

Appendix A.8.3

**Galway City Transport Project: Report on the presence of Annex I habitat *7220
Petrifying springs with tufa formation (O'Neill & Barron, 2015)**

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N6 Galway City Transport Project

REPORT ON THE PRESENCE OF
ANNEX I HABITAT *7220 PETRIFYING
SPRINGS WITH TUFA FORMATION

2015





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1 Introduction

1.1 Scope of the study

BEC Consultants Ltd. was appointed by Scott Cawley to conduct a search for the priority EU Annex I habitat *7220 Petrifying springs with tufa formation in relation to the proposed N6 Galway City Transport Project (GCTP). *7220 Petrifying springs with tufa formation is a Qualifying Interest for Lough Corrib candidate Special Area of Conservation (site code 000297), part of which is within the study area for the GCTP, though there are no records of this Annex I habitat having been found within the cSAC. A survey area was developed to investigate if *7220 Petrifying springs with tufa formation occur within the vicinity of the GCTP or within the southern portion of Lough Corrib cSAC. This survey area was to the north of Galway City, extending from the R337 at Barna to the existing N6. It extended north to include the area within the Lough Corrib cSAC south of Gortmore townland, on the west of Lough Corrib, and Annaghdown townland, on the eastern shore. While the focus of the survey in the north was within the cSAC, a buffer zone of approximately 1 km bordering the cSAC was retained within the survey area. This resulted in a survey area measuring 156 km², excluding Lough Corrib. The survey area for investigating the occurrence of *7220 Petrifying springs with tufa formation is shown in Figure 1. The aims of the survey were to:

- i) conduct a search for the Annex I habitat *7220 Petrifying springs with tufa formation within the scheme study area for the N6 Galway City Transport Project and southern section of Lough Corrib cSAC; and
- ii) record and document any areas of *7220 habitat found.

The convention of indicating priority Annex I habitats by an asterisk (*) is followed in this report.

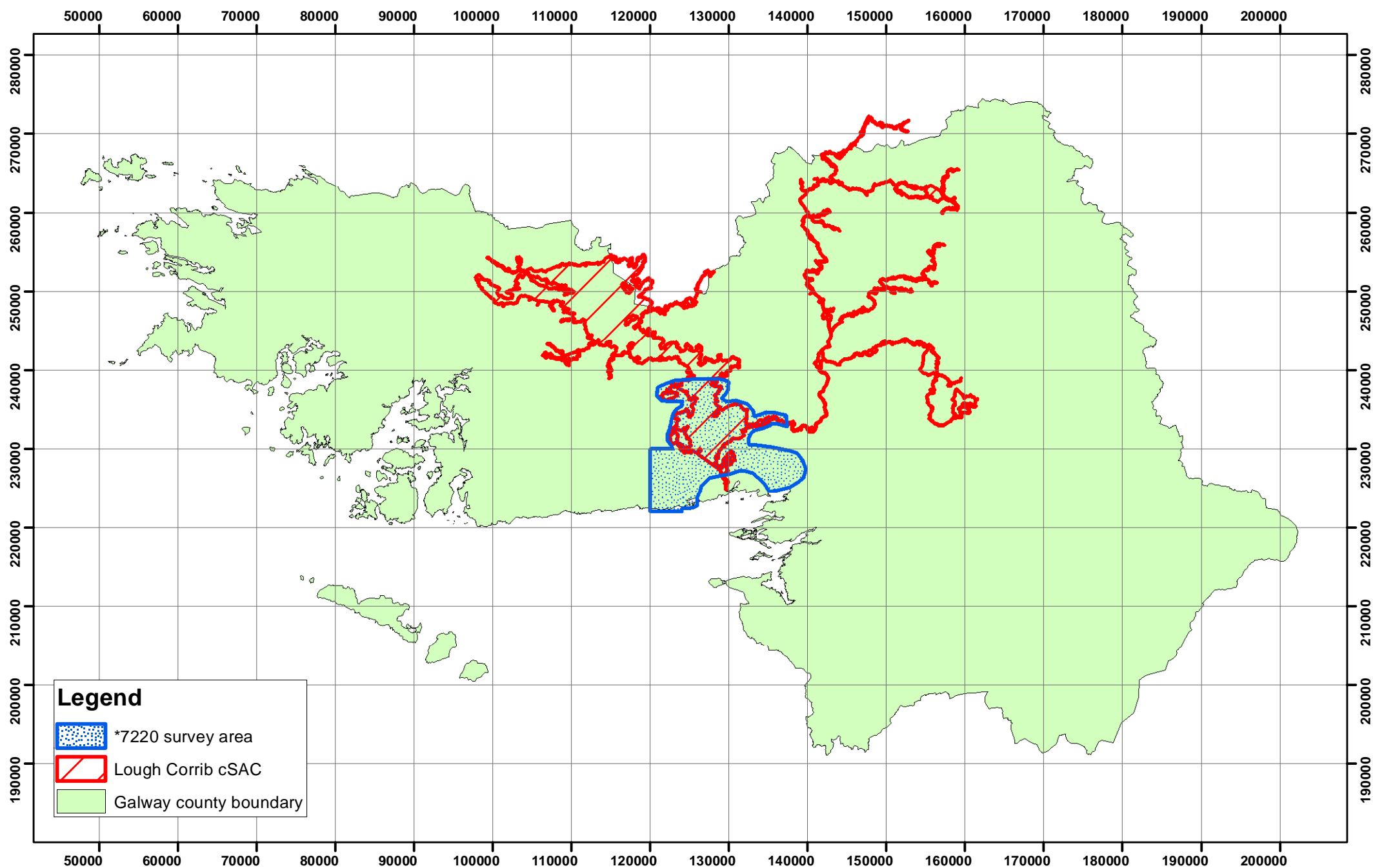
It should be noted that this survey was carried out in advance of any hydrogeological surveys associated with the N6 Galway City Transport Project.

