OLD QUAY SCHOOL BALLINA
PETRIFYING SPRING SCRUB CLEARANCE
November 2022

May 2023

Scrub clearance by hand from petrifying spring area, November 2022

Report produced by Denyer Ecology

This work was commissioned by River Moy Search and Rescue Ballina.

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Landowner permission from Mrs. Joan Cowley and the Cowley Family

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1 INTRODUCTION

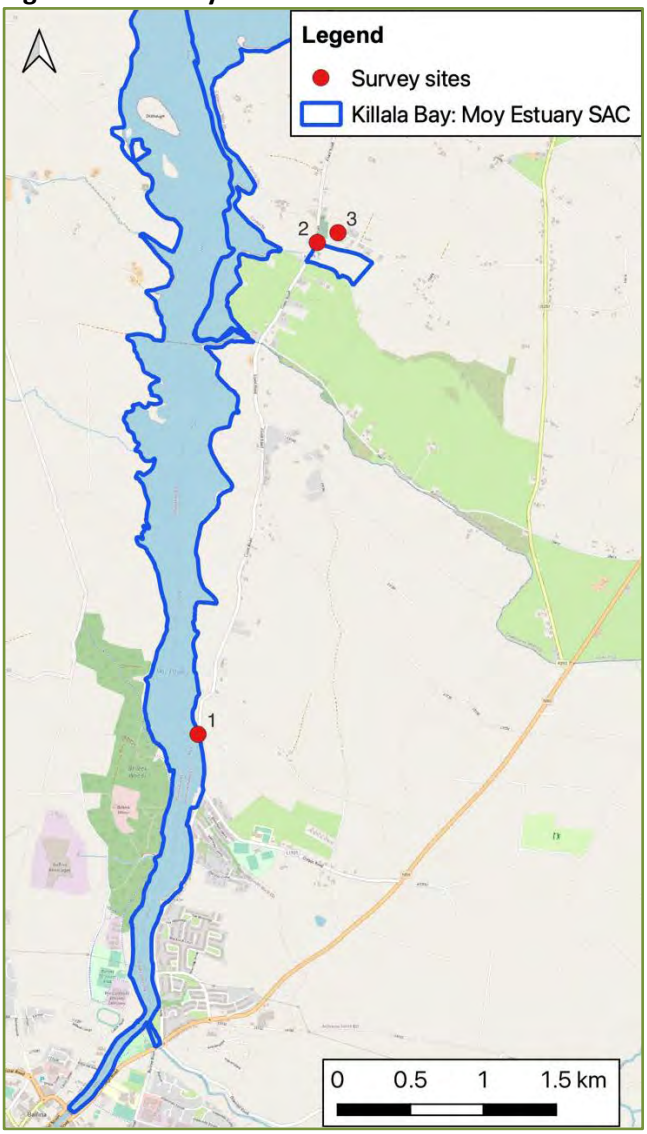
1.1 Background and survey area

Denyer Ecology was commissioned by River Moy Search and Rescue Ballina to supervise and monitor vegetation clearance from a petrifying spring near the Old Quay House, Ballina. This petrifying spring was surveyed in summer 2021 by Joanne Denyer (Denyer Ecology, 2021) and assessed as an Annex I priority petrifying spring [*7220]. It was becoming overgrown with scrub, and it was advised that sensitive scrub clearance be undertaken.

The work in 2022 involved in following:

- On site supervision of vegetation clearance works (Site 1, Figure 1.1).
- Monitoring of a petrifying springs plot set up in 2021.
- Assessment of areas of potential Annex I petrifying springs to the north (inland) of the Old Quay House (Sites 2 and 3, Figure 1.1).
- Assessment of areas of petrifying spring along the shoreline of the Moy Estuary to the north and south of the Old Quay House (these had not had flow during the main spring survey of summer 2021) (Site 1, Figure 1.1).

