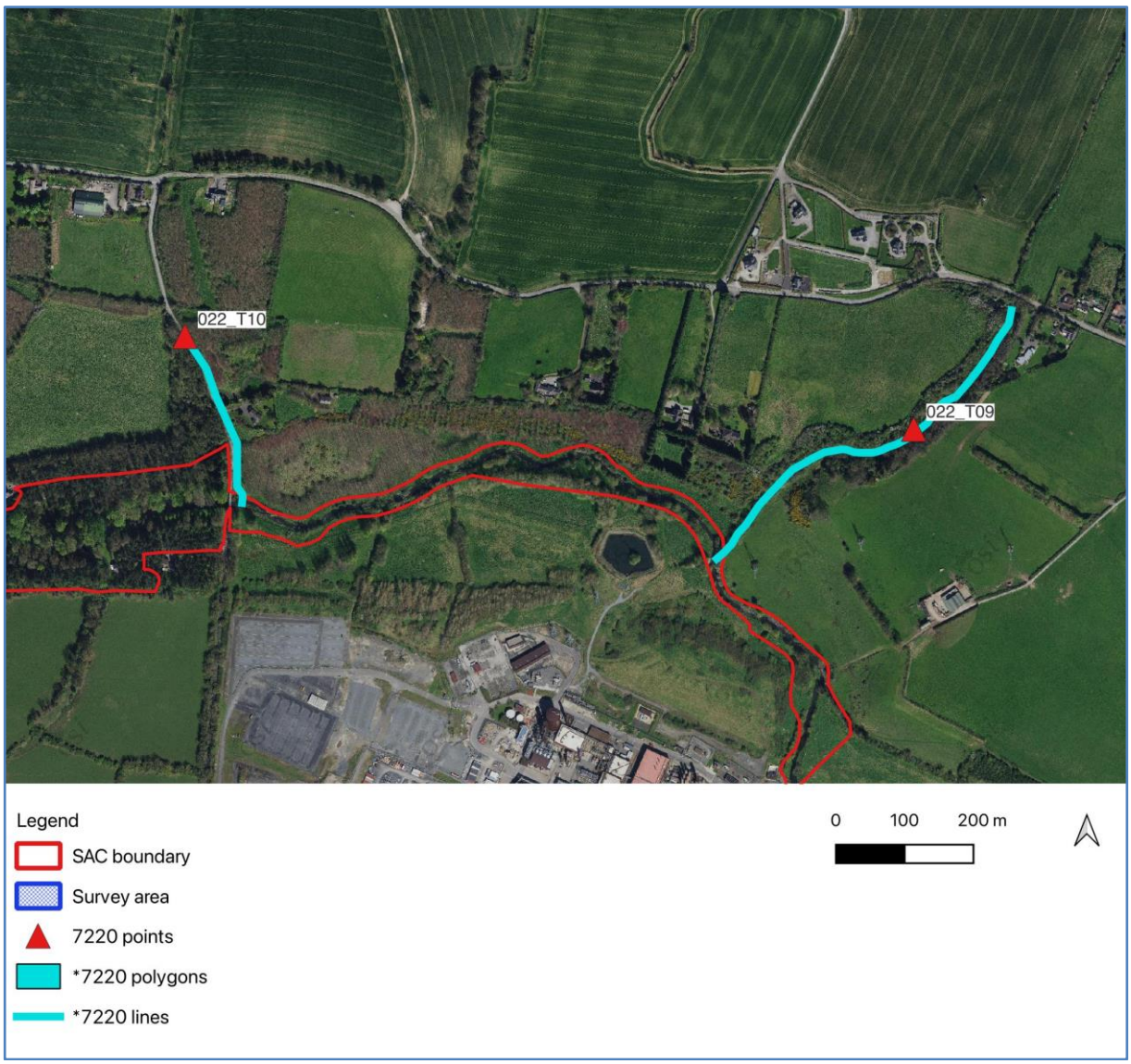


Figure 1b Rye Water Valley/ Carton SAC survey area (west), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Slieve Bloom Mountains SAC

Site details

PTRS23 Site code	PTRS23-023
County	Offaly
Designations	SAC (00412)
Landscape	Upland
Altitude	178 – 180 m

Survey details

Date(s) surveyed	19/10/2023		
Recorder(s)	George Smith		
Area surveyed (ha)	2.08 ha		
Subsites surveyed	Camcor River Valley		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
		3	
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figure 1), as this is the main spring site within the SAC (only one spring outside of this valley within the SAC).		

Site and petrifying spring description

Site description	Very large site with many tufa springs emerging in the lower slopes of the mountains. The typical spring situation is along moderate to steep slopes of river valleys where streams have cut through limestone till. The Camcor River Valley subsite includes two spring locations with tufa cascades forming on slopes over the floodplain terrace of the Camcor River, as well as a more extensive area of tufa cascade in the steep, narrow glen of a tributary stream (Glinsk Grove).			
Site management	The Glinsk Grove subsite is unmanaged. The Camcor River Valley subsite was formerly a conifer plantation, which has been clearfelled to allow natural regeneration of wet alluvial forest, which is now just past the thicket stage. This subsite has been deer fenced, but a few animals are able to get in and lightly graze the site.			
Petrifying spring type(s)	Springhead			
Petrifying Spring vegetation communities	Group 2 *Palustriella commutata-Geranium robertianum* springheads			
Main tufa type(s)	Cascade			
No. *7220 springs mapped	3 (4 mapped for whole SAC but many more mapped outside of the SAC)			
Area of *7220 (m^2)	0.043 ha			
National ranking	Moderate			
Species of note	n/a			
Water sample data	EC µS/cm	476 – 798	pH	7.02 – 7.45
	Nitrate mg/l	0 – 5 mg/l	Phosphate mg/l	0 – 2 mg/l
Other Annex habitats	*91E0			
Other Fossitt habitats	WD1; WN6			

Structure and functions

No. monitoring plots	3
% pass rate	33 %
Main criteria for failing S&F	Positive indicator species; negative bryophyte; nitrate; phosphate

Impacts

Impact code	Description	Timing	Scope	Influence
PA17	Agricultural activities generating pollution to surface or ground waters (including marine)	Ongoing & future	<50%	Medium
PB09	Clear-cutting, removal of all trees	Past	50-90%	Medium
PI03	Problematic native species	Ongoing & future	50-90%	Low
PI02	Other invasive alien species (other than species of Union concern)	Ongoing & future	<50%	Medium

Change from baseline

Plot M01 had 95% cascade tufa cover in 2012 but only 10% cascade tufa in 2023 and a reduction in positive indicator species from 4 to 1. This area is subject to frequent landslides which may have impacted tufa cover and species. There is also dense shading by *Fagus sylvatica*. Plot M01 failed phosphate level in both surveys. Plot M02 also had reduced tufa cover and positive indicator species from the baseline (2013). This plot was recovering from disturbance due to felling of conifers. The site is recovering to native alluvial forest which will have a long-term positive impact on the springs. Plot M03 had an increased number of positive indicator species compared to the baseline (2013). Plots M02 and M03 failed on phosphates in 2013 but this was not high enough level to be detected by the field kit in 2023. Nitrates were elevated in both surveys.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate

Conservation measures

Conservation measure code	Description
MI03	Management, control or eradication of other invasive alien species
MA10	Reduce/eliminate point or diffuse source pollution to surface or ground waters (including marine) from agricultural activities

Recommendations

Site management	Removal/ thinning of dense *Fagus sylvatica* in Glinsk Grove
Survey	No further survey required of SAC in short-term but additional spring sites in Slieve Bloom Mountains (outside of SAC) should have monitoring undertaken as many have not been surveyed since 2012-2013.
Hydrogeology	Investigate source of elevated phosphates and nitrates

Photograph 1 Wooded petrifying spring with cascade tufa in Glinsk Grove. Photograph George Smith.

Photograph 2 Wooded petrifying spring Camcor River Valley in area recently cleared of conifers. Photograph George Smith.

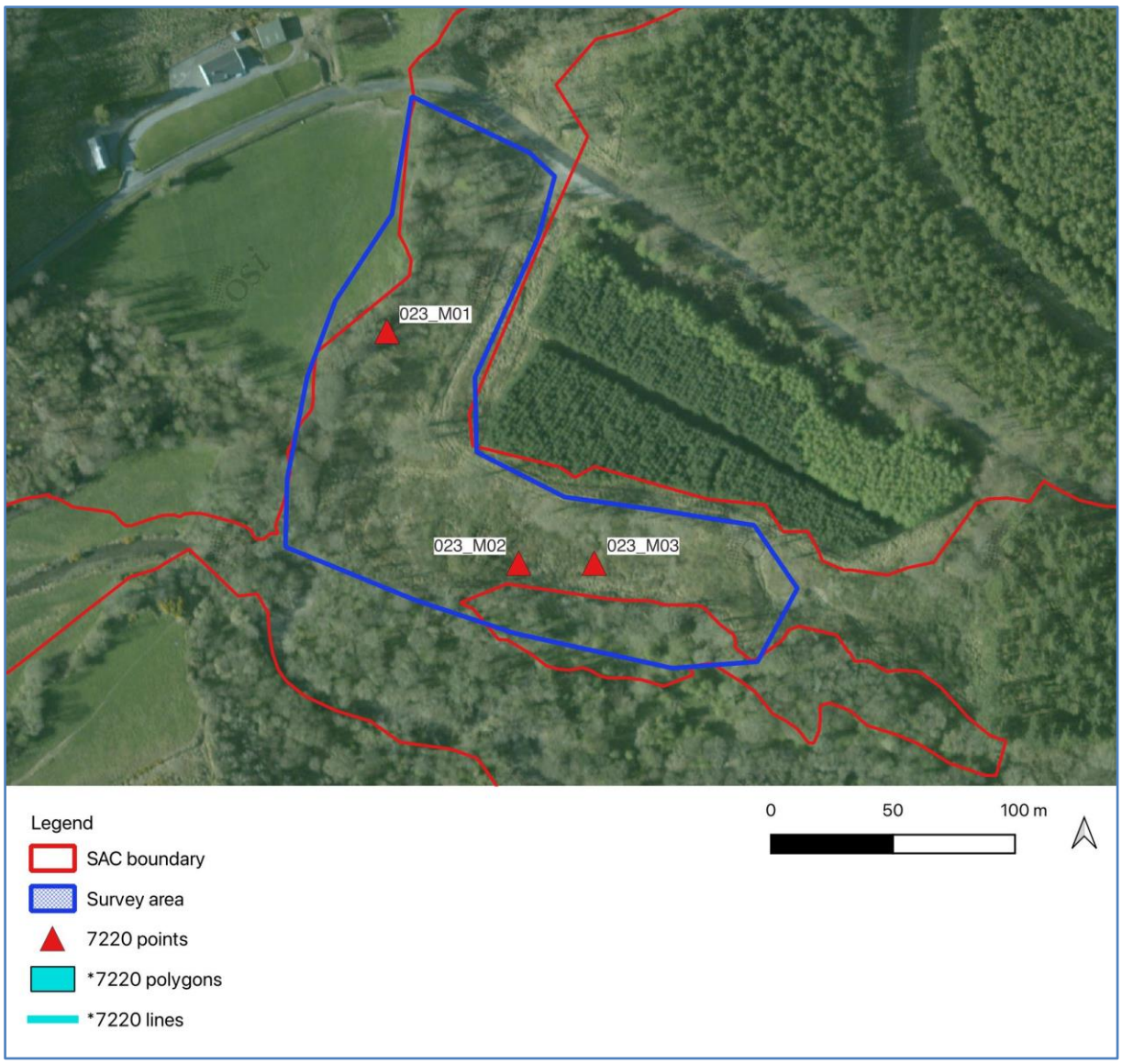


Figure 1 Slieve Bloom Mountains SAC survey area, petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Thomastown Quarry SAC

Site details

PTRS23 Site code	PTRS23-024
County	Kilkenny
Designations	SAC (002252)
Landscape	Lowland inactive quarry
Altitude	47 – 50 m

Survey details

Date(s) surveyed	20/10/2023		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	4.23 ha		
Subsites surveyed	n/a		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1	3	1
Water chemistry sampling	Field sampling		
Survey limitations	Northern part of SAC surveyed (Figure 1), as known springs in this location		

Site and petrifying spring description

Site description	Disused quarry with marl lined pools, tufa forming fen and springheads in scrub. Some of the springs are highly species rich. Scrub is developing around the wetland areas.			
Site management	None recorded			
Petrifying spring type(s)	Springhead; flush			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades Group 2 *Palustriella commutata-Geranium robertianum* springheads Group 7 *Palustriella falcata-Carex panicea* springs			
Main tufa type(s)	Cascade; paludal			
No. *7220 springs mapped	5			
Area of *7220 (m^2)	0.080 ha			
National ranking	High			
Species of note	*Chara hispida, Gymnostomum calcareum*			
Water sample data	EC µS/cm	575 - 820	pH	7.19 – 7.93
	Nitrate mg/l	0 – 1 mg/l	Phosphate mg/l	Not detectable
Other Annex habitats	GS1; PF1; WS1			
Other Fossitt habitats	6210; 7230			

Structure and functions

No. monitoring plots	5
% pass rate	100 %
Main criteria for failing S&F	One plot (P01) failed on positive indicator species but was heavily shaded and no obvious impacts so passed the condition assessment; one plot (Sh03) had adjacent *Cotoneaster* sp. but was not currently impacting the spring.

Impacts

Impact code	Description	Timing	Scope	Influence
PI02	Other invasive alien species (other than species of Union concern)	Ongoing & future	<50%	Low
PM07	Natural processes without direct or indirect influence from human activities or climate change	Ongoing & future	<50%	Low

Change from baseline

Three plots have baseline data (M02, M04, M05) and these all had an increase in positive indicator species from the baseline plots (2013). The baseline plots were undertaken in May and the current survey in October, so it may be that more species were able to be identified in the later survey. Tufa cover was similar between the survey periods for M02 and M04 but lower in M05. There does not seem to be an obvious difference between the years in photo comparison but water levels were high in 2023 and may have influenced detection of paludal tufa formation.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
MI03	Management, control or eradication of other invasive alien species

Recommendations

Site management	Removal of invasive species; consider management of scrub at wetland edges to prevent invasion into fen/ spring areas and to maintain survey access through site
Survey	Survey of remaining quarry area in south to check no additional petrifying springs in this area
Hydrogeology	None

Photograph 1 Species-rich petrifying spring vegetation in north of quarry with pool formation and soft paludal tufa. Photograph Joanne Denyer.

Photograph 2 Species-rich petrifying spring vegetation middle section of quarry in transition mire/ alkaline fen with standing water. Photograph Joanne Denyer.

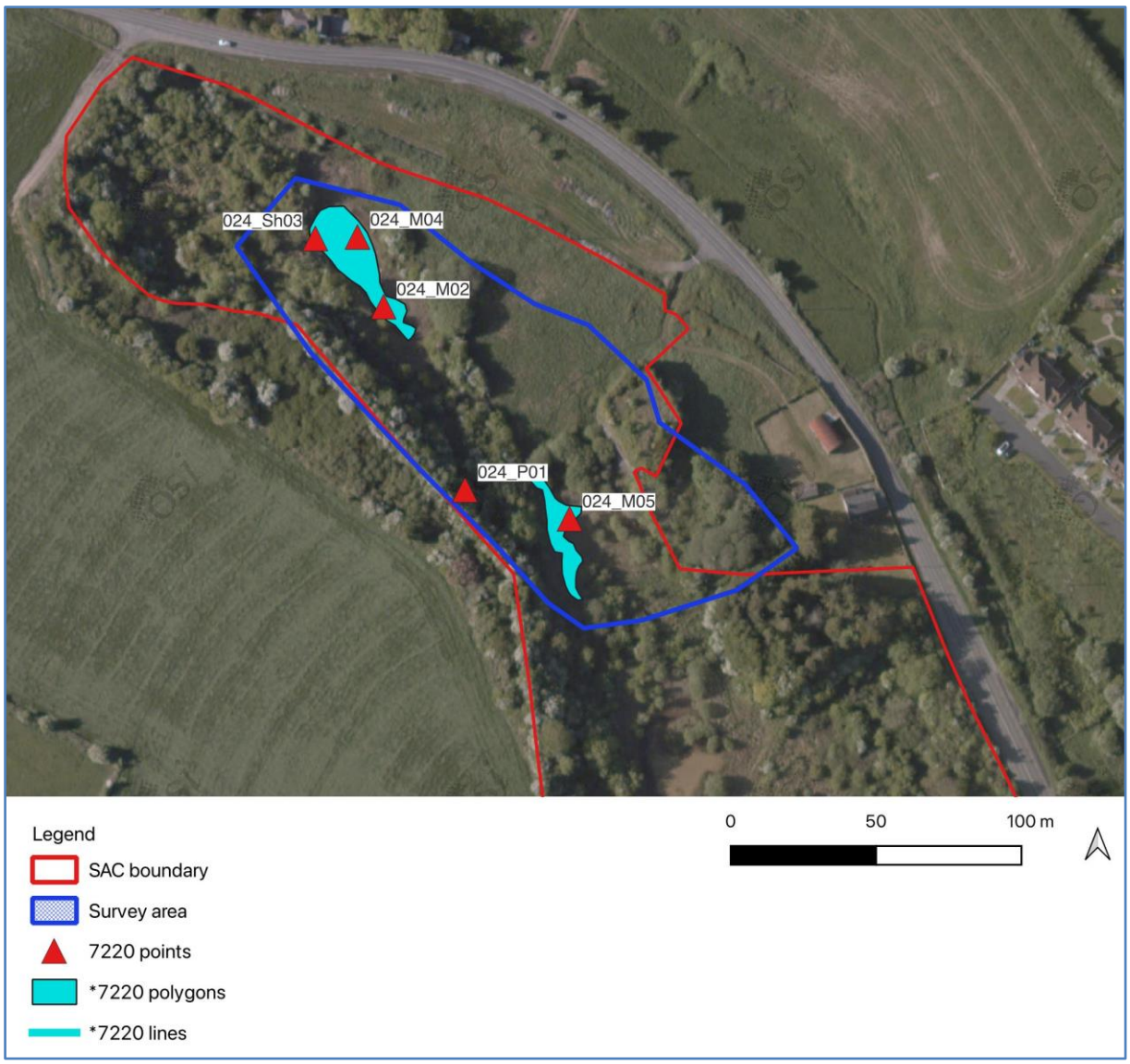


Figure 1 Thomastown Quarry SAC survey area, petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Beltany Mountain

Site details

PTRS23 Site code	PTRS23-025
County	Donegal
Designations	n/a
Landscape	Upland
Altitude	183 – 187 m

Survey details

Date(s) surveyed	03/10/2023		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	4.91 ha		
Subsites surveyed	n/a		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	2		
Water chemistry sampling	Field sampling		
Survey limitations	None (survey area shown on Figure 1)		

Site and petrifying spring description

Site description	Two areas of petrifying springs along faultine between granite and calcareous rocks. Southern spring is within a few metres of the boundary with Cloghernagore Bog and Glenveagh National Park SAC. Species rich sedge dominated springs with paludal tufa, one grades into transition mire (7140) in lower parts.			
Site management	Sheep grazing			
Petrifying spring type(s)	Springhead			
Petrifying Spring vegetation communities	Group 5 *Schoenus nigricans* Springs			
Main tufa type(s)	Cascade; paludal			
No. *7220 springs mapped	2			
Area of *7220 (m^2)	0.013 ha			
National ranking	Very high			
Species of note	n/a			
Water sample data	EC µS/cm	365 – 408	pH	7.53 – 8.11
	Nitrate mg/l	Not detectable	Phosphate mg/l	Not detectable
Other Annex habitats	GS3; GS4; PF3			
Other Fossitt habitats	4010; 7140			

Structure and functions

No. monitoring plots	2
% pass rate	100 %
Main criteria for failing S&F	Cotoneaster on slope above spring, but not in spring habitat.

Impacts

Impact code	Description	Timing	Scope	Influence
PI02	Other invasive alien species (other than species of Union concern)	Ongoing & future	<50%	Low

Change from baseline

No baseline data available

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
n/a	

Recommendations

Site management	No change to current low levels of sheep grazing
Survey	No further survey required in short-term
Hydrogeology	None

Photograph 1 Species-rich petrifying spring/ flush in north of site at base of rocky slope. Photograph Joanne Denyer.

Photograph 2 Species-rich petrifying spring/ flush in south of site, grading into transition mire. Photograph Joanne Denyer.