1.2 *7220 Petrifying springs with tufa formation

*7220 Petrifying springs with tufa formation, hereafter called petrifying springs, are listed as a priority habitat in Annex I of the EU Habitats Directive (92/43/EEC). The latest interpretation manual of EU habitats (CEC 2013) describes petrifying springs as *“hard water springs with active formation of travertine or tufa. These formations are found in such diverse environments as forests or open countryside. They are generally small (point or linear formations) and dominated by bryophytes (Cratoneurion commutati)”*. A number of plants are listed, with bryophytes of particular significance for this habitat. The definition for *7220 Petrifying springs with tufa formation given in the most recent “Status of EU Protected Habitats and Species” report for Ireland by the National Parks & Wildlife Service (NPWS 2013) is somewhat broader than that in the interpretation manual, encompassing “springs and seepages where tufa is actively deposited”, further stating that petrifying springs may occur either as spring heads or as seepage areas with tufa formation; these seepage areas often occur within alkaline fens, where the two habitats may form a continuum in which the two habitats cannot be distinguished from each other. This broader definition is the one that has been applied in this study.

Lyons & Kelly (2013) describe three main subtypes of this habitat that occur in Ireland, namely woodland springs, inland non-wooded springs, and coastal springs. Inland non-wooded springs on level sites typically occur within a mosaic of fen or flush vegetation, often as diffuse seepage areas without clearly identifiable spring points, and tend to be relatively larger than other petrifying spring habitat types, the flat topography enabling small seepage areas to affect a larger ground surface area

Figure 1. *7220 Survey area for N6 Galway City Transport Project



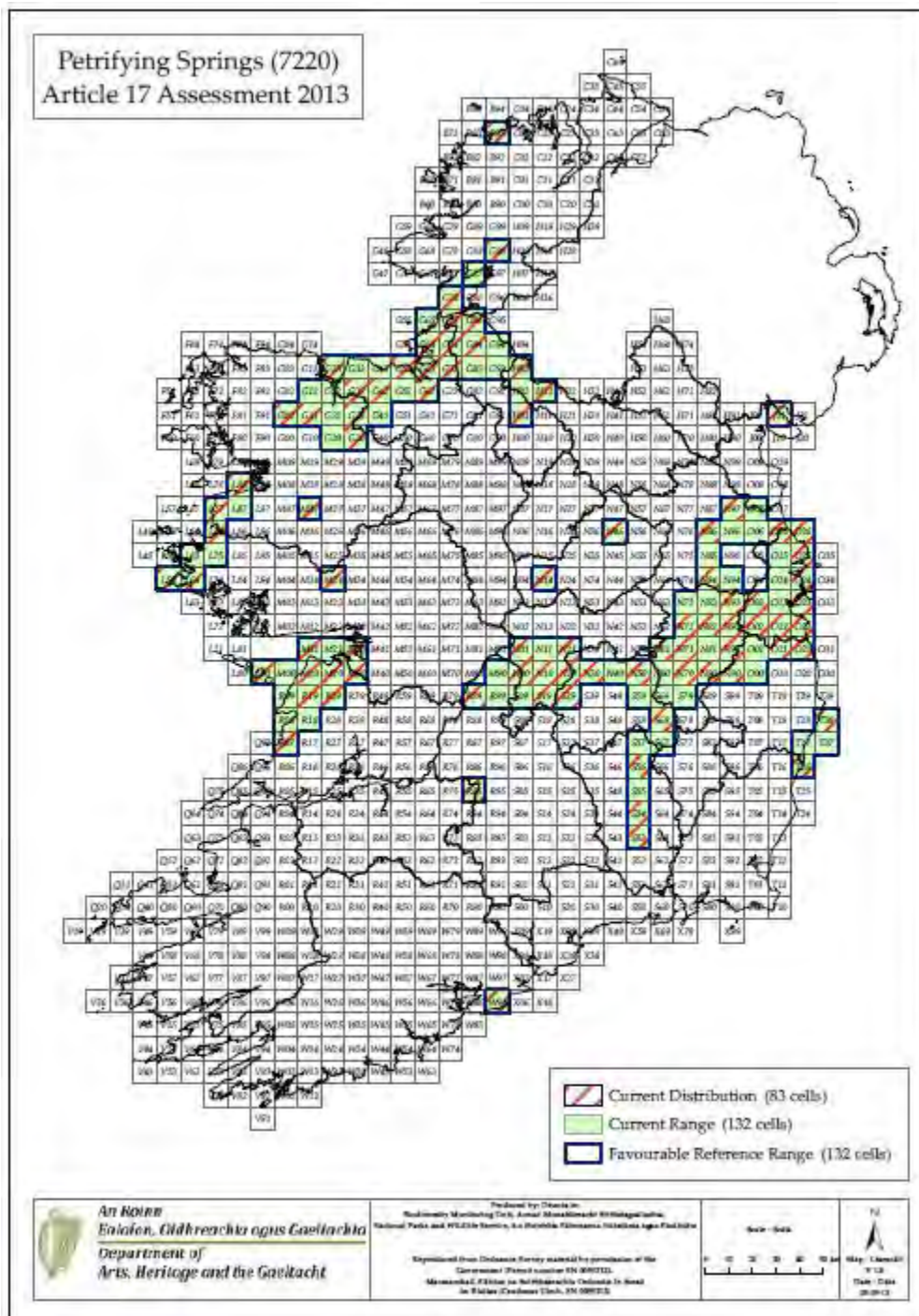


Figure 2. Current distribution and range of the Annex I habitat *7220 Petrifying springs with tufa formation, according to the 2013 national conservation assessment; reproduced from NPWS (2013).

than would be possible on sloping ground (Lyons & Kelly 2013). Of the three types, they are the most likely to occur in the study area. Woodland springs generally occur on hillsides covered with calcareous glacial till (Lyons & Kelly 2013), hence there is only a small likelihood that this spring type would occur in the study area, which is generally flat or gently sloping. The study area is not coastal, so coastal springs would not be expected to occur. Characteristic species occurring in Irish petrifying springs include the bryophytes *Palustriella commutata*, *Palustriella falcata*, *Eucladium verticillatum*, *Pellia endiviifolia*, *Cratoneuron filicinum*, *Bryum pseudotriquetrum* and *Didymodon tophaceus*, the grass *Festuca rubra*, the sedge *Carex panicea*, and the horsetail *Equisetum telmateia* (NPWS 2013).

