Waters of LIFE

Framework of Measures and Best Practice Guidelines for the Protection and Restoration of High Status River Waterbodies

Annex 3: Peat Extraction

Tables of Measures for Mitigating Significant Issues arising from Peat Extraction in Catchment Areas where the Objective is Restoration

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Contents

List of Tables

List of Figures

1 Introduction

The Waters of LIFE is a European Union funded Life Integrated Project which aims to help reverse the loss of Ireland's most pristine rivers. The ongoing loss of high-status waters is a worrying trend for water quality in Ireland. The protection and restoration of these waters is one of the key underpinning principles of the EU Water Framework Directive.

The project aims to develop, test and validate effective catchment management measures to reverse this declining trend. Six project catchments have been selected, five demonstration catchments and one control catchment. These are:

- Avonmore Sub Catchment 010, Wicklow.
- Blackwater Sub Catchment 060, Cork.
- Graney Sub Catchment 020, Clare.
- Lee Sub Catchment 060, Cork (Known as the Shornaugh River).
- Sheen Sub Catchment 010, Kerry. (Control).
- Suck Sub Catchment 020 Galway/Roscommon (known as the Island River).

The measures in this document were identified in the context of mitigating the issues related to peat extraction pressures acting on high status objective river waterbodies in general and the demonstration catchments in particular. However, these measures are equally applicable to river waterbodies which have been assigned a good status objective under the river basin management plan.

The Waters of Life "Framework of Best Practice Measures and Guidelines for the Protection and Restoration of High Status River Water Bodies" Report[1] provides the scientific basis and approach for selecting and implementing the most appropriate measures to protect and/or improve High Status Objective (HSO) river waterbodies in their Irish environmental settings.

2 Context

Approximately 30% of the catchment areas of HSO waterbodies are underlain by peat and peaty soils. Approximately 40% of this area is cut-over peat.

In HSO waterbodies in *Areas for Restoration*, 13 were impacted by extractive industries (mainly peat but also quarrying). In most HSO waterbodies peat extraction is in individual small-scale plots for domestic fuel and often on blanket bogs. High densities of these plots result in industrial scale cumulative impacts. Industrial extraction of raised bog peat also occurs.

Drainage based utilisation of peatlands is no longer accepted as a sustainable option. Measures presented here primarily seek to restore degraded bog habitat where feasible, or to establish other natural habitats that are compatible with sustainability principles.

Less than 20% of Irish peatlands are in near natural condition. Drained and cutover peatlands are a common feature of many HSO waterbodies. Drainage results in increased concentrations of ammonium (NH_4), phosphorus, base cations, heavy metals, dissolved organic carbon (DOC) and particulate organic carbon (POC) reaching receiving waters, depending on site-specific characteristics and management. Heavily overgrazed areas may be extensively gullied and require restoration/rehabilitation works to raise the water table and restore suitable hydrological conditions

[1] https://www.watersoflife.ie/app/uploads/2023/08/Measures_Framework.pdf

for the re-establishment of peat forming vegetation, to reduce erosion of peat silt, and to mitigate pollutant exports.

3 Explanatory Comments

- A key principle in deciding on and establishing measures is **"right measure in the right place"**. Determining the 'right measure in the right place' is based on a number of factors, such as the following:
  - i) The **issue of concern** (pollutants, hydrology, morphology). The main pollutants of concern arising from peat extraction are: sediment, DOC, NH_4 and pH. Each has differing potential both in their impact and abilities to be transported in water and, in particular, to be attenuated on the land and in the landscape.
  - ii) The **pressure(s**) causing the issues of concern, for instance, whether the peat cutting is licensed or unlicensed and industrial or local. In the case of pollutants, the relative **loading** from the pressure and the **likelihood** of the loading reaching the receptor are important factors that require consideration and assessment.
  - iii) The physical setting that determines the topography, water levels and flows, and the type and degree of peat cutting.
  - iv) Whether the objective is to **'restore' (improve) or 'protect' (maintain**), as more stringent and resource intensive measures are likely to be needed to achieve the restore/improve objective.

