



National Arterial Drainage Maintenance

List of Activities 2018 – 2021

**Environment Section
Engineering Services
Office of Public Works**

November 2018

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1. Introduction

There is no statutory requirement under the Arterial Drainage Acts 1945 & 1995, for the production of a 'Plan' or 'Programme', for Arterial Drainage Maintenance. However, following a Strategic Environmental Assessment (SEA) screening consultations with the Environmental Protection Agency (EPA), it was deemed appropriate for an SEA to be carried out to manage the ongoing drainage maintenance activities and/or works. This document has been produced to facilitate the SEA process as per the SEA Directive (Directive 2001/42/EC).

Where the Commissioners of Public Works have completed a drainage scheme under the Arterial Drainage Acts, 1945 and 1995, there is a statutory requirement to maintain the drainage works forming part of the Scheme. These drainage works include watercourses, embankments and other structures. Watercourses are subject to siltation and erosion, among other processes, while embankments are subject to settlement and erosion. Ongoing maintenance activities are of a cyclic nature which are to maintain the channel at a certain outfall datum and conveyance capacity by means of repetitive works. An annual programme of maintenance is compiled to maintain the drainage works which are prioritised based on the rate of deterioration and the risk arising. In any one year, approximately one-fifth of watercourses are maintained.

1.1 Timescale

The 2018 – 2021 timescale has been adopted to facilitate the coordination with the River Basin Management Plans (RBMP) and Catchment Flood Risk Assessment and Management Studies (CFRAMS). The main EU Directives in the water management sector such as the Water Framework Directive (WFD) and the Floods Directive set a six year cycle approach.

1.2 Arterial Drainage Maintenance

1.2.1 Arterial Drainage Schemes

The Office of Public Works is the body through which Central Government exercises its statutory responsibilities in respect of river drainage and flood relief works. It derives its statutory authority from the Arterial Drainage Acts, 1945 and 1995 and the European Communities (Assessments and Management of Flood Risk) Regulations 2010.

Table 1 OPW Schemes carried out under Arterial Drainage Acts 1945 & 1995

Scheme	Duration of Works	Areas Benefiting (hectares)
<i>Major Schemes (River Catchments over 100,000 acres in extent)</i>		
Brosna	1948-1955	34883
Glyde & Dee	1950-1957	10643
Feale	1951-1959	10724
Corrib-Clare	1951-1959	10724
Maine	1954-1964	30310
Inny	1959-1963	4694
Deel	1962-1968	20234
Moy	1960-1971	4816
Corrib-Headford	1967-1973	24685
Boyne	1969-1986	48157
Maigue	1973-1986	12343
Corrib-Mask	1979-1986	9712
Boyle	1982-1992	10845
Blackwater (Monaghan)	1984-1992	2367
<i>Minor Schemes (River Catchments 25,000 – 1000,000 acres)</i>		
Nenagh	1955-1960	2630
Ballyteige/Kilmore	1959-1961	931
Broadmeadow & Ward	1961-1964	2995
Killimor/Cappagh	1962-1968	5099
Bonet	1982-1992	1295
<i>Other Small Schemes (River Catchments less than 25,000 acres)</i>		
Clareen	1959-1961	445
Ouvane	1962-1963	162
Matt	1964-1965	202
Duff	1963-1965	1457
Brickey	1965-1967	405
Abbey	1964-1967	364
Knockcroghery	1967-1968	202
Creagh	1968-1969	405
Burnfoot/Skeoge	1968-1970	162
Kilcoo	1969-1971	162
Owenavorrhagh	1968-1970	1052
Carrigahorig	1968-1971	1538
Groody	1970-1973	1214
Deel and Swillyburn	1957-1961	1416
Cloonburn	1967-1968	162
<i>Estuarine Embankment Schemes</i>		
Shannon (Limerick)	1962-1971	4897
Shannon (Clare)	1958-1960	728
Fergus	1959-1960	728
Owenogarney	1955-1959	850
Swilly	1961-1968	1295

Scheme	Duration of Works	Areas Benefiting (hectares)
<i>Flood Relief Schemes</i>		<i>Completion Date</i>
Belclare, Clare River maintained as part of the Corrib-Headford Drainage Scheme		1995
Gort Town, Co. Galway maintained as part of the Gort Flood Relief Scheme		1997
Sixmilebridge, Co.Clare maintained as part of the Owengarney Catchment Drainage Scheme		1997
Lacken (Ardraham), Co. Galway maintained as part of the Lacken Drainage Scheme.		1997
Nanny River, Duleek, Co. Meath maintained as part of the Nanny Scheme.		1998
Mulkear River, Newport, Co. Tipperary maintained as part of the Mulkear River Scheme		1998
Ballymakeogh, Co. Tipperary maintained as part of the Scheme		1998
Mulkear River, Cappaghmore, Co. Limerick maintained as part of the Scheme		2000
Bridge End, Co. Donegal , improvement to the Skeoge Scheme and is maintained as part of the Scheme.		2000
Bandon River, Dunmanway, Co. Cork , this is maintained as part of the Scheme.		2001
Shinkeen Stream, Hazelhatch, Co. Kildare , this is maintained as part of the Scheme.		2001
Maam Valley, Co. Galway ; this was an improvement to the Scheme, and is maintained as part of the Scheme.		2001
Suir River, Carrick-on-Suir, Co. Tipperary ; this is maintained as part of the Scheme.		2003
Nore River, Kilkenny ; This is maintained as part of the Scheme		2006
Ennis, Co. Clare , maintained by the OPW but the maintenance of the pumps is through SLA with the County Council.		2013
Mornington, Co. Meath , maintained as part of the Mornington Scheme		2012
Tullamore, Co. Offaly , this is maintained as part of the Scheme.		2013
Clonmel, Co. Tipperary maintained by the OPW, however maintenance pumps is through SLA and the County Councils.		2014
Fermoy, Co. Cork maintained by the OPW, however maintenance pumps is through SLA and the County Councils.		2015
Mallow, Co. Cork maintained by the OPW, however maintenance pumps is through SLA and the County Councils.		2016
Belclare, Clare River maintained as part of the Corrib-Headford Drainage Scheme		1995
Gort Town, Co. Galway maintained as part of the Gort Flood Relief Scheme		1997
Sixmilebridge, Co.Clare maintained as part of the Owengarney Catchment Drainage Scheme		1997
Lacken (Ardraham), Co. Galway maintained as part of the Lacken Drainage Scheme.		1997
Nanny River, Duleek, Co. Meath maintained as part of the Nanny Scheme.		1998
Mulkear River, Newport, Co. Tipperary maintained as part of the Mulkear River Scheme		1998

1.2.2 OPW's Roles and Responsibilities in Arterial Drainage Maintenance

Under Section 37 of the Arterial Drainage Act 1945, the OPW is statutorily obliged to maintain all rivers, embankments and urban flood defences on which it has executed works since the 1945 Act (**Table 1**) in "proper repair and effective condition".

Maintenance referred to under the Arterial Drainage Act 1945 includes:

- i. The maintenance of river channels in a condition that ensures they are free-flowing, thus reducing flood risk and providing adequate outfall for land drainage.
- ii. The maintenance of river and coastal embankments, in a condition that protects benefiting lands to the extent defined in the Scheme, from risk of flooding.
- iii. The maintenance, repair and/or replacement of all structures forming part of a Scheme, including accommodation bridges, weirs, sluice barrages, sluices, pumping stations and tidal flap gates.

The Act uses the terms “*proper repair and effective condition*”. The performance criteria relate to the design standard of the original Scheme works, its condition and performance of the various watercourses, embankments etc.

Failure to comply with these obligations would be contrary to the Drainage Acts and could lead to a “writ of mandamus” or an award of compensation arising from claims for damage to the benefiting lands. All of the completed Arterial Drainage and Estuarine Embankment Schemes are now maintained under the statutory obligation.