While petrifying springs can occur in intensively managed agricultural settings, this is very much the exception rather than the norm and has only so far been seen in Co. Kildare, where other large tufa formations exist in the general area and where geological conditions are highly conducive to the development of the habitat (M. Lyons, pers. comm.). Some of the main threats to the habitat noted by Lyons & Kelly (2013) and NPWS (2013) could be ascribed to agriculture, such as land reclamation, lack of grazing, overgrazing and surface water abstractions.

In the recent assessment of the status of Annex I habitats in Ireland, habitat *7220 was assigned an overall conservation status of *Unfavourable – Inadequate*, and its known distribution, as of 19th November 2013, was mapped across 83 hectads (10 km grid squares), as shown in Figure 2 (NPWS 2013).

2 Methods

2.1 Desktop study and consultation

2.1.1 SAC files from NPWS

SAC files held by the National Parks & Wildlife Service (NPWS) were consulted to determine the current mapped distribution, if any, of petrifying springs within the Lough Corrib cSAC, and to check the explanatory notes accompanying the cSAC's Natura 2000 form for any reference to petrifying springs.

2.1.2 2013 Article 17 reporting

The latest "Status of EU Protected Habitats and Species in Ireland" report (NPWS 2013) was consulted to determine if any hectads mapped as containing petrifying springs coincided with the *7220 survey area.

2.1.3 Consultation

Consultation with the following individuals was carried out by telephone to determine if they were aware of any petrifying springs in the study area:

- Melinda Lyons, currently carrying out a Ph.D. on petrifying springs in Ireland;
- Julie Fossitt, NPWS Divisional Ecologist; and
- Rebecca Teesdale, NPWS ranger for Galway South-east.

2.2 Geographic Information System (GIS) interrogation of study area

2.2.1 Karst springs

The Geological Survey of Ireland (GSI), through the Department of Communications, Energy and Natural Resources website (www.dcenr.gov.ie), has made available geological data, including karstic features, for download. Karst springs were identified as a likely target for survey, as they, by definition, occur in limestone areas, and are identified by Lyons & Kelly (2013) as a specific subtype of petrifying spring found in Ireland. Estavelles, which can function as both a spring and a swallow hole, were also included. The GSI shapefile KarstFeatures_IG_Q1_2014.shp was downloaded and all karst springs and estavelles occurring in the study area were targeted for survey (Figure 3).

2.2.2 Selection of other priority areas to search for *7220

To target priority areas for survey within the 156 km² study area, GIS spatial analysis was used, in addition to the GSI's karst springs point data. Petrifying springs occur in calcareous substrates,

usually in the vicinity of watercourses. Using a combination of the EPA_RiverSegments_2012 polyline shapefile and the subsoils_IE polygon shapefile, both obtained from the Environmental Protection Agency (www.epa.ie), the following steps were carried out to create polygons with a higher probability of containing petrifying springs than the surrounding land:

- Creation of a soils layer for the study area in which only calcareous parent materials (Calcareous rock RckCa, Limestone tills TLs, Basic eskers BasEsk and Marine-blown sands Mbs) were retained (layer 1);
- Imposition of a 200m buffer zone around the RiverSegments layer occurring within the study area (layer 2); and
- Intersection of layer 1 with layer 2.

On completion of these steps, 70 polygons, ranging in size from 22 m² to 67 ha, were created and these formed the priority areas for survey (Figure 4).

2.3 Field study

The field survey for this work was carried out 11-14th March and 5th June 2014. The area around Menlough Fen and at Terryland was surveyed again as part of the general N6 Galway City Transport Project habitat mapping project in July 2014.

2.3.1 Karst springs

Locations within the survey area identified by the GSI dataset as having a karst spring feature were visited. The feature, if located, was photographed and searched for evidence of tufa formation. Where direct access was not possible, the areas were viewed through binoculars to identify features indicative of springs (e.g. flushes, seepage areas) or which might suggest there was potential for petrifying springs to develop (e.g. water features, semi-natural habitat). In the absence of additional evidence the area was not considered further. Cross-referencing with the GIS point data provided from the hydrogeology survey (Karst Study Report) was carried out in March 2015 when these data were made available.

2.3.2 Other priority areas to search

Polygons within the survey area identified as having a higher probability than surrounding land of petrifying spring formation (based on hydrological features in combination with edaphic factors) were walked and searched for evidence of tufa formation. As for karst springs, inaccessible areas were viewed through binoculars and features indicative of springs or flushes sought to determine whether or not to search the area further. As above, post-survey cross-referencing with the GIS point data provided from the hydrogeology survey (Karst Study Report) was carried out in March 2015.