  Therefore, each of these factors needs to be taken into account in deciding on measures prior to their establishment, as a means of ensuring that they are efficient and effective in achieving their objectives. The catchment science and management process that encompasses these factors is shown in Figure 1.

- A table providing a menu of measures for five issues of concern arising from peat extraction – sediment, DOC, NH_4, pH and hydrology (runoff and water levels) – has been compiled (Table 1).

- The table provides an estimate of the effectiveness of measures, that have been designed, located and established appropriately, to be used as a guide in assessing and deciding on possible measures. Four categories are given – High (H), Medium (M), Low (L), Insignificant (-).

- The measures have been categorised based on whether they are:
  - i) Mandatory.
  - ii) Incentivised or voluntary.

- While many of the measures have co-benefits for Green House Gas (GHG) emission reduction, carbon sequestration and terrestrial ecosystems, the primary objective is achieving Water Framework Directive (WFD) and Habitat Directive (HD) goals, and therefore the effectiveness scoring is based on the potential to mitigate the impact of the issues of concern on aquatic ecosystems.

- In compiling the table, the assumptions are:
  - i) The receptors are surface water ecosystems.
  - ii) Desk-based and field-based assessments have been undertaken in advance of decisions on measures. Therefore, the following factors are known, thereby providing the basis for decision-making on measures: a) the issues of concern arising from peat extraction that are impacting on the ecosystems (such as sediment, NH_4, DOC, pH and hydrology); b) the physical setting; c) the type of peat extraction – industrial or local; and d) the 'story' of the catchment.

iii) The effectiveness ratings are based on measures needed in the catchments of waterbodies in *Areas for Restoration* where, for instance, significant mitigation of the impacts may be needed.

iv) The High (H) rating has been reserved for measures that on their own will make a significant difference to improving the water quality.

v) To achieve receptor restoration and the desired aquatic ecosystem objective, a suite of measures at an appropriate scale will generally need to be established.

♦ When considering the content of the table, the recommended approach is to:

i) Ensure that characterisation of a waterbody catchment has been undertaken and the following is known: a) the required objective (e.g. status) has <u>not</u> been achieved and the catchment is therefore an *Area for Restoration*; b) the issues of concern; c) the physical settings; and d) the pressures causing the impacts.

ii) Start with the issue of concern (e.g. sediment).

iii) Keep in mind the main physical and pressure settings – topography, water levels and flows, and the type and degree of peat cutting.

iv) Analyse each possible measure in terms of potential to mitigate the impact of the issue of concern arising from the specific pressure (e.g. the potential to reduce the load of sediment entering a watercourse from peat extraction), and in the process make a significant contribution to restoring the waterbody to the required objective and condition.

v) Keep in mind that a combination of measures is likely to be needed.

vi) Use the measures effectiveness ratings when prioritising establishment of measures.

