

Ow (AFA0142) Priority Area for Action

Desk Study Report

March 2020

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1 Summary

Ow Priority Area for Action (PAA) consists of one waterbody, Ow_010, which is *At Risk* of achieving its WFD environmental objective of Good Ecological Status by 2027. Moderate biological conditions were driving Moderate Ecological Status in all WFD cycles (2009, 2012, 2015). The most recent biological survey in 2018 showed an improvement to Good biological conditions and as a consequence the overall Ecological Status 2013-2018 changed to Good. Further improvements in biological conditions were noted in 2019 where High biological conditions were observed both at the headwaters and at the Ow_010 monitoring location during 2019 Coillte biological assessment.

Based on the review of existing water quality data, the significant issue driving Moderate biological conditions in the past is unknown. However, sediment and nutrient release during forestry operations was observed during Hydrofor research project in Ow headwaters in 2012, highlighting lack of implementation of appropriate mitigation measures during harvesting operations. Therefore, siltation and possibly elevated phosphate could have been affecting biological conditions.

The EPA characterisation process recognised forestry as a single significant pressure in this waterbody, which could affect physical conditions of the river mainly through the morphological changes. Forestry plantations occupy significant area of the waterbody (30% of the land use) and there is a risk of potential nutrient and sediment release during future forestry operations. Most of the forest was also planted prior to the Forest Service's Forestry & Fisheries Guidelines issued in 1990, where the forest was planted to the river bank leading to additional challenges at harvesting stage. With steep topography, very thin subsoils and predominantly poorly drained and peaty soils, this waterbody is characterised by a quick rainfall – runoff response with dominant overland flows. This makes the waterbody prone to sediment loss during forestry activities, which could be enhanced by the drainage network.

Physical characteristics of the waterbody also affect acid sensitivity of the area. While, acidification conditions did not fail in any of the WFD Ecological Status assessments in Ow_010, pH values are still low in this waterbody. This will be further investigated with the EPA pH Review Project (supported by LAWPRO Local Catchment Assessment) which focuses on the assessment of the acidification drivers and ecology impacts in Wicklow catchments for further characterisation process.

Ow_010 is currently achieving its environmental objective of Good Ecological Status (2013 – 2018), therefore no Local Catchment Assessment (LCA) is planned for this waterbody. LAWPRO will however support EPA pH Review Programme in the acid sensitive catchments in Wicklow area. While Good Ecological status is currently achieved, considering the future forestry activities and the legacy issues this waterbody is still *At Risk* of maintaining Good conditions in the future. To ensure Good or High biological conditions all future forestry operations should adhere to appropriate mitigation measures to protect the water quality in the waterbody.

2 Introduction

2.1 Background to the Priority Area for Action (PAA)

Ow is one of the 29 areas recommended for action in the Midlands and Eastern Region. It was selected during regional catchment assessment workshop in May 2017 based on the draft River Basin Management Plan priorities, a set of agreed principles and the local priorities. Workshop attendees included representatives of Local Authority staff, Local Authority Waters and Communities Office (LAWCO) (now part of the Local Authority Waters Programme LAWPRO), Irish Water, Inland Fisheries Ireland, Forest Service - DAFM, Coillte, National Parks and Wildlife Service, Teagasc, Department of Housing Planning and Local Government, Geological Survey Ireland, National Federation of Group Water Schemes, Department of Agriculture, Food and Marine, Bord na Mona, Waterways Ireland and Environmental Protection Agency. The Ow PAA was selected as a priority area for action in the 2nd cycle. The EPA report includes the following reasons:

- High Ecological Status ecological objective water body requiring improvements.
- Building on work that is underway by Coillte.
- Multi agency collaboration between Coillte, Wicklow County Council and IFI.

The Ow Priority Area for Action (PAA) is located within Wicklow County and consists of one waterbody, Ow_010 (Figure 1), being *At Risk* of achieving Water Framework Directive (WFD) environmental objective of Good Ecological Status by 2027. Ow_010 waterbody (catchment size 13.3 km²) is the headwater to River Ow, which rises in southern parts of Wicklow Mountains (Lughaquilla Mountain and Slievemaan), south east from Glen Imaal Artillery Range. It is characterised by steep topography, with the peat bogs being dominant land cover used as a commonage land and mainly Coillte forest at the left bank of the river. Ow_010 flows south east, joins Ow_020 at Aghavannagh Bridge and together with Ow_030 flows towards Aughrim village, where it joins Derry Water to form Aughrim River. Aughrim River flows in the easterly direction, joins Avoca River, which discharges to Irish Sea at Arklow.

2.2 Information Sources Consulted

Several information sources were consulted during the preparation of the desk study for the Ow PAA including:

- WFD web application – EPA characterisation data and water quality data,
- Forest Service data and information,
- Coillte data and information,
- Coillte biological monitoring (2016, 2017, 2018, 2019)
- Hydrofor Project (Kelly-Quinn *et al.*, 2016),
- Mobile Monitoring Unit (MMU) assessment (CDM Smith, 2012),
- Geological Survey Ireland (GSI) information (Tedd *et al.*, 2017 and personal communication).

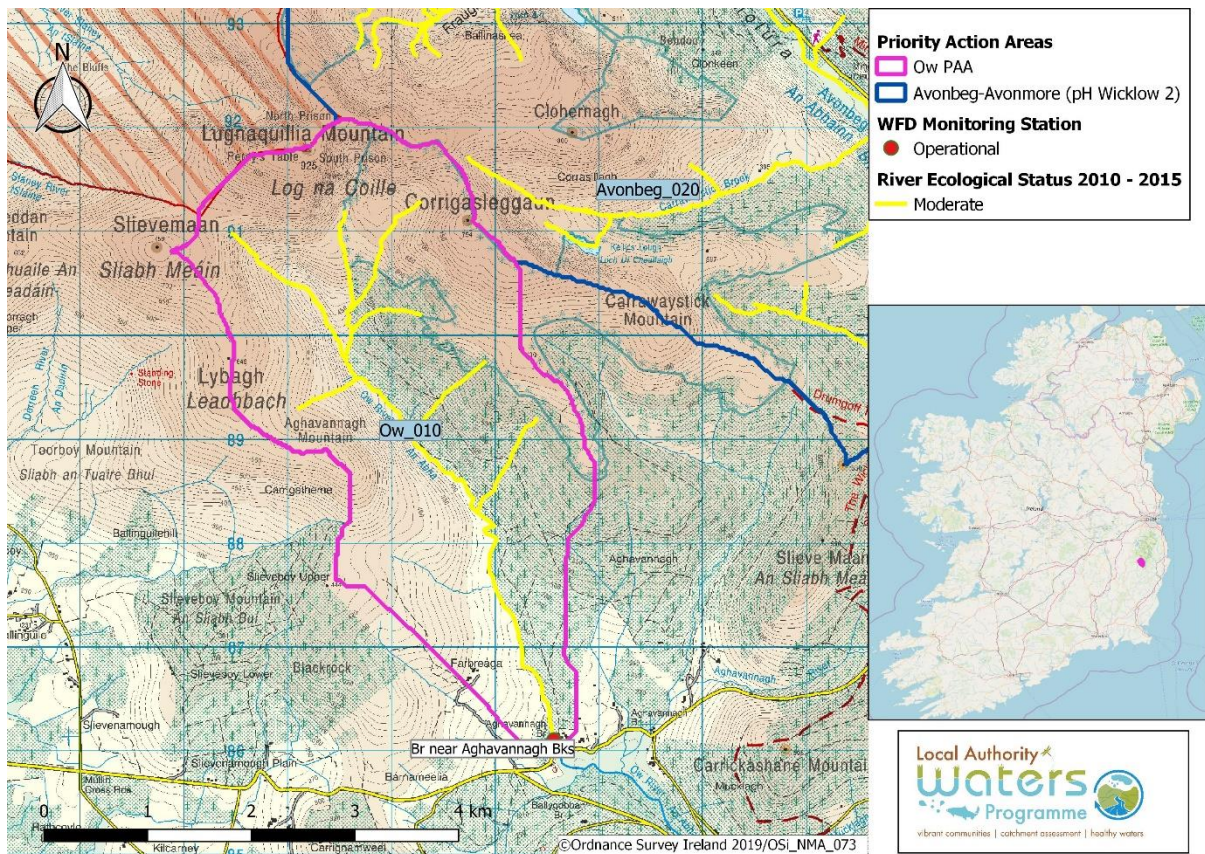


Figure 1 Ow PAA showing assigned 2010-2015 Ecological Status and the location of EPA monitoring point.