Figure 3. Karst springs in N6 GCTP *7220 survey area

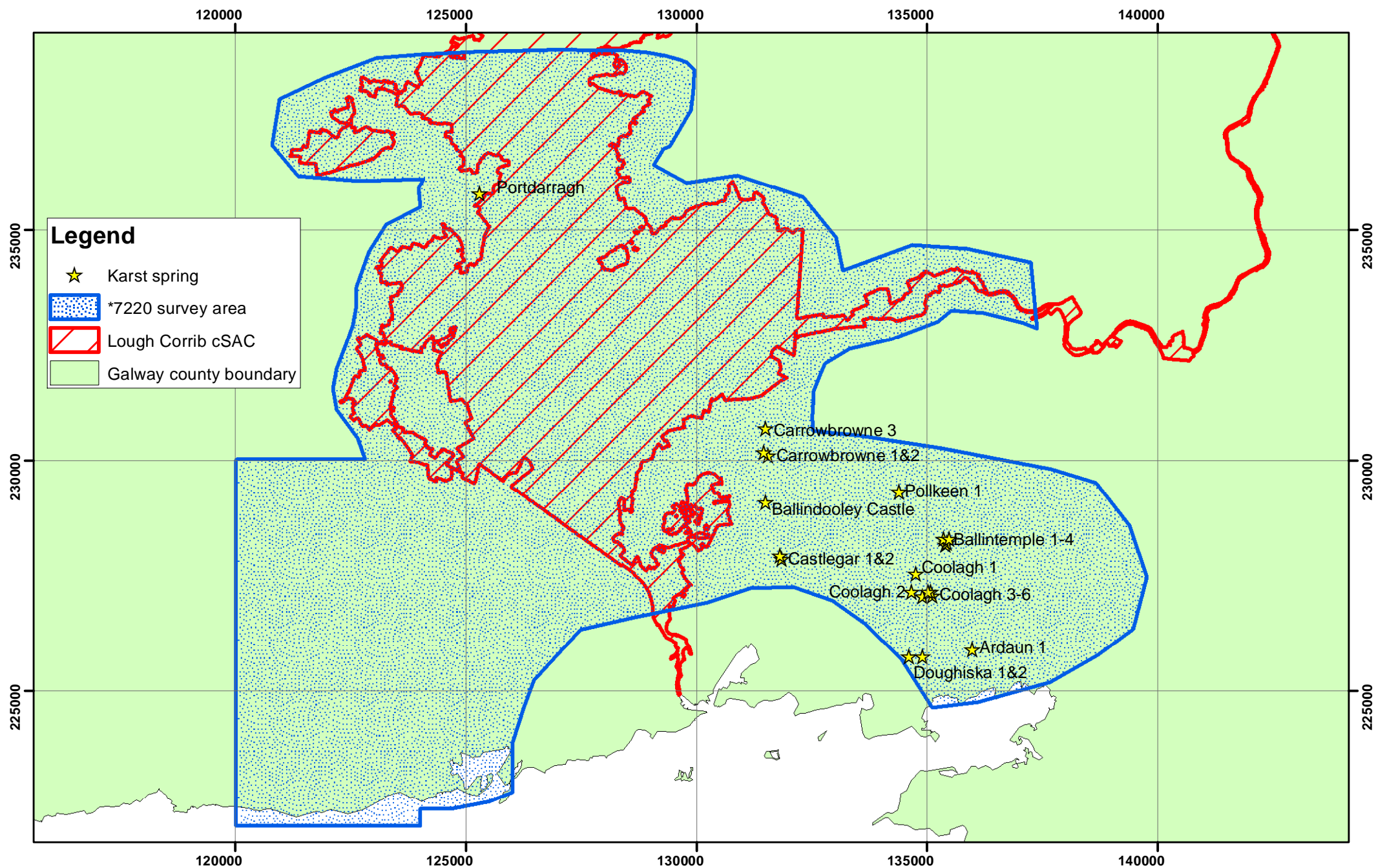
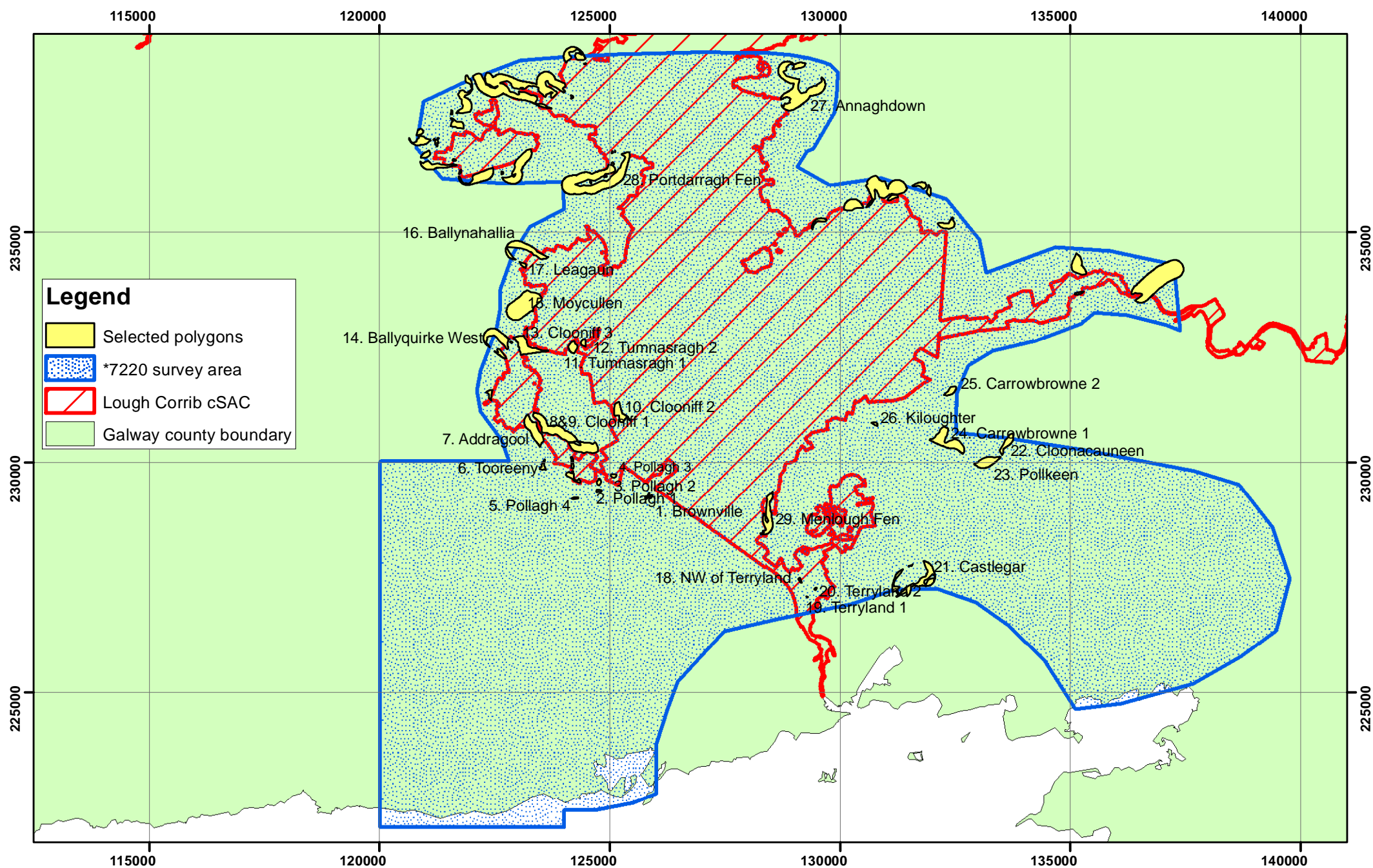


Figure 4. Polygons selected for survey on basis of edaphic and hydrological features



Note: Only numbered polygons were surveyed

3 Results

3.1 Desktop study and consultation

3.1.1 SAC files from NPWS

The NPWS file for Lough Corrib cSAC did not contain any mapped locations of petrifying springs. The explanatory notes admitted the possibility of their presence within the cSAC, as the site was deemed to have the “necessary ecological conditions required”; however, further survey and research was recommended. No additional data were available in the files to indicate that further surveys had been carried out.