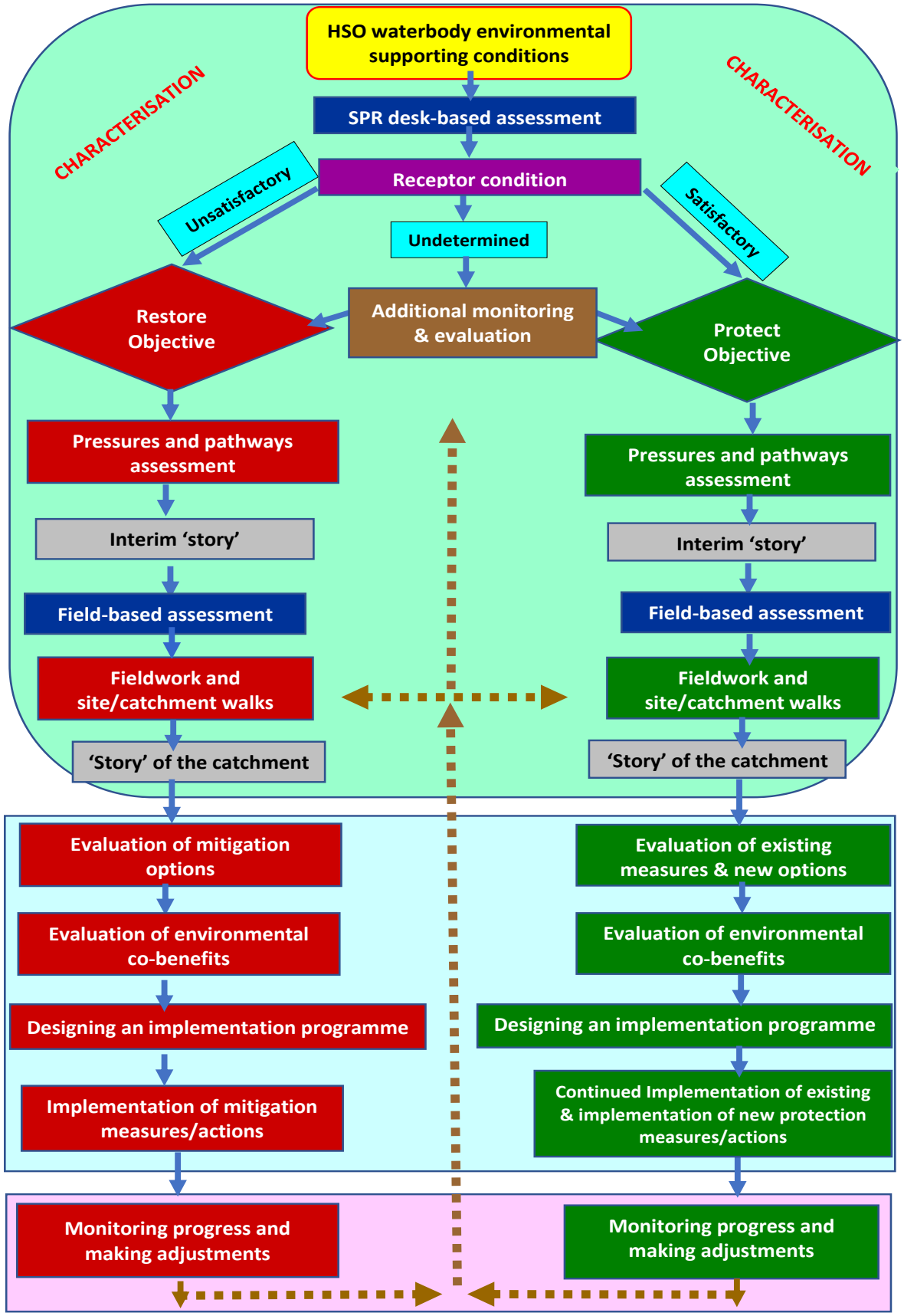

Figure 1: Process flowchart for evaluation of measures in HSO waterbody catchments.

Table 1: List of measures for Peat Extraction, categorised based on location in the landscape, with guidance on estimated effectiveness potential for pollutants and hydrology, where the objective is restoration to the required waterbody status or condition.