1.2.3 Extent of Operations

OPW Head Office is based in Trim, Co Meath. The maintenance function is divided into three regions for the purpose of programming and executing the work, **Table 2**. Each region has a main regional office with at least one sub office. The annual maintenance budget is circa €15 Million. The OPW maintain their own transport and excavator fleet and other specialised equipment such as weed cutting boats. The operations are carried out by a trained direct labour work force numbering circa 300. OPW direct labour staff uses a fleet of approximately seventy hydraulic excavators nationwide to execute the maintenance programme.

Table 2 OPW Drainage Maintenance Office Locations

Region	Main Regional Office	Sub-Office(s)
East	Newtown, Trim, Co. Meath	Ardee, Monaghan, Mullingar & Wexford
South West	Templemungret, Co. Limerick	Listowel & Portumna
West	Headford, Co. Galway	Ballina & Lifford

Figure 3.1 Arterial Drainage Catchments and RBDs

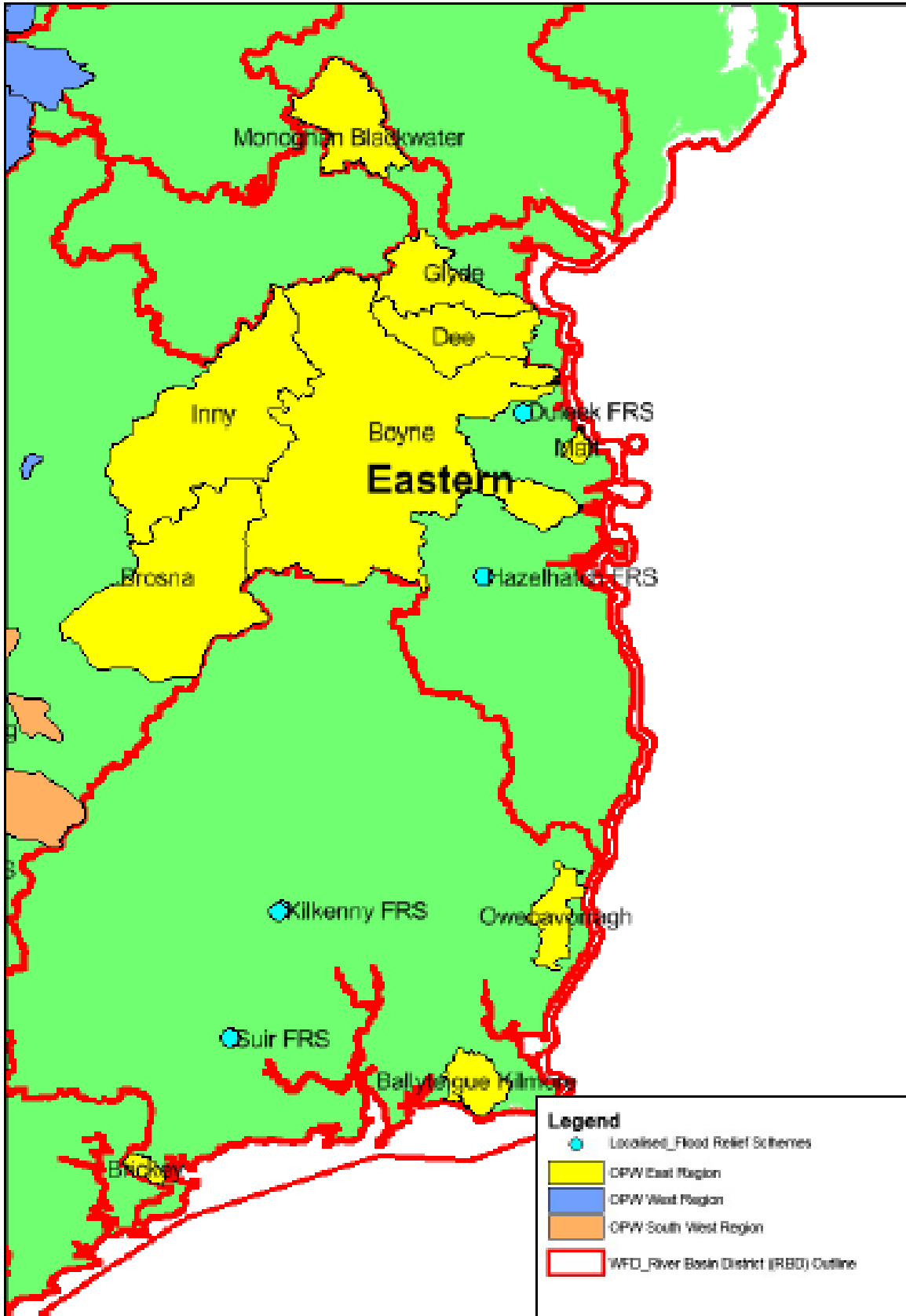


Figure 3.2 OPW East Region Schemes

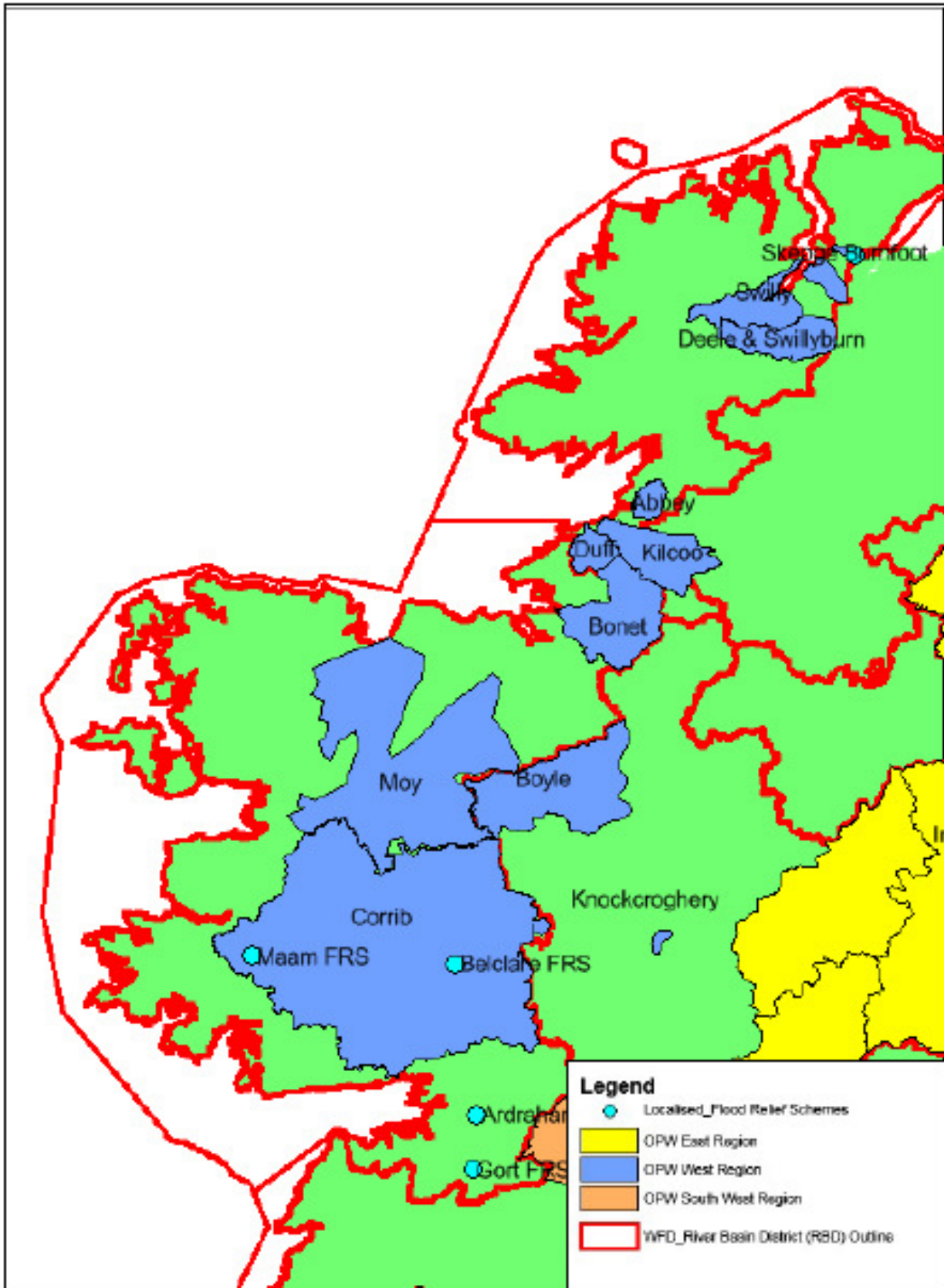


Figure 3.3 OPW West Region Schemes

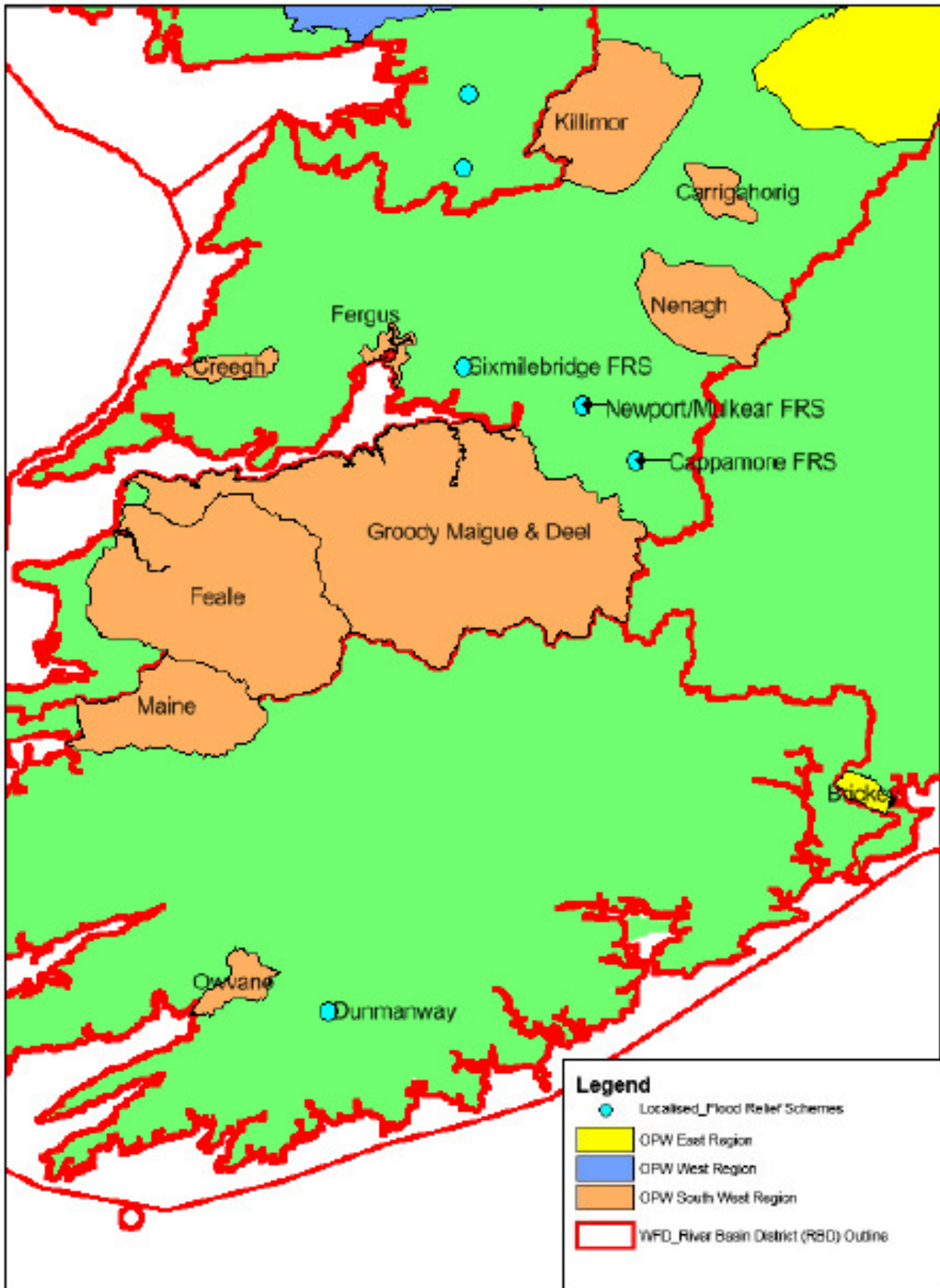


Figure 3.4 OPW South West Region Schemes

2.0 List of Activities

The National Arterial Drainage Maintenance 2018 – 2021 activities includes:

1. Channel Maintenance activities
2. Embankment Maintenance activities
3. Structural Maintenance activities
4. Flood Relief Scheme Maintenance activities

Statutory Arterial Drainage Maintenance entails the maintenance of completed Arterial Drainage Schemes and completed Flood Relief Schemes. The OPW are responsible for the maintenance of 11,500km of channel, 730km of embankments, some 18,500 bridges and 750 ancillary structures such as sluice gates, pumping stations and tidal barrages.

The majority of Arterial Drainage Maintenance works is on channel maintenance with the average channel requiring maintenance every four to six years. While this varies, with some channels requiring maintenance annually and others only requiring maintenance every twenty years, circa 2000km of channels are maintained annually and nearly all of the 11,500km of channels will have been maintained at least once over the Programme cycle of five years. Of the 750km of embankments, the frequency of maintenance tends to be more variable than that for channels with embankments scheduled for maintenance works as the need arises. There is an ongoing programme of Flood Relief Schemes carried by the OPW and statutory Arterial Drainage Maintenance includes the maintenance of these schemes. In respect of the various bridges and structures, a relatively small number are maintained annually i.e. circa 170 bridges and 30 other structures which are restricted to the most critical structures. Note that a portion of the 18,500 bridges are road bridges where the Local Authorities are responsible for the structural integrity, hence OPW maintenance operations typically exclude bridge deck or arch repair works on road bridges.