3.1.2 2013 Article 17 reporting

A total of 83 hectads were reported to contain petrifying springs (NPWS 2013); however, none of these hectads coincided with the study area. The study area is covered by hectads M22, M23, M32 and M33. The closest hectads in which petrifying springs were recorded were M21 and M31 in Co. Clare to the south, and M24 to the north, on the Galway/Mayo border (see Figure 2, reproduced from NPWS (2013)). NPWS (2013) describes the range for petrifying springs as being “concentrated in the midwest to northwest of Ireland (Counties Clare to Sligo) and in the east midlands from the Dublin coast, extending into Co. Kildare and the Slieve Bloom Mountains”. The study area falls outside of this range.

3.1.3 Consultation

None of the three people consulted were aware of petrifying springs within Lough Corrib cSAC or the study area. One location at Ballindooley Lough was suggested for survey by Melinda Lyons as having similar visual characteristics (as viewed on aerial photographs) to a known petrifying spring site in Co. Mayo. Both Melinda Lyons and Julie Fossitt suggested quarries (M. Lyons specified abandoned quarries) as possible sites for petrifying springs.

3.2 Field study

3.2.1 Areas recommended following consultation

An area at Ballindooley Lough was recommended for survey as a possible petrifying spring by Melinda Lyons. This area was viewed during the field survey in March 2014; however, due to heavy rainfall and severe flooding this area could not be surveyed until June 2014. When surveyed in June, significant marl deposits were seen in the shallow water at the edge of the lake on the northern and eastern but no tufa formations were seen.

Apart from a previously quarried area of rock at Terryland, results of which are detailed below in Table 2, no abandoned quarries were thought to exist in the study area. The quarries at Lackagh and the Roadstone Quarry on the N17 were considered to be active and were not surveyed as part of this study.

3.2.2 Karst springs

Table 1 lists the karst springs mapped by the Geological Survey of Ireland (GSI) within the study area and the observations noted during the field survey, including any limitations to the survey. Reference is made to the hydrogeology survey (Karst Study Report) where this provides further information. No tufa formation was noted at any of the karst springs located. Not all springs could be located, primarily due to the presence of buildings on the point indicated by GSI mapping. Two potential springs were not viewed in the field, one due to dangerous livestock, the other due to inaccessibility.

Interpretation of high-resolution aerial photographs, flown in 2013, was carried out as necessary for springs that could not be located or visited to determine the likelihood of petrifying springs being present. The predominance of improved or semi-improved agricultural farmland in these areas means that the likelihood of intact tufa-forming springs is negligible.

Table 1. Karst springs within the *7220 study area of the N6 Galway City Transport Project.

Spring name	Location given in GSI shapefile (Irish grid)	Survey notes
Coolagh 1	M13475 27550	Building located on GSI point; no springs or seepages noted in adjacent areas. No spring found during Hydrogeologist's survey.
Coolagh 2	M13466 27140	Dangerous livestock prevented examination of GSI point, which was located at edge of semi-improved field. Spoke to two landowners, including owner of livestock; neither had any knowledge of springs, wells or upwellings in the field or the local vicinity. Examination of aerial photo and 6" map indicate negligible likelihood of petrifying spring (no water feature). No spring found during Hydrogeologist's survey.
Coolagh 3	M13490 27050	Unable to access land; from aerial photo, location given for spring is adjacent to silage pit and within a farm storage area; negligible likelihood of petrifying spring. No spring found during Hydrogeologist's survey.
Coolagh 4	M13502 27160	House located on GSI point, no springs or seepages noted in adjacent areas. No spring found during Hydrogeologist's survey.
Coolagh 5	M13508 27140	Building located on GSI point, no springs or seepages noted in adjacent areas. No spring found during Hydrogeologist's survey.
Coolagh 6	M13511 27060	Cattle trough in vicinity of GSI point, no spring found. No spring found during Hydrogeologist's survey.
Ballintemple 1	M13536 28300	Area in vicinity of GSI point has been excavated, with piles of sand and gravel present, as well as much standing water; possibly a former spring, but not tufa-forming. No spring found during Hydrogeologist's survey.
Ballintemple 2	M13548 28300	No evidence of spring in vicinity of GSI point. Not accessed during Hydrogeologist's survey (dangerous livestock).
Ballintemple 3	M13543 28220	Walled spring under large hawthorn tree with scrub found 40m to east of GSI point; no tufa formation. Noted in Hydrogeologist's survey as a non-karst feature.
Ballintemple 4	M13540 28180	No evidence of spring in vicinity of GSI point. Does not coincide with Hydrogeologist's survey point.
Doughiska 1	M13490 25750	Spring found 27m south of GSI point; trees and wet vegetation noted; no tufa formation.
Doughiska 2	M13461 25740	No evidence of spring in vicinity of GSI point, which is in an old quarry. Seepages noted on old quarry face to the north, but no tufa formation. Hydrogeologist's survey notes natural flow and location of spring likely modified due to quarry excavation.

Table 1 (ctd.)