			Measures Effectiveness (High (H), Medium (M), Low (L), Insignificant (-)				
No.	**Cat.**	**Measure**	**Sediment**	**NH_4**	**DOC**	**pH**	**Hydrology**
E1	Source reduction & Control	For licenced activities, compliance with the measures in the licence (mechanised peat extraction only).	**H**	-	-	-	-
E2		Regulation of unlicenced/unregulated commercial peat extraction	**H**	-	-	-	-
E3		Cessation of peat extraction (industrial)	**M**	-	-	-	-
E4		Cessation of peat extraction (local)	**H**	**L**	**L**	**L**	-
E5		Cleaning out of settled silt in drainage channels before heavy rainfall.	**L**	-	-	-	-
E6		Bog reprofiling	**L**	**L**	**L**	**L**	-
E7	Mobilisation control	Raising water levels to at or close to ground level	**H**	**H**	**H**	**H**	**H**
E8		Sphagnum inoculation	**H**	**H**	**H**	**H**	**H**
E9		Control of inappropriate vegetation	-	**M**	**M**	**M**	-
E10		Care with machinery used in vicinity of streams and ditches, if feasible by having setback distances.	**L**	-	-	-	-
E11	Pathway Interception	Drain blocking[2]	**H-L**	**H-L**	**H-L**	**H-L**	**H-L**
E12		Bunding in appropriate locations	**H**	**M**	**M**	**M**	**M**
E13		Silt lagoons installed at the appropriate density and maintained frequently (Mechanised Peat Extraction only)	**M**	-	-	-	-
E14		In-ditch sediment ponds	**M**	-	-	-	-
E15		During excavation or cleaning of drains, damming of the drains at suitable locations to enable peat silt settlement.	**L**	-	-	-	-
E16		Establishment of wetlands as part of bog rehabilitation (e.g. fen)	**M**	**M**	**M**	**M**	**M**

Mandatory measure in the Regulations

[2] Effectiveness depends on resulting depth to the water table.

4 General Guidance on Measures

The measures for peat extraction are categorised depending on their location along the 'pollutant transfer continuum' in the landscape (Figure 2):

i) Measures to reduce or eliminate the pollutants or issue of concern.
ii) Measures to reduce mobilisation of pollutants on land.
iii) Pathway interception measures.