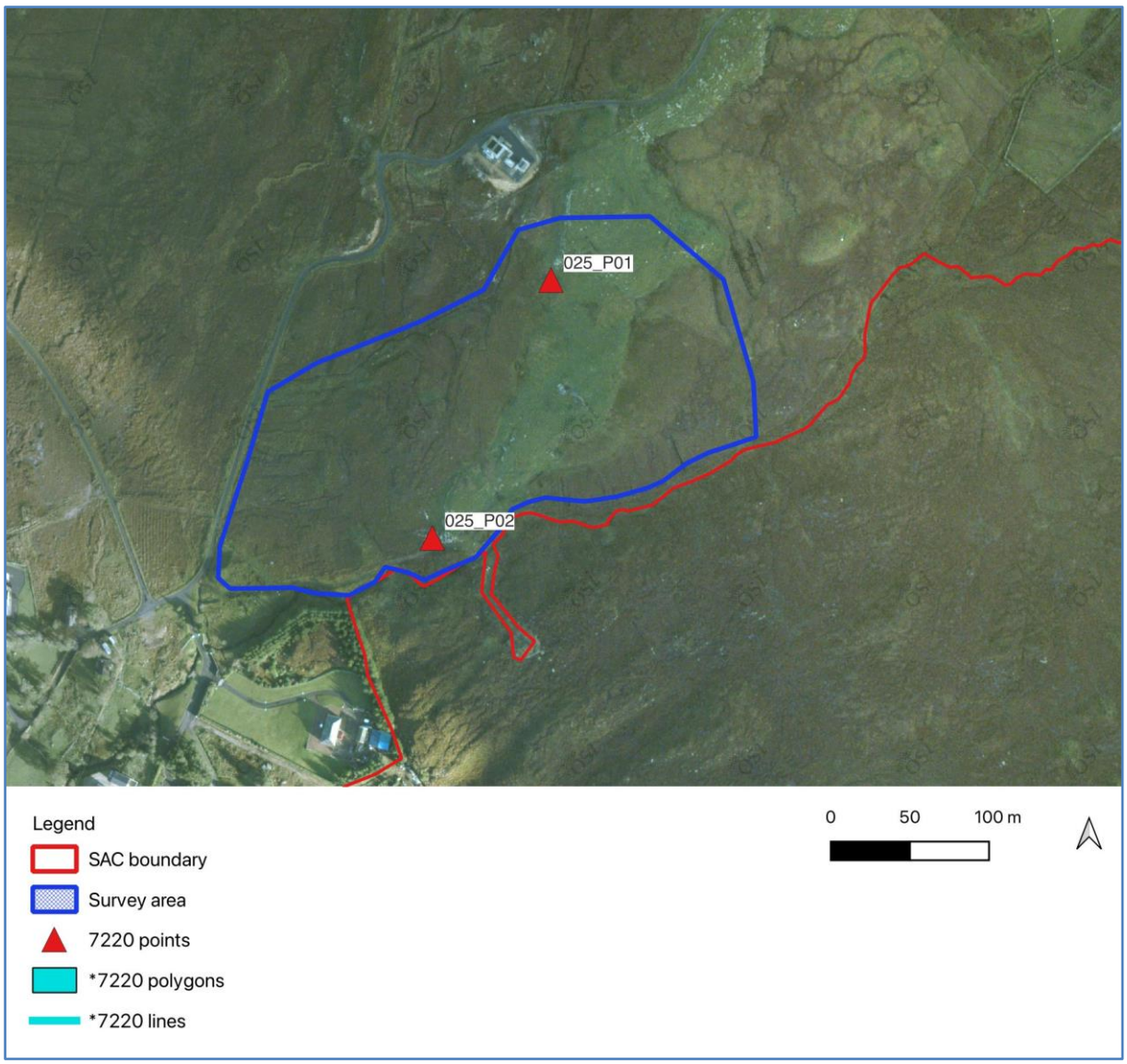


Figure 1 Beltany Mountain survey area, petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Hook Head SAC

Site details

PTRS23 Site code	PTRS23-026
County	Wexford
Designations	SAC (000764)
Landscape	Coastal
Altitude	2 – 32 m

Survey details

Date(s) surveyed	26/10/2023		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	2.39 ha		
Subsites surveyed	Baginbun Beach West; Sandeel Beach; Rock Well; Duncannon		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	2		5
Water chemistry sampling	Field sampling		
Survey limitations	All known petrifying spring sites within SAC surveyed (Figures 1a – 1d).		

Site and petrifying spring description

Site description	Several areas of petrifying springs and seepage over coastal rocks around the peninsula within the SAC. Massive cascade tufa in some areas. One spring site associated with an old holy well. Likely to be further springs around the coastline in this area.			
Site management	None recorded			
Petrifying spring type(s)	Springhead; seepage			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades			
Main tufa type(s)	Cascade			
No. *7220 springs mapped	14			
Area of *7220 (m^2)	0.023 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	756 - 3299	pH	7.7 – 8.18
	Nitrate mg/l	0 – 5 mg/l	Phosphate mg/l	0 – 0.05 mg/l
Other Annex habitats	1230			
Other Fossitt habitats	BC; BL1; CS1; CS3; LR; LS			

Structure and functions

No. monitoring plots	7
% pass rate	71%
Main criteria for failing S&F	Positive indicator species; nitrate; phosphate

Impacts

Impact code	Description	Timing	Scope	Influence
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	<50%	Medium
PL03	Old barriers or other obsolete infrastructures	Past	<50%	Low
PM05	Avalanches, landslides and collapse of terrain	Ongoing & future	<50%	Low

Change from baseline

No baseline data available

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate

Conservation measures

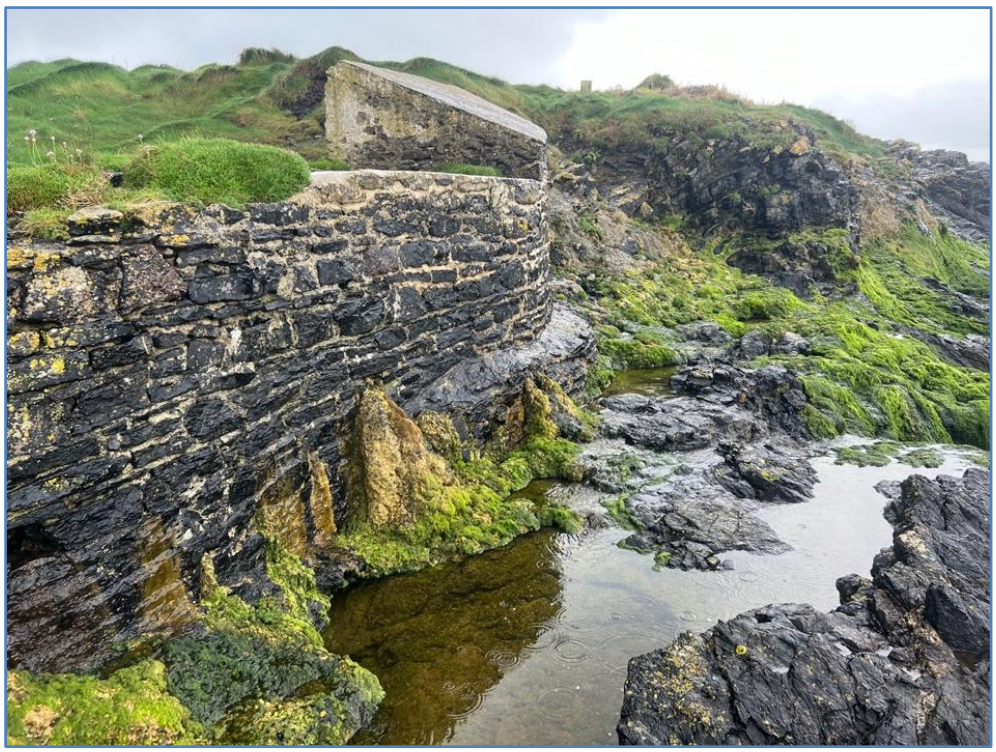
Conservation measure code	Description
MK01	Reduce impact of mixed source pollution

Recommendations

Site management	Ensure that petrifying springs around Rock Well are protected from any restoration works to the old well
Survey	No further survey required in short-term
Hydrogeology	Investigate source of elevated phosphates and nitrates

Photograph 1 Coastal petrifying spring seepage with cascade tufa at Baginbun Beach West. Photograph Joanne Denyer.

Photograph 2 Coastal petrifying spring seepage with cascade tufa and cushions of *Didymodon tophaceus* and *Eucladium verticillatum* at Sandeel Beach. Photograph Joanne Denyer.



Photograph 3 Coastal petrifying spring seepages with cascade tufa formed around old Holy Well at Rock Well, Churchtown. Photograph Joanne Denyer.

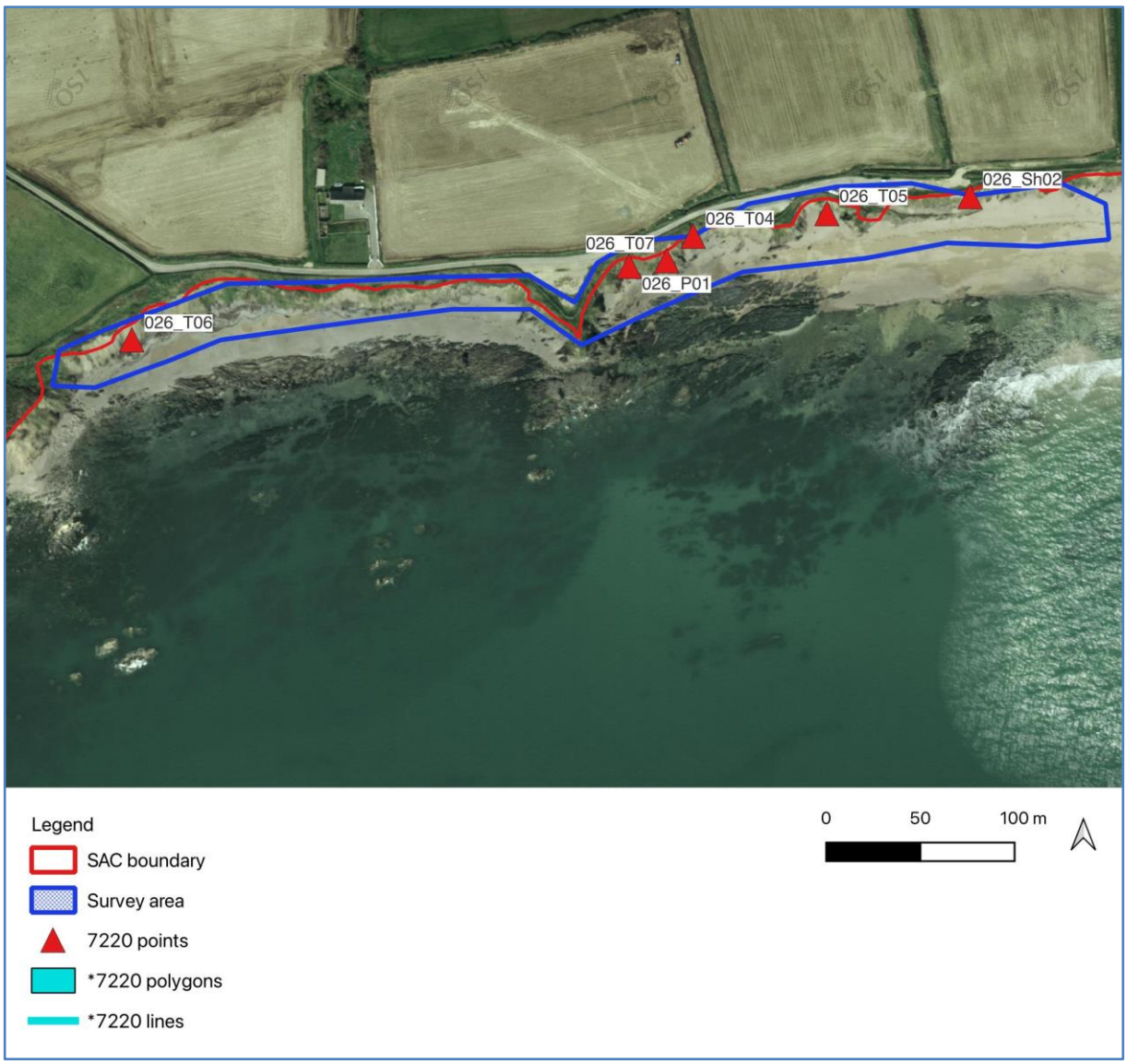


Figure 1a Hook Head SAC survey area (Baginbun Beach West), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Figure 1b Hook Head SAC survey area (Sandeel Beach), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Figure 1c Hook Head SAC survey area (Rock Well), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Figure 1d Hook Head SAC survey area (Duncannon), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Arroo Mountain SAC

Site details

PTRS23 Site code	PTRS23-027
County	Leitrim
Designations	SAC (001403)
Landscape	Upland
Altitude	188-288m

Survey details

Date(s) surveyed	03/07/2024		
Recorder(s)	Joanne Denyer & Eliška Vicherová		
Area surveyed	14.9 ha		
Subsites surveyed	North face and lower slopes on northern side		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	3	3	3
Water chemistry sampling	Field sampling only		
Survey limitations	Only part of SAC surveyed (Figures 1a & 1b), as it is an extensive upland site.		

Site and petrifying spring description

Site description	Surveyed area has highly species-rich petrifying spring springheads and flushes with *Saxifraga aizoides* and rare bryophyte species on the steep upper slopes and cliffs. The lower wet grassland slopes have frequent large species-rich flushes with abundant paludal tufa. A wooded ravine on lower slopes had several small examples of petrifying springs on the riverbanks, with cascade and paludal tufa. Many new areas were mapped and there is likely to be additional petrifying springs outside of the survey area. This is one of only three petrifying spring sites in Ireland with 'Outstanding' national ranking.			
Site management	Low level sheep grazing is maintaining high species-rich vegetation. *Saxifraga aizoides* was frequent and in flower on the upper slopes suggesting that grazing levels are not too high on the upper cliffs to support species-rich spring vegetation. There were no signs of livestock trampling within the petrifying springs.			
Petrifying spring type(s)	Springhead; flush; seepage			
Petrifying Spring vegetation communities	Group 2 *Palustriella commutata-Geranium robertianum* Springheads Group 4 *Palustriella commutata-Agrostis stolonifera* Springheads Group 7 *Palustriella falcata-Carex panicea* Springs Group 8 *Saxifraga aizoides-Seligeria oelandica* Springs			
Main tufa type(s)	Cascade; paludal; stream crust.			
No. *7220 springs mapped	11			
Area of *7220	0.15 ha			
National ranking	Outstanding			
Species of note	*Seligeria oelandica, Saxifraga aizoides*			
Water sample data	EC µS/cm	419-514	pH	7.52-8.23
	Nitrate mg/l	Not detectable	Phosphate mg/l	Not detectable
Other Annex habitats	8120; 8210			
Other Fossitt habitats?	GS4; ER2; WN2			

Structure and functions

No. monitoring plots	9
% pass rate	100 %
Main criteria for failing S&F	n/a

Impacts

Impact code	Description	Timing	Scope	Influence
PA08	Extensive grazing or undergrazing by livestock	Ongoing & future	50-90%	Low

Change from baseline

There has been an increase in area from the baseline (2013) – this is because a larger area was surveyed in 2024, and new spring sites were mapped. There was no reduction in area in the springs M05, M07 and M08 which have baseline data. The baseline data for M05 recorded 100% cascade tufa and in 2025 this was mapped as 100% paludal tufa – this is due to a difference in classification and does not represent a change in tufa formation. The number of positive indicator species in all three plots was higher in 2025 and may be due to difference in grazing pressure (possibly reduced) as both were surveyed in early July.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
n/a	n/a

Recommendations

Site management	No change to current low levels of sheep grazing
Survey	Survey of remaining area of SAC that was not surveyed in 2024
Hydrogeology	None

Photograph 1 North face of Arroo (view to south from lower slopes) with species-rich petrifying spring (flush) in foreground. Photograph Joanne Denyer.

Photograph 2 Species-rich petrifying spring on upper slopes of Arroo, with stream crust tufa and the rare bryophyte *Seligeria oelandica* (very small black moss). Photograph Joanne Denyer.

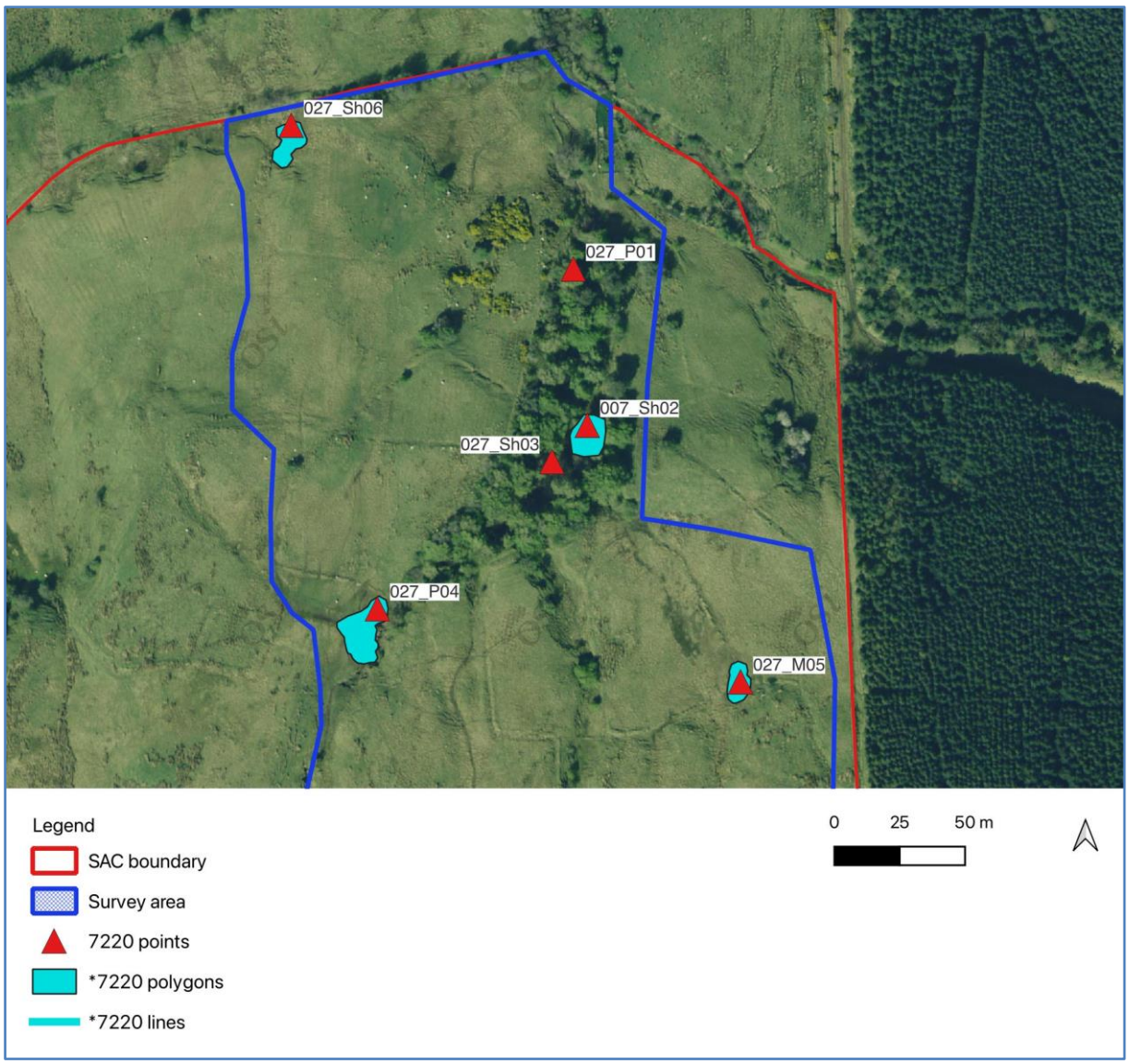


Figure 1a Arroo Mountain SAC survey area (north), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

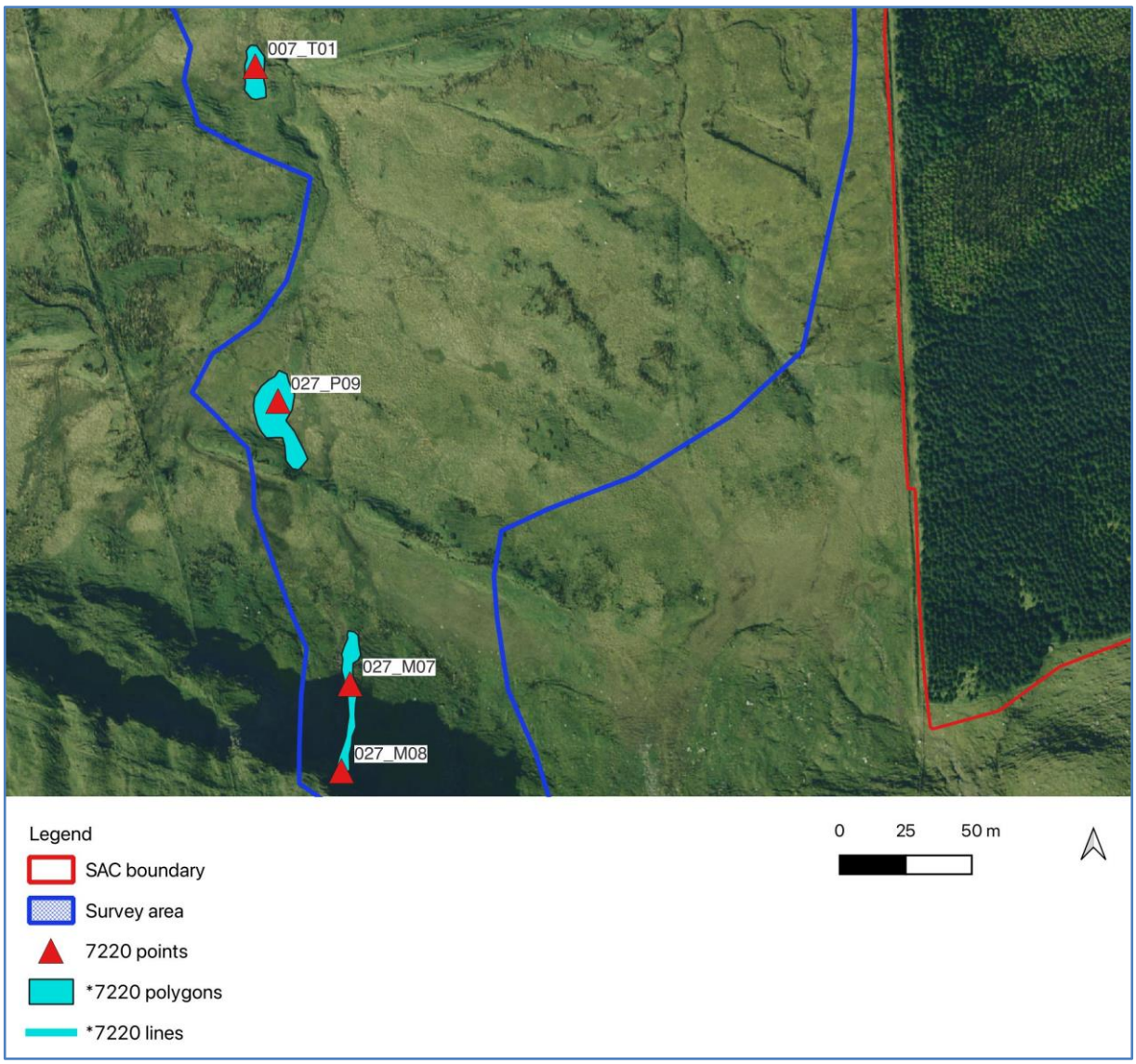


Figure 1b Arroo Mountain SAC survey area (south), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Carrowmore Point to Spanish Point and Islands SAC

Site details

PTRS23 Site code	PTRS23-028
County	Clare
Designations	SAC (001021)
Landscape	Coastal
Altitude	3 – 7 m

Survey details

Date(s) surveyed	15/05/2024		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	4.44 ha		
Subsites surveyed	Spanish Point		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1	2	4
Water chemistry sampling	Field sampling		
Survey limitations	All known petrifying springs surveyed (Figures 1a & 1b).		