Spring name	Location given in GSI shapefile (Irish grid)	Survey notes
Ardaun	M13598 25900	Depression in field to north of GSI point viewed from adjoining field; infilling with rocks and waste materials and has abundant Common Nettle growing. Hydrogeologist's survey notes depression is fed by runoff, not ground water. This indicates petrifying spring not present.
Castlegar 1	M13181 27940	Castlegar village well still extant but not tufa-forming.
Castlegar 2	M13185 27870	No evidence of spring in vicinity of GSI point; intensive farmland. Marl deposits were evident in the river banks near the GSI point for this spring, as well as in small streams and ditches in the vicinity; however, no evidence of tufa formation found. Does not coincide with Hydrogeologist's survey point.
Carrowbrowne 1	M13155 30110	No evidence of spring in vicinity of GSI point; intensive farmland. Does not coincide with Hydrogeologist's survey point.
Carrowbrowne 2	M13146 30170	No evidence of spring in vicinity of GSI point; intensive farmland. Does not coincide with Hydrogeologist's survey point.
Carrowbrowne 3	M13150 30700	Not visited; GSI point appears from aerial photo and viewing of adjacent land to be situated in semi-improved agricultural grassland; negligible likelihood of petrifying spring. Does not coincide with Hydrogeologist's survey point.
Ballindooley Castle	M13150 29100	Spring-fed well (GSI data and Hydrogeologist's survey note estavelle present here) found southeast of GSI point. No tufa formation.
Pollkeen	M13439 29320	No evidence of spring in vicinity of GSI point; intensive farmland. Does not coincide with Hydrogeologist's survey point.
Portdarragh	M12529 35800	Wet patch in centre of improved agricultural grassland present at GSI point may indicate site of former spring; however, no petrifying spring found. Does not coincide with Hydrogeologist's survey point.

3.2.3 Other priority areas searched

Table 2 lists details of the other areas targeted for survey following selection on the basis of hydrological features in combination with edaphic factors. It should be noted that the GSI dataset did not identify any karst features of interest in these areas. As for karst springs, interpretation of recent high-resolution aerial photographs was carried out for polygons that could not be visited to determine the likelihood of petrifying springs being present. Tufa formation was recorded at polygon 27 at Annaghdown; see section 3.2.4 below for further details.

Table 2. Polygons surveyed following selection on basis of edaphic and hydrological features.

Polygon no. / Townland	Centroid (Irish grid)	Survey notes
1/Brownville	M25809 29259	Access denied to polygon; well/spring at top of road was checked for tufa formation and characteristic mosses, but none were found.
2/Pollagh 1	M24761 29377	A wooded garden. Restricted view, but likelihood of petrifying spring is negligible.
3/Pollagh 2	M24763 29570	Wet woodland, no tufa formation was found.
4/Pollagh 3	M25083 29705	Wooded; unable to obtain access for survey.
5/Pollagh 4	M24252 29224	Restricted view; there now appears to be a newly built house and driveway over most of the polygon, likelihood of petrifying spring is negligible.
6/Tooreeny	M23551 29911	Road cuts through some of this polygon, woodland to the northeast could not be accessed.
7/Addragool	M23350 30692	Improved agricultural grassland, houses and woodland/scrub; includes rocky area adjacent to Ballyquirke Lough, which was searched, but no tufa formation was found.
8 & 9/Clooniff 1	M24046 30567	Almost entirely improved agricultural grassland and houses, no petrifying spring found.
10/Clooniff 2	M25208 31083	Flooded lakeside, limestone rocks present; habitat appears suitable for tufa formation, but a thorough search was conducted and no tufa formation was found.
11/Tumnasrah 1	M24198 32502	Flooding from drainage ditch noted but polygon is mostly improved agricultural grassland and houses; no evidence of tufa formation found.
12/Tumnasrah 2	M24430 32595	Polygon is mostly improved agricultural grassland and houses; some woodland/scrub noted (alder and brambles), as well as a wet hollow or ditch, but no evidence of tufa formation found.
13/Clooniff 3	M23182 32516	Wooded area partly on vertical rocky face running alongside road; no springs or water features found; no tufa formation found here or on west of road beside lake; improved agricultural grassland occurs west of woodland strip, likelihood of petrifying spring here is negligible.
14/Ballyquirke West	M22534 32726	Some of polygon is improved agricultural grassland, where likelihood of petrifying spring is negligible. Areas of woodland could not be accessed. Small river or drainage ditch runs through acidic bog nearby into Ballyquirke lake. No tufa formation found, but search in this area was not exhaustive and possibility of their occurrence cannot be ruled out.
15/Moycullen	M23118 33407	Improved agricultural grassland plus dwelling houses. No suitable habitat for petrifying springs present.
16/Ballynahallia	M23134 34624	Wet grassland and improved agricultural grassland; also noted presence of acidic bog; no tufa formation.
17/Leagaun	M23122 34291	Ash wood and calcareous grassland with mossy raised areas and wet hollows between; lazy beds present; seepage from adjacent bog noted but no tufa formation.

Table 2 (ctd.)

Polygon no. / Townland	Centroid (Irish grid)	Survey notes
18/NW of Terryland	M29131 27440	This polygon and entire vicinity surrounding it were walked; woodland and grassland (wet and dry calcareous) present but no evidence of tufa formation found.
19 & 20/Terryland 1 & 2	M29285 27079 & M29465 27259	Quarried area of calcareous rock east of selected area searched for petrifying springs but no water feature found. Selected polygons were viewed during general habitat mapping project and no evidence of petrifying springs was found. Hydrogeologist's survey noted possible spring in this area, but was dry at time of their survey, this absence of water signifying absence of petrifying spring.
21/Castlegar	M31674 27437	Marl deposits evident in main river banks, also in small streams and ditches in vicinity; however, river has been highly modified and no tufa formation found. Soil in this polygon is peaty. Damp patches and hollows evident in parts of polygon but no evidence of tufa or calcareous mosses in these. Hydrogeologist's survey notes springs and swallow holes in this polygon with water present.
22/Cloonacauneen	M33625 30419	Improved agricultural grassland; holy well near polygon viewed, but no water present.
23/Pollkeen	M33186 30004	Mostly improved agricultural grassland; one area of hazel woodland found but no water feature present.
24/Carrowbrowne 1	M32334 30464	Halting site on part of the polygon; remainder that could be seen appears to be improved agricultural grassland, where likelihood of petrifying spring is negligible. Northern part of polygon, which appears to be wet grassland from aerial photograph, could not be viewed.
25/Carrowbrowne 2	M32407 31550	Could not access; landfill site appears to cover much of this polygon; likelihood of petrifying spring is negligible.
26/Kiloughter	M30753 30840	Not visited. Semi-improved agricultural fields which are bounded by drainage ditches; likelihood of petrifying springs is negligible.
27/Annaghdown Fen	M29080 38128	Petrifying spring mosses and tufa formation noted – see full description below.
28/Portdarragh Fen & environs	M24684 36141	River rises in middle of calcareous fen; fairly extensive area of habitat suitable for petrifying spring, but no tufa formation or petrifying spring mosses found. Hazel woodland on limestone rock present north of river but no water feature found; pools of standing water in adjacent calcareous fields checked for evidence of tufa formation but none found.
29/Menlough Fen	M28439 28828	<i>Schoenus nigricans</i> fen with <i>Molinia caerulea</i> , <i>Succisa pratensis</i> and <i>Centaurea nigra</i> . Main area of fen was flooded in March but unflooded edge was surveyed; no tufa found. Subsequent surveys for general habitat mapping project following flooding abatement found no evidence of petrifying springs.