2.3 PAA Summary Information

The initial characterisation recommended actions for Ow PAA, and these are summarised in Table 1. A summary of risk, ecological status, known pressures and associated significance for this PAA are presented in Table 2.

Table 1 Initial characterisation actions assigned to the responsible organisations for Ow PAA.

Identifier	Responsible Organisation	Description
IA1 Provision of Information (FC001144)	Department of Agriculture, Food and the Marine	Forest Service - Ow was a catchment in Hydrofor Project and identified as an issue. No buffer strips in place as forest was planted prior to the 1990 Forestry & Fisheries Guidelines.
IA1 Provision of Information (FC001145)	Environmental Protection Agency	Capture under EPA Forestry pH Review

Table 2 Summary of status and pressures for Ow PAA.

WB Code	WB name	WB Type	Risk	High status obj.	Env. Objective date	Ecological Status				No of pressures	Pressure category	Pressure subcategory	Significant pressure (Y/N)
						2009	2012	2015	2018				
IE_EA_10O010100	OW_010	River	<i>At Risk</i>	No	2027	M	M	M	G	1	Forestry	Forestry	Yes

WB – Waterbody; G – Good; M – Moderate.

3 Receptor information & assessment

3.1 Context and Setting

The Ow Priority Area for Action (PAA) consists of one waterbody, Ow_010, which is *At Risk* of achieving its WFD environmental objective of Good Ecological Status by 2027. Moderate biological conditions were driving Moderate Ecological Status in all WFD cycles. Most recent EPA biological survey in 2018 indicated an improvement to Good biological conditions resulting in the overall Ecological Status 2013-2018 changing to Good. Coillte monitoring shows improvements to High biological conditions in 2019.

Ow_010 waterbody forms the headwaters to the Ow River. It is located in the Wicklow Mountains Special Area of Conservation (SAC) and Special Protection Area (SPA). It is also included in the Wicklow Groundwater Drinking Water Protected Area and is considered as *Margaritifera* sensitive area (catchment of other extant populations, but not designated site).

3.2 WFD Information

EPA Biological Quality Rating (Q-values) is conducted at the Br near Aghavannagh Bks monitoring station (RS10O010100), see Figure 1.

Overview of Q-Values and nutrient sampling at the EPA monitoring station is summarised in Table 3. Data show good biological conditions until 2006, after which conditions declined to Moderate. These conditions stayed unsatisfactory for four subsequent assessment surveys (2006, 2009, 2012, 2015) up until 2018, when Q-value improved to Good. Physico-chemical data do not show nutrient or acidification impacts therefore the significant issue affecting biological conditions for this waterbody is unknown. Figure 2 shows pH fluctuations for this waterbody. Acidification conditions did not fail WFD threshold of 4.5 in any of the WFD cycle, however pH values can be low for this waterbody with values falling below 5.5 biological threshold.

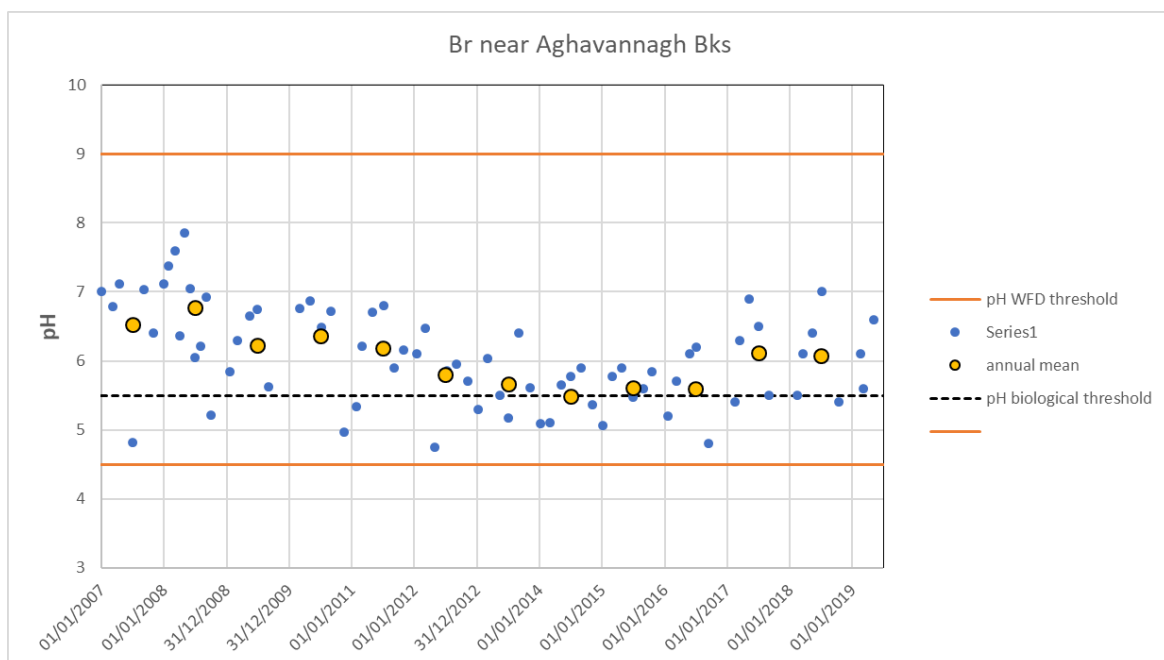


Figure 2 Temporal variations and annual mean values for pH at Ow_010 at Br near Aghavannagh Bks monitoring station.

Table 3 Summary of Q-Value and chemical data for Ow PAA.

Waterbody		Ow_010
Risk Category		At Risk
Monitoring station		Br near Aghavannagh Bks
Monitoring station number		RS100010100
Monitoring station type		Operational
Biological Status		
Q values	1990	5
	1994	4
	1997	4
	2000	4
	2003	4
	2006	3-4
	2009	3-4
	2012	3-4
	2015	3-4
	2018	4
Water chemistry		
Baseline PO4+ (2016-2018)		0.005
Baseline NH4+ (2016-2018)		0.011
Baseline NO3- (2016-2018)		0.146
HYMO		slight siltation noted in 2015 Q-value survey notes
Conceptual model required (Y/N)		N
Ecological Status 2010-2015		Moderate
Ecological Status 2013-2018		Good
EPA Biologist comments 2015		Although the diversity of macroinvertebrate fauna has improved, the paucity of sensitive macroinvertebrate species recorded at Aghavannagh Bridge (0100) continues to indicate unsatisfactory ecological conditions in the upper reaches of the Ow River in July 2015. The diversity of pollution sensitive macroinvertebrate fauna noted at Ballymanus Bridge and Roddenagh Bridge indicated satisfactory ecological conditions in the lower reaches of the Ow river.
EPA Q-Value survey (2015)		16 invertebrate taxa were recorded. 0 sensitive mayfly, 1 sensitive stonefly; the abundance of sensitive taxa was low. key tolerant taxa: Simuliidae (Few), Gammarus (Absent) and Baetis rhodani (Dominant).
EPA Biologist comments 2018		Satisfactory ecological conditions were observed on the Ow river in June 2018. The diversity of pollution sensitive macroinvertebrate species indicated some improvement at Aghavannagh Bridge (0100).
Protected areas		IEPA1_EA_G_076, Wicklow Drinking Water Protected Area Partly in the Wicklow Mountains SAC (IE0002122) and SPA (IE004040) <i>Margaritifera</i> sensitive area - catchment of other extant populations*
Significant issue: Waterbody		Currently achieving status objective

* 'Margaritifera sensitive area - Catchments of other extant populations. These mussel populations may lie (in part) within SAC, other nature conservation sites or in the wider countryside. Those populations within SAC were not considered of sufficient quality to warrant designation for the species and detailed restoration objectives, targets, plans or measures are unlikely to be developed. However, the potential effects of any plans, developments or activities on the populations, including the potential to cause 'environmental damage' as per the Environmental Liability Directive and Regulations, must be determined through SEA, EIA or other ecological assessment. The NPWS holds some detailed information on the distribution and abundance of freshwater pearl mussels in a small number of these catchment.'

3.3 Supplementary Information – Coillte biological assessment

A free-lance aquatic ecologist was retained by Coillte to carry out biological assessment of the River Ow in accordance with felling licence conditions attached to the specific harvest areas. The assessments are carried out annually since 2016 and these include assessments of macroinvertebrates (Q-value), macroalgae, macrophytes and bryophytes, silt plumes, and measurements of dissolved oxygen, pH and conductivity (Coillte, 2016; Coillte, 2017; Coillte, 2018; Coillte, 2019).