Site and petrifying spring description

Site description	In the southern part of the site there are areas of cascade tufa forming on the vertical cliffs. These grade into each other to form seepage zones. In the northern part of the site there are rocky shelves on the shoreline over which petrifying springs flow, forming cascades over the rocks. There is one spring that formerly had an unusual form of 'honeycomb' tufa, but this is now heavily polluted.			
Site management	None recorded			
Petrifying spring type(s)	Seepage			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades			
Main tufa type(s)	Cascade			
No. *7220 springs mapped	11			
Area of *7220 (m^2)	0.069 ha			
National ranking	Very high			
Species of note	n/a			
Water sample data	EC µS/cm	751 - 1058	pH	7.75 – 8.12
	Nitrate mg/l	2 – 5 mg/l	Phosphate mg/l	0 – 2 mg/l
Other Annex habitats	1220			
Other Fossitt habitats	CB1; CS1			

Structure and functions

No. monitoring plots	7
% pass rate	71 %
Main criteria for failing S&F	Negative bryophyte; nitrate; phosphate

Impacts

Impact code	Description	Timing	Scope	Influence
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	50-90%	Medium

Change from baseline

In the middle and southern part of the beach there was either no change (M04) or a large increase (M03) in positive indicator species, and no change in tufa formation, compared to the baseline (2012). In both sampling years, nitrate was elevated. One plot in the northern end of the beach (Sh06) also has baseline data. This was described in having an unusual form of 'honeycomb' tufa in 2012, which was a pale colour. Indicator species cover was low, but two species were present. In the current survey this spring was covered with filamentous algae, the tufa was discoloured and grey and there were no positive indicator species (a plot was not laid out due to the obvious pollution present). Nitrate levels were borderline fail, but phosphate was the highest recorded in the 2023-24 national survey (>2 mg/l). The threshold for high quality is ≤0.015 mg/l phosphate. In the baseline survey both nitrate and phosphate below the condition assessment thresholds.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate

Conservation measures

Conservation measure code	Description
MK01	Reduce impact of mixed source pollution

Recommendations

Site management	No change
Survey	Monitoring of polluted petrifying spring (Sh06) in northern part of site
Hydrogeology	Investigate source of elevated phosphates and nitrates

Photograph 1 Coastal petrifying spring with massive cascade tufa formation, extending onto beach below, southern beach. Photograph Joanne Denyer.

Photograph 2 Highly polluted petrifying spring discharging over coastal rocks at north of beach. Photograph Joanne Denyer.

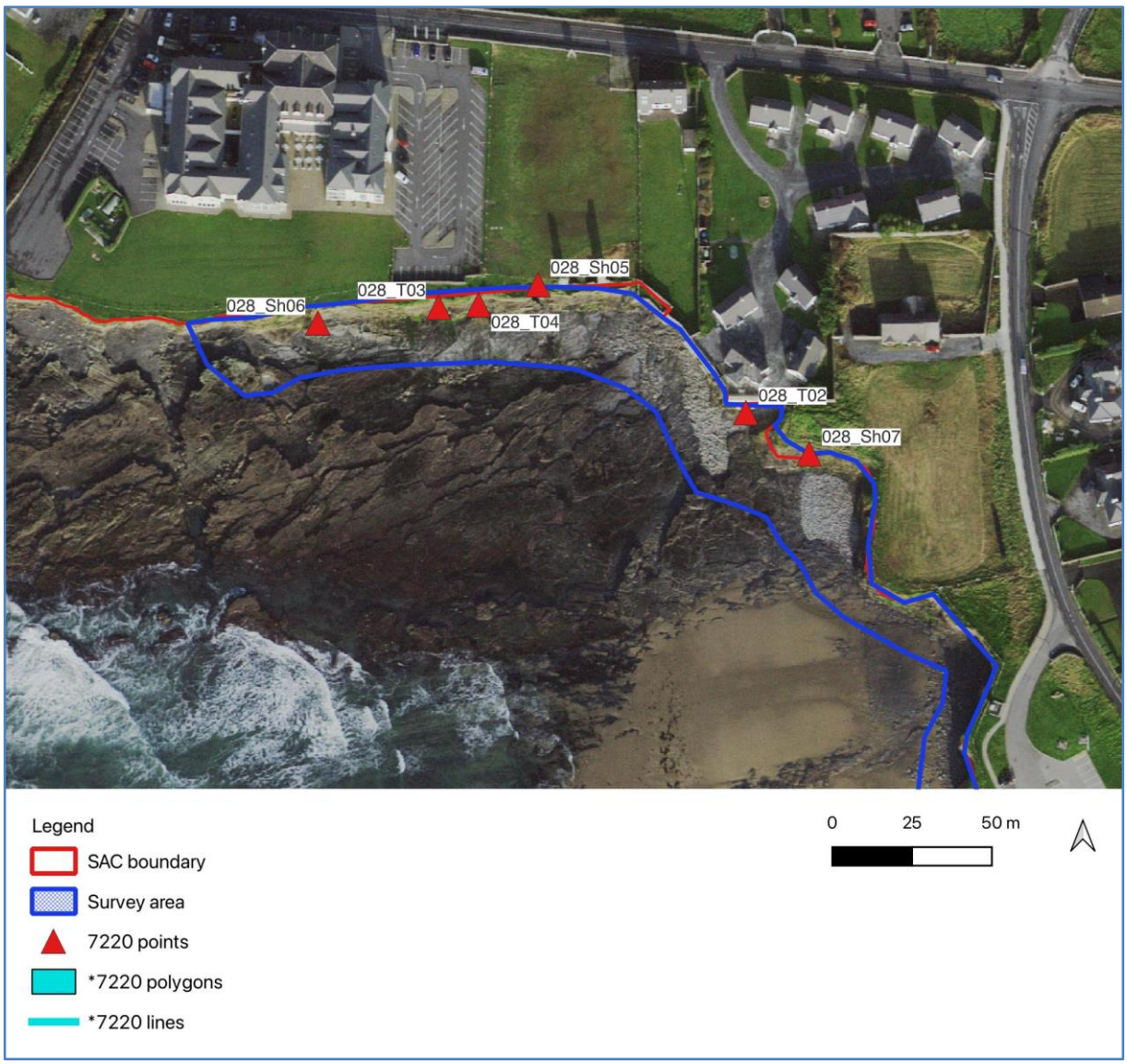


Figure 1a Carrowmore Point to Spanish Point and Islands SAC survey area (north), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Figure 1b Carrowmore Point to Spanish Point and Islands SAC survey area (south), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Clonaslee Eskers and Derry Bog SAC

Site details

PTRS23 Site code	PTRS23-029
County	Laois
Designations	SAC (000859)
Landscape	Lowland esker
Altitude	95 m

Survey details

Date(s) surveyed	13/09/2024		
Recorder(s)	George Smith		
Area surveyed (ha)	4.99 ha		
Subsites surveyed	Clonaslee Eskers (east of site)		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	3	1	
Water chemistry sampling	Insufficient flow for water chemistry testing		
Survey limitations	Only part of SAC surveyed (Figure 1) as this is the only known location for petrifying springs		

Site and petrifying spring description

Site description	The site is a series of seasonal tufa forming flushes at the base of an esker. Dry at the time of survey. Hydrological monitoring is taking place, and baseline plot QL149 has been lost to a pit equipped with a water gauge. One petrifying spring (to the east of new plot P04) could not be relocated and may be completely overgrown now.			
Site management	The site and surrounds have been recently cleared of encroaching woody vegetation. Presently ungrazed.			
Petrifying spring type(s)	Flush; seepage			
Petrifying Spring vegetation communities	Group 5 *Schoenus nigricans* Springs Group 6 *Carex lepidocarpa* Small Sedge Springs			
Main tufa type(s)	Paludal			
No. *7220 springs mapped	4			
Area of *7220 (m^2)	0.036 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	Not determined	pH	Not determined
	Nitrate mg/l	Not determined	Phosphate mg/l	Not determined
Other Annex habitats	7230			
Other Fossitt habitats	GS1; PF1; WS1			

Structure and functions

No. monitoring plots	4
% pass rate	0 %
Main criteria for failing S&F	Negative woody species; vegetation height

Impacts

Impact code	Description	Timing	Scope	Influence
PA05	Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming)	Ongoing & future	50-90%	Medium
PL01	Abstraction from groundwater, surface water or mixed water	Ongoing & future	<50%	High
PL05	Modification of hydrological flow	Ongoing & future	50-90%	Medium

Change from baseline

There was one baseline plot from 2013 but that has been lost, and a new baseline plot was recorded in an adjacent area (P02). This has a similar number of positive indicator species and tufa cover to the original baseline plot.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Unfavourable-Inadequate	Unfavourable-Bad	Unfavourable-Inadequate	Unfavourable-Bad

Conservation measures

Conservation measure code	Description
MA04	Reinstate appropriate agricultural practices to address abandonment, including mowing, grazing, burning or equivalent measures
MK02	Reduce impact of multi-purpose hydrological changes

Recommendations

Site management	Introduce grazing or other management to open vegetation and reduce vegetation height. Ensure that petrifying spring locations are protected from installation of any hydrological monitoring equipment.
Survey	No further survey required in short-term
Hydrogeology	Investigate whether there have been changes in hydrology, as springs dry at time of survey.

Photograph 1 Petrifying spring vegetation at plot P01. Photograph George Smith

Photograph 2 Petrifying spring vegetation at plot P03. Photograph George Smith.

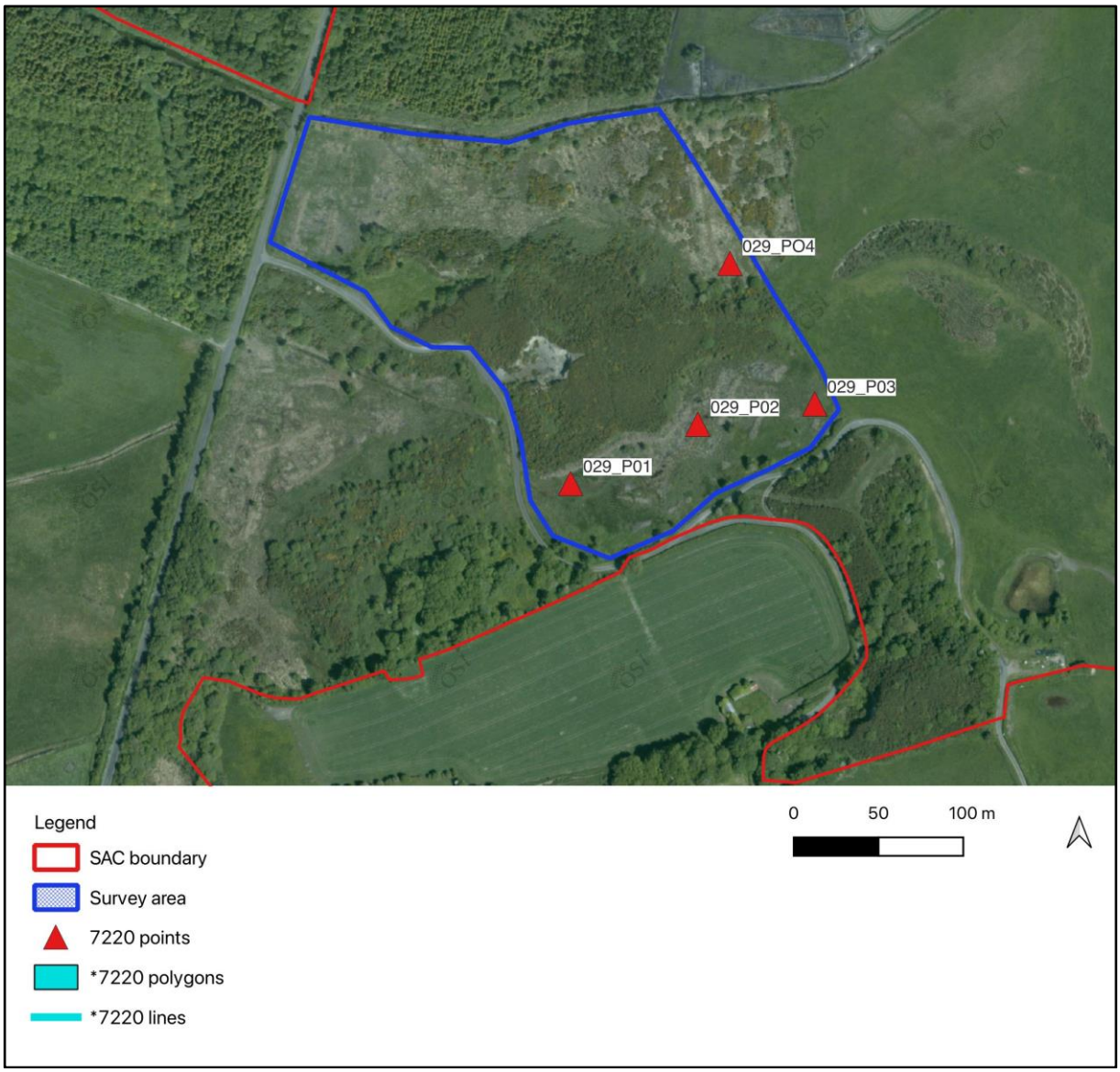


Figure 1 Clonaslee Eskers and Derry Bog SAC survey area, petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Cumeen Strand/Drumcliff Bay (Sligo) SAC

Site details

PTRS23 Site code	PTRS23-030
County	Sligo
Designations	SAC (000637)
Landscape	Coastal
Altitude	6 – 7 m

Survey details

Date(s) surveyed	18/07/2024		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	3.7 ha		
Subsites surveyed	Ballincar; Rosses Point		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1	1	
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figures 1a & 1b) as these are the only known locations for petrifying springs		

Site and petrifying spring description

Site description	Two areas were surveyed: the estuary shoreline at Ballincar and coastal seepages at Rosses Point. At Ballincar the petrifying springs forming tufa cascades in the coastal spray zone on a low bank. Some of the tufa extensive but overgrown with vegetation so not possible to determine how far back from the coastline they extend. At Rosses Point there are tufa deposits on coastal spray zone rocks. Some of these have large cascade tufa formations and the zone can be seen from a distance as the freshwater supports pale green filamentous algae.			
Site management	None recorded			
Petrifying spring type(s)	Seepage			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades			
Main tufa type(s)	Cascade			
No. *7220 springs mapped	2			
Area of *7220 (m^2)	0.012 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	652 - 755	pH	7.09 – 8.08
	Nitrate mg/l	0 – 5 mg/l	Phosphate mg/l	Not detectable
Other Annex habitats	1130			
Other Fossitt habitats	CB1			

Structure and functions

No. monitoring plots	2
% pass rate	50 %
Main criteria for failing S&F	Negative bryophyte; nitrate; impact to water flow

Impacts

Impact code	Description	Timing	Scope	Influence
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	50-90%	Low

Change from baseline

Baseline plot data (2012) only available for plot M01. This had one less positive indicator species than the baseline, but two additional positive indicator species were recorded adjacent to the plot. Nitrate levels were elevated (both in the baseline and 2024 survey), but otherwise the plot was considered in good condition. However, a comparison with photographs from 2012 shows that this spring has become overgrown with a reduction in the cover of positive indicator species and there is some dry tufa compared to the baseline. So, there is a reduction in condition, although it still passes the assessment. There was no baseline plot data for P02, but it was recorded in 2010 as being 'Unfavourable-inadequate'.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Unfavourable-Bad	Unfavourable-Inadequate	Unfavourable-Bad

Conservation measures

Conservation measure code	Description
MK01	Reduce impact of mixed source pollution
MK02	Reduce impact of multi-purpose hydrological changes

Recommendations

Site management	Protect Ballincar shoreline from disturbance and development
Survey	Survey of remaining shoreline east of Ballincar (requires low tide) to may any additional petrifying springs
Hydrogeology	Investigate source of elevated nitrates in both springs and possible impact to water flow at Ballincar.

Photograph 1 Cascade tufa along shore at Ballincar with dry (white) inactive tufa. Photograph Joanne Denyer.

Photograph 2 Cascade tufa on coastal slopes at Rosses Point. Photograph Joanne Denyer.

Figure 1a Cumeen Strand/Drumcliff Bay (Sligo) SAC survey area (Ballincar), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

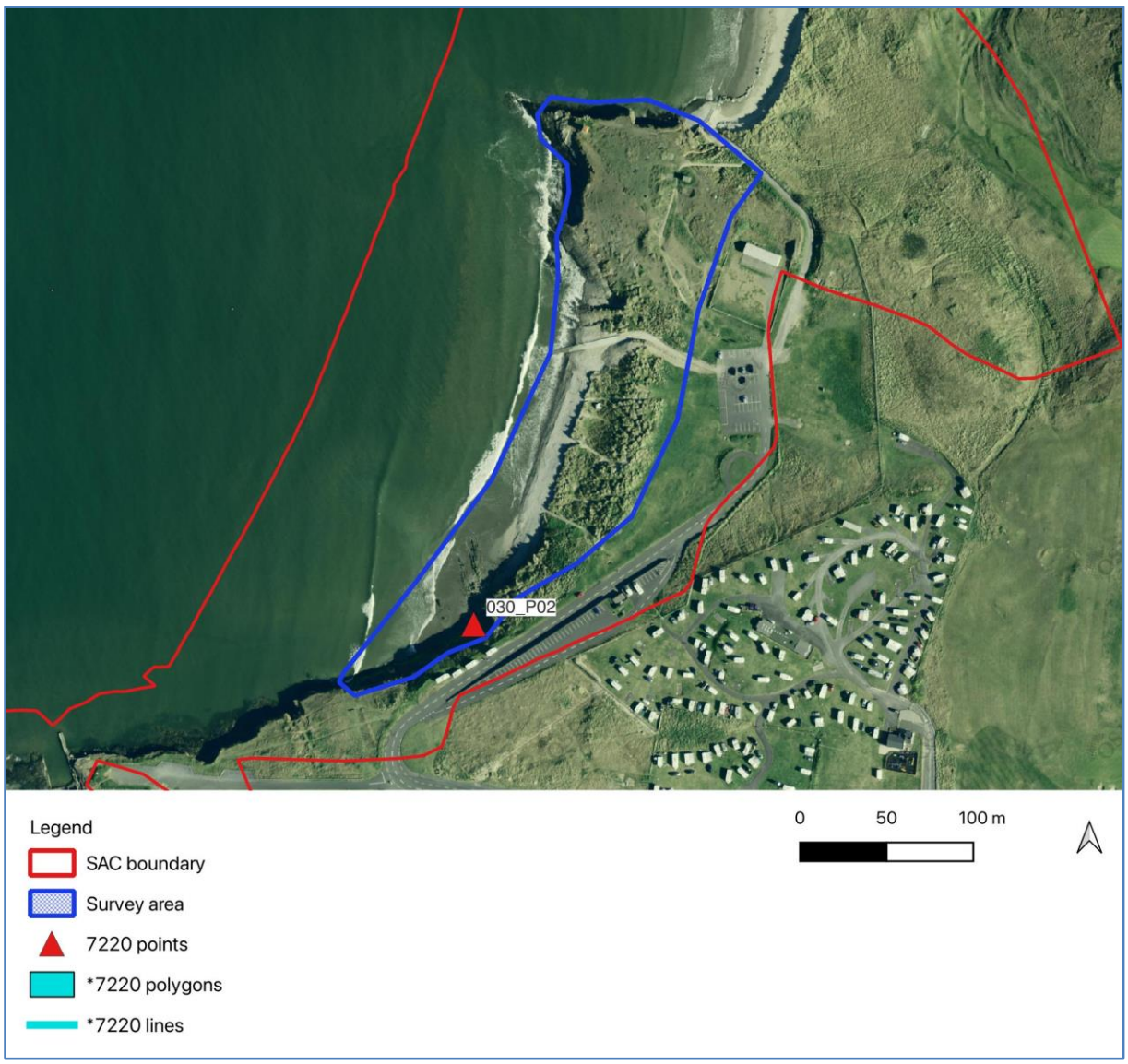


Figure 1b Cumeen Strand/Drumcliff Bay (Sligo) SAC survey area (Rosses Point), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Fin Lough (Offaly) SAC

Site details

PTRS23 Site code	PTRS23-031
County	Offaly
Designations	SAC (000576)
Landscape	Lowland esker/ fen
Altitude	38 m

Survey details

Date(s) surveyed	09/09/2024		
Recorder(s)	George Smith		
Area surveyed (ha)	3.73 ha		
Subsites surveyed	North-east of site, base of esker		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	2		
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figure 1), as it is an extensive wetland		

Site and petrifying spring description

Site description	Sporadic seepages zone at base of esker where it meets alkaline fen. They include shallow seeps and permanently wet, tufa-forming flushes. Petrifying spring vegetation species-rich.			
Site management	Partly cattle grazed, part fenced off			
Petrifying spring type(s)	Flush; seepage			
Petrifying Spring vegetation communities	Group 5 *Schoenus nigricans* Springs			
Main tufa type(s)	Paludal			
No. *7220 springs mapped	2			
Area of *7220 (m^2)	0.033 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	1074 - 1076	pH	6.81 – 7.44
	Nitrate mg/l	Not detectable	Phosphate mg/l	Not detectable
Other Annex habitats	7230			
Other Fossitt habitats	FW4; GA1; PF1			

Structure and functions

No. monitoring plots	2
% pass rate	100 %
Main criteria for failing S&F	Phosphate may be slightly elevated (field test kit appeared to colour slightly but water sample not clear). However, no impact on condition of petrifying springs.