3.2.4 Description of *7220 Petrifying spring with tufa formation at Annaghdown

One area of petrifying spring, comprised of four discrete polygons (Figure 5), was found in calcareous fen at the extreme northwest of the study area, located approximately 1 km outside of the cSAC.

Townland: Annaghdown

Grid reference (Irish grid): M29600 38350

Approximate area of habitat: 850 m²

General description of habitat and landscape context:

The first of the four polygons is a strip measuring 0.5 m x 12 m. Diffuse deposits of tufa were noted. Species recorded include *Palustriella* sp., *Scorpidium revolvens*, *Calliergonella cuspidata*, *Schoenus nigricans*, *Cardamine pratensis*, *Carex* cf. *panicea*, *Juniperus communis*, *Carex viridula*, *Agrostis* cf. *stolonifera*, *Nostoc* blue-green alga, and filamentous green alga.

Flotsam from the lake is being deposited on the tufa, and tracks (whether from people or livestock is unclear) run through the strip. Just below the tufa formation is a small pool measuring 3.5 m x 6 m, 22 cm deep, in which tufa deposits on the vegetation in the water were seen. Species recorded here include *Scorpidium* sp., *Ranunculus flammula* and *Eleocharis* sp., with *Schoenus nigricans*, *Calliergonella cuspidata*, *Carex* sp., *Succisa pratensis* and *Festuca rubra* growing at the edge of the pool.

Anthills were noted along the lake shore on slightly higher ground, while Juniper formations were noted in the vicinity of the tufa formations, and *Cladium* fen was seen further into the lake.

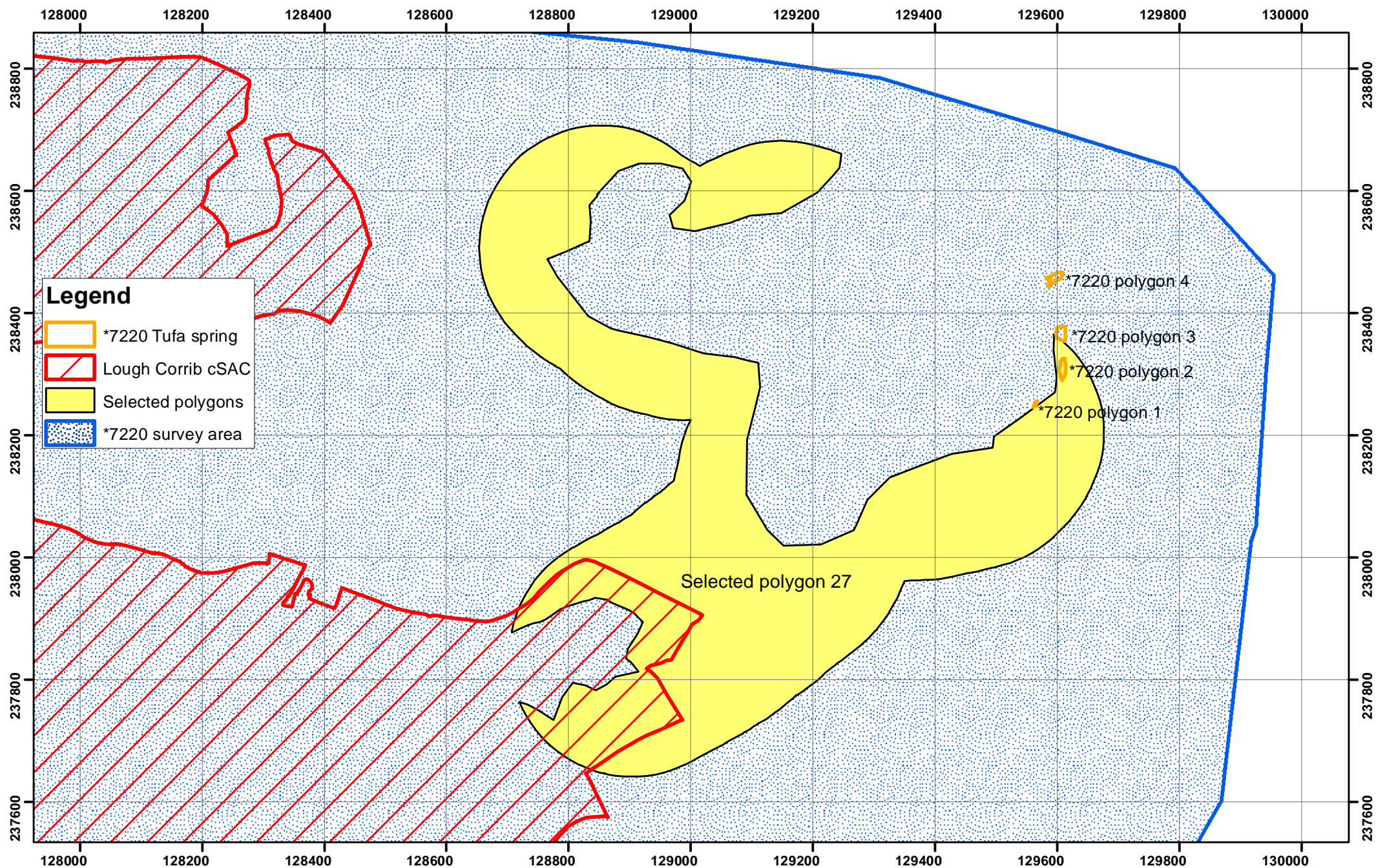
A second, larger area of tufa formation (polygon 2) is located approximately 50 m northeast, and it was evident during the field survey that this area had been inundated during recent flooding.