Sampling locations are shown in Figure 3. Site 1A and Site 1B are two upstream locations in Ow_010 (Site 1A - western tributary with no forestry, Site 1B - eastern tributary with forestry located to the east); Site 2 is located at the EPA monitoring station (Br near Aghavannagh Bks, RS100010100) for Ow_010 and Site 3 is located at the EPA monitoring station (Ballymanus Bridge, RS100010300) for Ow_020.

Assessment results are shown in Table 4. Results indicate improvement of biological conditions to High in 2019 for all the sites surveyed. Tributary 1A indicated High biological conditions for all the years surveyed (2016 – 2019). Biological conditions in tributary 1B improved from Good to High in 2018. Site 2 (EPA monitoring location for Ow_010) showed Moderate biological conditions in 2016 and 2017, which improved to Good in 2018 and to High in 2019. Improvement to Good conditions occurred in the same year where there were improvements from Good to High in the tributary upstream (Site 1B) suggesting knock-on effect. Site 3 (further downstream, Ow_020) showed Good biological conditions in 2016 which declined to Poor in 2017. Q-value improved to Good in 2018 and high in 2019 at this location.

No impacts on biological conditions were found during the assessments. None of the macroalgae recorded were associated with nutrient enrichment. There was also no siltation issue found for the surveyed sites. pH values were above WFD threshold of 4.5 and above biological threshold of 5.5. Presence of acid-sensitive species confirmed that the sites are not affected by acidification. Low conductivity values reflect siliceous geology of the area. High DO values were recorded in 2019, however no further impact was found.

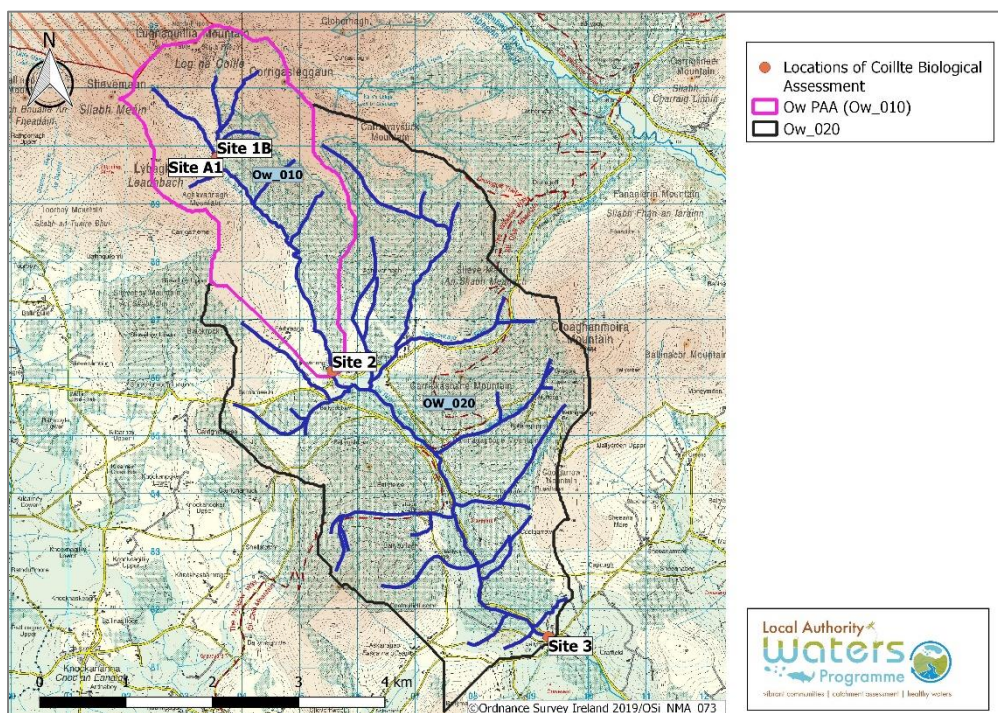


Figure 3 Locations of Coillte biological assessments.

Table 4 Coillte biological assessment in Ow_010 and Ow_020 (Source: Coillte).

Site surveyed	Year	Site 1A	Site 1B	Site 2	Site 3
Q-Values	2016	4-5	4	3-4	4
	2017	4-5	4	3-4	3
	2018	4-5	5	4	4
	2019	4-5	5	4-5	4-5
Macrcoalgae, Bryophytes and Liverworts.	2016-2019	None of the species recorded are associated with nutrient enrichment			
Silt plumes	2016-2019	No silt plumes were recorded at any of the sites surveyed			
pH	2016	7.2	6.3	7.8	7.6
	2017	6.8	6.9	7.2	7.3
	2018	6.8	6.9	7.2	7.3
	2019	6.8	6.8	6.9	6.9
Comment		The abundance of mayfly nymphs (particularly Baetis rhodani and Seratella ignita) indicates that the macroinvertebrate community is not being significantly affected by acidification at the sites surveyed.			
Conductivity (µS/cm)	2016	21.6	23.6	28.1	45
	2017	28	27	38	53
	2018	28	27	38	53
	2019	32	34	42	72
Dissolved Oxygen (%)	2016	95.3	96.1	93.2	89.6
	2017	89	89.6	91.8	89.6
	2018	112.1	109.1	88.4	89.4
	2019	122	118.6	134.5	130
Dissolved Oxygen (mg/l)	2016	9.9	10.27	9.84	9.51
	2017	9.4	9.5	9.4	9.5
	2018	11.4	11.1	8.9	9.1
	2019	13.2	12.9	14.2	14.3
Temperature (°C)	2016	14.5	12.7	13	12.9
	2017	13.2	13.3	14.7	13.3
	2018	12.5	12.5	14	14
	2019	11.3	11.1	12.1	10.6

3.4 Supplementary Information – Mobile Monitoring Unit

As part of WFD implementation process, The Eastern River Basin District established Mobile Monitoring Unit (MMU) to gather monitoring data and identify local pressures. Investigative assessment undertaken by the MMU in the Ow River was carried out in 2011, however details of this assessment are not available. Following information is provided within the MMU report (CDM Smith, 2012): ‘The Watershed Warden performed macro invertebrate SSRS kick sampling to assess the quality of the Ow River upstream from the EPA monitoring station. Local pressures were identified. Further investigative work and data collection was carried out in relation to forestry pressures in the catchment.’

3.5 Supplementary Information – Hydrofor project

Two first order tributaries of River Ow were included in Hydrofor project (Kelly-Quinn *et al.*, 2016) investigations of nutrient and sediment inputs before, during and after clearfelling (April 2012).

Monitoring showed an increase in sediment and nutrient release (phosphorous) at both sites during felling operations with highest concentrations recorded during rainfall events when there was nearly 100% felling completed. Felling activities ceased during heavy rainfall. There were no silt traps observed in the streams draining the catchments or in roadside drainage ditches. Deep rutting created by the forwarder within the felled area and an extraction route located beside the stream may have contributed to higher nutrient and sediment load reaching the stream network. While brush mats were used, they were considered ineffective at these sites as a soil and water protection measure. After felling operations ceased total suspended solids concentrations were considerably lower than during felling, however concentrations were still more than twice the pre-felling measurements for 18 months after clearfelling.

Lower levels of suspended solids and nutrients were recorded in a different Hydrofor site (Glennamong), where silt traps were in use and extra brush was placed on rutted extraction routes as a water management control during forestry operations. Suspended sediment losses from the study catchment were marginally higher than from the control catchment (an adjacent moorland) for the first six months after clearfelling and became similar over the following six months (or within a year following clearfelling). However, phosphorous values at this site were still higher during clearfelling operations than in the control catchment. Higher soluble reactive phosphorus export at this site was still recorded over one-year period after clearfelling ceased (most likely due to release from harvested residues).

Hydrofor report notes that *‘the differences between the Glennamong and Ow studies indicate that existing guidelines have value particularly in relation to sediment attenuation. At the Glennamong site – where guidelines were generally adhered to – there was negligible impact on the receiving stream, whereas at the River Ow sites – where guidelines were not fully adhered to – large amounts of sediment and nutrients were measured in the receiving stream.’*

Additionally, results also showed that the area of the clearfell in relation to the total catchment area had an important bearing on the impact of the nutrients and sediment inputs to the receiving waters. Greater impacts in regard to nutrient and suspended solid losses were noted in catchments where the harvesting site occupied 25% of the catchment area than a site occupying 6% of the total catchment.

For more detailed results and discussions, please refer to Hydrofor project (Kelly-Quinn *et al.*, 2016).