Figure 1.1. Survey sites 2023



1.2 Relevant expertise

Dr Joanne Denyer (Denyer Ecology)

Dr Joanne Denyer is a highly experienced botanist and bryologist with 20 years' experience of ecological survey and research. She is experienced in the identification of all plant groups, including difficult groups such as aquatic macrophytes, charophytes and bryophytes. Dr Denyer specialises in wetland habitats and including Annex I habitat priority petrifying springs and has worked on a wide range of projects and sites in relation to this habitat. This includes detailed survey, assessment and monitoring, Ecological Impact Assessment and acting as an expert witness on calcareous springs at Oral Hearing. She provides advice on this habitat to County Councils and National Parks and Wildlife Service (NPWS). In 2018 she assisted NPWS in the Article 17 reporting (national Conservation Status Assessment) on Petrifying springs to the European Commission (under Article 11 of the Habitats Directive, each member state must report every 6 years on the conservation status of Annex I habitats). She is the lead author of the recently published NPWS Irish Wildlife Manual No. 42, '*Guidelines for the assessment of Annex I priority petrifying springs in Ireland*' (Denyer *et al.,* 2023).

1.3 Desktop information

The following resources were consulted:

- 2021 Petrifying spring survey report for the Moy Estuary area (Denyer Ecology, 2021).

1.4 Consultation

The following organisations and individuals were consulted for this project:

- National Parks and Wildlife Service
- Site landowners (undertaken by River Moy Search and Rescue Ballina)

2 SCRUB CLEARANCE

2.1 Methodology

- Scrub clearance was undertaken in November 2022 by a team of 5 contractors with experience of working on sensitive sites.
- Vegetation clearance was undertaken outside of the breeding bird season and in liaison with relevant National Parks and Wildlife Service (NPWS) staff.
- The scrub clearance was supervised on site by a petrifying springs ecologist (Dr Joanne Denyer).
- Clearance was undertaken using hand strimmer and chainsaws (where required for woody vegetation) (Photograph 2.1).
- As the scrub was cleared it could be seen where there was petrifying spring vegetation under the scrub. This was used to guide where further clearance should be undertaken, to ensure all former spring areas were cleared of scrub.
- The invasive plant Winter Heliotrope *Petasites fragrans* is present on the site and on the spring mound (Photograph 2.2). To ensure that there was no spread of this species, areas of Winter Heliotrope were avoided by the contractors. It was not possible to fence these areas as there were several patches of the plant scattered throughout the working area. Before commencement of work, the workers were shown the plant and where it was on site, how to access areas and where not to go. All works were supervised by the project ecologist.
- The access routes, working area and removal of vegetation all avoided Winter Heliotrope areas.
- Where Winter Heliotrope was present on the spring, these areas were not cleared of vegetation to avoid any disturbance to Winter Heliotrope.
- All vegetation was cleared by hand to avoid the use of machinery around Winter Heliotrope.
- One machine was used to lift the bags of vegetation from the spring into the truck on the road (Photograph 2.3). This was used from the top of the bank. A safe access point on the bank, with no Winter Heliotrope, was identified which was just wide enough for the machinery as

there were frequent scattered plants here. The machinery use was supervised by the project ecologist.

- All material that was cut on the spring was raked and removed from site (Photograph 2.4). The rakes were used lightly so as not to damage any petrifying springs vegetation below. Some Ivy stem mats were left on the upper bank as clearance could have led to later erosion from bare soil. However, most of the woody/ scrub debris was able to be removed.
- The scrub/ treeline to the south of the spring was topped (not removed) to reduce shading of the spring but avoid disturbance of Winter Heliotrope which was growing nearby (Photograph 2.5).
- The area to the south of the spring, where there had been past dumping of vegetation on the estuary bank, was not cleared. This was because there was Winter Heliotrope growing on the bank and machinery could not be used in this area. An Invasive Species Plan (ISP) is being prepared to treat this area so that the vegetation can be removed. Machinery use is required here because of the volume of dumped material.

Photograph 2.1. Vegetation clearance using hand strimmer

Photograph 2.2. Winter Heliotrope *Petasites fragrans* on the main spring mound

Photograph 2.3. Machinery lifting cleared vegetation (under supervision by the project ecologist). Red arrow shows Winter Heliotrope.

Photograph 2.4. Hand raking of cleared vegetation (avoiding areas of Winter Heliotrope – red arrow)

Photograph 2.5. Topping of hedgerow shading spring from south (avoiding area of Winter Heliotrope – red arrow)

2.2 Results

Photos of the spring mound before and after vegetation clearance are shown in Photographs 2.6-2.11. Once the vegetation had been cleared, tufa, occasional petrifying spring indicator species and flowing water could be seen which had previously been hidden under the vegetation (Photographs 2.12-2.15).