2.1 Channel Maintenance Activities 2018 – 2021

Channel maintenance operations normally involves removing the build up of foreign or natural material that impedes the free flow of water. Predominately this consists of the removal of water-entrained silt and associated vegetation from the bed of the channel by suitably rigged hydraulic excavators. Restrictions in channels due to bank slippage or damage would be re-graded to the original profile. Channel breaches due to bank erosion would be resolved by re-profiling the bank in-situ or in some cases by importing protection material such as rock armour or log poles. In addition, other larger vegetation such as trees, which impinge on channel capacity are either removed in whole or impingement is reduced by selective removal of lower branches. The material removed in the maintenance operations is normally spread along the bank, or on top of existing spoil heaps where present. In most cases, no alterations to the bank are required and in some cases the channel is not disturbed at all if no build up of material is present.

Some channels are steep and fast flowing, which are subject to flash floods, bank erosion and rapid movement of bed gravel. However, 60 – 70% of Scheme channels are of gentle longitudinal gradient and subject to relatively rapid deposition of silt, especially those that are subject to prolific growth of in-stream vegetation. The steeper sections of channel normally require relatively little maintenance works. The majority of maintenance works are on smaller lower-lying channels, with 90% of works in channels with a base width of less than three metres. The average channel requires maintenance every four to six years.

Channels with prolific weed growth may require maintenance annually, particularly where downstream bridges are at risk of being blocked due to a flow of decaying vegetation in autumn. Conversely, some channels may only require maintenance every twenty years due to the self-cleaning characteristics of the channel.

A number of channels have an annual prolific growth of aquatic plants, but are too wide or the bank conditions are too unstable to allow maintenance by way of excavators. Weed cutting boats are engaged in these cases, or where a particular channel requires to be cleared of vegetation but it is not deemed necessary to remove silt or other heavy material. In all, approximately 90km of channel are cleaned annually by four weed cutting boats, operating on a seasonal basis, with the majority of the works concentrated in the West of Ireland.