3.6 Conclusion on Significant issues

- Waterbody is currently achieving its WFD objective of Good Ecological Status

Moderate Ecological status was driven by Moderate biological conditions (2009, 2012, 2015). Significant issue driving decline in biological conditions is however unknown. No nutrient enrichment or siltation issue is evident from the data, however Hydrofor project highlighted poor practices and sediment and nutrient release during felling activities in 2012. Acidification conditions did not fail in this waterbody, but pH values can be fluctuating and can be very low. Coillte biological surveys results indicate however presence of acid sensitive species suggesting acidity does not impact the ecology.

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While Ecological Status of this waterbody improved to Good, considering the high forest cover in this waterbody, there is still a risk of possible impacts during forestry activities. Appropriate measures should be implemented during any future operations in order to maintain Good biological conditions.

4 Significant pressure information

4.1 Initial EPA Characterisation

Main pressure identified during the WFD characterisation process is forestry (Table 5), affecting ecological status through altered habitat due to morphological changes. Following impact assessment has been noted for this pressure:

- During invertebrate sampling, substrate siltation was noted to be compacted to loose. During the workshops, sediment from forestry was identified as a significant pressure.

Table 5 Initial EPA characterisation.

Waterbody Name	Id	Category	Sub Category	Significant ?	Pressure & Impact details
Ow_010	WBP0001150	Forestry	Forestry	Yes	Altered habitat due to Morphological changes

4.2 Forestry

Forestry constitutes 30% of the land use in Ow_010 waterbody. It primarily consists of Coillte forest (99%) with high conifer forest being the dominant forest land use type. It is located on a slope at the north east side of the catchment, adjacent to the left bank of the Ow River (Figure 4).

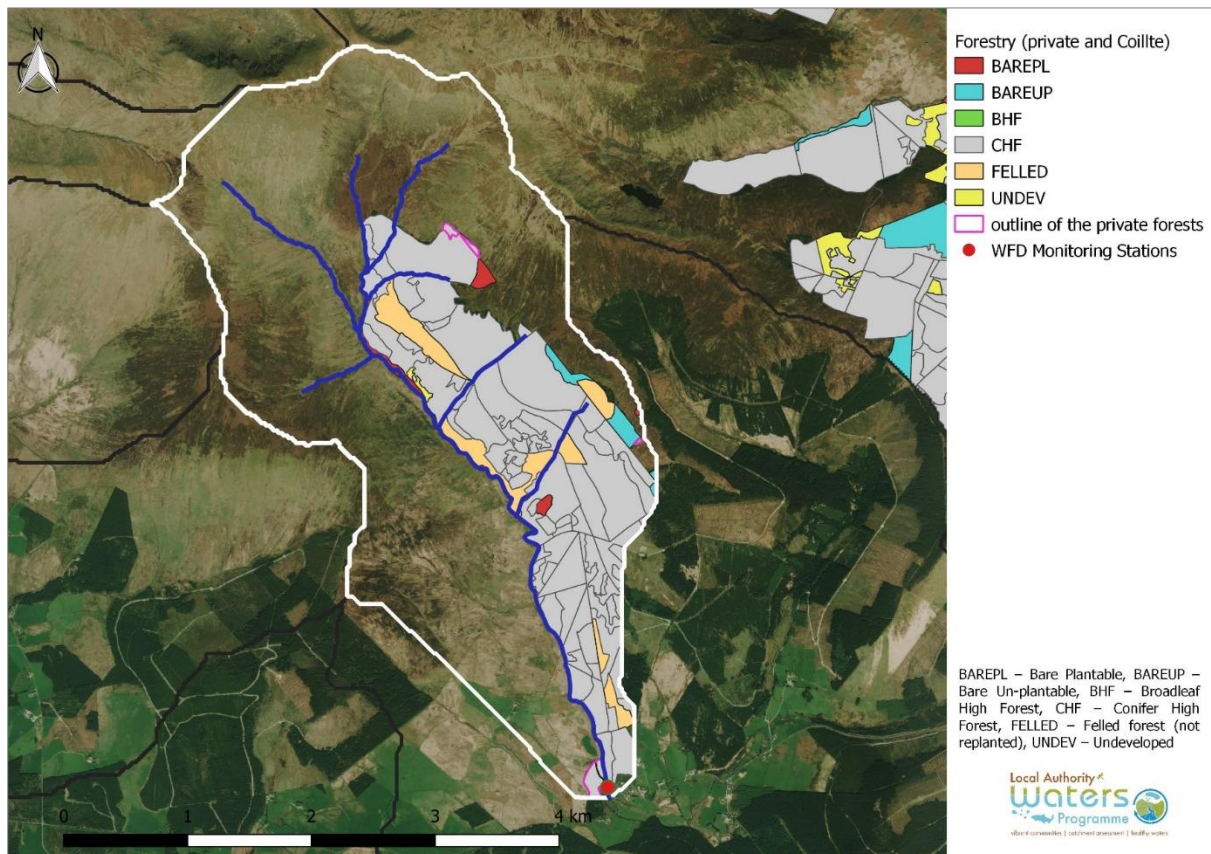


Figure 4 Forestry land use types in Ow_010 (data source: Forest Service).

Felling, thinning but also planting operations can contribute to siltation and nutrient release which can affect biological conditions. Information on felling and thinning operations was sought from Coillte and Forest Service, these were provided from 2010 onward. Table 6 shows Coillte forestry operations timeline for Ow_010 and corresponding biological conditions. Figure 5 and Figure 6 show location of these operations indicating their proximity to the stream network.

Majority of the forestry in Ow_010 was planted in the seventies with parts planted closer to the monitoring point between 1994 and 1997 (including small area of private forests), prior to the Forest Service’s Forestry and Fisheries Guidelines. This creates forestry legacy issues, where the forest could be planted right to the banks of the river. This could also potentially create impacts on water quality due to overshadowing. Close proximity of the trees to the river also creates challenges during thinning and felling activities, where sediment loss is more difficult to control.

Table 6 Summary of Coillte forestry operations in Ow_010 in relation to biological conditions at the EPA monitoring location (data source: Forest Service and Coillte).

year	area planted (ha)	area under felling operations (ha)	area under thinning operations (ha)	Sampling year	EPA Q-value	Coillte Q-Value
< 1978	210					
1994-1997	40	n/a*	n/a**	1990	5	
				1994	4	
				1997	4	
				2000	4	
				2003	4	
2004	6	n/a*	n/a**			
2006	11	n/a*	n/a**	2006	3-4	
2009	10		29.6	2009	3-4	
2010		8.1	129.9			
2011						
2012		37.5	65.3	2012	3-4	
2013	9		88.2			
2014	37					
2015			38.4	2015	3-4	
2016		14.9		2016		3-4
2017		30.7		2017		3-4
2018	15	3.1		2018	4	4
2019		11.2	37.1	2019		4-5
2020		41.7				
2021		33.1				
2022		3.3				
2023		13				

* potentially planted compartments were felled 2 years beforehand.

** potentially ongoing thinning operations with forestry planted <1978.

Note that 2020-2023 are planned future activities.