Photographs 2.6-2.11. View of petrifying spring mound before (photos on left) and after (photos on right) vegetation clearance

Photograph 2.6a. Before vegetation clearance – mound of petrifying spring hidden beneath scrub (view to E from estuary)	**Photograph 2.6b.** After vegetation clearance – mound of petrifying spring can now be seen (view to E from estuary)
	
Photograph 2.7a. Before vegetation clearance – most of petrifying spring hidden beneath scrub (view to SE from estuary)	**Photograph 2.7b.** After vegetation clearance – petrifying spring mound now visible (view to SE from estuary)
	

Photograph 2.8a. Before vegetation clearance – petrifying spring hidden beneath scrub (view to NE from estuary)	**Photograph 2.8b.** After vegetation clearance – petrifying spring mound now visible (view to SE from estuary)
	
Photograph 2.9a. Before vegetation clearance – most of petrifying spring hidden beneath scrub and second water channel not visible (view to W from roadside)	**Photograph 2.9b.** After vegetation clearance – petrifying spring mound exposed and water flow on N part now visible (view to W from roadside)
	

Photograph 2.10a. Before vegetation clearance – only a narrow channel still open, due to scrub on northern section of petrifying spring (view to E from estuary)	**Photograph 2.10b.** After vegetation clearance – northern section of petrifying spring mound now exposed (view to E from estuary)
	
Photograph 2.11a. Before vegetation clearance – the northern part of the mound compeltely covered in scrub (view to NW from top of bank)	**Photograph 2.11b.** After vegetation clearance – northern section of petrifying spring mound exposed and water flow visible (view to NW from top of bank)
	

Photograph 2.12. Area where water flows into spring (after flowing under road) now visible (view to N)

Photograph 2.13. Water visible flowing across area of spring which was previously covered by scrub

Photograph 2.14. Tufa and petrifying spring bryophytes in area newly cleared of scrub on spring mound

Photograph 2.15. Tufa formation on roots and other woody material at the estuary edge of the mound

2.3 Future work

- Additional monitoring plots were not set up at the time of vegetation clearance, as it was not clear where the course of the petrifying spring will settle now that the scrub has been removed. These plots will be set up in 2023 once the water flow has settled and spring vegetation starts to recover.
- The spring should be monitored in 2023 to see if an additional vegetation strim is needed.
- The Winter Heliotrope should be monitored in 2023 and any change in distribution recorded. An Invasive Species Plan (ISP) is being prepared for the area and it will hopefully be possible to treat the Winter Heliotrope that is present on the spring (and adjacent areas).

3 OLD QUAY HOUSE SPRING MONITORING PLOT

3.1 Methodology

The petrifying spring baseline plot which was established in 2021 was re-surveyed in 2022. The methodology followed Lyons & Kelly (2016) and Denyer *et al.,* (2023) (which was in preparation at the time of survey). One plot was surveyed. In addition, a water sample was collected and the following parameters were measured at an EPA approved laboratory: pH, ammonia, alkalinity, calcium, magnesium, potassium, sodium, chloride, nitrate, phosphate and sulphate.

3.2 Results

The full details of the surveyed plot are included in Appendix A and summarised in Table 3.1. The water chemistry data is included in Appendix B.

Table 3.1 Summary of monitoring plot characteristics

Survey year	Spring no.	Plot no.	Vegetation community	Tufa formation	Positive indicator species	Plot species richness
2021	M04	MR02	Group 4	Total 100%: Cascade 60%; paludal 10%; stream crust 30%	5	15
2022	M04	MR02	Group 4	Total 100%: Cascade 60%; paludal 10%; stream crust 30%	5	17

- In 2021 the monitoring plot failed on one criterion: presence of an invasive species (note that this was excluded in error in Denyer (2021); the 2021 Quay House monitoring plot details have been updated and are included in Appendix A as the baseline).
- In 2022 the monitoring plot failed 2 criteria: invasive species and negative bryophyte indicator species (as one species *Cratoneuron filicinum*, was abundant).
- In both monitoring surveys the invasive species *Petasites fragrans* was present in the spring. It had a cover of 3% in 2021 and 5% in 2022.
- The main difference in species cover between the two surveys was that in 2021 the positive bryophyte indicator species *Palustriella commutata* was abundant with 30% cover and negative bryophyte indicator species *Cratoneuron filicinum* was 3%. In 2022, *Palustriella commutata* had 5% cover and *Cratoneuron filicinum* 20% cover.
- It is possible that this change is due to ongoing impact high nutrients in the spring from the dumped vegetation and scrub that had developed on the spring mound. However, this would most likely lead to an increase in nitrates and the level of nitrates (1.7 mg/l in 2021 and 2.0 mg/l in 2022) is well below the condition assessment threshold of 10mg/l.
- Phosphate levels in the spring are below the condition assessment threshold of 15 µg/l and quote close to this level (10 µg/l in 2021 and 13 µg/l in 2022).
- Further monitoring will assess if there is an ongoing increase in nutrient levels in the spring water.