Historical databases have been built up in all regions. From these are extracted a base line list of channels which are due for cleaning. Critical sections of these channels are inspected and a work programme developed. This takes account of requests from the general public and potential flooding risk to roads, properties, urban areas and sewage works.

In developing the works programme, special consideration is given to potential impacts on fisheries, Natura 2000 Sites and the environment. This includes assessment of all works for their potential to impact on Natura 2000 sites by an external ecological consultants, specific timing of certain works, and consultation with both Inland Fisheries Ireland and National Parks and Wildlife Service

In general, scheme channel maintenance work is carried out by trained OPW drivers, using a hydraulic excavator. The material removed is normally spread along the bank or on top of existing spoil heaps where present.

2.2 Embankment Maintenance Activities 2018 – 2021

Most Embankment Schemes are tidal in nature hence they tend to be located at estuaries. The foremost inland embankments are the Annagh Embankments, on the Inny Arterial Drainage Scheme. During the period between 1987-1993 the financial resources for drainage maintenance were reduced resulting in a reduction in staff numbers and in the capability of OPW to carry out necessary work. By 1994 the deteriorating condition of the embankments, which at some critical locations had been eroded to less than half their original volume, gave cause for great concern, especially in Kerry, Wexford and Donegal. A programme of embankment strengthening was put in place to redress this.

Currently, programming of maintenance work consists of regular inspections of sections of embankments, which are known from experience to be at risk, together with additional inspections after a storm at sea, or a high tidal/flood event in the case of tidal embankments. Embankments are scheduled for works when it is deemed that the structure is in need of repair to maintain an effective condition. Repair works normally take the form of topping up clay embankments to design height and structural strengthening by importing rock/soil material or utilising in-situ material.

In addition, the programme extends to the refurbishment of the deteriorated embankments in Kerry, Wexford and Donegal. The Shannon Embankments are also undergoing refurbishment works, due to their importance to flood defence for Limerick and Shannon Town. The refurbishment of the embankments is carried out by contract or by direct labour.

2.3 Structural Maintenance Activities 2018 – 2021

During the course of the original Arterial Drainage Scheme excavations following the 1945 Act, circa 18,500 accommodation bridges were modified or replaced as required. These bridges provide riparian farmers with farm vehicular/foot access. The type of bridge provided depended on the width, depth and required flow capacity, and ranged from concrete piped culverts to larger concrete or masonry spanned bridges.

In general, as channel maintenance work proceeds, the bridges are inspected by supervisory industrial staff, and if required repairs/replacements are programmed. On many occasions, it is not necessary to totally replace the structure, and repairs such as under-pinning foundations or replacement of wing walls, parapets or deck are carried out to extend the bridge life.

Currently all Scheme structure maintenance work is carried out by the direct labour gangs. Approximately 170 bridges are repaired/replaced each year. Ancillary structures such as sluice gates, tidal barrages and pumping stations are repaired or replaced as necessary to maintain their respective operating function.

2.4 Part 1.4 - Flood Relief Scheme Maintenance Activities 2018 – 2021

Flood Relief Schemes completed since the Arterial Drainage (Amendment) Act, 1995 also have a statutory maintenance requirement. The requirement for maintenance is identified at regional level on an annual basis, and included in the Annual Arterial Drainage Maintenance Programme. Maintenance cycles vary depending on the characteristics of the Flood Relief Scheme. Original scheme works that included durable structural works such as new embankments, retaining walls or hard bank reinforcement typically require little or no maintenance while some flood relief scheme channels require periodic silt removal or riparian vegetation management, to maintain the designed channel capacity.

2.5 Programme Exclusions

The National Arterial Drainage Maintenance Activities 2018 – 2021 list of activities does not include the following:

- Newly constructed Arterial Drainage Schemes.
- Catchment Flood Risk Assessment & Management Studies (CFRAMS).
- New Flood Relief Schemes – carried out under the Arterial Drainage Acts 1945-1995, which entail aspects such as public exhibition and Ministerial approval. Modern Flood Relief Schemes typically involve relatively large-scale engineering construction, generally within the confines of an urban area and designed to specific criteria such as 1 in 100 year flood protection.
- Drainage Districts – channel maintenance works on the various Drainage Districts by Local Authorities or Drainage Boards.

2.5 Process and Stages in Drainage Maintenance

Where the Commissioners of Public Works have completed a drainage scheme under the Arterial Drainage Acts, 1945 and 1995, there is a statutory requirement to maintain the drainage works forming part of the Scheme. These drainage works include watercourses, embankments and other structures. Watercourses are subject to siltation and erosion, among other processes, while embankments are subject to settlement and erosion.

National Plan

The National Plan sets out the strategy, actions and measures that are considered to be the most appropriate at this stage of assessment, including a programme of structural and non-structural measures to be implemented and has identified the responsible body/bodies for implementing those measures.

Multi-annual programmes

Ongoing maintenance activities are of a cyclic nature which are to maintain the channel at a certain outfall datum and conveyance capacity by means of repetitive works. This document is the multi-annual programme of the activities that are carried out to maintain Arterial Drainage Schemes. This is subject to non-statutory SEA and accompanying Appropriate Assessment.

Five-year maintenance programmes are also produced for each Arterial Drainage Scheme for Appropriate Assessment on a five year cycle (see Figure 1).

Annual programmes of maintenance works

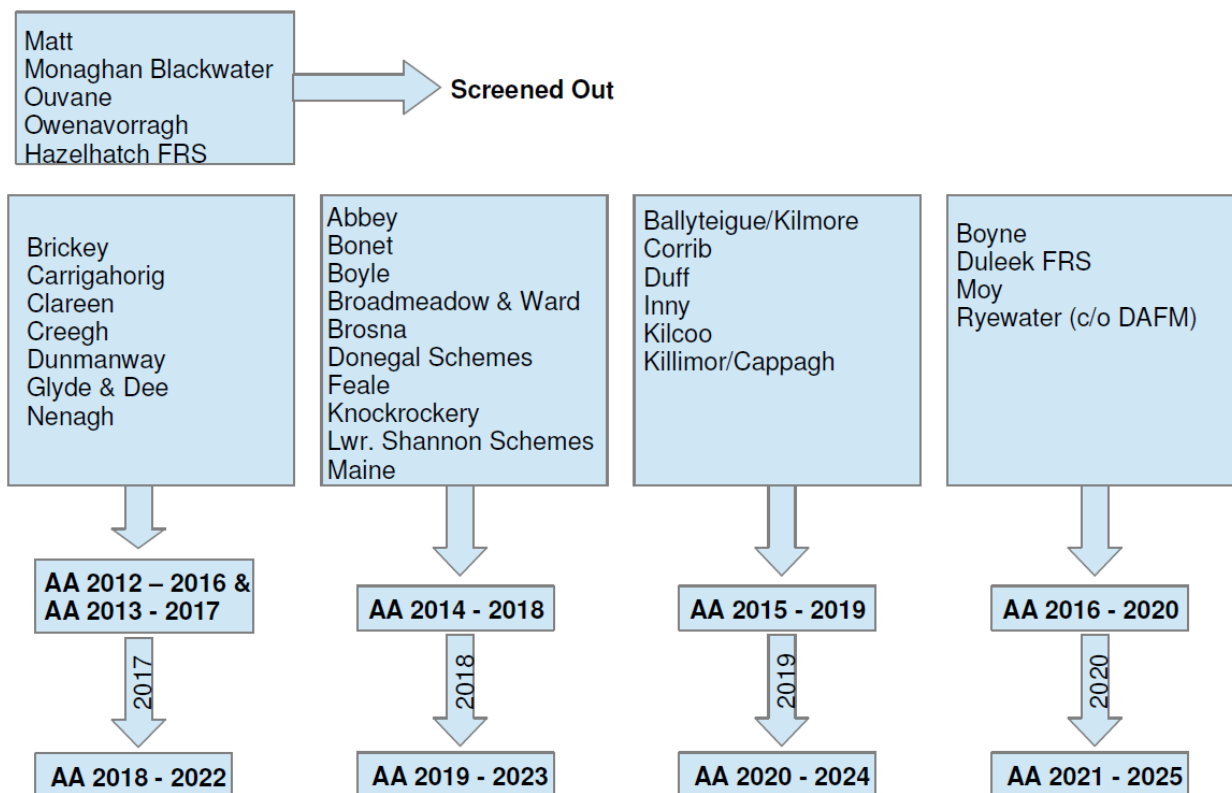
An annual programme of maintenance is compiled to maintain the drainage works which are prioritised based on the rate of deterioration and the risk arising. In any one year, approximately one-fifth of watercourses are maintained.