Impacts

Impact code	Description	Timing	Scope	Influence
PX04	No pressures or threats	Ongoing & future	>90%	n/a

Change from baseline

Site was visited in 2009 but there were no baseline plots undertaken. Conservation score was 4 (Moderate) in 2009, assessed as 5-6 (High) in 2024.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
n/a	n/a

Recommendations

Site management	No change to current low levels of cattle grazing
Survey	Survey of remaining area of SAC that was not surveyed in 2023, particularly eastern section of esker base.
Hydrogeology	Laboratory testing of water sample to assess if phosphates elevated

Photograph 1 Petrifying spring/ flush vegetation at base of esker. Photograph George Smith.

Photograph 2 Paludal tufa on bryophytes in petrifying spring/ flush. Photograph George Smith.

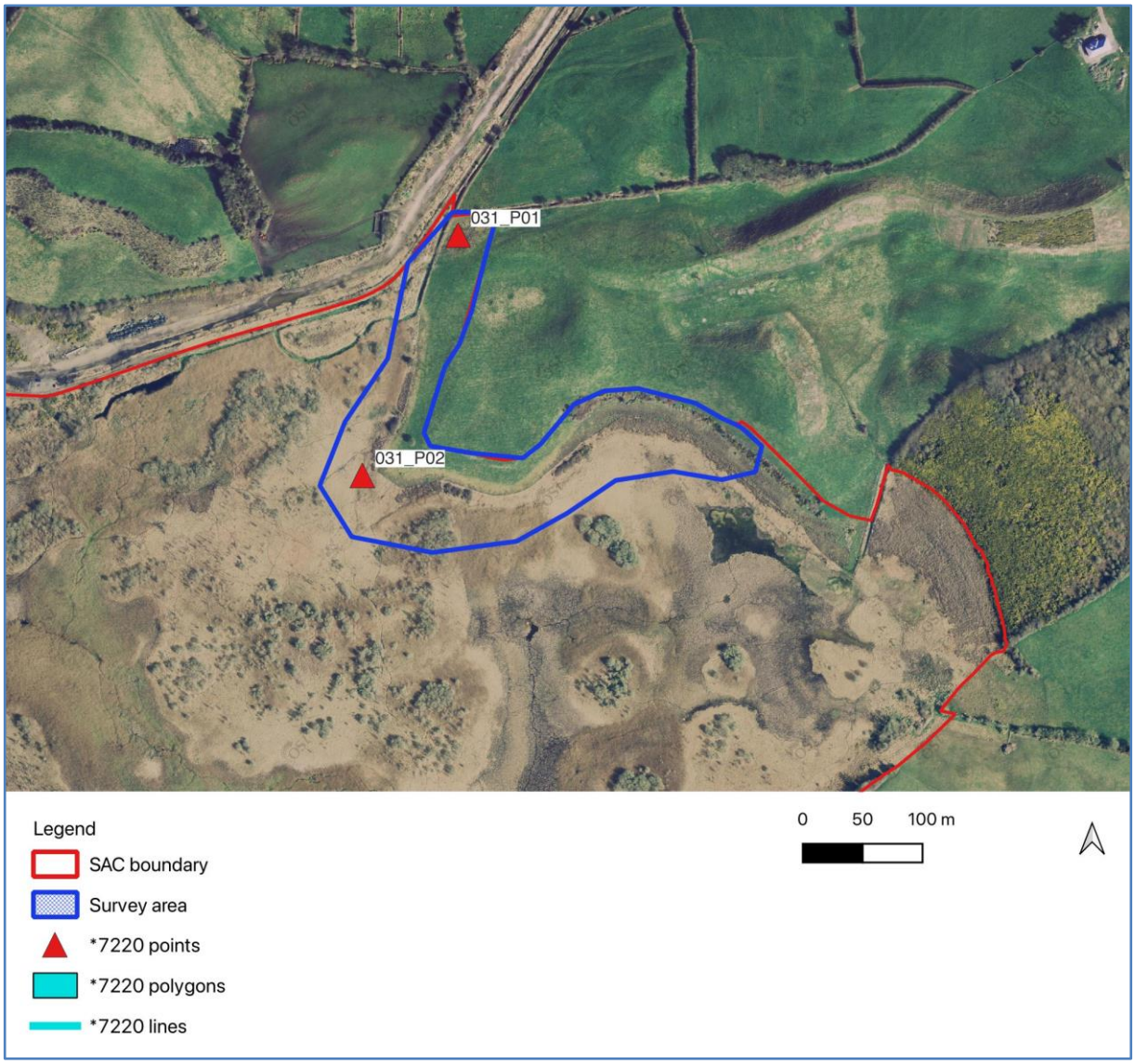


Figure 1 Fin Lough (Offaly) SAC survey area, petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Lisduff Fen SAC

Site details

PTRS23 Site code	PTRS23-032
County	Offaly
Designations	SAC (002147)
Landscape	Lowland fen
Altitude	65 m

Survey details

Date(s) surveyed	14/09/2024		
Recorder(s)	George Smith		
Area surveyed (ha)	3.58 ha		
Subsites surveyed	Southern part of fen		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
		3	
Water chemistry sampling	Field sampling		
Survey limitations	Southern part of SAC surveyed (Figure 1), as known springs in this location. Potential for additional springs in north of SAC.		

Site and petrifying spring description

Site description	Lisduff Fen is an Annex I alkaline fen (7230) with several tufa-forming seepages in hollows and in in historic drainage ditches.			
Site management	Approximately half of the fen where 7220 petrifying springs are located is accessible to cattle grazing, but in practice they spend little or no time grazing the fen, apart from the southern end and the extreme western fringe.			
Petrifying spring type(s)	Seepage			
Petrifying Spring vegetation communities	Group 5 *Schoenus nigricans* Springs			
Main tufa type(s)	Paludal			
No. *7220 springs mapped	3			
Area of *7220 (m^2)	0.004 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	979	pH	7.72
	Nitrate mg/l	2 mg/l	Phosphate mg/l	0.1 mg/l
Other Annex habitats	7230			
Other Fossitt habitats	PF1			

Structure and functions

No. monitoring plots	3
% pass rate	0 %
Main criteria for failing S&F	Positive indicator species; phosphate; water flow; vegetation height

Impacts

Impact code	Description	Timing	Scope	Influence
PA05	Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming)	Ongoing & future	50-90%	Medium
PL05	Modification of hydrological flow	Ongoing & future	50-90%	High
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	50-90%	Medium

Change from baseline

All three plots had a decrease in positive indicator species from the baseline (2013). Paludal tufa cover had decreased in all plots from 75 – 100 % (2013) to 20 – 35 % (2024). A comparison of photographs shows that the vegetation was more open with high paludal tufa cover in 2013. Nitrate was elevated in 2013 in one sample and phosphate was very high in both 2013 and 2023.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Unfavourable-Bad	Unfavourable-Inadequate	Unfavourable-Bad

Conservation measures

Conservation measure code	Description
MA13	Manage agricultural drainage and water abstraction (incl. the restoration of drained or hydrologically altered habitats)
MK01	Reduce impact of mixed source pollution

Recommendations

Site management	Increase of grazing levels/ encourage cattle to seasonally graze spring areas. Block active drains.
Survey	No further survey required in short-term
Hydrogeology	Investigate source of elevated phosphates and restoration (e.g. drain blocking) required to reduce impacts to water flow.

Photograph 1 Overgrown petrifying spring within *Schoenus* alkaline fen. Photograph George Smith.

Photograph 2 Paludal tufa on the moss *Scorpidium cossonii* in overgrown petrifying spring. Photograph George Smith.

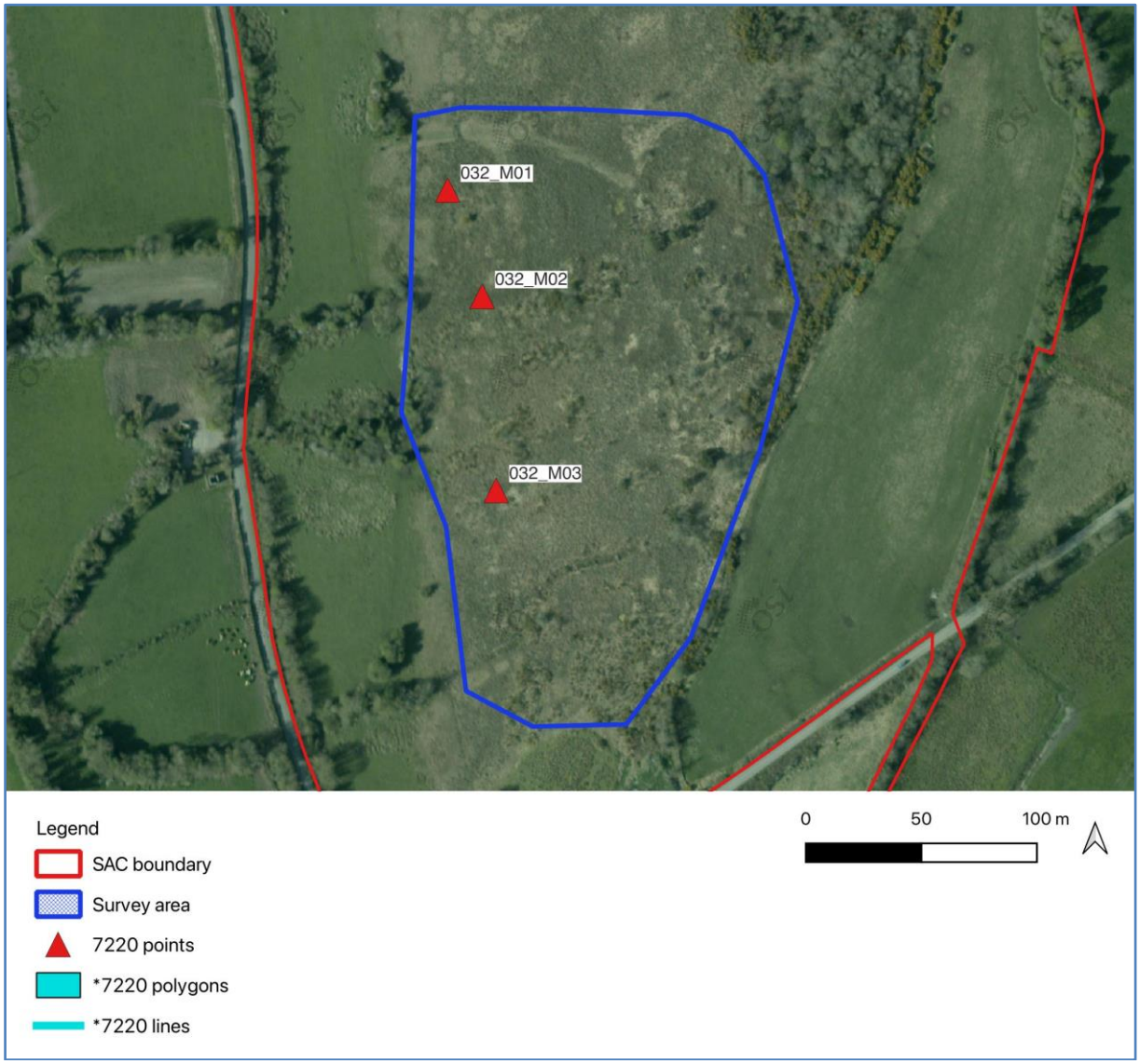


Figure 1 Lisduff Fen SAC survey area, petrifying spring locations and monitoring points. Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Lower River Shannon SAC

Site details

PTRS23 Site code	PTRS23-033
County	Tipperary
Designations	SAC (002165)
Landscape	Wooded river valley
Altitude	148 m

Survey details

Date(s) surveyed	20/06/2024		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	3.34 ha		
Subsites surveyed	n/a		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1		
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figure 1), as some areas were difficult to access due to steep overgrown riverbanks and soft mud.		

Site and petrifying spring description

Site description	This is an area of wet woodland in a steep sided river valley. Petrifying springs had been recorded during woodland survey, but no precise location was given. There are many flushes with some petrifying spring species, but only one petrifying spring (with tufa and positive indicator species) was recorded. This was in a small spring channel and dominated by *Equisetum telmateia*.			
Site management	None recorded			
Petrifying spring type(s)	Flush			
Petrifying Spring vegetation communities	Group 2 *Palustriella commutata-Geranium robertianum* springheads			
Main tufa type(s)	Oncoids & ooids			
No. *7220 springs mapped	1			
Area of *7220 (m^2)	0.001 ha			
National ranking	Moderate			
Species of note	Low			
Water sample data	EC µS/cm	450	pH	7.62
	Nitrate mg/l	2 – 5 mg/l	Phosphate mg/l	Not detectable
Other Annex habitats	*91E0			
Other Fossitt habitats	WN6			

Structure and functions

No. monitoring plots	1
% pass rate	100 %
Main criteria for failing S&F	Nitrate levels elevated, but all other criteria pass

Impacts

Impact code	Description	Timing	Scope	Influence
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	50-90%	Low

Change from baseline

No baseline data available

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
MK01	Reduce impact of mixed source pollution

Recommendations

Site management	Avoid disturbance as some areas very wet and easily damaged by trampling
Survey	No further survey required in short-term
Hydrogeology	Investigate source of elevated nitrate

Photograph 1 Petrifying spring vegetation in woodland seepage, dominated by tall *Equisetum telmateia*. Photograph Joanne Denyer.

Photograph 2 Sparse oncoids/ ooid tufa formation in petrifying spring. Photograph Joanne Denyer.

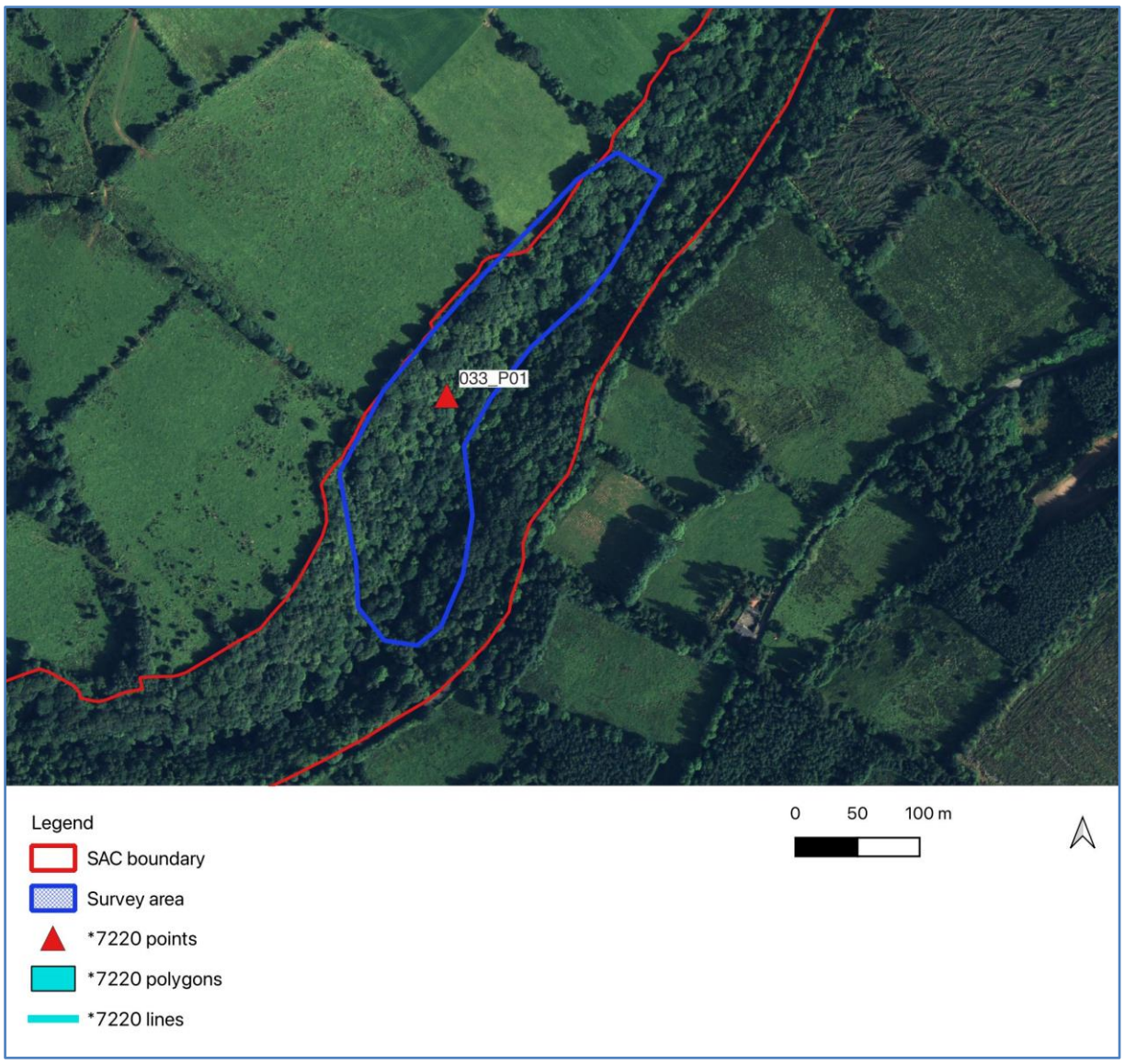


Figure 1 Lower River Shannon SAC survey area, petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Murvey Machair SAC

Site details

PTRS23 Site code	PTRS23-035
County	Galway
Designations	SAC (002129)
Landscape	Coastal rocks and machair
Altitude	6 – 22 m

Survey details

Date(s) surveyed	31/07/2024		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	31.63 ha		
Subsites surveyed	n/a		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	2		2
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figure 1), as this is where springs have been recorded, and the remainder of the site is more acidic.		

Site and petrifying spring description

Site description	Petrifying spring/ seepages are present in two habitats on the site. There are several areas of seepage over coastal rocks in the south-east and west of the site with cascade tufa. These had some flow recorded at the time of survey. In addition, there are areas on the machair which are less sloping or flat, where there is extensive paludal tufa. No water flow was present in these, but the ground was damp. There is erosion of sandy habitats at the site, but this does not seem to be affecting the petrifying springs, and it may be that the tufa binds the sand and reduces wind damage. In the south of the site there is tufa bound sand in several areas, but without petrifying spring indicator species.			
Site management	Rabbit droppings and a hare observed. No livestock at time of survey.			
Petrifying spring type(s)	Seepage			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades Group 6 *Carex lepidocarpa* Small Sedge Springs			
Main tufa type(s)	Cascade; paludal			
No. *7220 springs mapped	9			
Area of *7220 (m^2)	0.134 ha			
National ranking	High			
Species of note	*Moerckia flotoviana*			
Water sample data	EC µS/cm	762 - 906	pH	7.73 – 7.75
	Nitrate mg/l	Not detectable	Phosphate mg/l	< 0.05 – 0.2 mg/l
Other Annex habitats	*21A0			
Other Fossitt habitats	CB1; CD6; CS1			

Structure and functions

No. monitoring plots	4
% pass rate	100 %
Main criteria for failing S&F	Phosphate high but all other criteria pass and springs currently in good condition

Impacts

Impact code	Description	Timing	Scope	Influence
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	<50%	Low

Change from baseline

No baseline data available

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
MK01	Reduce impact of mixed source pollution

Recommendations

Site management	No change to current low levels of rabbit grazing
Survey	No further survey required in short-term
Hydrogeology	Investigate source of elevated phosphates

Photograph 1 Cascade tufa in seepage over coastal rocks with *Eucladium verticillatum, Didymodon tophaceus* and *Hymenostylium recurvirostrum* var. *recurvirostrum*. Photograph Joanne Denyer.

Photograph 2 Small sedge petrifying spring vegetation in machair with paludal tufa abundant on *Scorpidium cossonii*. Photograph Joanne Denyer.