3.3 Future work

- The monitoring plot should be re-surveyed in 2023 to assess if there has been any change in the spring in relation to the vegetation clearance.
- As noted in Section 2.3, further plot(s) should be set up on the spring in 2023 in areas where there is regular water flow and likely to be tufa formation.
- Water chemistry sampling should be repeated in 2023. If possible, this should include a sample from the spring origin to the east of the road (with landowner permission) to assess where the high phosphate levels are arising.

4 ADDITIONAL SPRING SITES

4.1 Methodology

Areas that had the potential to support Annex I petrifying springs that were either not surveyed in 2021 (as unknown) or only have winter flow, were visited. The aim was to assess if they support tufa formation and petrifying spring vegetation. Detailed water chemistry was collected from one of the springs. This was sent for analysis to an EPA approved laboratory. These were analysed for a number of parameters of including pH, conductivity, nitrates and phosphates (Appendix B).

4.2 Results

The results of the survey of additional potential petrifying spring sites are summarised in Table 4.1. Their locations are shown on Figures 1.1 and 4.1. None of the additional sites were considered to support Annex I petrifying spring habitat, although site 2 did have locally extensive tufa formation and one positive indicator species. All springs except site 4 are located within/ adjacent to the River Moy SAC are important wetland features of this SAC.

Table 4.1. Summary of additional potential petrifying springs

Site	Description	Photo
Site 1 Seasonal springs along the shoreline from the Old Quay House main spring (Figures 1.1 & 4.1)	Northern point on Figure 4.1. Tufa present on rocks with some flow. No bryophytes or flowering plants that are indicative of petrifying springs present. Unclear if slight flow was due to recent heavy rain or if there is permanent seepage here. = Non-Annex tufa forming spring	
	Seasonal stream flowing from estuary bank. No bryophytes or flowering plants that are indicative of petrifying springs present and no tufa observed. =Non-Annex spring/ stream	

Site	Description	Photo
Site 2 Roadside tufa, nr Killanley Church (Figure 1.1)	This site is located within and adjacent to an inland area of the Moy Estuary SAC (Figure 1.1.). Tufa forms around drains at the edge of a field and it is possible that there is tufa formation within the field. The bryophytes *Pellia endiviifolia* and *Cratoneuron filicinum* were present. Although heavily tufa forming, there were not enough positive indicator species present for this to be an example of an Annex I petrifying springs. However, there may be additional tufa springs in this area in areas that are less disturbed by drain cleaning and which have more species. = Non-Annex tufa forming spring	
Site 3 Stream with potential tufa, nr Killanley Church (Figure 1.1)	This is a small stream which flows through farmland. The pH of the stream was 7.5 so it is a calcareous stream and possibly partially spring fed. Watercress *Nasturtium officinale* was dominant in the channel. However, no tufa was observed. A water sample showed that nitrate (0.66 mg/l) and ortho-phosphate (12.0 µg/l) were under the threshold level for good condition in a petrifying spring (although the phosphates are still moderately high). = Non-Annex spring fed stream (no tufa)	

Figure 4.1. Location of additional spring/ seepages at Site 1

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APPENDICES

APPENDIX A - QUAY HOUSE SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2021 & 2022

Survey 2021

Site name: Quay House	**Spring name:** M04	**Relevé No.:** MR02
Survey date: 05/08/2021	**Relevé dimensions:** 2m x 2m	**Relevé area:** 4m^2
Grid reference: G2573321569	**Spring type:** Stream flowing into estuary	
Slope: 20°	**Altitude (m):** ca. 11m	**Aspect:** W
pH: 8.11 (field); 7.7 (lab)	**EC:** 750 µS/cm (lab)	**Temp.:** 12.4 (field)