The third polygon, located about 30 m north of polygon 2, is the most extensive, measuring 22 m x 17 m. *Carex viridula*, *C. panicea*, *Schoenus nigricans* and *C. flacca* are present. Bryophytes are sparse. Due to the paucity of vegetation, the sand and gravel substrate is readily visible here. Tufa is being deposited on this inorganic substrate, but deposits were also noted on the vegetation. This area is prone to trampling. The area of tufa formation extends both above and below the flood zone; therefore some flotsam is present on some of the Annex I habitat here. Horses graze this area periodically, with evidence provided by old droppings.

Polygon 4 is located approximately 75 m north of polygon 3. Tufa formation on *Scorpidium* sp. is particularly noticeable here. At this furthest extent of the habitat, *Schoenus nigricans*, *Anagallis tenella* and *Succisa pratensis* are the main vascular plant species noted, with cover of *S. pratensis* good for the time of year, suggesting it might be of value as a site for Marsh Fritillary.

It should be noted that all of these tufa deposits occur in seepage areas rather than springs. As such, they do not conform to the definition of petrifying springs as given in the EU Interpretation Manual of Annex I habitats, but they do conform to the broader definition of petrifying springs used by NPWS for Ireland.

Figure 5. Areas of *7220 habitat at Annaghdown



4 Discussion

A single location was found of the Annex I habitat *7220 Petrifying springs with tufa formation within the *7220 study area for the N6 Galway City Transport Project. The area was located approximately 1 km east of the Lough Corrib cSAC. This find represents a new record for the habitat, adding hectad M23 to the known distribution and range of *7220 habitat in Ireland.

The finding of the tufa deposits at Annaghdown indicate the GIS approach adopted through this project to assist in the identification of potential sites was successful. However due to the large extent of the survey area this cannot be taken to be definitive proof of the absence of petrifying springs from the remainder of the scheme study area. It is considered that, where targeted features (karst springs from the GSI dataset, and calcareous polygons near watercourses identified from GIS spatial analysis) occur in the context of improved or semi-improved agricultural grassland or farmland, and where no water features can be detected from high-resolution aerial photographs or six-inch maps, the likelihood of petrifying springs occurring in these situations is negligible.

According to the Environmental Protection Agency's (EPA) subsoils polygon shapefile, the parent material of much of the area found during this survey to contain petrifying spring habitat was acidic cutover peat (albeit located close to calcareous parent materials) rather than a calcareous substrate, which was assumed would be the case during polygon selection. It is therefore possible that the selection parameters used to prioritise areas for survey may have missed some potential areas of petrifying spring on cutover peat located in close proximity to calcareous substrate.

The tufa deposits noted at Annaghdown were as a result of seepage rather than from a spring. According to the Interpretation Manual of EU Habitats (CEC 2013), Annex I habitat 7230 Alkaline fens may also be associated with tufa formation, defining 7230 habitat as "*wetlands mostly or largely occupied by peat- or tufa-forming small sedge and brown moss communities developed on soils permanently waterlogged, with a soligenous or topogenous base-rich, often calcareous water supply, and with the water table at, or slightly above or below, the substratum*". However, as noted above in section 1.2, the definition for *7220 Petrifying springs with tufa formation given in the most recent "Status of EU Protected Habitats and Species" report for Ireland (NPWS 2013) is somewhat broader than that in the interpretation manual, encompassing seepage areas in addition to spring heads, which may occur in close association with 7230 Alkaline fens. While the possibility exists that the habitat at Annaghdown documented by this survey could be referable to Annex I habitat 7230 rather than *7220, the authors are confident that, on the basis of the definition given in NPWS (2013), *7220 habitat does exist at this site as described.

5 References

- CEC (Commission of the European Communities) (2013) Interpretation manual of European Union Habitats EUR28. European Commission, DG Environment.
- Hodd, R. (2015)
- Lyons, M.D. & Kelly, D.L. (2013) Conservation status assessment for petrifying springs. Unpublished report for National Parks & Wildlife Service, Dublin.
- NPWS (National Parks & Wildlife Service) (2013) The Status of EU Protected Habitats and Species in Ireland. Habitat Assessments Volume 2. Version 1.1. Unpublished report, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

6 Websites for data downloads

Geological Survey of Ireland (GSI) data downloaded from Department of Communications, Energy & Natural Resources website at

<http://www.dcenr.gov.ie/Spatial+Data/Geological+Survey+of+Ireland/GSI+Spatial+Data+Downloads.html>

Soils data downloaded from EPA at <http://gis.epa.ie/GetData/Download>

Rivers vector dataset requested and obtained directly from EPA via “Contact us” page:
<http://gis.epa.ie/Contactus>

Appendix 1: Photographs of habitats surveyed for *7220 Petrifying springs with tufa formation for N6 Galway City Transport Project



Plate 1. Flooded area of potentially suitable habitat for *7220 at Menlough



Plates 2 & 3. Marling visible along river bank at Castlegar



Plate 4. Dry well/karst spring at Cloonacauneen



Plates 5 & 6. Quarried area near Terryland



Plates 7 & 8. River source and adjacent calcareous small sedge fen at Portdarragh



Plates 9 & 10. Lakeside limestone habitat at Clooniff



Plate 11. Lazy beds at Leagaun



Plates 12 & 13. Tufa deposition at Annaghdown



Plates 14 & 15. Overview and detail of *7220 Petrifying springs with tufa formation habitat at Annaghdown; tufa formation visible in foreground in sparsely vegetated, trampled areas in overview (left) and in close-up (right)



Plates 16 & 17. Marl deposits at Ballindooley Lake



Plate 18. Spring-fed well near Ballindooley Castle



BEC Consultants Ltd.

43 Herbert Lane,
Dublin, D02 TE86

Telephone: +353 (0)1 6619713

Email: info@botanicalenvironmental.com

Web: www.botanicalenvironmental.com