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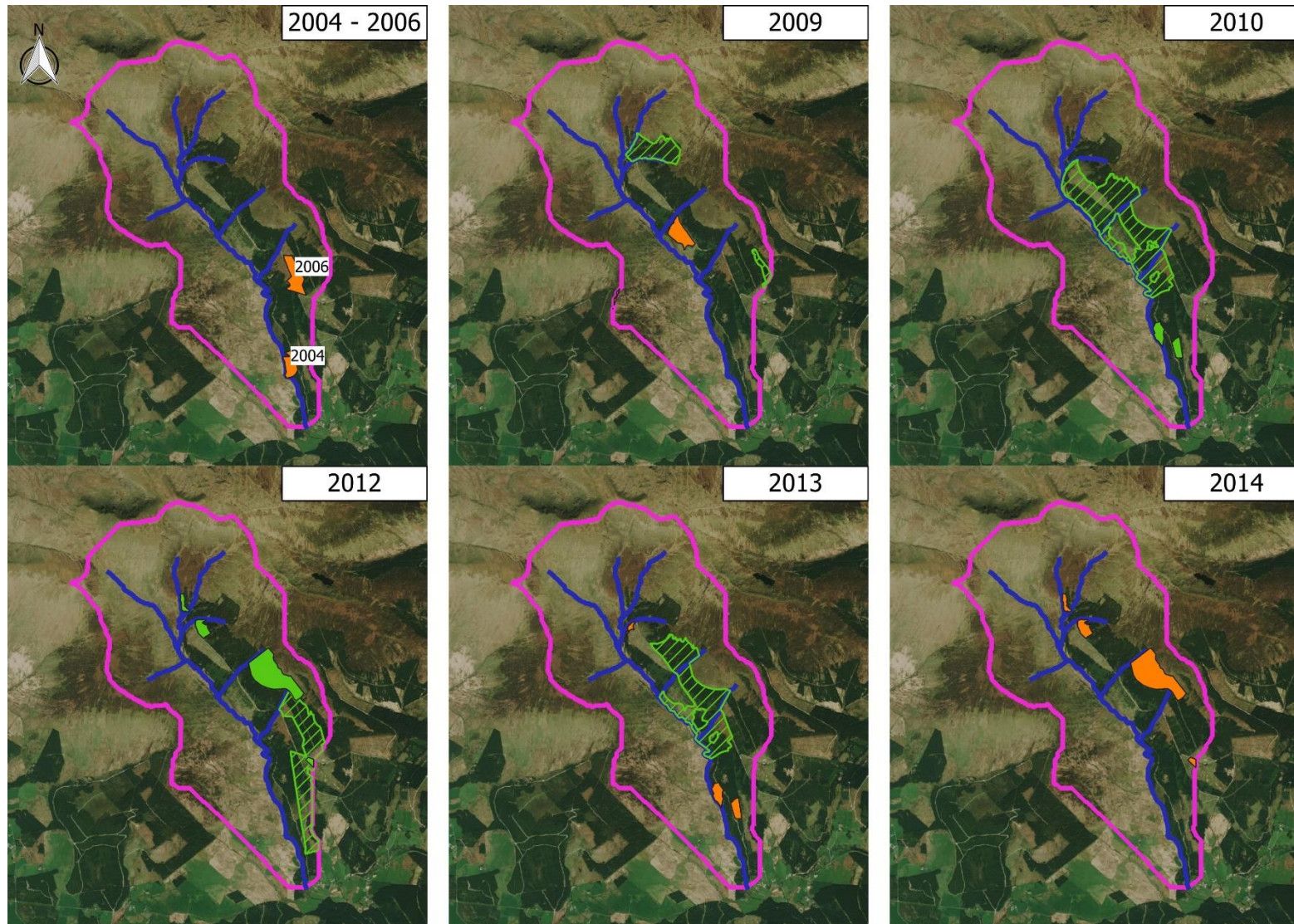


Figure 5 Coillte forestry operations 2004 – 2014 in Ow PAA. See legend in Figure 6 (data source: Coillte).

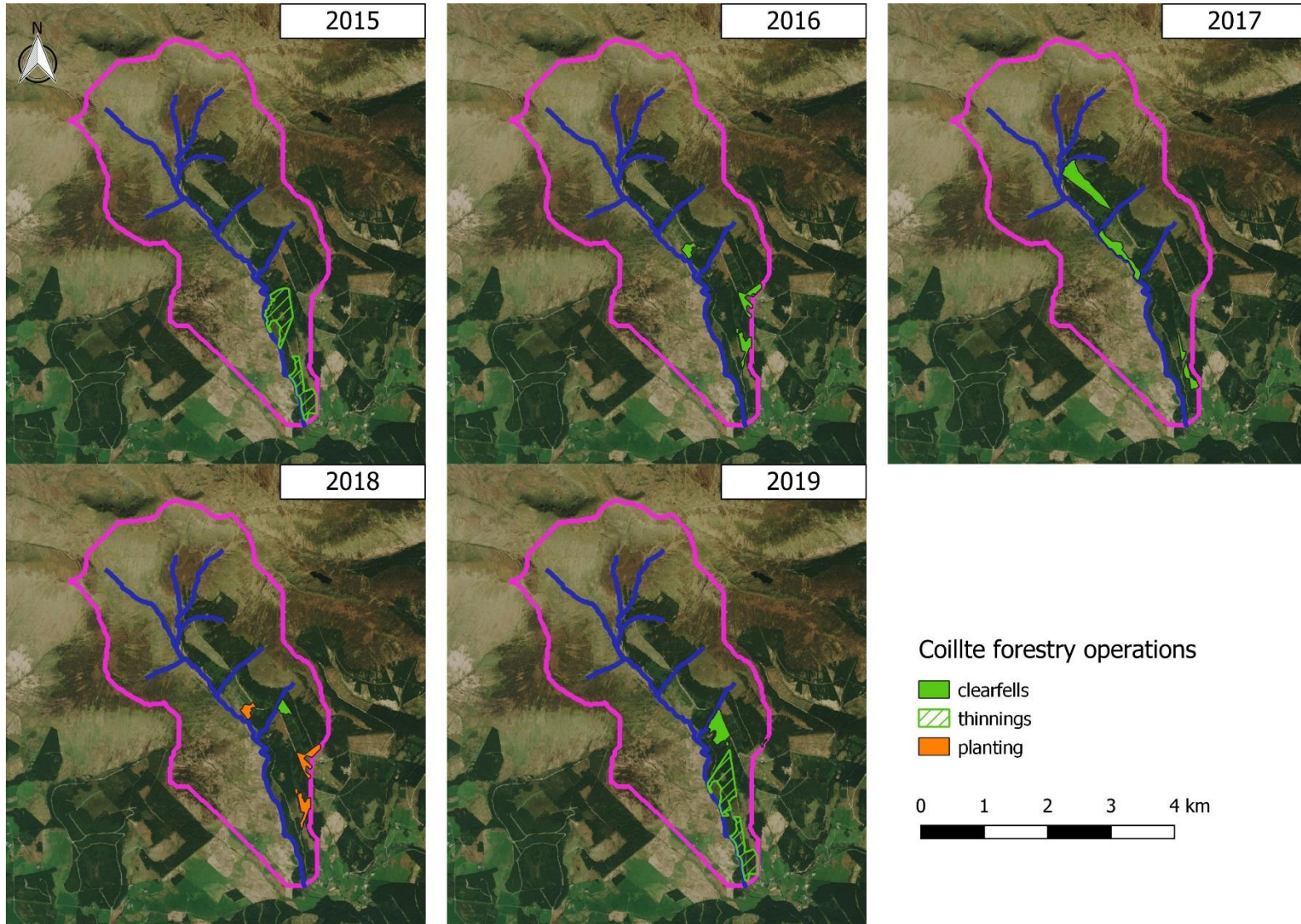


Figure 6 Coillte forestry operations 2015 – 2019 in Ow PAA (data source: Coillte).

EPA biological surveys at Ow_010 commenced in 1990 and Good biological conditions existed here since 1990 to 2003 (with High conditions only in 1990). Biological conditions in this waterbody deteriorated in 2006 (Q-Value 3-4). Therefore, an impact on biological conditions must have occurred between 2003 and 2006. No chemistry data is available for those years and nutrient data available since 2007 indicate no nutrient issues in this waterbody.

Based on the GIS layer available, a few forest compartments were planted in 2004 and 2006 in Ow_010. This represented the first planting activities in the catchment since 1997. It is possible that felling operations occurred in these compartments around two years before planting, and with the possible sediment release during these activities this could potentially explain change in biological conditions in 2006. Furthermore, based on plantation age, thinning activities can be assumed to have taken place between 2003 and 2006 for the forest planted between 1970-1972, which could have had an additional impact on biological conditions.

Based on Hydrofor report (Kelly-Quinn *et al.*, 2016), appropriate mitigation measures were not implemented during 2012 clearfelling at the two Hydrofor study sites (located in Ow first order streams) and this suggests that potentially poor practices could have caused site siltation affecting biological conditions. Moderate biological conditions persisted until 2017 and these conditions improved to Good in 2018 (Table 6). In 2018, much less area was felled in comparison to previous years. However, there was still considerably high percentage of area being felled in the preceding year 2017 with some parts being adjacent to the stream.

Biological conditions in the headwaters also improved from Good (Q-value of 4 in 2017) to High (Q-value of 5 in 2018) in one of the tributaries (east, Coillte Site 1B) in 2018. This improvement could have had a knock-on effect on macroinvertebrate communities further downstream. There was a considerable area being felled and thinned (2009-2012 and 2017) upstream of this headwater tributary prior to the improvements in 2018 (with a lot of the forest being adjacent to the river network) (Figure 5-6,) and with no operations in this area since then, it is possible that there was enough of the time for the biological conditions to improve.