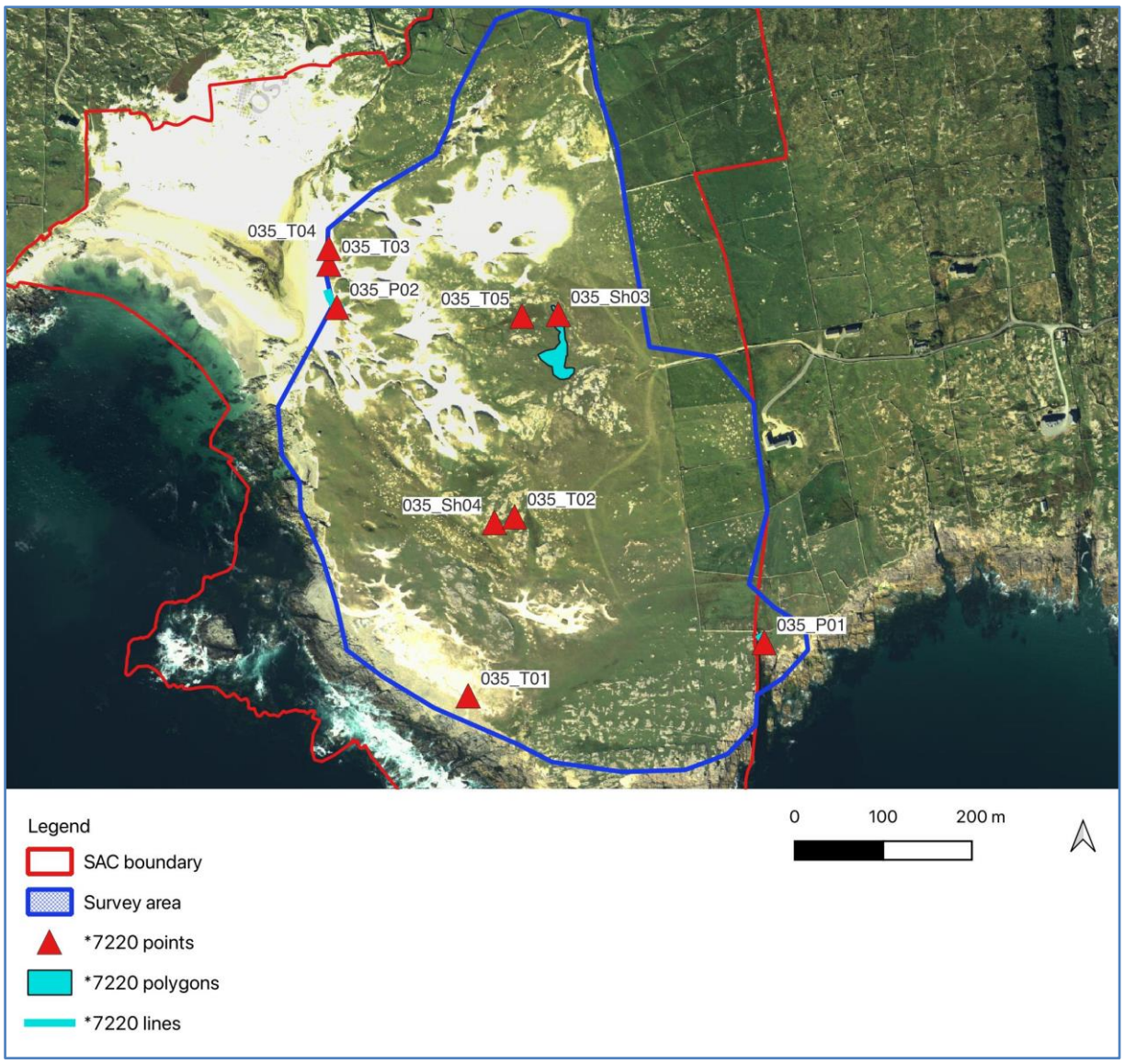


Figure 1 Murvey Machair SAC survey area, petrifying spring locations and monitoring points. Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Mweelrea/Sheeffry /Erriff Complex SAC

Site details

PTRS23 Site code	PTRS23-036
County	Mayo
Designations	SAC (001932)
Landscape	Coastal rocks and machair
Altitude	2 – 11 m

Survey details

Date(s) surveyed	0108/2024		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	55.64 ha		
Subsites surveyed	Dooaghtry flush and coast		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	2	1	3
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figures 1a – 1b), as this is an extensive coastal site.		

Site and petrifying spring description

Site description	Petrifying spring/ seepages are present in three habitats on the site. There is an extensive petrifying spring/ flush system in the north of the survey area. This has high cover of paludal tufa and is very species rich with the rare *Catoscopium nigritum* present. To the west and south there are species-rich seepages with paludal tufa on the coastal turf/ machair and larger areas of cascade tufa over coastal rocks.			
Site management	None present at time of survey but likely to be sheep grazed			
Petrifying spring type(s)	Flush; seepage			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades Group 5 *Schoenus nigricans* Springs			
Main tufa type(s)	Cascade; paludal			
No. *7220 springs mapped	11			
Area of *7220 (m^2)	0.631 ha			
National ranking	Very high			
Species of note	*Catoscopium nigritum; Moerckia flotoviana*			
Water sample data	EC µS/cm	382 - 761	pH	7.33 – 7.86
	Nitrate mg/l	Not detectable	Phosphate mg/l	Not detectable
Other Annex habitats	*21A0; 2190			
Other Fossitt habitats	CD5; CD6			

Structure and functions

No. monitoring plots	6
% pass rate	100 %
Main criteria for failing S&F	n/a

Impacts

Impact code	Description	Timing	Scope	Influence
PX04	No pressures or threats	Ongoing & future	>90%	n/a

Change from baseline

There was a reduction in positive indicator species in plot M01 compared to baseline (2012). However, these species were present in adjacent areas of spring, so may be due to plot positioning. Plot P02 was moved slightly and a new baseline plot created to include the rare moss *Catoscopium nigritum.* There was a slight increase in positive indicator species in this plot. There was a decrease in recorded tufa formation in plot M01, but a comparison of photographs shows little difference between 2012 and 2024, so it is due to interpretation of paludal tufa. The vegetation was grazed very short in 2012 (photographs) and there was taller vegetation within and adjacent to the flush in 2024. No baseline plot data was available for the other plots. Sh06 was in favourable condition in 2012, with a conservation score of 3. It was in favourable condition in 2024, with a conservation score of 4.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
n/a	n/a

Recommendations

Site management	No change to current low levels of grazing
Survey	Survey of remaining area of SAC that was not surveyed in 2024
Hydrogeology	None

Photograph 1 Dooaghtry flush petrifying spring vegetation with paludal tufa and rare moss *Catoscopium nigritum*. Photograph Joanne Denyer.

Photograph 2 Species-rich petrifying spring vegetation Dooaghtry flush with paludal tufa. Photograph Joanne Denyer.

Photograph 3 Cascade tufa over coastal rocks with species-rich petrifying spring vegetation. Photograph Joanne Denyer.

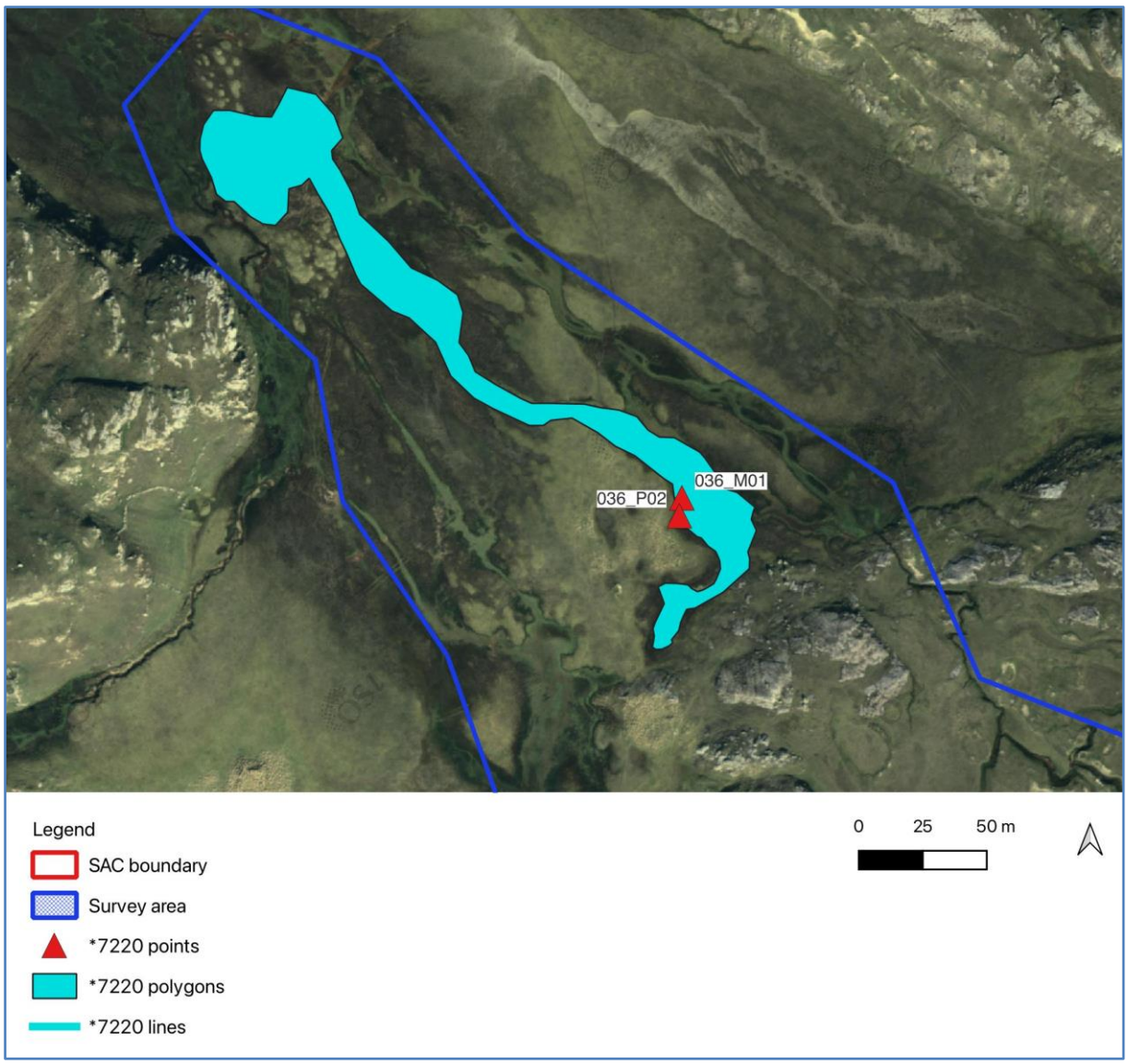


Figure 1a Mweelrea/Sheeffry /Erriff Complex SAC survey area (north), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

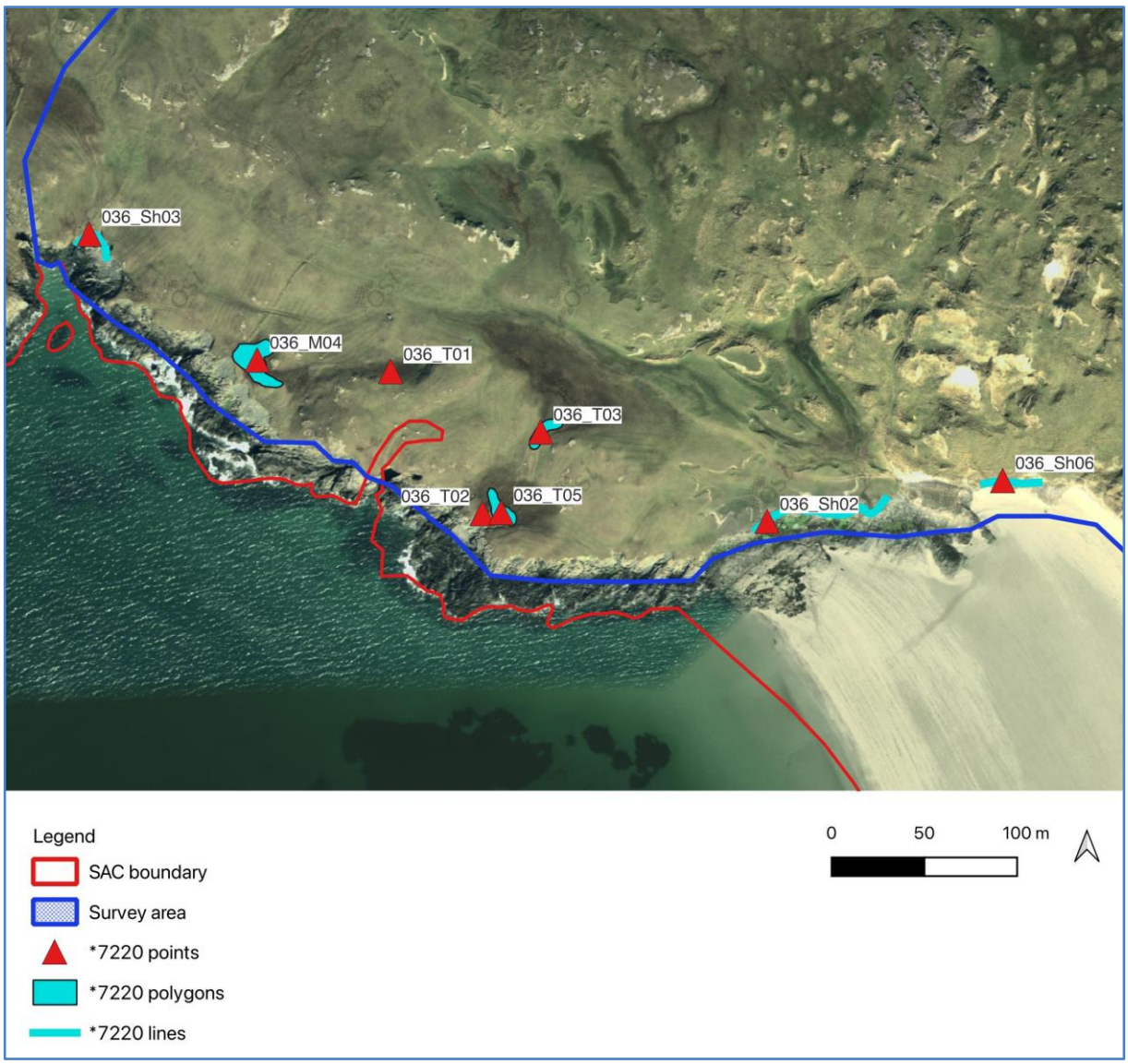


Figure 1b Mweelrea/Sheeffry /Erriff Complex SAC survey area (south west), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

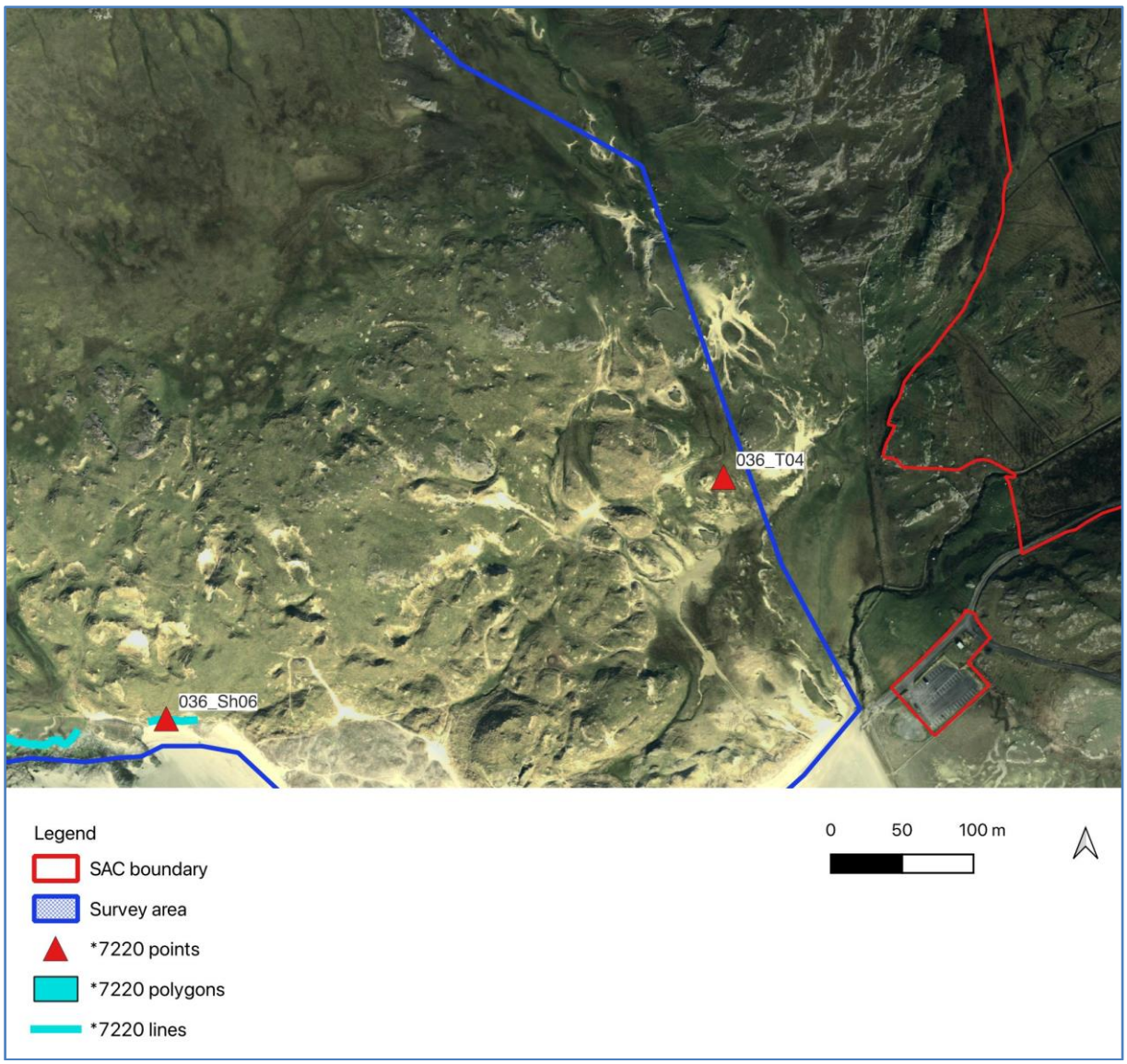


Figure 1c Mweelrea/Sheeffry /Erriff Complex SAC survey area (south west), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Ox Mountains Bogs SAC

Site details

PTRS23 Site code	PTRS23-037
County	Sligo
Designations	SAC (002006)
Landscape	Upland
Altitude	116 – 198 m

Survey details

Date(s) surveyed	02/07/2024		
Recorder(s)	Joanne Denyer & Eliška Vicherová		
Area surveyed (ha)	9.43 ha		
Subsites surveyed	North of Easky Lough; Easky River valley, Letterunshin		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	5		1
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figures 1a – 1c), as it is an extensive upland site.		

Site and petrifying spring description

Site description	Two areas within the site visited, north of Easky Lough and in the Easky River Valley, Letterunshin. The petrifying springs were mostly species-rich seepages, grading into alkaline fen, transition mire or blanket bog. Paludal tufa the most frequent form of tufa.			
Site management	None recorded			
Petrifying spring type(s)	Springhead; flush; seepage			
Petrifying Spring vegetation communities	Group 5 *Schoenus nigricans* Springs Group 6 *Carex lepidocarpa* Small Sedge Springs Group 7 *Palustriella falcata-Carex panicea* springs			
Main tufa type(s)	Cascade; paludal; oncoids & ooids			
No. *7220 springs mapped	6			
Area of *7220 (m^2)	0.027 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	378 - 640	pH	6.77 – 7.4
	Nitrate mg/l	Not detectable	Phosphate mg/l	Not detectable
Other Annex habitats	*7130; 7140; 7230			
Other Fossitt habitats	ED3; GS3; GS4; HH3; PB2; PF1; WN			

Structure and functions

No. monitoring plots	6
% pass rate	83 %
Main criteria for failing S&F	Negative bryophyte cover

Impacts

Impact code	Description	Timing	Scope	Influence
PE01	Roads, paths, railroads and related infrastructure	Ongoing & future	<50%	Low

Change from baseline

No baseline data available

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
ME06	Habitat restoration of areas impacted by transport

Recommendations

Site management	Move access track/ road to avoid petrifying spring P06.
Survey	Survey of remaining area of SAC that was not surveyed in 2024
Hydrogeology	None

Photograph 1 Petrifying spring springhead with abundant *Palustriella falcata* within wet heath, north of Easky Lough. Photograph Joanne Denyer.

Photograph 2 Petrifying spring springhead within *Schoenus nigricans* fen/ transition mire in upper Easky River Valley. Photograph Joanne Denyer.