Spring description: This is a spring which arises in a property to the east of the coast road. It flows down the hill and under the road. Below the road it forms a large tufa mound (Figure 1.1) and discharges into the estuary. The main tufa formation is cascade tufa but there is also significant stream crust tufa in the main spring channel and some paludal tufa. The tufa mound extends approximately 20m along the shoreline. Where the spring joins the estuary, the tufa cascades are algal covered. Much of the main tufa mound is dominated by trees and scrub. The relevé was undertaken in the area with the highest cover of petrifying spring vegetation. The vegetation is bryophyte dominated, with abundant *Palustriella commutata* and occasional to frequent *Bryum pseudotriquetrum, Palustriella falcata* and *Brachythecium rivulare.* The main vascular plants are *Agrostis stolonifera, Festuca rubra* and *Potentilla reptans* with patches of *Equisetum variegatum*. The invasive non-native species *Petasites fragrans* is present.
The vegetation has most affinity to **Group 4 *Palustriella commutata-Agrostis stolonifera Springheads*** vegetation community (Lyons & Kelly, 2017).

Relevé location:

The relevé (Figure 1.1; red arrow Photograph 1.1) is located on the top of the tufa mound.

Figure 1.1. Relevé location (M04)

Photograph 1.1. Relevé location (view to W)

DETAILED RELEVÉ

Physical characteristics

Tufa	% Cover	Water	% Cover	Surface	% Cover
Cascade	60	Flowing/ trickling	40	Living field/ ground flora	80
Paludal (3)	10	Pool/ standing water	5	Bare tufa (active/ recent)	20
Stream crust	30	Dripping	-	Ancient/ inactive tufa	-
Oncoids/ ooids	-	Damp	55	Leaf litter/ standing dead	-
Dam	-	Dry, not impacted by spring	-	Bare soil	-
Cemented rudites	-	Other:	-	Bare stone	-
Non-tufa	-			Other:	-
TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Paludal tufa: 1 = weak/ thin/ discontinuous, 3 = strongly forming/ continuous/ conspicuous

APPENDIX A - QUAY HOUSE SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2021 & 2022

Shrub/ canopy layer

Species	Routed outside Canopy (%)	Routed inside Canopy (%)	Routed inside Height (m)
Acer pseudoplatanus	5	-	-
Rubus fruticosus agg.	-	-	-
TOTAL CANOPY (ROOTED INSIDE + ROOTED OUTSIDE) %	**TOTAL %:** 5		
MAX HEIGHT (m) ABOVE QUADRAT (ROOTED INSIDE + ROOTED OUTSIDE):			1 m

Field/ ground flora

FORBS	%	GRAMINOIDS	%	BRYOPHYTES	%	WOODY	%
Potentilla reptans	10	*Agrostis stolonifera*	10	*Plagiomnium elatum*	1	*Hedera hibernica*	1
Angelica sylvestris	3	*Festuca rubra*	3	*Cratoneuron filicinum*	3		
Petasites fragrans	3			*Calliergonella cuspidata*	1		
				Palustriella commutata	30		
				Bryum pseudotriquetrum	8	**TOTAL WOODY <50cm**	**1**
				Brachythecium rivulare	3		
				Palustriella falcata	3	**PTERIDOPHYTES**	
				Plagiomnium undulatum	1	*Equisetum variegatum*	1
						TOTAL PTERIDOPHYTES	**1**
						ALGAE	
						Filamentous algae	0
						TOTAL ALGAE*	**0**
TOTAL FORBS	**16**	**TOTAL GRAMINOIDS**	**13**	**TOTAL BRYOPHYTES**	**50**	**TOTAL COVER**	**80**

*Algae not included in total vegetation cover (Lyons & Kelly, 2016)

Photos

Photograph 1.2. Tufa cascades where spring joins estuary (view to south)

Photograph 1.3. Vegetation within relevé (*Palustriella commutata, Equisetum variegatum, Potentilla reptans*)

APPENDIX A - QUAY HOUSE SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2021 & 2022