As majority of the forestry in Ow catchment has been planted prior to the Forest Service's Forestry and Fisheries Guidelines, forestry plantation is being restructured during all new forestry operation providing for vegetated setbacks which provide additional measure for future forestry activities. Timing of operations, rainfall conditions, size of forest operations in relation to the catchment size and location to the stream network, but also mitigation measures implemented during and after the operations, all play important role in protecting the water quality of the river network.

Areas where future forest activities are scheduled to occur in this waterbody together with the recommendations to protect river network were included in the referral to Forest Service for the protect function in this waterbody. To maintain Good or High biological conditions in Ow_010, all future forestry operations require appropriate mitigation measures to be implemented in order to protect the water quality in this PAA.

4.3 Conclusion on Significant Pressures

Main pressure identified for this PAA is forestry, which can affect morphological conditions of the waterbody. While the biological conditions improved to Good (and High in 2019 Coillte assessments),

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continued efforts should be made to ensure appropriate measures are in place during future forestry operations to maintain Good or High biological conditions.

This waterbody is also included in the EPA pH Review Project, which focuses on the assessment of the acidification drivers and ecology impacts in Wicklow catchments for further characterisation process.

5 Pathway information & analysis

Pathway for sediment transport, which could alter physical conditions of the waterbody is via overland flow where poorly drained and peaty soils exist. With steep topography, very thin subsoils and predominantly poorly drained and peaty soils, this waterbody is characterised by a quick rainfall – runoff response with dominant overland flows. This makes the waterbody prone to sediment loss during forestry activities, which could be enhanced by the drainage network. Moreover, physical characteristics of the waterbody also affect acid sensitivity of the area. These characteristics are summarised in the Table 7 in this section and shown in Figures 7 – 10 in Appendix I of this report.

Table 7 Ow_010 physical characteristics.

Factor	Description & relevance
Land Cover/ Land Use	<ul style="list-style-type: none"> • Peatland is the dominant land use which constitutes commonage areas located on the hills. • Forestry constitutes 30% of the land use (mainly Coillte high conifer forest), located on a slope at the north east side of the catchment, adjacent to the left bank of the Ow River.
Soil (Figure 7)	<ul style="list-style-type: none"> • Peaty soils (blanket peat, 40%), mainly at the higher parts of the catchment. • Poorly drained soils (shallow soils (podzols (peaty), lithosols, peats, with/or without a peaty/organic horizon) derived from mainly acidic parent material; c.50%), mainly surrounding river network.
Bedrock (Figure 8)	<ul style="list-style-type: none"> • Granites and other Igneous Intrusive rocks (dominant, 90%), Ordovician Metasediment (norther part of the waterbody) <p>Note on pH background:</p> <ul style="list-style-type: none"> • pH natural groundwater background: Groundwater in the non-calcareous sedimentary and igneous lithological groups has the lowest pH values with medians of 6.03 and 6.07 respectively. Igneous rocks pH data show 5th %ile of 5.35, 95%ile of 7.53 and median of 6.07 (Tedd <i>et al.</i>, 2017). • Groundwater pH data available for Avonmore_010, of similar physical characteristics show pH of 6.6 for Sraghmore Wicklow Visitor Centre and one sample from a private well in the Avonbeg_030 catchment of 7 pH units on 03/02/1997 (GSI, pers. comm.). • pH data available for Askinagap Group Water Scheme located in Ow_020 waterbody in Wicklow Mountains of similar geology and characteristics (Ordovician Metasediments and poorly drained soils with forestry/ grassland as land use) show pH from 5.1 to 6.8 pH units with a mean of 6.0 pH.

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Factor	Description & relevance
Topography	<ul style="list-style-type: none"> located in Wicklow Mountains with higher topography surrounding all sides of the river. High topography may influence flashiness of the flows. If land is overgrazed, it may also affect slope erosion.
Subsoil	<ul style="list-style-type: none"> Blanket peat, Rock, Scree, Granite till.
Subsoil permeability	<ul style="list-style-type: none"> Subsoils very shallow, with depth to bedrock <3m being dominant. Moderate permeability along the river network and south side of the waterbody.
Aquifer (Figure 9)	<ul style="list-style-type: none"> PI – Poor aquifer – bedrock which is generally unproductive except for local zones (dominant), LI – Locally Important Aquifer – Bedrock which is moderately productive only in local zones; (small parts at the north).
Groundwater vulnerability (Figure 10)	<ul style="list-style-type: none"> Extreme and X-Extreme dominant with bedrock outcrop in places, Moderate along the river network and south side of the waterbody.

6 Interim story of the Priority Area for Action

Ow Priority Area for Action (PAA) consists of one waterbody, Ow_010, which is At Risk of achieving its WFD environmental objective of Good Ecological Status by 2027. Moderate biological conditions were driving Moderate Ecological Status in all WFD cycles (2009, 2012, 2015). Most recent biological survey in 2018 indicated a return to Good biological conditions, resulting in an improvement of the overall Ecological Status 2013-2018 to Good. Improvements to High biological conditions were observed in headwaters and at the Ow_010 monitoring location during 2019 Coillte biological assessment.

Based on the review of existing water quality data, the significant issue driving Moderate biological conditions in the past is unknown. However, sediment and nutrient release during forestry operations was observed during Hydrofor research project in Ow headwaters in 2012, highlighting lack of adequate measures implementation during forestry operations. Therefore, siltation and possibly elevated phosphate could have been affecting biological conditions.

The EPA characterisation process recognised forestry as a single significant pressure in this waterbody, which could affect physical conditions of the river mainly through the morphological changes. Forestry plantations occupy significant area of the waterbody (30% of the land use) and there is a risk of potential nutrient and sediment release during future forestry operations. Most of the forestry was also planted in the past, prior to the Forest Service’s Forestry and Fisheries Guidelines, and therefore there might be additional challenges during felling of forestry sites which were planted up to the river banks. With steep topography, very thin subsoils and predominantly poorly drained and peaty soils, this waterbody is characterised by a quick rainfall – runoff response with dominant overland flows. This makes the waterbody prone to sediment loss during forestry activities, which could be enhanced by the drainage network.

Physical characteristics of the waterbody also affect acid sensitivity of the area. While, acidification conditions did not fail in any of the WFD Ecological Status assessments in Ow_010, pH values are still low in this waterbody with a risk that this may affect biological conditions. This impact will be further investigated with the EPA pH Review Project (supported by LAWPRO Local Catchment Assessment) which focuses on the assessment of the acidification drivers and ecology impacts in Wicklow catchments for further characterisation process.

Ow_010 currently is achieving its environmental objective of Good Ecological Status (2013 – 2018), therefore no Local Catchment Assessment (LCA) is planned for this waterbody. LAWPRO will however support EPA pH Review Project in the acid sensitive catchments in Wicklow area. While Good Ecological status is currently achieved, considering the future forestry activities and the legacy issues this waterbody is still At Risk of maintaining Good conditions in the future. To ensure the continued Good or High biological conditions, all future forestry operations should adhere to implementing appropriate measures to protect the water quality in the waterbody.

7 Workplan

The summary of assigned WFD actions for this waterbody is presented below in Table 8.

Table 8 Summary of EPA actions and responsible organisations for Ow_010.

Identifier	Responsible Organisation	Description
IA1 Provision of Information (FC001144)	Department of Agriculture, Food and the Marine	Forest Service - Ow was a catchment in Hydrofor Project and identified as an issue. No buffer strips in place as plantation is pre regulations.
IA1 Provision of Information (FC001145)	Environmental Protection Agency	Capture under EPA Forestry pH Review

Considering improvements to Good Ecological Status no Local Catchment Assessment is planned for this waterbody. LAWPRO will however support EPA pH Review Programme in the acid sensitive catchments in Wicklow area.

7.1 EPA pH review Project

EPA pH Review Project focuses on the assessment of the acidification drivers and ecology impacts in waterbodies in Wicklow Mountains area where waterbodies are at risk of failing acidification conditions. Ow PAA but also Liffey Upper and Avonbeg-Avonmore PAAs are included in this Review Project. LAWPRO will assist EPA in the review process through Local Catchment Assessment. Installation of in-situ pH probes for continuous and high-resolution measurements in selected sites included in the EPA pH Review Project is proposed. This data will help refine conceptual understanding of the pH impact helping further EPA characterisation process for the acid-sensitive catchments in Wicklow area.