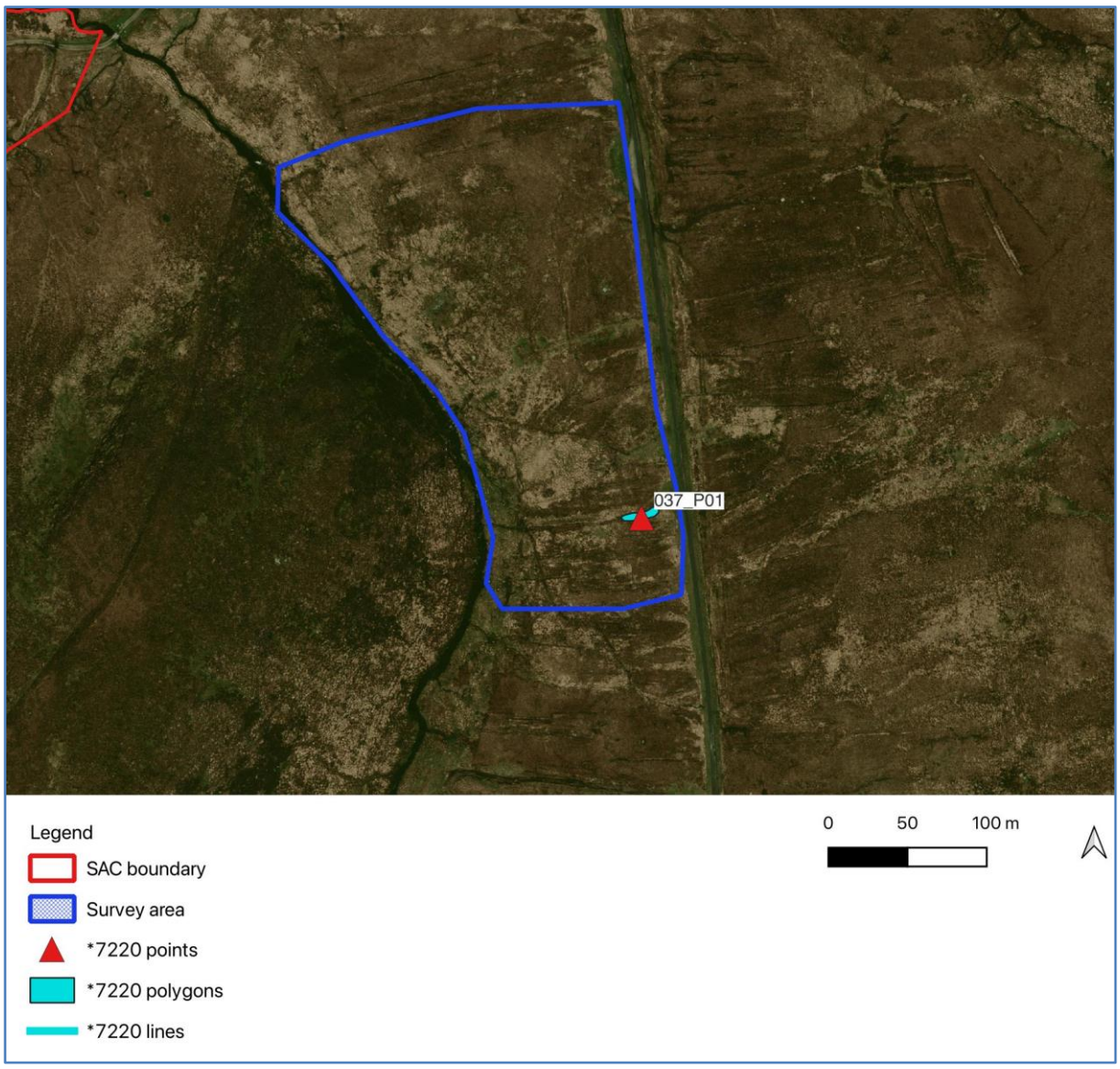


Figure 1a Ox Mountains Bog SAC survey area (north of Easky Lough), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

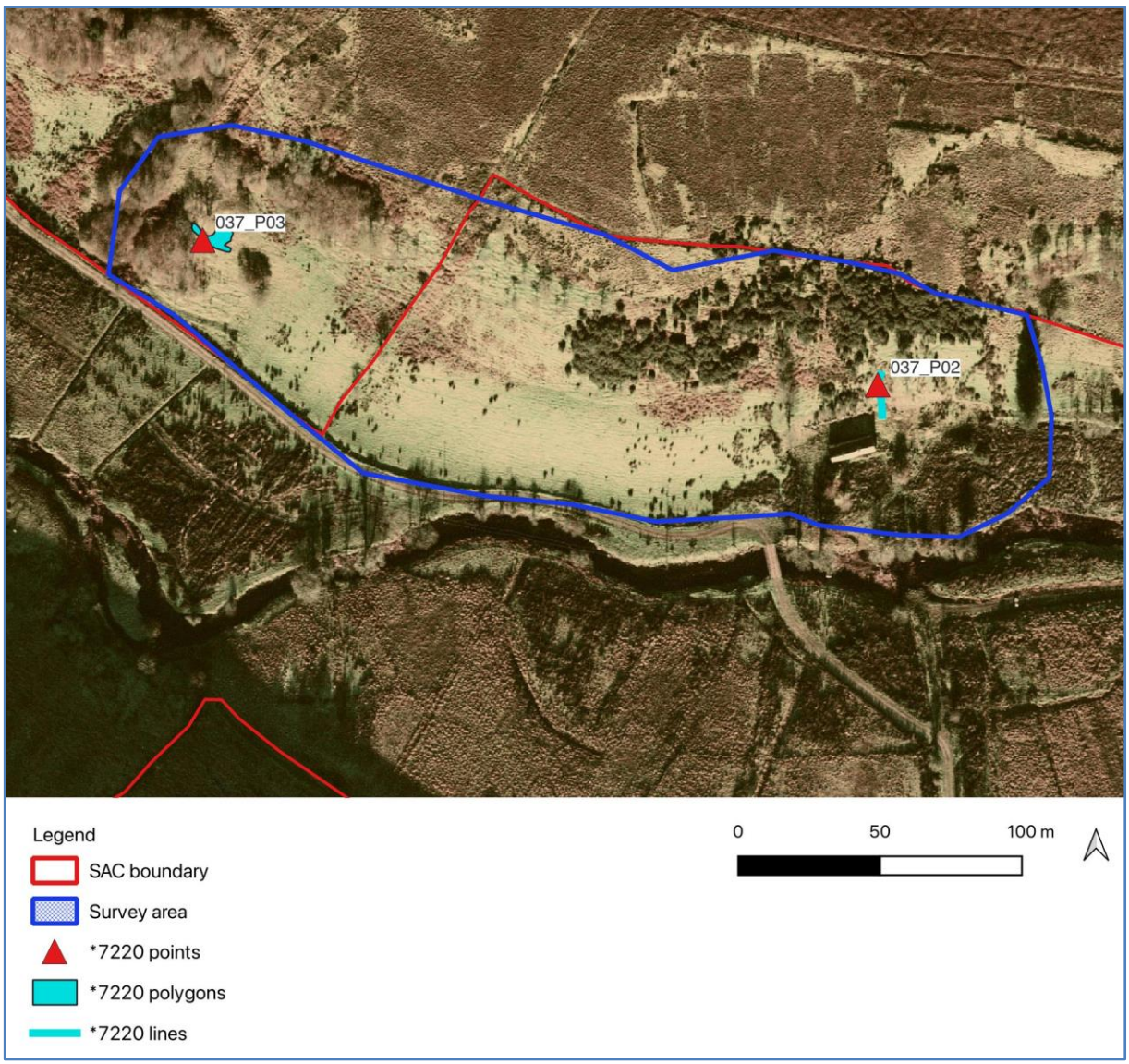


Figure 1b Ox Mountains Bog SAC survey area (Letterunshin lower valley), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

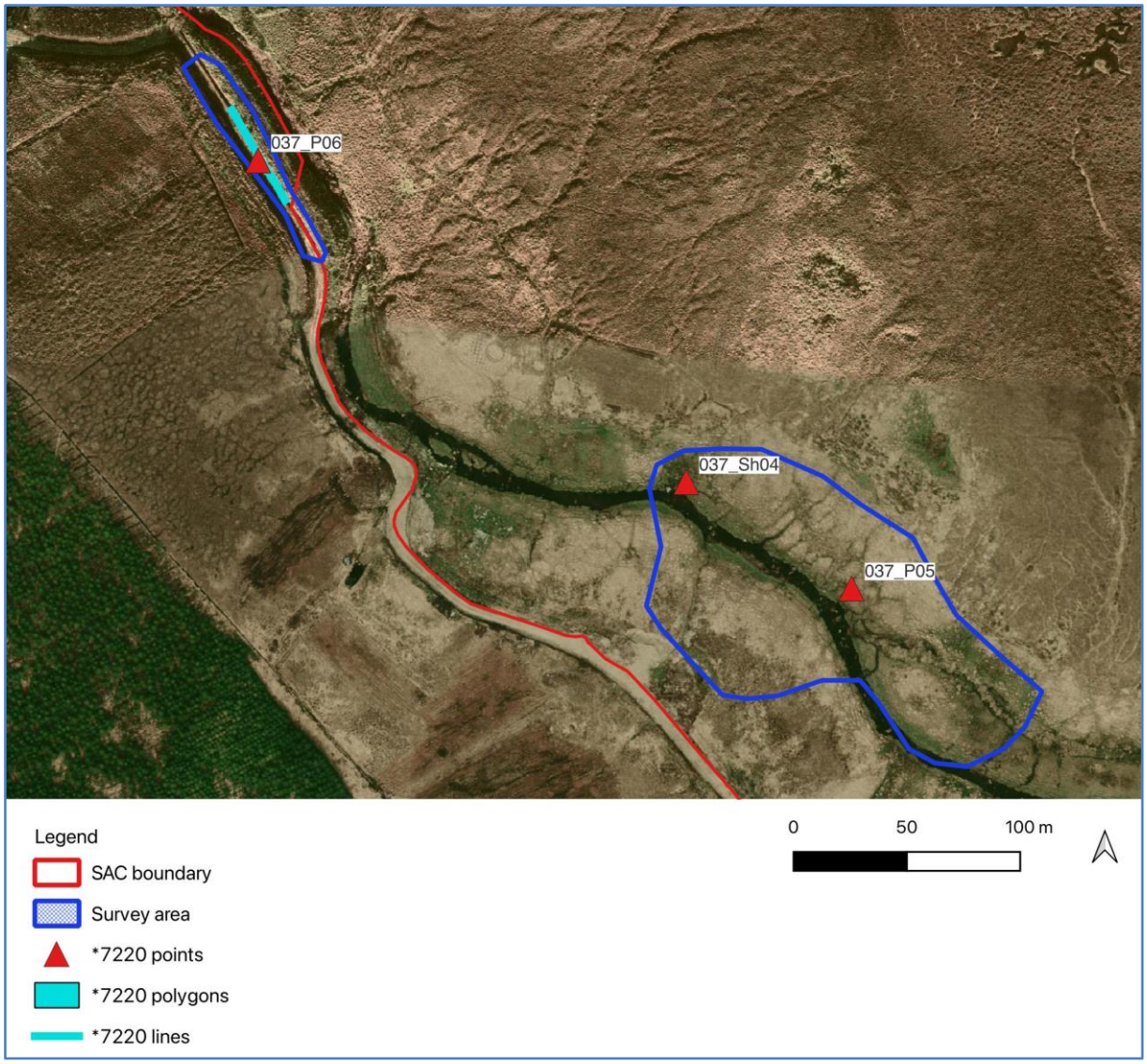


Figure 1c Ox Mountains Bog SAC survey area (Letterunshin upper valley), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Pollardstown Fen SAC

Site details

PTRS23 Site code	PTRS23-038
County	Kildare
Designations	SAC (000396)
Landscape	Lowland valley
Altitude	85 – 87 m

Survey details

Date(s) surveyed	19/06/2024		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	5.49 ha		
Subsites surveyed	n/a		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1	4	2
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figures 1a – 1d), as it is an extensive wetland site.		

Site and petrifying spring description

Site description	A series of springheads around the edge the fen, both north and south of the SAC. The petrifying springs arise in tall *Schoenus nigricans* dominated fen with paludal tufa. The tufa is strongly formed around the springheads. They have become overgrown in recent years and the rare moss *Tomentypnum nitens* is less frequent. A new petrifying spring area was recorded in the north-west of the site and there may be additional unknown petrifying springs.			
Site management	None recorded			
Petrifying spring type(s)	Springhead; flush			
Petrifying Spring vegetation communities	Group 5 *Schoenus nigricans* Springs			
Main tufa type(s)	Paludal			
No. *7220 springs mapped	10			
Area of *7220 (m^2)	0.228 ha			
National ranking	Very high			
Species of note	*Tomentypnum nitens*			
Water sample data	EC µS/cm	612 – 672	pH	7.16 – 7.66
	Nitrate mg/l	0 – 2 mg/l	Phosphate mg/l	0 – 0.05 mg/l
Other Annex habitats	7230			
Other Fossitt habitats	PF1; WS1			

Structure and functions

No. monitoring plots	7
% pass rate	71 %
Main criteria for failing S&F	Positive indicator species; phosphate

Impacts

Impact code	Description	Timing	Scope	Influence
PA05	Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming)	Ongoing & future	50-90%	High
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	<50%	Low

Change from baseline

Plot M02 had a reduction in positive indicator species compared to the baseline survey from 2013. This has previously been described as Group 6 small sedge petrifying spring vegetation, but in 2024 was dominated by tall *Schoenus nigricans.* The high quality indicator species *Tomentypnum nitens* was recorded from this plot in 2013 but was not found in 2024 in the plot or adjacent area. Phosphate levels were elevated in 2024, but not in 2012. Plot M04 had an increase in positive indicator species from the baseline. Plot M05 had the same number of positive indicator species but *Tomentypnum nitens* was not recorded from this spring or adjacent areas where it had previously been present. The vegetation is very overgrown.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate

Conservation measures

Conservation measure code	Description
MA04	Reinstate appropriate agricultural practices to address abandonment, including mowing, grazing, burning or equivalent measures
MK02	Reduce impact of multi-purpose hydrological changes

Recommendations

Site management	Reintroduction of grazing to reduce vegetation height and open vegetation
Survey	Survey of remaining area of SAC that was not surveyed in 2024
Hydrogeology	Investigate potential elevated phosphates in the south-west of the site. Reduce drainage/ abstraction from fen vegetation.

Photograph 1 Petrifying spring springhead with strong paludal tufa in north west of site, grading to *Schoenus* fen around springhead. Photograph Joanne Denyer.

Photograph 2 Overgrown petrifying spring springhead in north west of site, ground quaking and unstable underfoot around springhead. Photograph Joanne Denyer.

Figure 1a Pollardstown Fen SAC survey area (north eastern area), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

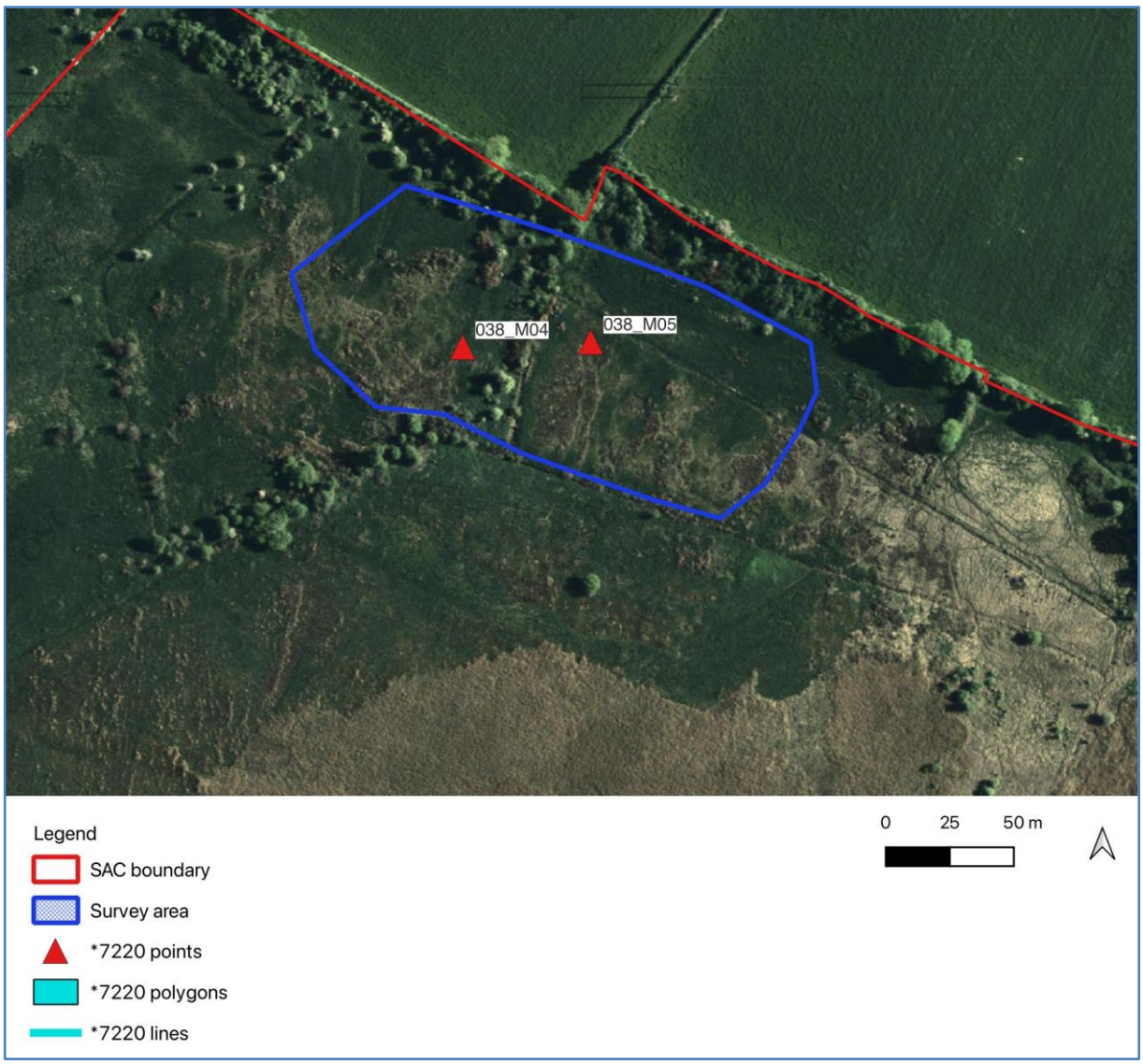


Figure 1b Pollardstown Fen SAC survey area (north western area), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Figure 1c Pollardstown Fen SAC survey area (south eastern area), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

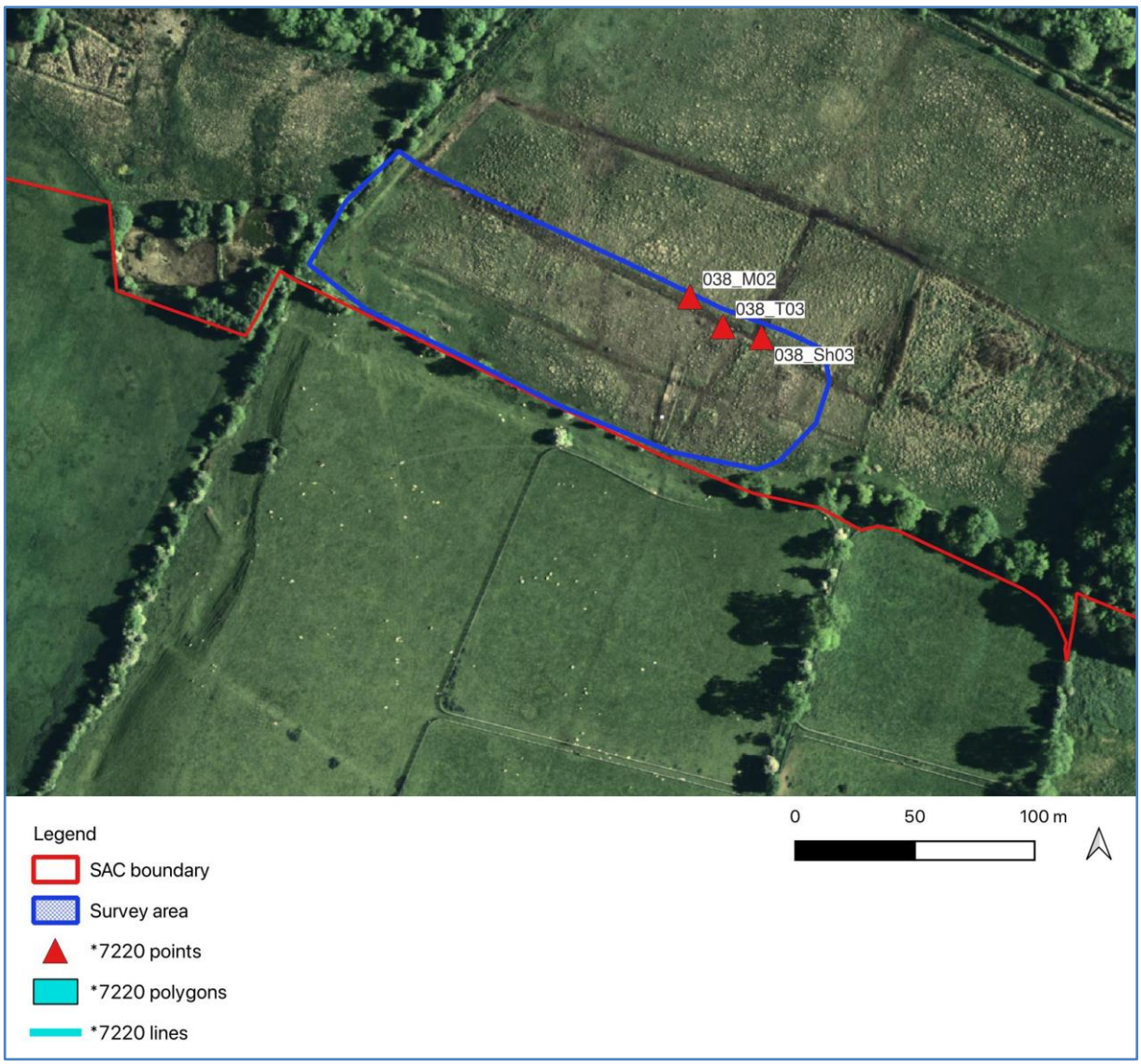


Figure 1c Pollardstown Fen SAC survey area (south western area), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

River Barrow and River Nore SAC

Site details

PTRS23 Site code	PTRS23-039
County	Kildare & Kilkenny
Designations	SAC (002162)
Landscape	Lowland river valley and canal
Altitude	29 – 125 m

Survey details

Date(s) surveyed	14/06/2024; 17/07/2024; 27/09/2024		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	9.68 ha		
Subsites surveyed	Dysart; Monasterevin; Dinin River		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	2	1	1
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figures 1a – 1c), as it is an extensive river SAC.		