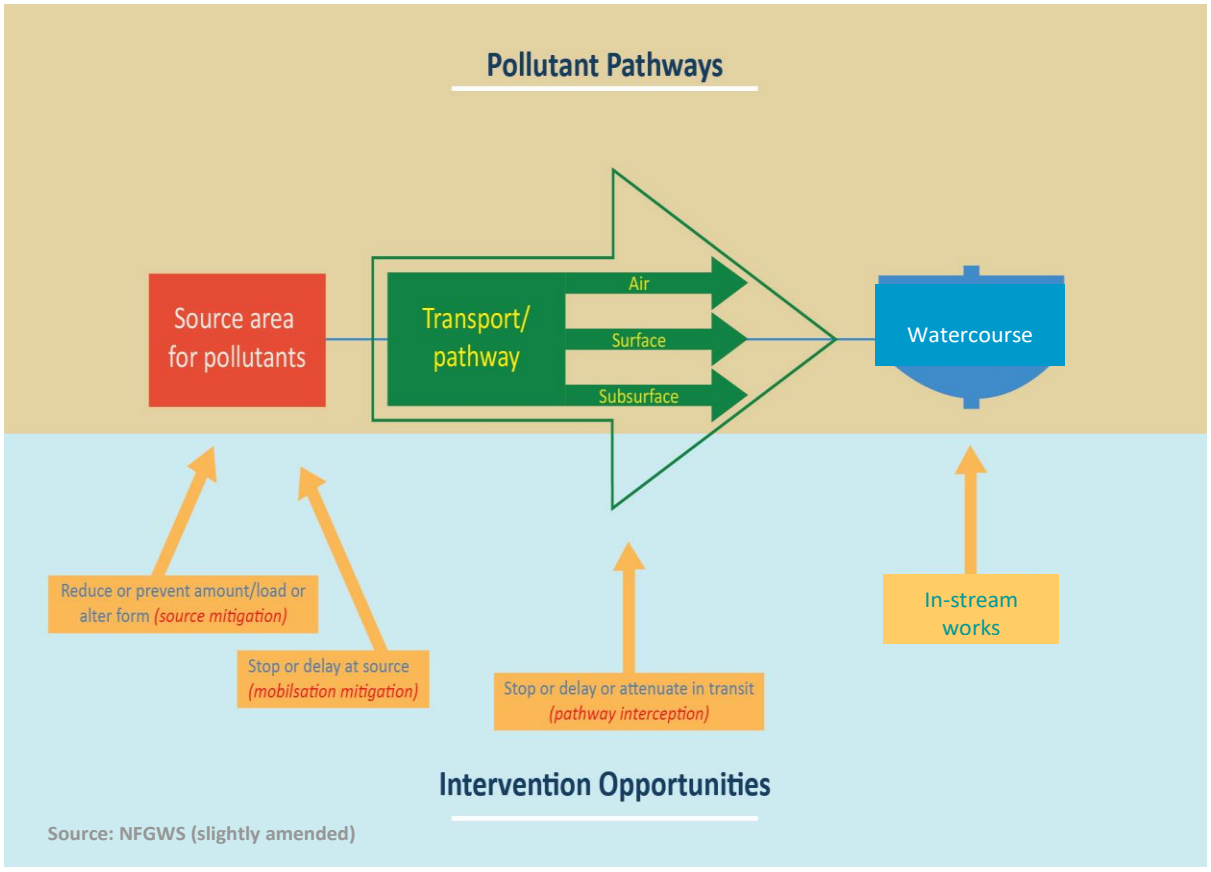

Figure 2: Representation of the pollutant transfer continuum.

4.1 Habitat restoration / rehabilitation / reclamation

Measure design elements

Peatland habitat measures implementation in HSO waterbodies or sensitive catchments requires careful consideration of the existing land use and the sensitivity and vulnerability of the surface water and groundwater receptor. Hydrological recovery may be a slow process taking decades and may be monitored using dip wells or piezometers.

Inspection of dams post installation to ensure integrity and performance is essential. Restoration of peatland in steeply sloping settings may not be feasible with current technologies, due to the risk of dam failure or bog slides. Where unfavourable site modifications, e.g. shallow peat depth, would not support restoration, a new habitat type including mosaics of bog/fenland, woodland, heather and scrub/open water could be considered. Large scale creation of lakes on industrial cutaway bog is not considered here as it is unlikely to be appropriate in HSO waterbodies.

Implementation

Drain blocking to raise the water table is a common restoration measure on peatlands. Initial survey of drain locations and slopes will determine the locations and density of dams. Choice of damming material depends on peat properties, slope, substrate type, drain dimensions and expected flows. Ideally it should be informed by high resolution topographic data. Measures on steeper slopes need to be addressed with caution due to the elevated risk of slope failure.

Peat dams (peat plugs) are commonly used on smaller drains on lower slopes, where mineral substrate is not exposed, and flows are lower. It is relatively cheap and requires no materials to be imported to site. In other scenarios, plastic, wooden dams, sometimes in combination with peat, may be used. Wooden dams can also be used to create 'leaky dams'. Spacing of dams depends on slopes and flows but should be a minimum of 10m apart.

Reprofiling may be required where a production field has a high central camber, to create a final profile with a largely flat or slightly concave surface. On cutaway with increased slopes, it is more advantageous to create shallow depressions, 10-20cm deep and a maximum of 20m long (although sizing will be dictated by natural topography).

Shallow berms may be used to improve rewetting of cutaway bog, helping cells to retain surface water and slowing water movement through the cutaway. This engineering measure is more suitable for larger areas of cutaway bog as the berms need to be at least 4-5m wide to accommodate an excavator and other equipment and also to provide suitable protection to resolve the anticipated hydraulic forces within the newly created cells. In areas that have been heavily overgrazed or denuded of vegetation a proactive approach to re-introducing appropriate vegetation on bare peat areas may be necessary, including reed inoculation and proactive targeted inoculation of suitable peatland areas (such as areas with deep peat) with *Sphagnum*.

Invasive species pose a threat to peatlands particularly where human activities have increased vulnerability. Species which are a problem for peatland conservation (and restoration) include rhododendron, pitcher plant and giant rhubarb.