All above OPW Arterial Drainage Maintenance Activities plans and/or programmes are subject to a mandatory Screening of Appropriate Assessment on an ongoing 5-year basis (refer to Figure 1). Plans and/or programmes screened-out will continue to project-stage and those screened-in will undergo the preparation of a Natura Impact Statement (NIS) for the works. The NIS is mandatory, where necessary and carried out by the OPW for any relevant plan/projects as per the Birds (2009/147/EC) and Habitat Directive ([92/43/EEC](#)) and the Regulation 42 of the European Communities (Birds and Natural Habitats) Regulation, 2011.

The SEA process and AA screening processes are independent from each other but are complementary in fulfilling the OPW's obligations.

Figure 1. Arterial Drainage Maintenance Activities- National Schedule of 5-year AA screening for Schemes

Arterial Drainage Maintenance activities – national schedule 5year Appropriate Assessments for Schemes



Project-level programmes

The Arterial Drainage Scheme 5 year maintenance programmes stemming from the Plan will apply a range of measures that will mitigate potential environmental impacts. While the applicability of processes and particular measures will be dependent on the nature and scale of each project, examples of typical processes and measures that will be implemented where applicable at the different stages of project implementation are set out below. Proposed activities outside of the maintenance programmes shall be subject to their own assessments, following the same approach.

- **Project Mitigation-Consenting Process:** The consenting process for the progression of measures involving physical works will require the applicable environmental assessments. Also, the consenting authorities may set out specific environmental conditions as part of the project approval.
- **Project Mitigation-Pre-Construction / Detailed Design:** For the detailed design of projects, where options are available, the design uses a hierarchy to mitigation measures along the following principles: avoid creating the potential impact where feasible; minimise the potential impact through mitigating measures; Enhance the environment to better than pre-project conditions, where reasonably possible

Project Mitigation-Construction Stage: For large and complex works and sites, where environmental management may entail multiple aspects, a project specific Construction Environmental Management Plan (CEMP) may be developed. This will form a framework for all environmental management processes, mitigation measures and monitoring and will include other environmental requirements such as invasive species management measures, if

applicable. A designated environmental officer, project ecologist and project archaeologist will be appointed, as appropriate for the project as necessary. The integration of the SEA process, the screening of AA, and the preparation of the Plan has ensured that:

- Environment, social and economics were considered at all stages of the process
- Environmental constraints were identified at the early stages in the process and screened out a number of flood risk management measures and options
- The preferred measures have been selected based on a number of assessments
- Public consultation and stakeholder consultation was undertaken throughout the preparation of this Plan.

3.0 Environmental Management

All maintenance operations are carried out in accordance with OPW's Environmental Management Protocols and Standard Operating Procedures.

3.1 OPW Environmental Management Protocols

Communications - Statutory Stakeholders

- By the end of each year, each Arterial Drainage Maintenance Region to forward a draft version of its Annual Drainage Maintenance Programme for the upcoming year to OPW's Environment Section, and to the Inland Fisheries Ireland (IFI) EREP Project Manager who will review it for appropriate sites and study locations for the Environmental River Enhancement Programme (EREP) project.
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- By end of each year, each Arterial Drainage Maintenance Region to forward the relevant sections of the final version of its Annual Drainage Maintenance Programme for the upcoming year with a copy of appropriate scheme maps, to the Department of Arts, Heritage, Regional, Rural, and Gaeltacht Affairs (DAHRRGA), Development Applications Unit and/or IFI Directors.
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- When compiling the programme the type of works proposed should be indicated for each channel under the headings A-F:
A – Silt & Vegetation Management
B – Aquatic Vegetation Cutting
C – Bank Protection
D – Bush Cutting/Branch Trimming
E – Tree Cutting
F – Bridge/ Structure Repairs
- Ideally, approximate timing (season/month) and approximate duration of works should be included for each channel.
- Works that fall within Special Areas of Conservation (SAC), Special Protection Areas (SPA) or Natural Heritage Areas (NHA) are to be highlighted on the programme.
- As a follow up, the Arterial Drainage Maintenance Regions offer the opportunity for a meeting with the stakeholders to discuss the Annual Drainage Maintenance Programme and where a meeting is requested, preferable for this to take place as early as possible in the year.

Interim Stakeholders Meetings

- In addition to the start of the year stakeholder meeting to overview the Annual Works Programme, Regional Offices will offer and facilitate a schedule of more frequent and catchment focused meetings.
- The need and the frequency of these meetings will be determined on a regional basis in partnership with the relevant stakeholders.
- Typically, a frequency of every 2-3 months to discuss the following 2-3 months work on the catchment, identifying any further environmental sensitivities, appropriate mitigating measures, follow up joint site visits where deemed beneficial and flagging any opportunities for added benefit in proposed River Enhancement works.

- Typical attendance includes a range of OPW Management Staff, i.e. Engineer, Technician and/or Foreman, NPWS Rangers and/or DCO and IFI Officers.
 - OPW Engineer will compile minutes of the meeting to record attendance and a brief account of main decisions and follow up actions.
 - Any channel specific information resulting from these meetings, such as timing requests should be entered into the Records Database in accordance with the National Recording Process.
- Consultations with statutory stakeholders such as NPWS and IFI are of critical importance to continuously improving environmental performance. However, in the interest of maximising the efficiency of stakeholders input, Management Staff are as far as practical, to plan their consultative requirements and address a range of aspects in any one discussion forum. Interim Stakeholder Meetings or similar forums offer good opportunities to maximise consultation efficiencies.

Correspondence

- All Environment related correspondence/complaints are recorded on the Engineering Services Correspondence Database as per normal protocol. Complaints received are forwarded to the Environment Section should assistance be required. All queries/complaints are responded to within 21 days.

Cultural Heritage

- The OPW is committed to the protection of architectural buildings and structures listed on the Record of Protected Structures (RPS) and designated areas of architectural importance such as Architectural Conservation Areas (ACAs), as well as, archaeological features listed on the Record of Monuments and Places (RMP) or other listed National Monument and Archaeological Sites.
- The OPW will ensure that areas adjacent to the works are not of cultural, architectural, or archaeological significance. If so, appropriate measure and guidelines to be used in order to protect these.
- Such measures may include desk-based assessments and licensed (by DAHRRGA) on-site walkover and/or waded/underwater assessments and survey work to define further the nature and extent of the cultural heritage assets.
- Specific monitoring to build scientific evidence on the effectiveness of mitigation measures by way of pilot studies in consultation with DAHRRGA and the Underwater Archaeology Unit of the National Monument Service which would help inform decision on short to long-term archaeological requirements are concerned.
- New guidance incorporated into SOPs and protocols to enable field operatives and engineers to protect known and likely unknown features.