8 Review of mitigation options

8.1 Siltation

Number of measures exist that can prevent release of fine sediments during forestry operations. These include use of silt traps, silt fencing, soil and log dams, settlement areas, in-stream straw bales, use of brush mats, appropriate timing of operations and appropriate use of machinery, no machinery use when felling at the water bank or the installation of setbacks. Appropriate maintenance of silt traps during, but also after forestry operations (Hydrofor project indicated increased suspended solids up to 18 months after felling operations) is critical to avoid siltation of the receiving stream network. All forestry operations should adhere to Standards for Felling and Reforestation (Forest Service, 2019)

8.2 Acidification

Implementing measures for acidification require confidence in pressure drivers and acidification impacts on the ecology. Ecological impacts and acidity drivers (chemistry) will be assessed through the EPA pH review project.

9 Communications

Stakeholder meeting was held on 13th May 2019 in the form of a field visit in Ow catchment in Wicklow. Attendees included Forest Service - DAFM, Coillte, LAWPRO, Wicklow Co Co and EPA. Challenges of the forestry legacy issues, examples of measures and future co-operation were discussed.

No community information meeting was planned for this PAA considering forestry being a single pressure.

Date of completion of Desk Study: March 2020

10 References

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Appendix I Maps

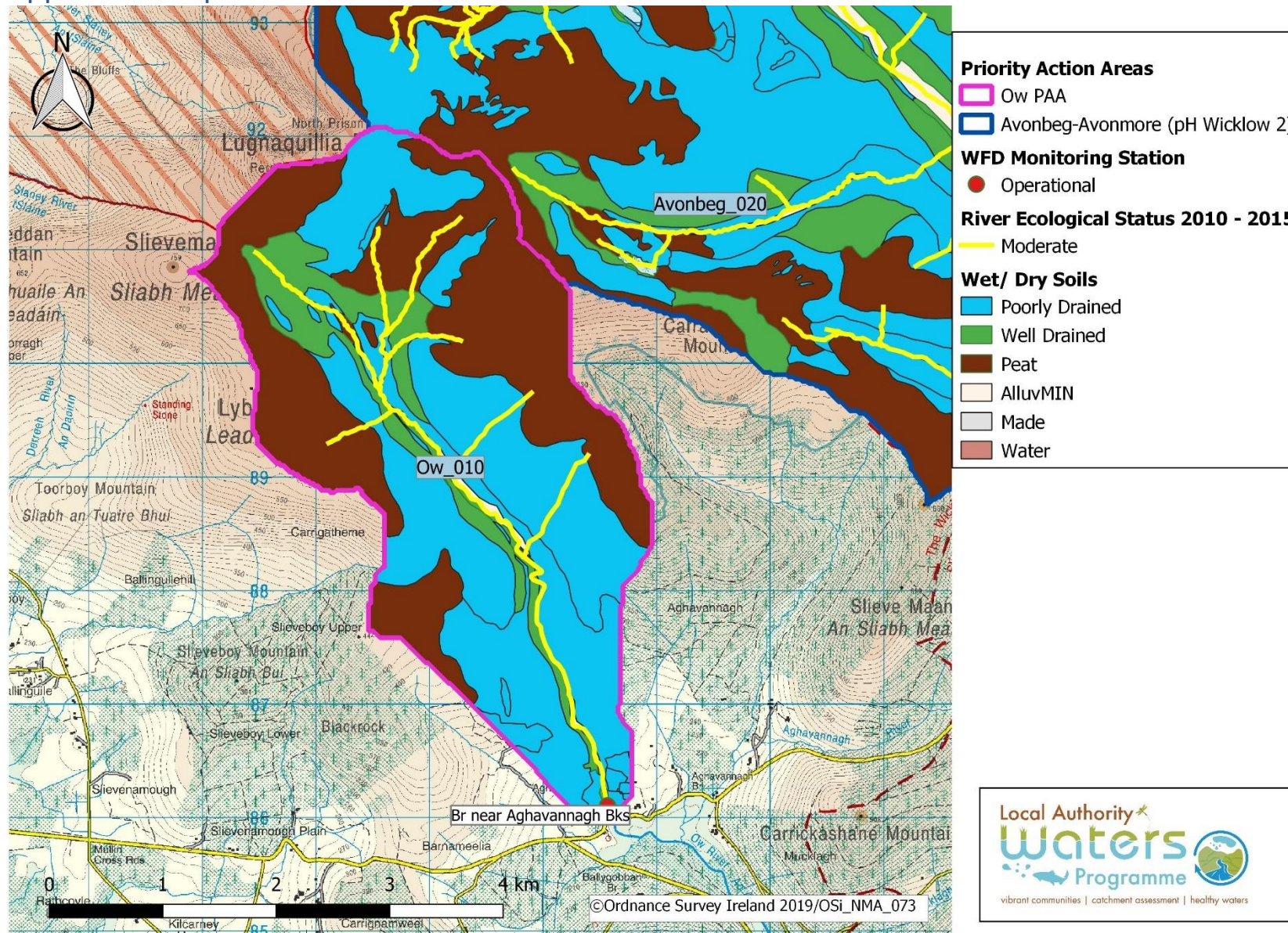


Figure 7 Wet and Dry Soils within Ow PAA.

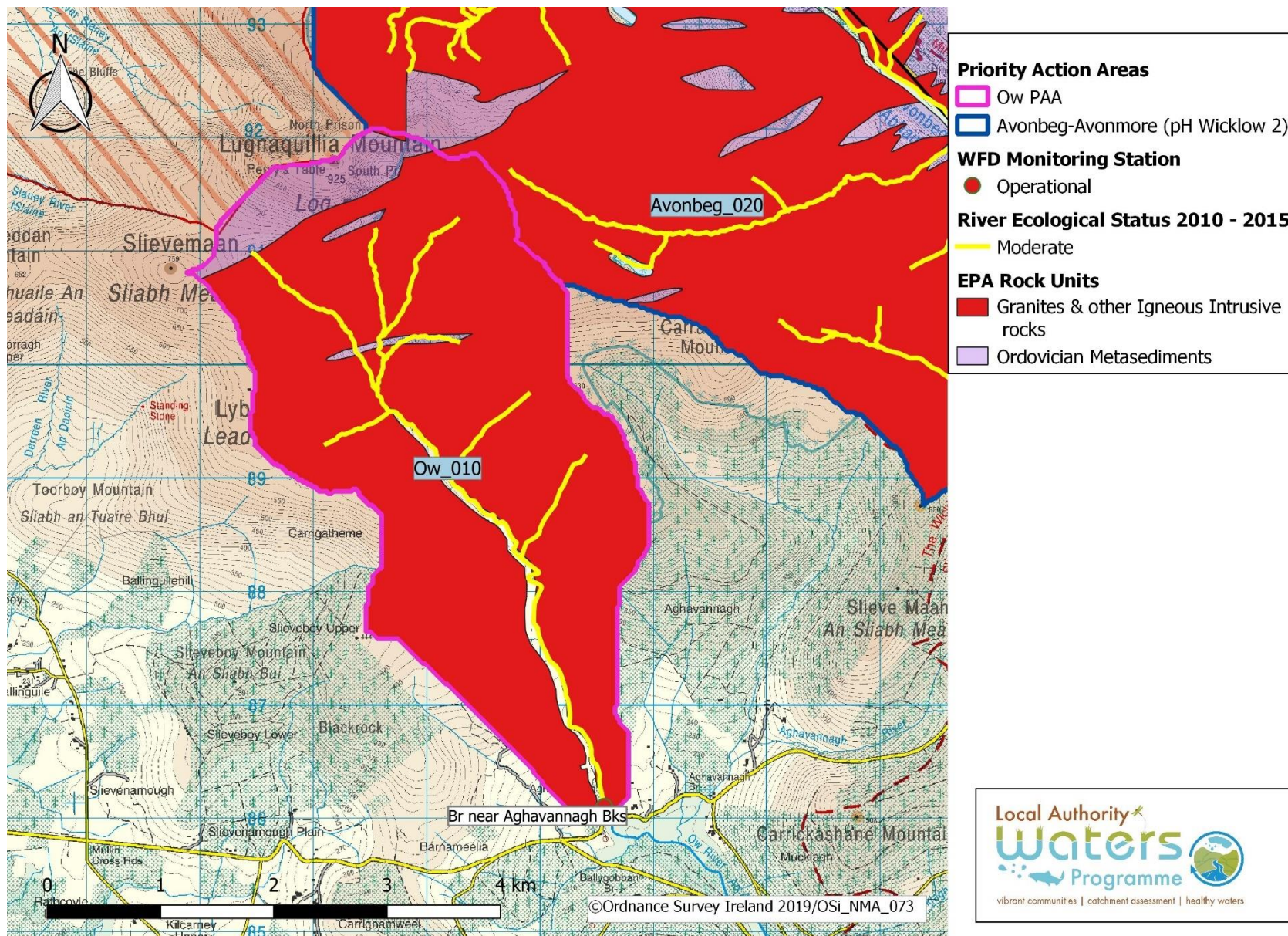
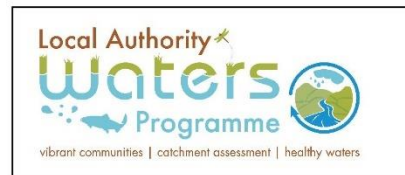


Figure 8 Rock Units within Ow PAA.