Condition assessment

Criteria	Result	Target value	Result and pass/ Fail
Species assessment criteria			
High quality indicator species	0 recorded	n/a (included below)	n/a (included with positive indicator species)
Positive indicator species	5 species recorded: *Festuca rubra, Palustriella commutata, Palustriella falcata, Bryum pseudotriquetrum, Equisetum variegatum*	3 species AND no loss from baseline number of species	Result = 5 positive indicator species **PASS**
Typical accompanying species (neutral indicators)	1 species recorded: *Agrostis stolonifera*	n/a	For information only
Invasive species	1 species recorded *Petasites fragrans*	Absent	Result = Absent **FAIL**
Negative herbaceous indicator species	0 species recorded	Total cover should not be dominant or abundant	Result = Absent **PASS**
Negative bryophyte indicator species	2 species recorded: *Cratoneuron filicinum, Brachythecium rivulare*	No one species dominant or abundant; if ≥2 species present) then fails if ≥2 are frequent or 1 is abundant	Result = 2 occasional **PASS**
Negative woody indicator species	Absent from relevé (but present on spring mound)	Absent (except in wooded springs)	**PASS**
Spring water composition and flow			
Nitrate level	Baseline unknown 2021 value = 1.7 mg/l	No increase from baseline and not above 10 mg/l	**PASS**
Phosphate level	Baseline unknown 2021 value (Ortho-P) = <10 µg/l	No increase from baseline and not above 15 µg/l	**PASS**
Water flow	Not determined	No alteration of natural flow	No obvious alteration **PASS**
Impacts of grazing			
Field layer height	25cm	Height between 10 and 50cm	Result = 10cm **PASS**
Trampling/dung	Absent	Impact should not be abundant/dominant	Result = Absent **PASS**
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		Green - Favourable	**Result = 1 Fail - UNFAVOURABLE - INADEQUATE**
1 - 2 Fail		Amber - Unfavourable Inadequate	
>2 Fail		Red – Unfavourable Bad	
Future prospects: Negative activities			
L02 Natural succession resulting in species composition change (other than by direct changes of agricultural or forestry practices)		Moderate negative impact, originating inside of site	**UNFAVOURABLE - INADEQUATE**

Conservation Score

Criteria	Result	Score
Species diversity score	5 positive indicator species (=moderate)	2
HQ Indicator Species	0	0
Tufa-forming capacity	Massive, strongly consolidated deposits (very high)	4
Other positive characteristics	Spring discharges into Killala Bay/Moy Estuary SAC	1
Conservation Score		7
Rank		**Very high**

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Survey 2022

Site name: Quay House	**Spring name:** M04	**Relevé No.:** MR02
Survey date: 08/11/2022	**Relevé dimensions:** 2m x 2m	**Relevé area:** 4m^2
Grid reference: G2573321569	**Spring type:** Stream flowing into estuary	
Slope: 20°	**Altitude (m):** ca. 11m	**Aspect:** W
pH: 7.76 (field); 7.7 (lab)	**EC:** 734 µS/cm (lab)	**Temp.:** 10.9 (field)

Spring description: This is a spring which arises in a property to the east of the coast road. It flows down the hill and under the road. Below the road it forms a large tufa mound (Figure 2.1) and discharges into the estuary. The main tufa formation is cascade tufa but there is also significant stream crust tufa in the main spring channel and some paludal tufa. The tufa mound extends approximately 20m along the shoreline. Where the spring joins the estuary, the tufa cascades are algal covered. Much of the main tufa mound is dominated by trees and scrub. The relevé was undertaken in the area with the highest cover of petrifying spring vegetation. The vegetation is bryophyte dominated, with abundant *Palustriella commutata* and occasional to frequent *Bryum pseudotriquetrum, Palustriella falcata* and *Brachythecium rivulare.* The main vascular plants are *Agrostis stolonifera, Festuca rubra* and *Potentilla reptans* with patches of *Equisetum variegatum*. The invasive non-native species *Petasites fragrans* is present.
The vegetation has most affinity to **Group 4 *Palustriella commutata-Agrostis stolonifera Springheads*** vegetation community (Lyons & Kelly, 2017).

Relevé location:

The relevé (Figure 2.1; red arrow Photograph 2.1) is located on the top of the tufa mound.