Walkover Surveys

- As a component to the EREP Project, on a number of channels, EREP project team members will request for Walkover Surveys as an opportunity to discuss in detail on site the environmental enhancement options for a particular channel with a range of relevant stakeholders.
- Typical attendance will be an IFI EREP representative, a range of OPW Management Staff and relevant Operational Crew if deemed beneficial, local IFI Officer and/or NPWS Ranger or DCO.
- OPW Management Staff to liaise with EREP team and coordinate the site visit with local IFI and NPWS to facilitate their participation if these stakeholders wish to attend.
- Environmental river enhancement plans are then prepared by the IFI EREP team and issued to the relevant OPW Engineer for inclusion in the annual works programme

Appropriate Assessments

- A national framework has been set up where Arterial Drainage Maintenance activities will undergo Appropriate Assessment (AA) to include all required activities for a 5 year period, as referred to in Section 2.5.
- Environment Section procures for the annual `Environmental Consultancy Services` contract, prepares the 5 year programme for each scheme and issues completed AA Screening Statements/Conclusion Statements to the respective OPW engineers as completed.
- The Ecological Consultant will consult with OPW management to define the precise extents of proposed works in each Natura 2000 Site during the 5 year period.
- In addition, the Ecological Consultant will be carrying out walkover surveys for pre and post maintenance works for a representative number of the sites and OPW Management will be required to facilitate the same.
- OPW Management Staff will issue the relevant completed Assessments directly to the NPWS District Conservation Officer. In addition, Environment Section will issue all of the Assessments to the Development Applications Unit, Department of Arts, Heritage, Regional, Rural, and Gaeltacht Affairs.
- Preferably the Appropriate Assessments are forwarded to the DCO as soon as it is completed, but in any case with a minimum of three weeks notice before commencement of the works.
- Management Staff to implement all prescribed mitigating measures and ensure that Operational Staff are made aware of all relevant site specific mitigating measures.

Environmental River Enhancement Programme (EREP)

- After reviewing the draft Annual Works Programme, IFI EREP team contact the relevant OPW Regional Office and request follow up meetings as required to discuss aspects of the programme in relation to the EREP.
- River enhancement sites require hydromorphological surveys to ensure they are technically feasible as envisaged. This is to be coordinated by the IFI EREP team with local IFI and OPW personnel as required, in addition, all EREP are subject to a project level appropriate assessments.
- Sites shortlisted by the IFI EREP project team for capital enhancement works are emanating from a screening process of technical feasibility in terms of gradient and water quality. Also, sites are selected on other requirements such as

the Water Framework Directive Programme of Measures under the requirements for morphology.

- IFI EREP team in consultation with the local IFI and OPW staff, will prioritise sites on a basis of best return for investment. IFI EREP team will liaise with the Regional Offices to assist in identifying channels deemed suitable for capital enhancement which should be integrated with the following years work programme. In some cases, a situation may arise where the site selected is not overlapping with the annual Drainage Maintenance Programme but where feasible and subject to any third party agreement, OPW will accommodate these works.
- Similarly for enhanced maintenance works, IFI EREP team in consultation with the local IFI and OPW, will select sites again that are technically feasible and offer best return for investment. These sites will normally be from channels on the annual Drainage Maintenance Programme.
- IFI EREP project team will coordinate all the scientific monitoring works, provide the enhancement design details and guidance to OPW Management Staff and maintain a level of site supervision proportional to the complexity of the works and the experience of the OPW Staff involved.
- Consultations with local IFI through the interim stakeholder meetings are encouraged to identify sites suitable for enhancement works and in some cases the local IFI may also be in a position to produce an enhancement design. All enhancement designs and works are to be coordinated through the IFI EREP team to facilitate formal recording into the national EREP project and allow for biodiversity and/or hydromorphology monitoring if required. Local IFI may coordinate with IFI EREP team or alternatively OPW Regional Staff coordinate directly with the EREP team.
- A small portion of channels have more infrequent maintenance cycles and these cases can offer particularly good opportunities for enhanced maintenance type works. Channels programmed where maintenance works have not being carried out for in excess of 10 years, to be flagged to IFI EREP team for possible walkover surveys and guidance on appropriate Environmental Drainage Maintenance (EDM) procedures.
- Management Staff to ensure that as far as practical, all Operational crews have an opportunity to get experience on these projects.
- Each Regional Engineer is to make provision in the Annual Works Programme for Plant & Labour resources in addition to provisions in the Annual Budget for materials subject to expenditure constraints. Typical resources are as follows:

Capital Enhancement

Region	Target (Km)	Capital Costs	Machine Weeks	Man Weeks
East Region	20	€200,000	30	60
South West Region	14	€140,000	21	42
West Region	16	€160,000	24	48
	50	€500,000	75	150

- Progress targets for EREP to be shown on monthly production reports.
- OPW are the primary contact point for liaison with landowners including the organising of access and egress for machinery and materials. Brochures on EREP are available in all Regional Offices. Additional copies can be obtained through OPW Environment Section.

- Management Staff are encouraged to maximise the use of all available on-site materials such as stone from historical spoil heaps as opposed to importing materials at a higher cost.
- In addition, Management Staff are encouraged to maximise synergies with other funding sources such as Fisheries Development grants attained by local Angling Clubs, which could be combined with OPW plant and labour to supply materials.
- In all cases, Inland Fisheries Ireland is the statutory authority to give design guidance to OPW. Angling Clubs or other sectoral funding sources to liaise with the Fisheries authorities in respect of all design and environmental monitoring requirements.
- As-Built plans are to be completed by the IFI EREP team for all enhancement works. This will entail a site visit by IFI and relevant OPW Staff where requested. These will be retained by IFI as well as any relevant design information.
- IFI EREP team will forward a copy of the as-built plans to Environment Section who will upload the same to Alfresco for access to the information by all Staff.
- At the end of the year, IFI EREP team will forward Environment Section a GIS layer of that year's works for uploading to OPW's GIS records.

National Recording Process

- Weekly Record Cards records information on Lamprey, Crayfish, Kingfisher, Mussels, Otter and other site specific environmental information as arises.
- Environmental information on Cards will be recorded onto the Records Database by each Drainage office. The latest Records Database has been revised to integrate environmental records.
- On an interim basis, a copy of all Cards with environmental information to be copied and forwarded to Environment Section by each Drainage Office. This is to allow Environment Section to review the detail of information being recorded, feedback to the Operational crews through the Management Staff and attain a national consistency in the style of information being recorded.
- All relevant information to be uploaded to GIS by Environment Section.
- All other relevant environmental information sourced by Management Staff whether from direct observations or through stakeholder consultations, should be entered into the Records Database.
- Relevant environmental information sourced through the EREP project and related research will be forwarded by IFI EREP team to Environment Section directly for centralised GIS uploading.
- On a bi-annual basis, Environment Section will compile an update of Weekly Records Cards species records and make available to all Staff via Social text to assist in tracking progress.
- On an ongoing basis, Environment Section will make available the various OPW compiled species records to other authorities to assist in contributing to any appropriate national conservation knowledge.
- As described above, each drainage office will upload onto the Records Database all environmental information from the Weekly Record Cards and all other broader environmental information attained by Management Staff. Within a few years, it's envisaged that multiple regional Staff will be able to use the new Records Database, and then environmental information from all sources will be uploaded directly by a whole host of Staff. Typically this will include any mitigating agreements for particular channels agreed with stakeholders or any other individuals observation such as protected species presence noted during a separate site visit.

Salmonids

- As far as practicable, the maintenance works are to be scheduled to accommodate salmonid (Salmon & Trout) spawning areas, as is in place across all regions for many years. This is a widespread measure on many catchments and is most applicable to medium gradient channels with gravel substrate.
- Prior to works commencing, consult with local IFI. Ideally, consultations to be conducted through Interim Stakeholder Meetings or alternatively, direct contact in respect of the specific site.
- Maintenance operations on salmonid spawning beds typically carried out between July and September but timing subject to adjustment due to local knowledge of IFI.
- Raking of spawning gravels to improve spawning capacity also typically carried out between July and September.
- River enhancement works to enhance both the fisheries and the broader ecology of the drainage channel are covered under the EREP project.
- In the future, as the extent of completed enhancement works increases, there is a risk of damage to structures due to future maintenance. All channels scheduled for maintenance to be checked against GIS records for presence of previous enhancement works. Where a presence is indicated, carry out a site visit as appropriate and in consultation with IFI, devise on-site procedures to protect or enhance existing instream structures.