Peatlands that are degraded due to drainage, previous afforestation, peat harvesting or overgrazing. These will be identified by areas of bare peat, peat hags or exposed mineral soils, and eroding banks. Significant peat silt deposits may be visible in local watercourses.

The sources of peat silt may be readily identified. Measures must consider ongoing usage of sites for grazing or peat harvesting.

Likely response times to achieve specified targets

Hydrological recovery may be a slow process taking decades. Monitoring water levels in a peatland is essential following blocking of drains with dams. This gives valuable information on the effectiveness of drain blocking activity. Monitoring of flora and fauna will indicate the success of restoration works.

Environmental co-benefits

The measure complements peatland conservation programmes and climate change mitigation. Healthy peatlands are sinks for very substantial amounts of carbon. Peatlands play a vital role in regulating the global climate by acting as long-term carbon sinks. They are also habitats for unique assemblages of plants and animals that are increasingly threatened on a global scale. Restoration can assist in achieving aims of climate mitigation planning and the objectives of the Habitats Directive and biodiversity plans. Peatland restoration may reduce costs of treatment of drinking water sources by reducing DOC and potential formation of Trihalomethanes (THMs).

Constraints on measures selection or implementation
Socio economic acceptability: peatland restoration requires agreements with land owners and providing compensation payments for loss of turf cutting or for permission to carry out works on privately owned land.

Estimated costs
Such costings need to consider the projected lifespan of measures and the likely timeframe required for measure deployment in achieving objectives.

Peatland restoration may involve land acquisition, preparation of restoration and drainage management plans and training contractors to carry out specialist restoration works. The price of restoration for all peatlands designated of conservation importance in Ireland has been estimated in 2020 at €1 billion by the National Parks and Wildlife Service. The total area of these designated peatlands is approximately 250,000 ha. This indicates rough costs of about €4,000 per ha for restoration.

4.2 Use of dams (peat/wooden/plastic/ leaky) in drains and soakaway areas

In areas where active peat extraction is ongoing or where unfavourable site modifications could not support restoration, dams may be used to attenuate flows/erosion, and mitigate against loss of sediment and generation of nutrients through peat decomposition. Construction will be similar to methods outlined in habitat restoration above but will not be as extensively applied. Strategic points and sites where surface water drainage converges may be prioritised. Where possible, overflow should be diverted to vegetated areas. Dams are also useful where drains are being excavated or cleaned. Damming at appropriate locations will aid settlement of peat silt.

Measure design elements
Dams may be placed at strategic locations on pathways connecting critical source areas to watercourses.

Implementation
Locations should be in low gradient areas of drains and, ideally, in smaller drains. Bank conditions and drain substrate will influence the type and construction of dam deployed.

Peatlands that are degraded due to drainage, previous afforestation, peat harvesting or overgrazing will be identified by areas of bare peat, peat hags or exposed mineral soils, and eroding banks. Significant peat silt deposits may be visible in local watercourses.

Critical sources of peat silt may be readily identified and drainage pathways to local receiving waters. Dams should be sited at intervals along the pathway.

Likely response times to achieve specified targets
Dams will have immediate effect on silt transport but will require ongoing inspection and maintenance. The measure will intercept pathways of peat silt export, but source problems should be addressed by complementary measures.

Environmental co-benefits
Damming of peat drains reduces silt export and can assist in achieving the objectives of the Habitats Directive and biodiversity plans by reducing chronic impacts on aquatic systems. Damming may also reduce costs of treatment of drinking water sources. This measure will help to raise water tables locally with potential biodiversity benefits.

Constraints on measures selection or implementation

1. Socio economic acceptability: damming of drains may increase water table levels locally and impact on surrounding land uses.
2. Potential for adverse impacts on other parameters, habitats or species: unlikely
3. Gains or losses of natural assets: protection of downstream aquatic systems and habitats.
4. Scalability issues: there is likely to be substantial opportunities for implementing drain damming in many HSO waterbodies.