Figure 2.1. Relevé location (M04)

© OpenStreetMap contributors

Photograph 2.1. Relevé location (view to W)

DETAILED RELEVÉ

Physical characteristics

Tufa	% Cover	Water	% Cover	Surface	% Cover
Cascade	60	Flowing/ trickling	40	Living field/ ground flora	75
Paludal (3)	10	Pool/ standing water	5	Bare tufa (active/ recent)	10
Stream crust	30	Dripping	-	Ancient/ inactive tufa	-
Oncoids/ ooids	-	Damp	55	Leaf litter/ standing dead	5
Dam	-	Dry, not impacted by spring	-	Bare soil	-
Cemented rudites	-	Other:	-	Bare stone	-
Non-tufa	-			Other:	-
TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Paludal tufa: 1 = weak/ thin/ discontinuous, 3 = strongly forming/ continuous/ conspicuous

APPENDIX A - QUAY HOUSE SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2021 & 2022

Shrub/ canopy layer

Species	Routed outside Canopy (%)	Routed inside Canopy (%)	Routed inside Height (m)
Acer pseudoplatanus	5	-	-
Rubus fruticosus agg.	-	-	-
TOTAL CANOPY (ROOTED INSIDE + ROOTED OUTSIDE) %	**TOTAL %:** 5		
MAX HEIGHT (m) ABOVE QUADRAT (ROOTED INSIDE + ROOTED OUTSIDE):			1 m

Field/ ground flora

FORBS	%	GRAMINOIDS	%	BRYOPHYTES	%	WOODY	%
Potentilla reptans	15	*Agrostis stolonifera*	10	*Cratoneuron filicinum*	20	*Hedera hibernica*	1
Angelica sylvestris	1	*Festuca rubra*	1	*Calliergonella cuspidata*	1		
Petasites fragrans	5			*Palustriella commutata*	5		
Calystegia sepium	<1			*Bryum pseudotriquetrum*	5		
Filipendula ulmaria	<1			*Brachythecium rivulare*	3	**TOTAL WOODY <50cm**	**1**
				Palustriella falcata	3		
				Rhynchostegium riparioides	<1	**PTERIDOPHYTES**	
						Equisetum variegatum	1
						Asplenium scolopendrium	1
						TOTAL PTERIDOPHYTES	**2**
						ALGAE	
						Filamentous algae	0
						TOTAL ALGAE*	**0**
TOTAL FORBS	**22**	**TOTAL GRAMINOIDS**	**11**	**TOTAL BRYOPHYTES**	**38**	**TOTAL COVER**	**75**

*Algae not included in total vegetation cover (Lyons & Kelly, 2016)

Photos

Photograph 2.2. Relevé (view to W)

Photograph 2.3. Vegetation within relevé (*Cratoneuron filicinum, Equisetum variegatum, Potentilla reptans*)

APPENDIX A - QUAY HOUSE SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2021 & 2022

Condition assessment

Criteria	Result	Target value	Result and pass/ Fail
Species assessment criteria			
High quality indicator species	0 recorded	n/a (included below)	n/a (included with positive indicator species)
Positive indicator species	5 species recorded: *Festuca rubra, Palustriella commutata, Palustriella falcata, Bryum pseudotriquetrum, Equisetum variegatum*	3 species AND no loss from baseline number of species	Result = 5 positive indicator species and no change from baseline **PASS**
Typical accompanying species (neutral indicators)	1 species recorded: *Agrostis stolonifera*	n/a	For information only
Invasive species	1 species recorded *Petasites fragrans*	Absent	Result = Present **FAIL**
Negative herbaceous indicator species	0 species recorded	Total cover should not be dominant or abundant	Result = Absent **PASS**
Negative bryophyte indicator species	3 species recorded: *Cratoneuron filicinum, Brachythecium rivulare,*	No one species dominant or abundant; if ≥2 species present) then fails if ≥2 are frequent or 1 is abundant	Result = 1 abundant **FAIL**
Negative woody indicator species	Absent from relevé (but present on spring mound)	Absent (except in wooded springs)	**PASS**
Spring water composition and flow			
Nitrate level s	Baseline 2021 = 1.7 mg/l 2022 value = 2.0 mg/l	No increase from baseline and not above 10 mg/l	Slight increase from baseline, but only two data points so not possible to detect trend yet **PASS**
Phosphate level (Ortho-P)	Baseline 2021 = <10 µg/l 2022 value = 13 µg/l	No increase from baseline and not above 15 µg/l	Slight increase from baseline, but only two data points so not possible to detect trend yet **PASS**
Water flow	Not determined	No alteration of natural flow	No obvious alteration **PASS**
Impacts of grazing			
Field layer height	25cm	Height between 10 and 50cm	Result = 10cm **PASS**
Trampling/dung	Absent	Impact should not be abundant/dominant	Result = Absent **PASS**
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		Green - Favourable	**Result = 2 Fail UNFAVOURABLE-INADEQUATE**
1 - 2 Fail		Amber - Unfavourable Inadequate	
>2 Fail		Red – Unfavourable Bad	
Future prospects: Negative activities			
L02 Natural succession resulting in species composition change (other than by direct changes of agricultural or forestry practices)		Moderate negative impact, originating inside of site	**UNFAVOURABLE - INADEQUATE**