Lamprey (Brook, River & Sea) & Crayfish

- All channels scheduled for maintenance to be checked against GIS records for presence of Lamprey or Crayfish.
- In accordance with the OPW Protocols and SOPs, Operational Staff will closely observe the spoil three times daily and report to the Foreman any Lamprey or Crayfish located.
- Mitigating procedures to apply when GIS records indicate species presence, or Operational Staff locate Lamprey or Crayfish during operations, or where particularly suitable habitat is identified by an environmental stakeholder.
- If significant populations are encountered, notify IFI EREP team and facilitate scientific studies if site deemed suitable by IFI.
- If significant populations are encountered, notify NPWS Ranger and local IFI Officer and conduct site visit as necessary.
- Combination of Mitigating Measures to be selected as applicable to the site while balancing the Flood Risk Management requirements and a sustainable approach to the conservation of Lamprey and/or Crayfish.
- Identify extent of channel applicable and the mitigating measures to apply.
- Inform Operational Staff of mitigating requirements.

On site measures

- Skip sections to retain intact habitat either in one long reach or multiple short reaches.
- Maintenance in an upstream direction to avoid secondary disturbance of a species moving downstream. Balance with the advantage of maintenance in a downstream direction where instream vegetation minimises siltation.
- Confine maintenance to 2/3 of channel width leaving marginal vegetation and silt intact.
- Maximise use of weed cutting bucket particularly where aquatic vegetation removal is the primary objective. This is effective for Lamprey juveniles as they are in the silt. For Crayfish, cutting of "Flaggers" type vegetation is effective but

cutting of “water celery” mat type vegetation is less effective as it can result in Crayfish being removed within the weed mass.

Forward planning measures

- Annual maintenance of the channel in shorter segments sequentially completing the same over a number of years. Balance with maintaining reasonably operational efficiency in terms of machinery moving, transport, access and egress.
- Longer time periods between maintenance cycles e.g. move from 4-6 years to 7 to 8 years. Balance with overall river ecology as longer maintenance cycles will lead to more heavy-scale works.
- Timing of maintenance to accommodate Lamprey spawning. Stakeholder consultations between OPW and local IFI for salmonid mitigating purposes, to include consideration of Lamprey spawning. This is to be applied to channels where Lamprey spawning habitat is known as informed by IFI or other stakeholder. For River & Brook Lamprey, no works on relevant spawning channel from end March to start of June subject to adjustment due to local knowledge of IFI. For Sea Lamprey, as they spawn during the summer months, restrictions from late April to early July are required. To be applied to channels where Sea Lamprey spawning is known as informed by IFI or other stakeholder and timing subject to adjustment due to local knowledge of IFI. Note that Sea Lamprey are much less widespread so envisaged that the scale of this mitigation will be very limited.
- Loosening spawning bed gravels. Stakeholder consultations between OPW and IFI for salmonid gravel loosening purposes, now to include consideration of Lamprey spawning as above.
- Enhance channel profile such as skewed cross section and promote deposition of silt along margins. Integrate with IFI discussions on planning the EREP to avail of enhancement opportunities particularly for channels where Lamprey or Crayfish presence is recorded.
- Modification of OPW structures which impede upstream fish migration. Identification of weirs as barriers to be as informed by IFI or other stakeholder. Where modification designs required, liaison with IFI EREP team to integrate the improvement works into the EREP project. Identification of a bridge apron step attained through ongoing site inspections by OPW Management Staff or other stakeholder. In consultation with IFI, steps at bridges to be modified by a rock armour type ramp or similar. Envisaged that these measures will be of a limited scale on drained channels.

GIS Records:

- Where Lamprey or Crayfish are discovered, Operational Staff will have recorded the same on the Weekly Record Cards. Cards with species location information will be uploaded to the Records Database as stated in the National Recording Process.
- All new Lamprey spawning location information attained through stakeholder consultation to be recorded on the Records Database in accordance with the National Recording Process.
- All database records of species location will be uploaded to GIS by Environment Section.
- IFI EREP team conducting ongoing research on Lamprey & Crayfish as a component of the EREP works. Scientific data calculating species density for

some sites will be developed and to be supplied by IFI to OPW and uploaded to GIS by Environment Section.

Otter

- Research to date indicates that Otters are widespread across all sizes of drainage channels nationally, hence it is prudent to assume that Otter use any particular site.
- In accordance with the Otter SOP, Operational Staff will walkover the works area one week in advance in conjunction with the Health & Safety assessment noting dense cover with access directly to the water that is to be avoided where feasible.
- In addition, any recognisable signs of Otter presence observed such as Spraints, Footprints or suspected Holts, will be recorded on the Weekly Record Cards. These signs were identified in Otter Awareness Training carried out across all regions in 2008.
- While holts are usually well concealed, where Operational Staff observe a suspected holt such as a burrow opening, in consultation with Management Staff, subject to flood risk management functions, no channel or bankside vegetation to be conducted within 30m of a known or potential Otter holt/ resting site. If breeding is suspected at a holt site this buffer zone will be increased to 150m.

Bridge mammal crossing enhancement

- As a component of ongoing consultations with NPWS and other stakeholders, evidence may arise from time to time as to a particular spot for Otter road kill. Typically this can arise where the Otter always traverses the roadway as opposed to going through the bridge. While this scenario is not known to be a widespread issue in Ireland, the highest risk locations are on the National Primary Roads which have the heaviest traffic volumes.
- There are 170 National Primary Road bridges on OPW channels as listed in the table referenced below and Management Staff are to have particular regard to these locations if evidence arises on a possible road kill “hot spot”.
- Enhancement works will typically take the form of a bolt-on wildlife ledge or similar. Design and configuration is to be carried out in consultation with NPWS and relevant Local Authority.
- On an annual basis, Environment Section will review the national website www.biology.ie which records Otter road kill reports from the public. Any road kill location which overlaps with an OPW channel will be flagged by Environment Section to the relevant Management Staff.
- Current understanding is that Otter road kill is not a significant issue in Ireland. It's envisaged that while the justification for bridge mammal crossing works may arise for some scenarios, these measures will be of a limited scale on drained channels.

Freshwater Pearl Mussel

- GIS records from NPWS show the locations of the 91 known FWPM populations in Ireland.
- The following OPW channels have been identified as containing FWPM:

Channel	Scheme	Location	Most Recent Record

CH9	Corrib Headford	Oughterard	2009
C1/21/3	Moy	Approx 500yrds from outfall to into L. Cullin	2004
C1 Sect M8	Moy	Ballygallagart	2004
C1/21/14	Moy	Crossmolina	2008
C1	Dunmanway FRS	d/s of the Long Bridge	2003
C1	Owvane	Approx 1400 yrds from outfall	2002
C1	Feale	d/s Listowel near Scartleigh cemetary	2006
**Owenahe	Moy	u/s of C1/54	1996
**Brown Fle	Maine	Trib of C1 Maine near Farranfore	1987
** Galey Riv	Feale	Approx 1400yrds u/s of C1/18 near Ahavoher Br.	1950
**River Liffe	Ryewater	(Lucan) Approx 3.5km d/s C1 Ryewater outfall	1894

*** Although not on OPW channels - these channels may or may not contain populations of FWPM. Works in the vicinity which could impact on a possible population need to be considered in close consultation with local NPWS knowledge.*

- While highly unlikely to have instream works in a FWPM habitat, if a new population located by Operational Staff during operations, works to cease.
- Notify NPWS and in consultation with NPWS, area to be skipped or non in-stream works carried out as agreed for the specific site.
- For operations in the vicinity of known populations, mitigating procedures to apply:
 - Consult with NPWS and local IFI and conduct site visit as necessary.
 - Typically only selective non in-stream works adjoining the population.
 - Works such as removal of a fallen tree is to be completed by lifting clear of the channel to minimise any channel bed disturbance due to the branches being dragged.
 - Assess need for silt management procedures for works upstream of the population and implement in consultation with NPWS.