Site and petrifying spring description

Site description	Three petrifying spring sites were surveyed. Monasterevin is seepage from a canal bridge with cascade tufa; Dysart is strongly forming cascade tufa on a steep wooded valley slope and Dinin River is a series of small seepages with less strongly formed cascade and paludal tufa and oncoids and ooids in sloping valley woodland.			
Site management	Cattle signs in woodland at Dinin River in the eastern end of the wood. No other site management recorded.			
Petrifying spring type(s)	Springhead; flush; seepage			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades Group 2 *Palustriella commutata-Geranium robertianum* springheads			
Main tufa type(s)	Cascade; oncoids & ooids			
No. *7220 springs mapped	4			
Area of *7220 (m^2)	0.009 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	449 - 662	pH	7.72 – 8.2
	Nitrate mg/l	0 – 5 mg/l	Phosphate mg/l	Not detectable
Other Annex habitats	91A0; *91E0			
Other Fossitt habitats	BL1; WN2; WN6			

Structure and functions

No. monitoring plots	4
% pass rate	100 %
Main criteria for failing S&F	Nitrate elevated in two plots but otherwise plot sin good condition

Impacts

Impact code	Description	Timing	Scope	Influence
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing & future	50-90%	Low

Change from baseline

Baseline plot data was available for M02 only (2012). Positive indicator species number had increased and there was no change in the cover of positive indicator species or tufa cover. Phosphates were slightly elevated in the baseline survey (2012), this may not have been high enough to be detected by the field kit in 2023. Nitrate was possibly elevated in 2024 (borderline result). The Dinin River site was in favourable condition with a conservation score of 4 in 2010 (5 in 2024). The Monasterevin site was in favourable condition with a conservation score of 2 in 2012 (6 in 2024). The tufa and petrifying spring vegetation was more developed in 2024 compared to photographs from 2012.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
MK01	Reduce impact of mixed source pollution

Recommendations

Site management	Monasterevin – protect site from any re-pointing or similar works which could remove the tufa and vegetation
Survey	Survey of remaining area of SAC that was not surveyed in 2024
Hydrogeology	Investigate source of elevated phosphates and nitrates at Dysart site

Photograph 1 Cascade tufa and species-rich petrifying spring vegetation on Monasterevin Grand Canal / River Barrow aqueduct. Photograph Joanne Denyer.

Photograph 2 Cascade tufa with *Eucladium verticillatum* and *Palustriella commutata* on steep slope in wooded valley, Dysart. Photograph Joanne Denyer.

Photograph 3 Petrifying spring tufa with sparse vegetation and abundant oncoids and ooids, wooded river valley, Dinin. Photograph Joanne Denyer.

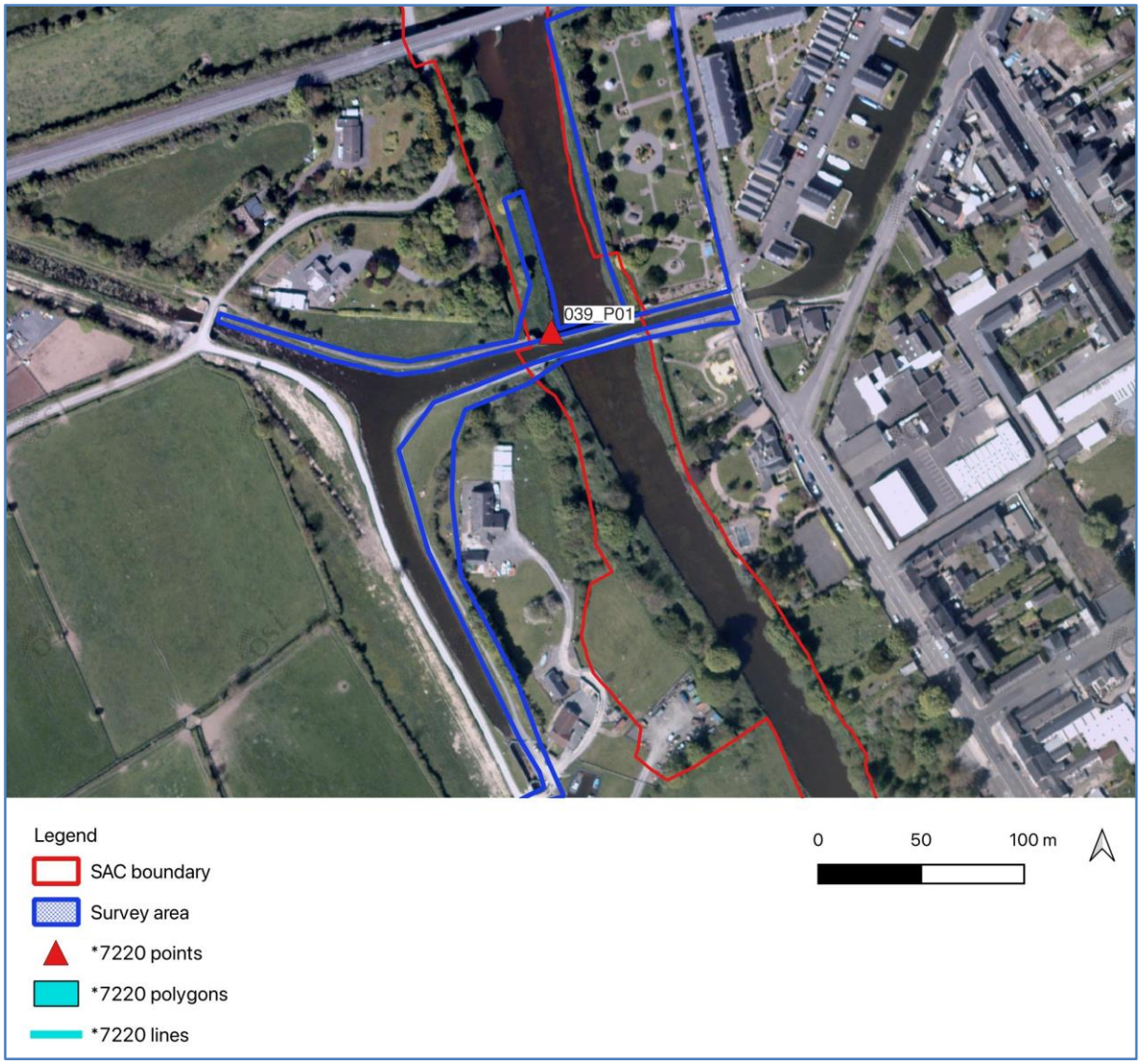


Figure 1a River Barrow and River Nore SAC survey area (Monasterevin), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

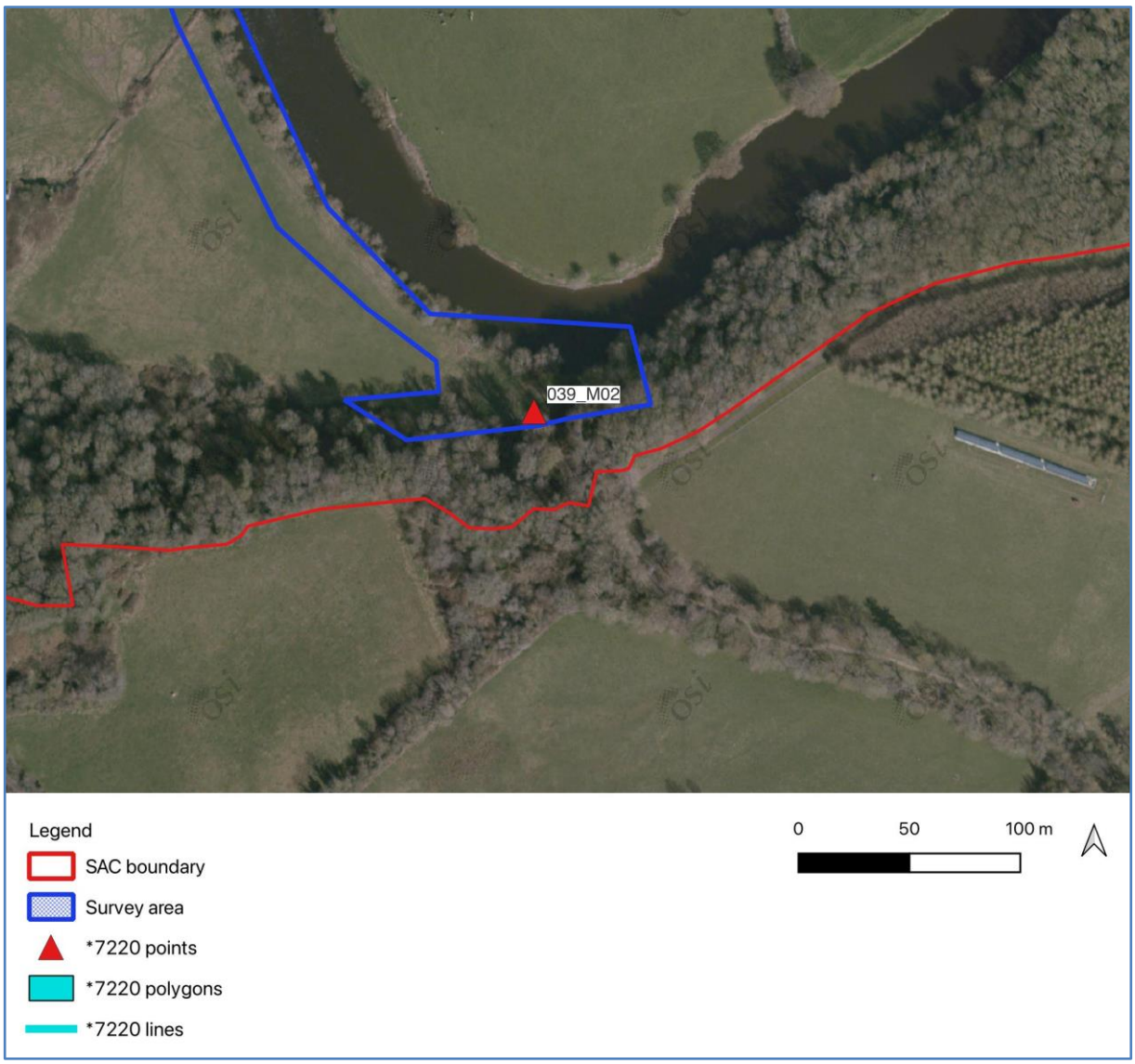


Figure 1b River Barrow and River Nore SAC survey area (Dysart), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

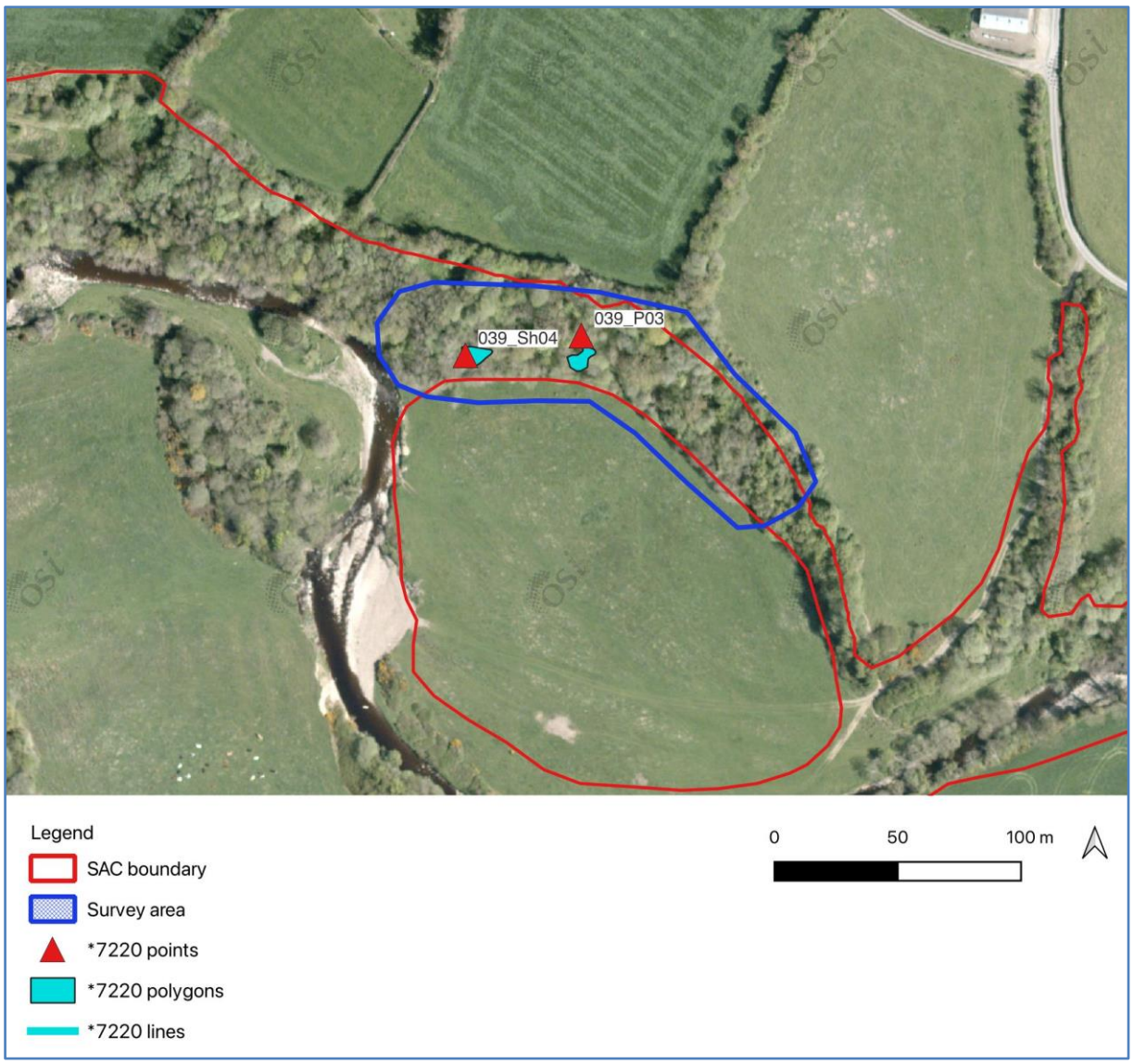


Figure 1c River Barrow and River Nore SAC survey area (Dinin River), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Slieve League SAC

Site details

PTRS23 Site code	PTRS23-040
County	Donegal
Designations	SAC (000189)
Landscape	Coastal
Altitude	3 – 5 m

Survey details

Date(s) surveyed	25/07/2024		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	2.53 ha		
Subsites surveyed	Malin Bhig/Malin Beg		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	2		
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figures 1a & 1b), as this is the only known petrifying spring site		

Site and petrifying spring description

Site description	Petrifying spring/ seepages on coastal rocks forming small amounts of cascade tufa. Little obvious water flow but vegetation damp to touch. Small seepages frequent throughout central area of rocks.			
Site management	None recorded. Recreational activity (beach users and tour buses) but no signs of impacts to petrifying springs.			
Petrifying spring type(s)	Seepage			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades			
Main tufa type(s)	Cascade			
No. *7220 springs mapped	11			
Area of *7220 (m^2)	0.009 ha			
National ranking	High			
Species of note	*Adiantum capillus-veneris; Moerckia flotoviana*			
Water sample data	EC µS/cm	865	pH	7.58
	Nitrate mg/l	Not detectable	Phosphate mg/l	Not detectable
Other Annex habitats	1230			
Other Fossitt habitats	CS1			

Structure and functions

No. monitoring plots	2
% pass rate	100 %
Main criteria for failing S&F	n/a

Impacts

Impact code	Description	Timing	Scope	Influence
PX04	No pressures or threats	Ongoing & future	>90%	n/a

Change from baseline

No baseline data available

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
n/a	n/a

Recommendations

Site management	No change. Ensure that any tourist development on cliffs above petrifying springs does not impact water flow or quality.
Survey	No further survey required in short-term
Hydrogeology	None

Photograph 1 Cascade tufa on coastal rocks with *Adiantum capillus-veneris* and *Moerckia flotoviana* within petrifying spring. Photograph Joanne Denyer.

Photograph 2 Cascade tufa on coastal rocks with *Moerckia flotoviana* and abundant *Didymodon tophaceus* within petrifying spring. Photograph Joanne Denyer.

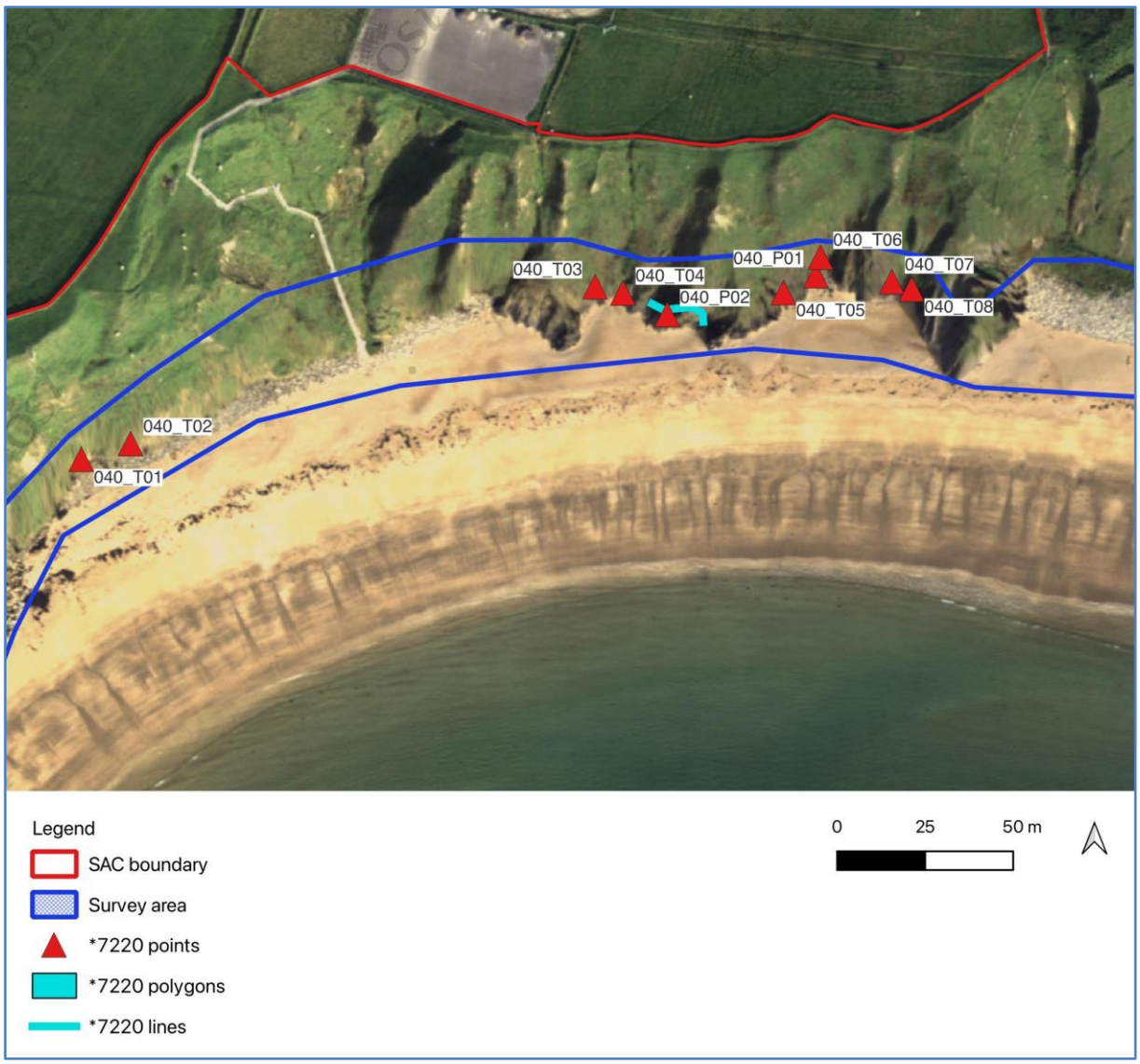


Figure 1a Slieve League SAC survey area (west beach), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