APPENDIX A - QUAY HOUSE SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2021 & 2022

Conservation Score

Criteria	Result	Score
Species diversity score	5 positive indicator species (=moderate)	2
HQ Indicator Species	0	0
Tufa-forming capacity	Massive, strongly consolidated deposits (very high)	4
Other positive characteristics	Spring discharges into Killala Bay/Moy Estuary SAC	1
Conservation Score		7
Rank		**Very high**

EPA Laboratory Test Report

EPA Regional Inspectorate Castlebar
John Moore Road
Castlebar
Co. Mayo

Final

Report To:	External Customer	Project:	EPA-22-02163
	bvfdbvd	Report Number :	7114
	bfdb	Entity:	MISC
		Location/Site:	MISC
		Site Visit Number:	

Sample Number:	22-18788	**Sampled Date:**	08/11/2022 15:50:22
Sampling Point:	MISC	**Sampled By:**	River Moy Search and rescue
Description:	Old Quay School Riverbank F26EW63 petrifying stream	**Replicate / Split:**	None
		Grab/Composite:	Grab
Sample Condition:	Normal	**Received in Lab:**	08/11/2022

Parameter	Result	Units	Limits	Measurement Uncertainty	Analysis Date	Lab	Method
Ammonia	<0.02	mg/l N		24%	09/11/2022	CB	EPA_W07 *
BOD	<1	mg/l O2		28%	15/11/2022	CB	EPA_W04 *
Chloride	26.6	mg/l		13%	09/11/2022	CB	EPA_W07 *
COD	<20	mg/l O2		12%	15/11/2022	CB	EPA_W01 *
Conductivity @25'C	734	µS/cm		11%	09/11/2022	CB	EPA_W08 *
Nitrite	<4	µg/l N		11%	09/11/2022	CB	EPA_W07 *
o-Phosphate	0.013	mg/l P		25%	09/11/2022	CB	EPA_W07 *
pH	7.7	pH units		0.3 pH units	09/11/2022	CB	EPA_W09 *
Suspended Solids	309	mg/l		17%	14/11/2022	CB	EPA_W03 *
Total Oxidised Nitrogen	2.0	mg/l N		18%	09/11/2022	CB	EPA_W07 *

Comment:

Sample Number:	22-18789	**Sampled Date:**	08/11/2022 15:50:28
Sampling Point:	MISC	**Sampled By:**	River Moy Search and rescue
Description:	Killanley Church Pertifying stream	**Replicate / Split:**	None
		Grab/Composite:	Grab
Sample Condition:	Normal	**Received in Lab:**	08/11/2022

Parameter	Result	Units	Limits	Measurement Uncertainty	Analysis Date	Lab	Method
Ammonia	<0.02	mg/l N		24%	09/11/2022	CB	EPA_W07 *
BOD	<1	mg/l O2		28%	15/11/2022	CB	EPA_W04 *
Chloride	29.5	mg/l		13%	09/11/2022	CB	EPA_W07 *
COD	<20	mg/l O2		12%	15/11/2022	CB	EPA_W01 *
Conductivity @25'C	689	µS/cm		11%	09/11/2022	CB	EPA_W08 *
Nitrite	<4	µg/l N		11%	09/11/2022	CB	EPA_W07 *
o-Phosphate	0.012	mg/l P		25%	09/11/2022	CB	EPA_W07 *
pH	7.5	pH units		0.3 pH units	09/11/2022	CB	EPA_W09 *
Suspended Solids	80	mg/l		17%	14/11/2022	CB	EPA_W03 *
Total Oxidised Nitrogen	0.66	mg/l N		18%	09/11/2022	CB	EPA_W07 *

Comment:

Report Approved By:

Alan Stephens - Regional Chemist

Results in bold are outside specified limits, not taking account of measurement uncertainty. * Indicates accredited method. nm = not measured, nr = not reported, vob = visible on bottom. The temperature reading of a **composite** sample is provided to allow the interpretation of the field pH result only.

Field Measurements are performed on the date of sampling. Results relate only to the item tested as received.