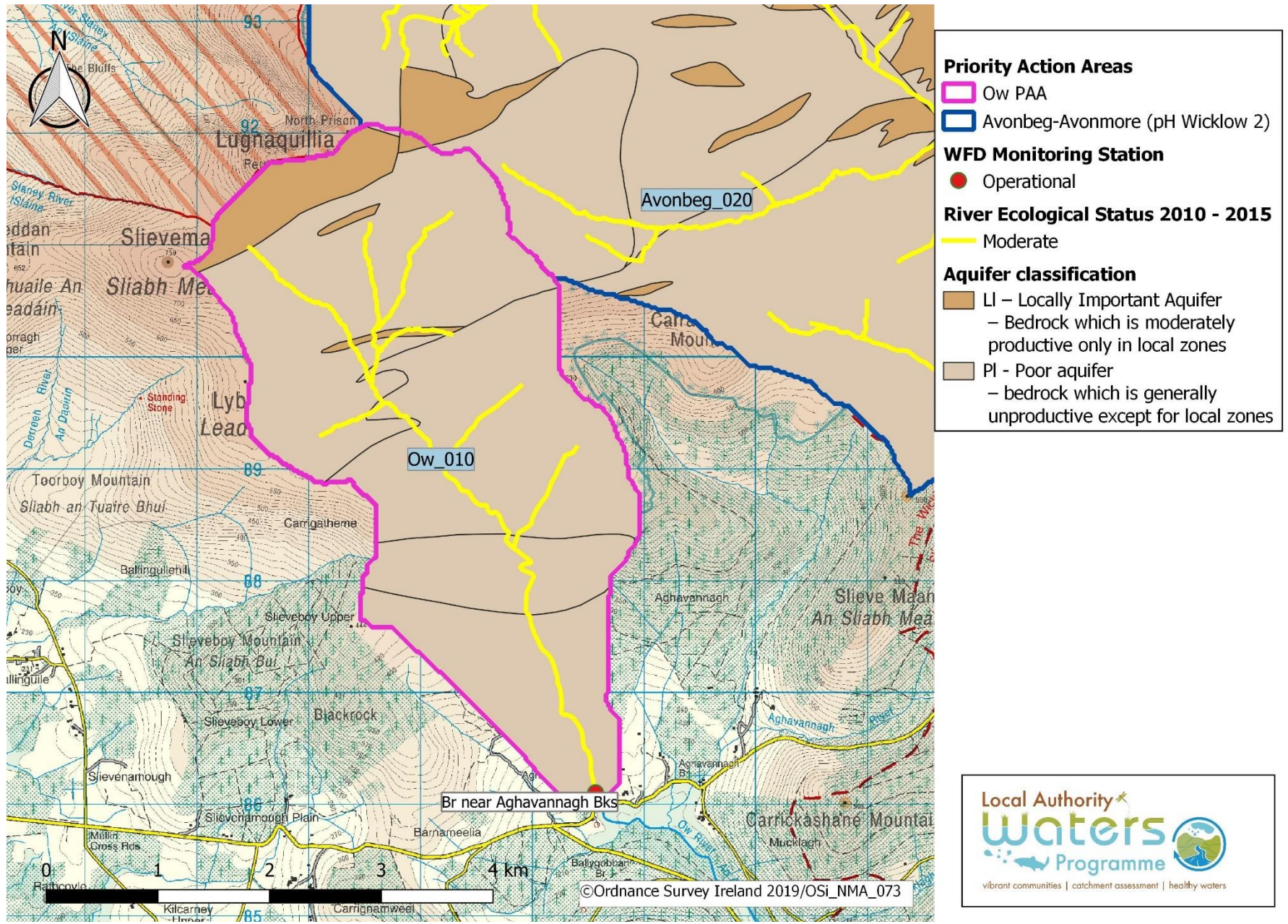


Figure 9 Aquifer type within Ow PAA.

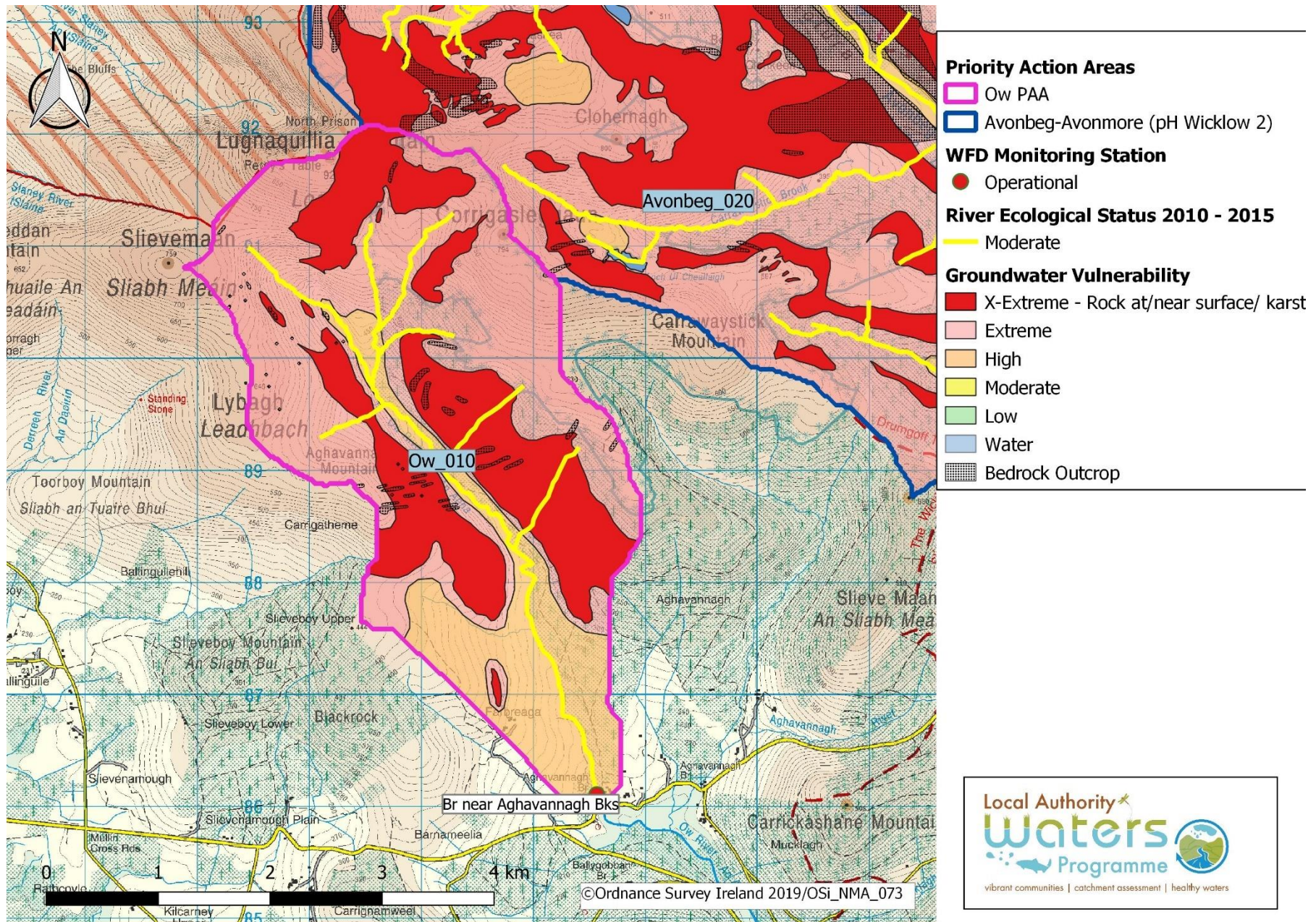


Figure 10 Groundwater Vulnerability within Ow PAA.

Further Information

8th March 2022

Since completion of this desk study, EPA 3rd cycle characterisation concluded that Ow_010 is now *Not at Risk* and achieving its environmental objective of Good ecological status. Forestry is no longer a significant pressure.