Estimated costs

Cost of installation of individual structures is low and less than approximately €300. Maintenance is required but even replacement of structures at low frequency is not excessive.

4.3 Sediment/Silt traps / Sediment Ponds / Constructed Wetlands

Silt lagoons or sediment ponds and wetlands have been shown to purify runoff from extracted peatlands, reducing organic N, total N and suspended solids. In addition, wetlands can enhance removal of other nutrients, sequester carbon, produce biomass and promote biodiversity. They have limited effectiveness for particulate organic matter (peat silt) and methods favouring filtering over settlement should be preferred. They do not remove significant amounts of DOC and other nutrients.

Silt lagoons are used to remove low density organic matter arising from erosion of excavated peatlands. Lagoons are substantial structures, and may be of elaborate design. They must provide adequate retention times for settlement of peat silt. Frequent maintenance and procedures to remove accumulated silt are essential. Lagoons may require fencing.

In ditch sediment traps include settlement basins widened into an existing channel, usually done on artificial open drainage ditches, to allow suspended sediment to settle out and collect. These can also incorporate leaky dams.

Measure design elements

This measure is similar to that described for agricultural scenarios. Such structures are suitable for siting at end of extensive drainage systems. Gradients are typically very low in many of the potential peatland deployment locations, and careful assessment of drain falls is required during site selection where gravity flows are used. Site access for construction and maintenance of larger basins must be adequate.

Implementation

Silt lagoons require regular inspection to ensure that they remain safe and are functioning properly. Dimensions of settlement lagoons will vary depending on the collection area and runoff. For peat silts the maximum flow velocity through the lagoon should be less than 10cm/s. To achieve this, capacity of the order of 50m^3 per ha served may be required. Typical lagoons in bogs with active extraction are 8-12m wide, and 1.5-2m deep. Length is varied in relation to area served and capacity required, but may be 50-300m long. Baffles may be included to assist settlement.

Where peat extraction is ongoing silt loads of up to 4m^3/ha may be retained in silt lagoons and will require frequent removal and suitable disposal/spreading. Drainage channels may also require cleanout, particularly where heavy rainfall is forecast. As with any use of heavy machinery in the vicinity of drains, ditches or streams, care should always be taken to minimise risk of peaty sediment being lost to waters during the works. Maintain setback distances where possible.

Such features should be located at the downstream end of drainage systems. It may be necessary to divert drains into the collecting system for maximum efficiency. Final discharge of clarified water should be by surface pathways across vegetated areas.

Lagoons should be positioned so that they do not constitute a serious downstream risk in the event of failure. Siting at locations close to receiving water courses allows maximum areas to be treated, but lagoons must not be in flood plains or areas liable to flooding.

Heavily impacted and degraded peatland areas with obvious extensive erosion and/or active peat harvesting should be considered.

The site should be level and provide sufficient mechanical strength to eliminate risk of lagoon failure. Drainage leading to the lagoon should be of low gradient and outfalls should not promote scouring downstream.

Likely response times to achieve specified targets
Once established, appropriately constructed silt lagoons will provide effective mitigation for peat silt loading to receiving waters. Sources of peat silt will need to be addressed through other complementary measures in a treatment train approach.

Environmental co-benefits
This measure may also be deployed in peatland restoration and species protection projects undertaken in line with objectives of the Habitats Directive. Biodiversity benefits will accrue to downstream receiving waters.

Constraints on measures selection or implementation

i) Socio economic acceptability: likely to be acceptable in peatland scenarios provided landowners are incentivised.
ii) Potential for adverse impacts on other parameters, habitats or species: unlikely.
iii) Gains or losses of natural assets: protects downstream drinking water sources.
iv) Scalability issues: these are large structures and multiple replication is unlikely.

Estimated costs
Installation costs are relatively low and principally relate to plant hire and some piping. Some site survey may be required to ensure that the lagoon location and dimensions are adequate to achieve required performance criteria for the area served. Regular maintenance will be an ongoing cost until source issues are remediated.