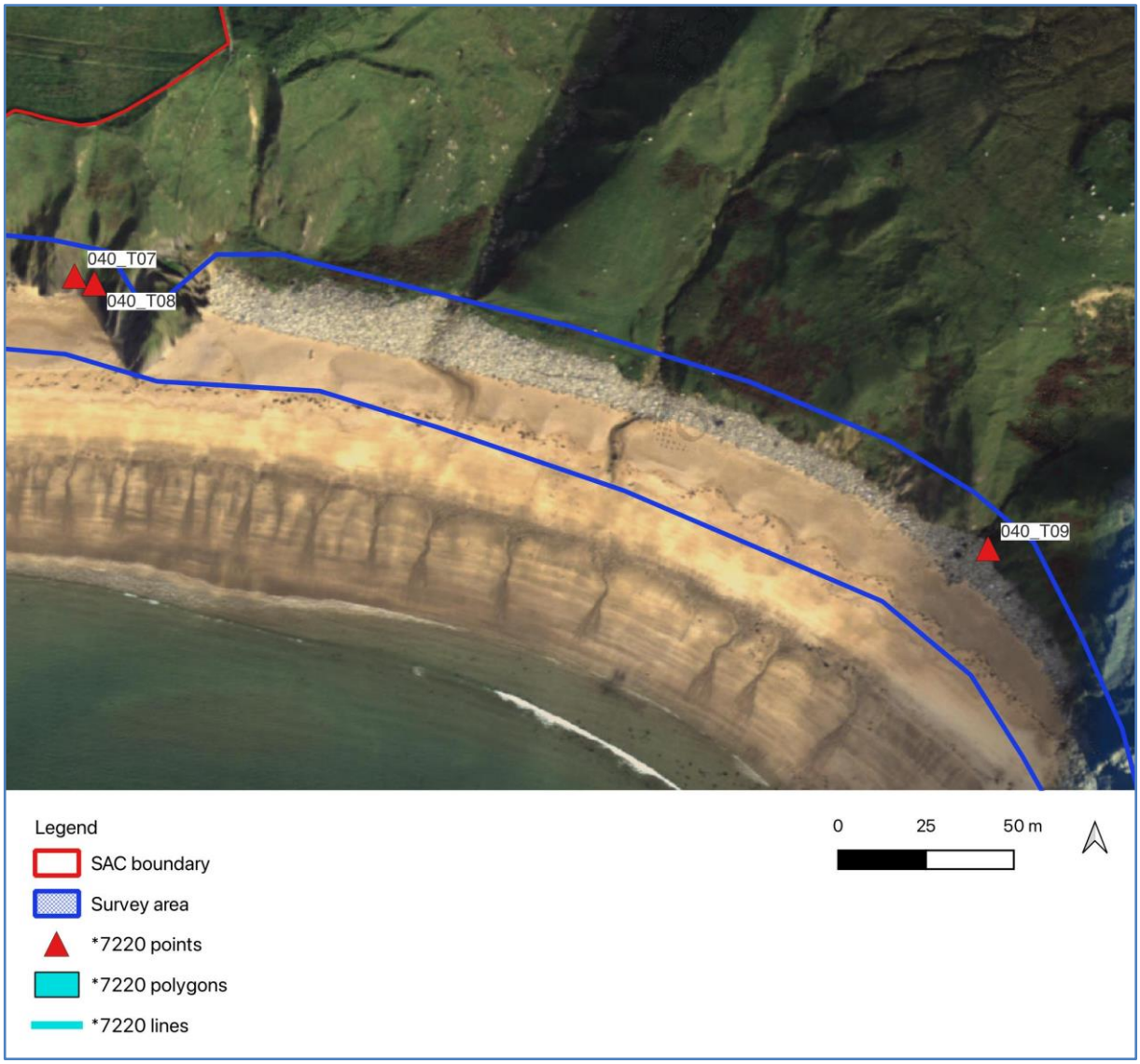


Figure 1b Slieve League SAC survey area (east beach), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Bray Head

Site details

PTRS23 Site code	PTRS23-041
County	Wicklow
Designations	SAC (000741)
Landscape	Coastal woodland
Altitude	48 m

Survey details

Date(s) surveyed	31/5/2024		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	8.02 ha		
Subsites surveyed	n/a		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1		
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figure 1), as this is the only known petrifying spring site.		

Site and petrifying spring description

Site description	Area of wet woodland with streams and seepages in a small valley on the north-easter side of the site. There is a small amount of tufa present in one stream with petrifying spring species, but this is very localised. The spring is highly shaded and there are a number of pipes in the area suggesting potential drainage.			
Site management	None recorded			
Petrifying spring type(s)	Springhead			
Petrifying Spring vegetation communities	Group 2 *Palustriella commutata-Geranium robertianum* springheads			
Main tufa type(s)	Cascade			
No. *7220 springs mapped	1			
Area of *7220 (m^2)	0.0003 ha			
National ranking	Low			
Species of note	n/a			
Water sample data	EC µS/cm	362	pH	7.66
	Nitrate mg/l	Not detectable	Phosphate mg/l	Not detectable
Other Annex habitats	*91E0			
Other Fossitt habitats	WN6			

Structure and functions

No. monitoring plots	1
% pass rate	0 %
Main criteria for failing S&F	Positive indicator species; water flow

Impacts

Impact code	Description	Timing	Scope	Influence
PL05	Modification of hydrological flow	Ongoing & future	>90%	Medium

Change from baseline

No baseline plot but bryophyte survey in 2019 recorded more tufa and cover of positive indicator species.

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Inadequate

Conservation measures

Conservation measure code	Description
MK02	Reduce impact of multi-purpose hydrological changes

Recommendations

Site management	Currently used as an occasional access path which causes some trampling damage. Consider fencing/ brush piles, to discourage access through this small valley.
Survey	No further survey required in short-term
Hydrogeology	Investigate impacts of pipes and other potential impacts to hydrology of the spring area.

Photograph 1 Spring with *Equisetum telmateia* but no tufa with plastic pipe in spring channel. Photograph Joanne Denyer.

Photograph 2 Shaded petrifying spring vegetation in spring with small amounts of cascade tufa. Photograph Joanne Denyer.

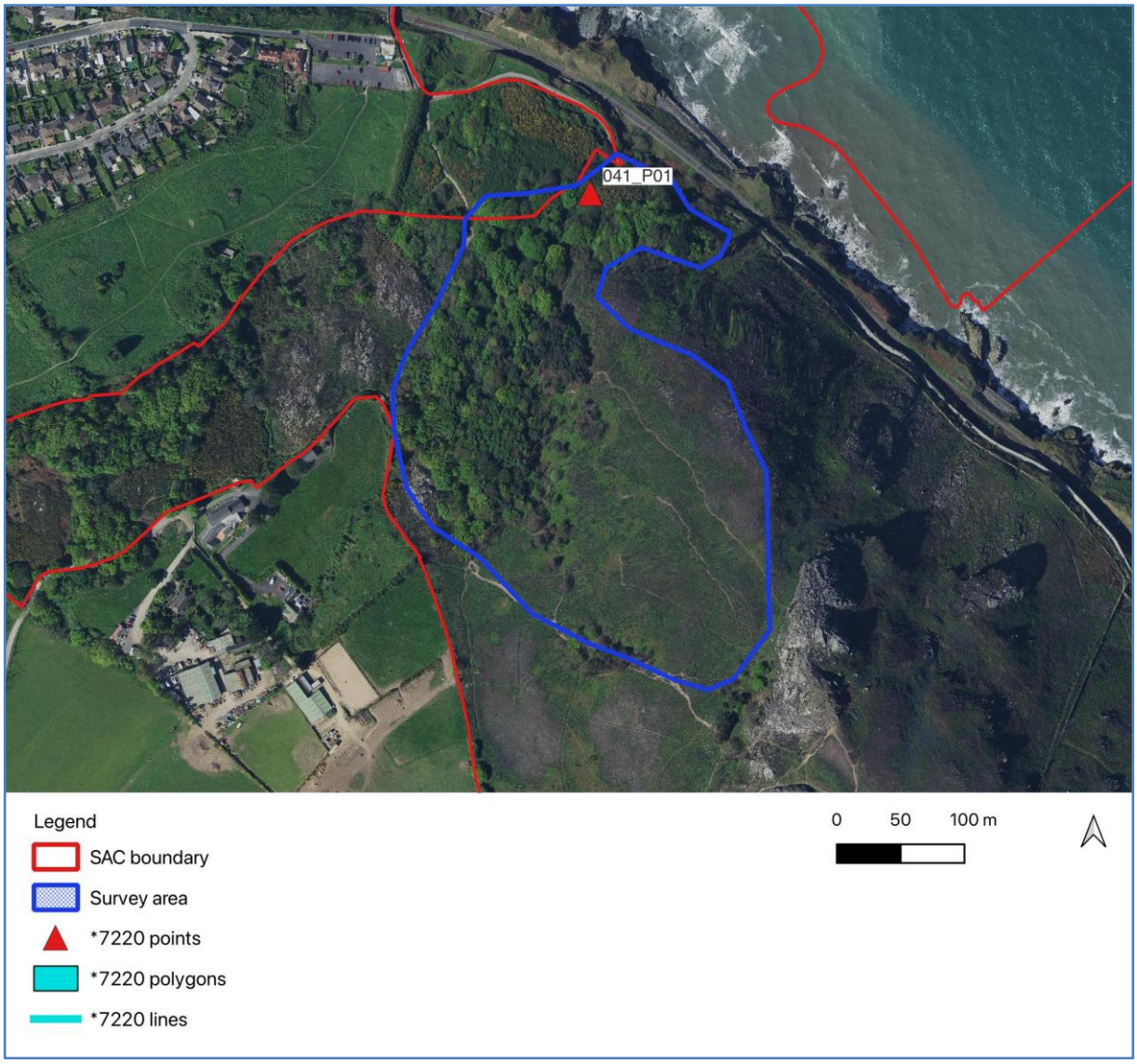


Figure 1 Bray Head SAC survey area, petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

St John's Point SAC

Site details

PTRS23 Site code	PTRS23-042
County	Donegal
Designations	SAC (000191)
Landscape	Coastal
Altitude	3 – 8 m

Survey details

Date(s) surveyed	24/07/2024		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	0.95 ha		
Subsites surveyed	n/a		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1		1
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figures 1a & 1b), as these are the only known petrifying spring sites.		

Site and petrifying spring description

Site description	Petrifying spring/ seepages along southern and northern end of beach over coastal rocks. Lower parts submerged at high tide. Extensive zone on northern shoreline with some large cascade mounds and frequent *Didymodon tophaceus* and *Eucladium verticillatum*. Additional massive tufa cascade mounds on tall cliffs in south-west of site but inaccessible for survey.			
Site management	Cattle grazing of machair but no management on beach or cliffs			
Petrifying spring type(s)	Seepage			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades			
Main tufa type(s)	Cascade			
No. *7220 springs mapped	4			
Area of *7220 (m^2)	0.020 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	328	pH	6.59
	Nitrate mg/l	Not detectable	Phosphate mg/l	Not detectable
Other Annex habitats	1230			
Other Fossitt habitats	CS1			

Structure and functions

No. monitoring plots	2
% pass rate	100 %
Main criteria for failing S&F	n/a

Impacts

Impact code	Description	Timing	Scope	Influence
PX04	No pressures or threats	Ongoing & future	>90%	n/a

Change from baseline

No baseline data available

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
n/a	n/a

Recommendations

Site management	n/a
Survey	Survey petrifying springs on coastal cliffs in south-west of site (may require climbing equipment)
Hydrogeology	None

Photograph 1 Massive cascade tufa with petrifying spring vegetation on high inaccessible cliffs in south-west of SAC. Photograph Joanne Denyer.

Photograph 2 Cascade tufa over rocks on northern beach shoreline with abundant *Didymodon tophaceus, Eucladium verticillatum* and *Schoenus nigricans*. Photograph Joanne Denyer.

Figure 1a St John's Point SAC survey area (north), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

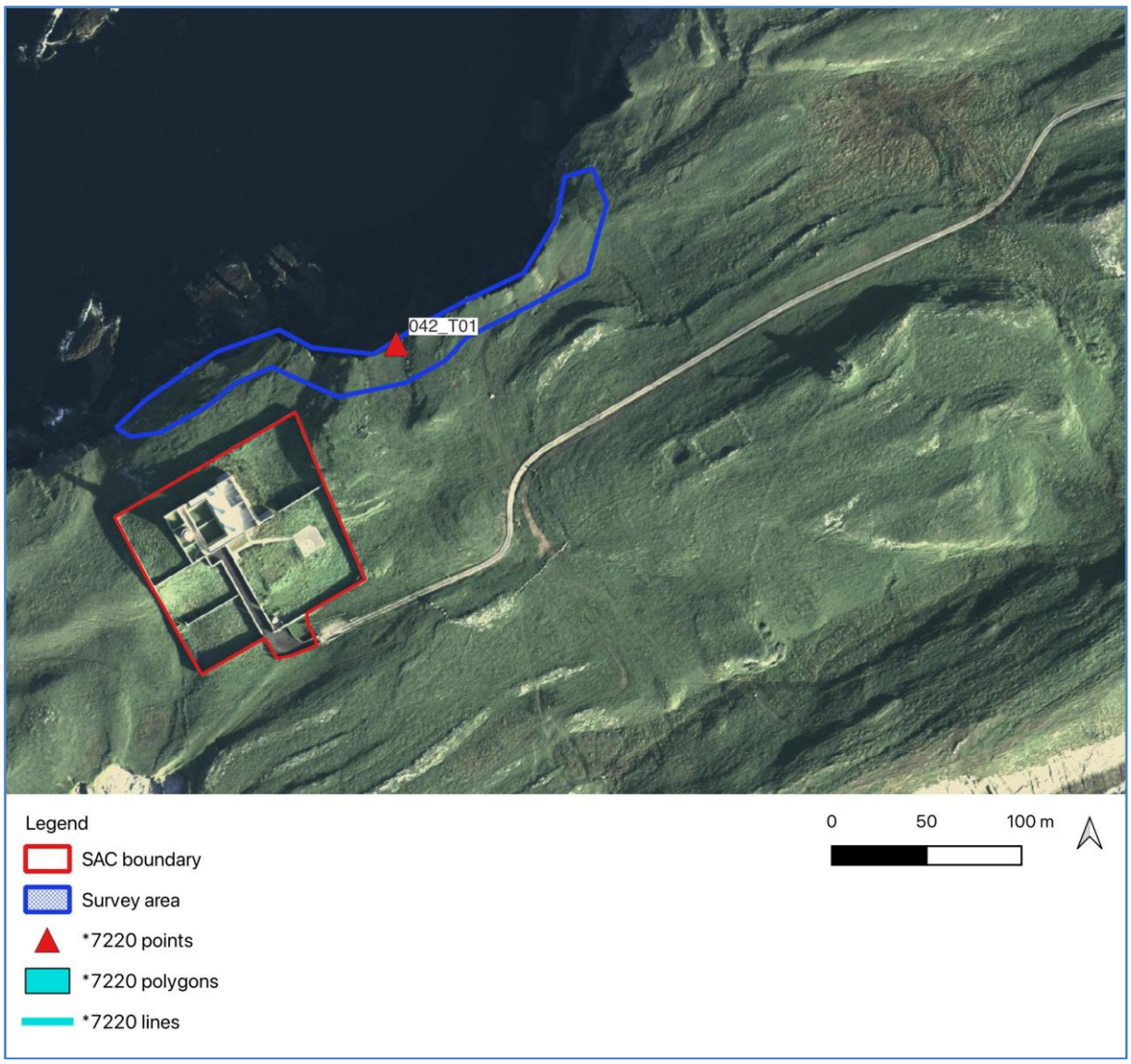


Figure 1b St John's Point SAC survey area (south), petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

Slieve Tooey/Tormore Island/Loughros Beg Bay SAC

Site details

PTRS23 Site code	PTRS23-043
County	Donegal
Designations	SAC (000190)
Landscape	Coastal
Altitude	2 – 38 m

Survey details

Date(s) surveyed	25/07/2024		
Recorder(s)	Joanne Denyer		
Area surveyed (ha)	2.61 ha		
Subsites surveyed	Maghera beach		
Assessment plots	Full baseline plots	Monitoring plots	Short survey plots
	1		3
Water chemistry sampling	Field sampling		
Survey limitations	Only part of SAC surveyed (Figure 1), as this is the only known petrifying spring site.		

Site and petrifying spring description

Site description	Frequent seepages on coastal rocks. Sand bound together by calcium deposition to form soft 'tufa bound sand', with some areas of harder 'typical' tufa present higher up on rocks. Many areas inaccessible due to height and slope of rocks (and some not accessible even at low tide). Typical petrifying spring species present.			
Site management	None recorded. Recreational activity but no signs of impacts to petrifying springs.			
Petrifying spring type(s)	Seepage			
Petrifying Spring vegetation communities	Group 1 *Eucladium verticillatum-Pellia endiviifolia* tufa cascades			
Main tufa type(s)	Cascade			
No. *7220 springs mapped	11			
Area of *7220 (m^2)	0.018 ha			
National ranking	High			
Species of note	n/a			
Water sample data	EC µS/cm	321 - 335	pH	7.8 – 8.17
	Nitrate mg/l	Not detectable	Phosphate mg/l	Not detectable
Other Annex habitats	1230			
Other Fossitt habitats	CS1			

Structure and functions

No. monitoring plots	4
% pass rate	100%
Main criteria for failing S&F	n/a

Impacts

Impact code	Description	Timing	Scope	Influence
PX04	No pressures or threats	Ongoing & future	>90%	n/a

Change from baseline

No baseline data available

Overall site assessment *7220

Area	Structure & functions	Future prospects	Overall status
Favourable	Favourable	Favourable	Favourable

Conservation measures

Conservation measure code	Description
n/a	n/a

Recommendations

Site management	n/a
Survey	No further survey required in short-term
Hydrogeology	None

Photograph 1 Cascade tufa and soft tufa bound sand on rocks with petrifying spring vegetation up steep slope from beach. Photograph Joanne Denyer.

Photograph 2 Part of seepage line with cascade tufa near large cave entrance, up slope from beach. *Palustriella commutata* abundant with soft tufa bound sand, but also some harder more typical tufa. Photograph Joanne Denyer.

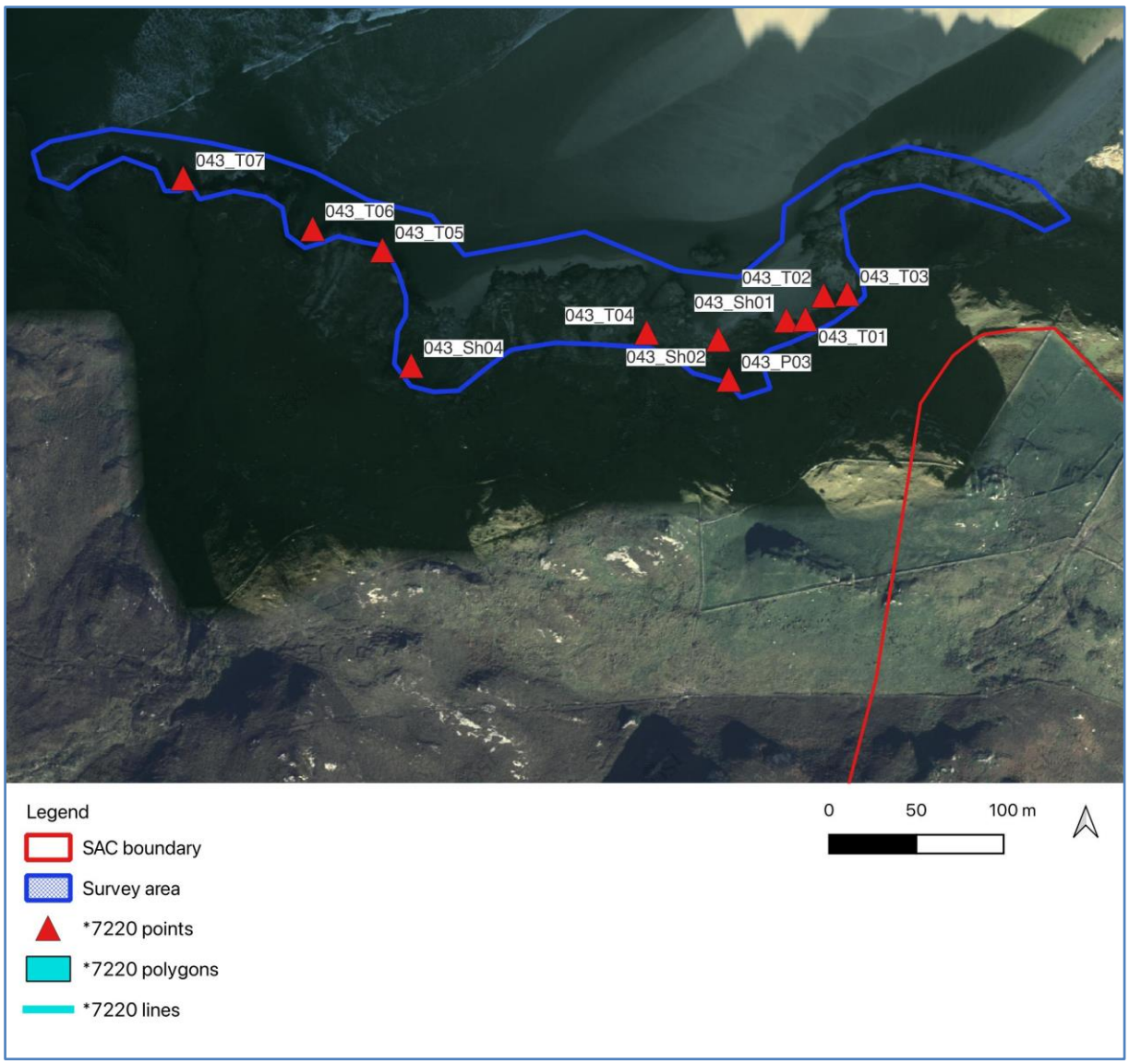


Figure 1 Slieve Tooey/Tormore Island/Loughros Beg Bay SAC survey area, petrifying spring locations and monitoring points.
Tailte Éireann aerial imagery abstract.
P = baseline plot; M = monitoring plot; Sh = Short survey; T = Target note

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