4.4 Regulatory control in HSO Waterbodies – site specific assessment viz High Ecological Status (HES) issues

Environmental Impact Assessment (EIA) and Appropriate Assessment (AA) are required for peat extraction projects in excess of 30 ha and such sites are also subject to planning controls. Bord na Mona has now formally ended all peat harvesting on its lands but domestic production for horticulture and mushroom production continues on 'ecologically destroyed' bogs.

A separate regulatory regime that will bring smaller-scale commercial peat extraction (on lands of less than 30 ha) under a new local authority licensing system is to be developed, and will incorporate EIA and AA, as required, and enforcement powers.

Any permitting of peat or mineral extraction in HSO waterbodies or their upstream sub-catchments should consider high status specific requirements when assessing such plans and should liaise with statutory bodies including EPA Catchment Management Unit.

Implementation
Roles and remits in relation to small scale peat cutting (<30ha) will be set out in the regulatory instruments to be developed.

Likely response times to achieve specified targets
For licenced activities, immediate mitigation will be delivered.

Environmental co-benefits
Biodiversity benefits derive from reduced impacts on receiving environments and provision of diverse habitats through restoration and after-care plans.

Constraints on measures selection or implementation

i) Socio economic acceptability: control of domestic peat cutting is likely to prove very challenging and will require extensive consultation and compensation schemes.
ii) Potential for adverse impacts on other parameters, habitats or species: unlikely, and EIA and AA are requisites of any consenting process.
iii) Gains or losses of natural assets: potential habitat gains through after-care or restoration.
iv) Scalability issues: the proposed regulatory scheme will apply to all peat cutting less than 30ha in extent.

4.5 Consenting notifiable actions in relation to sites of European Importance (Natura Network)

The Minister for Housing, Planning and Local Government is required to be notified in relation to specified activities in Sites of European Importance, and such activities should not proceed without prior consent. Where peatlands in HSO waterbodies coincide with conservation designations, a range of activities requiring consent may offer an opportunity to mitigate impacts of peat extraction and ancillary activities.

Measure design elements
Designated actions requiring consent in Blanket Bogs, Heaths, Raised Bogs, Cutaway Bog and Bog Woodland include: creation of new tracks or paths; burning of vegetation, reclamation, infilling, ploughing or land drainage; rock removal/cutting turf except from existing banks; no cutting from intact (uncut) areas; commercial peat moss or turf extraction; alteration of the banks, bed or flow of watercourses; burning areas of vegetation over 5 ha, or burning any area more often than once every 15 years; and for Raised Bogs - drainage works on the bog or within the local water catchment area.

Implementation
It is an offence to carry out an Activity Requiring Consent without prior consent, and the onus is on landowners to apply for permission to the Minister. However, article 27(5)(e)(vii) of the Birds and Natural Habitats Regulations requires that all Public Authorities in the exercise of their functions, insofar as the requirements of the Birds Directive and the Habitats Directive are relevant to those functions, shall take account of all relevant activities requiring consent.

Peatland areas where cutting or associated drainage, track building and other activities may impact on a site of European importance.

Likely response times to achieve specified targets
Control of activities that might significantly impact on Sites of European importance will have immediate benefits to the peatland sites on which they are implemented. Legacy issues will require other complementary measures and may take many years to resolve and achieve objectives.

Environmental co-benefits
The measure can deliver biodiversity benefits through protection of European sites. Reduced damage to peatlands through control measures also delivers climate change mitigation in the form of reduced GHG emissions and increased carbon sequestration.

Constraints on measures selection or implementation

i) Socio economic acceptability: required by the Habitats Directive.
ii) Potential for adverse impacts on other parameters, habitats or species: unlikely.
iii) Gains or losses of natural assets: protection of peatland habitat and qualifying interests of sites of European importance.
iv) Scalability issues: applies to all peatland areas where overlap with, or potential impact on Natura sites occurs.

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