Swan & Duck Mussels

- Swan and Duck Mussels are not strictly a protected species, however they are of conservation interest.
- Both species are similar in appearance and habitat requirements and distinguishing between them is not necessary unless local environmental stakeholders can identify the exact species.
- As the Mussel SOP, if Operational Staff locate the same, Management Staff will be notified.
- Where significant populations are encountered notify NPWS Ranger and local IFI Officer, and where they are interested in visiting the site, facilitate a site visit as necessary.
- Identify extent of channel applicable and the mitigating measures to apply.

- Typical Mitigating Measures include:
- Operational Staff to observe spoil and return any Mussels to the channel whom are expected to recolonise the channel bed.
- Maximise use of weed cutting bucket particularly where aquatic vegetation removal is the primary objective.
- Skip sections to retain intact habitat either in one long reach or multiple short reaches.
- Confine maintenance to 2/3 of channel width leaving marginal vegetation and silt intact.
- Record species presence on the Weekly Record Cards which will be recorded on the Records Database.

Kingfisher

- Avoid disturbing nesting sites in banks.
- Visual sightings of Kingfisher by Operational Staff to be recorded on the Weekly Record Cards.
- Sightings by Management Staff to be recorded on the Weekly Record Cards where works in progress or on other occasions, record by separate map or channel reference format.
- All sightings to be recorded on the Records Database in accordance with the National Recording Process.
- All database records of species location will be uploaded to GIS by Environment Section.
- On an annual basis, Environment Section will issue the records to Birdwatch Ireland whom will add to the national Kingfisher database.

Birds

- Removal of any abnormally dense layer of vegetation is to be executed between September and February (inclusive) to minimise impacts on nesting birds unless there are other overriding requirements such as Health & Safety.
- For SPAs containing important over-wintering bird populations, in consultation with the NPWS, regard to be given to timing or phasing of the works to minimise potential disturbance.

Bats

- While the removal of large mature trees is not typically a requirement of maintenance works, where the case arises, in consultation with NPWS, regard to be given to the likelihood of bat roosting habitat.
- Typical mitigating measure would be to leave tree in fallen position for 24hrs to allow any bats vacate.
- Masonry bridges offer niches and crevices suitable for bat roosts and where masonry bridges are scheduled for maintenance works, regard to be given to the likelihood of bat roosting habitat. Typical maintenance works at low level such as wing wall repair or underpinning foundations have limited potential to impact on bat roosts. Where the case arises that repair works are to be above the high water level such as the upper arch, in consultation with NPWS, assess the potential for the works impacting on bat roosts.
- Typical mitigating measure would be to contract a bat specialist to survey for bat presence before works commence, to avoid entombment of any bats.

Wetlands - Bogs, Fens & Turloughs

- All channels scheduled for maintenance which overlap SAC designations to be checked against the list of channels that impinge on Raised Bog, Fen habitat or Turloughs and have regard to any NPWS agreements noted *.
- OPW Management Staff to consult with NPWS for expert opinion as to any evidence of ongoing ecological decline of the Bog, Fen or Turlough and judgement on, if the drainage datum set by the Drainage Scheme and its maintenance is an ongoing contributing factor by affecting the hydrological regime of the same.
- Where a likely impact is identified, conduct site visit as necessary and in consultation with NPWS, mitigating measures to be selected such as:
 - Skipping the channel in question while taking cognisance of the flood risk management requirements.
 - Maximise use of weed cutting bucket particularly where aquatic vegetation removal is the primary objective.
 - Inspection by OPW line management to assess the possibility of over digging the channel below the original design datum. Presence of an existing water level control such as a bridge floor to be established and alternative reference datum to be installed if deemed warranted.

** Environment Section currently developing a list of channels which overlap with Raised Bog, Fen habitat and Turloughs within SACs. Channels that are subject to a previous NPWS agreement /understanding of the extent of maintenance will be recorded.*

Invasive Species – Plants

- Multiple invasive plant species are widespread nationally as described in the SOP and prudent to assume that one or more of these plants can be present on any works site.
- At present the OPW does not have any direct responsibility for the management of Invasive species. However to ensure OPW operations are not a vector for these invasives, measures are required to reduce the risk of spread.
- Ensure machine washing equipment transported to site for all appropriate machinery movements as described in the Invasive Species SOP.
- Ongoing EDM site audits by Environment Section will include confirmation that machine washing was executed in accordance with the SOP for the last applicable machine transfer.
- In some cases, OPW will assist other authorities in the control of invasive species. In these projects, the works are typically carried out in partnership between a number of authorities such as IFI, NPWS and relevant Local Authority. As scenarios arise where OPW are requested to assist in an invasive species control project, Management Staff are encouraged to support the multi-authority partnership model which will maximise resource efficiencies for all parties while still achieving a broader environmental good.

Invasive Species – Zebra Mussel

- Zebra Mussels are present in the River Shannon, Grand Canal and are in many lakes such as L Derg, L Ree, L Garra, L Key, L Derragh, Derravaragh, L Sheelin and L Corrib. This species is spreading and it is prudent to assume that works in any large sluggish river or near a lake has potential to contain Zebra Mussel.
- For any proposed works in the vicinity of potential Zebra Mussel waters, flag for Operational Staff and ensure particular attention to cleaning procedures for all equipment prior to removal from site.

- Any new location of Zebra Mussel uncovered during operations, notify NPWS and IFI for their information.
- Record on Weekly Record Sheet which will be uploaded on the Records Database in accordance with the National Recording Process.
- On an annual basis, Environment Section will collate the records nationally and issue to any relevant authorities to assist in tracking the species spread.

Tree Management

- A small portion of channels have more infrequent maintenance cycles typically where self cleaning gradients are present. These sites can entail abnormally dense tree cover which may be required to be managed for conveyance or fisheries purposes. Removal of any abnormally dense layer of vegetation is to be executed between September and February (inclusive) to minimise impacts on nesting birds unless there are other overriding requirements.
- IFI requests to reduce “tunnelling” on drainage channels to be accommodated where feasible. OPW Management Staff to facilitate a site visit with the IFI Officer as required and devise a selective approach to the tree removal so as to retain a dappling of shade along the channel length.
- Excess woody vegetation to be collected and utilised by the following in order of preference:
 - Reused by adjoining landowner for domestic firewood.
 - Subject to landowners agreement, stockpile excess to form natural cover and niche habitat, preferably with some connection of cover to the channel e.g. along a hedge leading to the water.
 - Shred and spread along the adjoining top of bank allowing the material to degrade rapidly and recolonisation of the underlying vegetation.

Environmental Drainage Maintenance (EDM) Guidelines

- A portion of operational crews will be audited annually for implementation of the EDM Guidelines and other standard environmental procedures as adopted.
- Auditing will be carried out separately by both IFI and OPW Environment Section on a rotational basis to ensure all operational crews are audited at least once every three years.
- Audit results will be recorded on a standard format with the following feedback:
 - All audit results will be forwarded to the relevant Engineer for that Drainage Scheme within two working weeks.
 - In the event of an audit showing elements of unreasonable non-compliance with procedures, the relevant Engineer will be notified within one working day.
 - Audit results will be forwarded to OPW Systems Co-ordinator for inclusion in monthly regional benchmarking reports.
 - IFI EREP team will compile an overall summary of their findings in their end of year report under the EREP project.

- Design for Enhanced Maintenance works under EREP will include a design element for full scale implementation of the EDM Guidelines such as Boulder Replacement and Excavating Pools.
- Management Staff to ensure that as far as practical, all Operational crews have an opportunity to get experience on these projects.

OPW Standard Operating Procedures (SOPs)

A total of 7 No. Standard Operating Procedures are applied during operational works. These SOPs set out actions designed to eliminate, or substantially reduce impacts to identified species and their associated habitats. These include:

- Cultural Heritage Guidance Notes
- Environmental Drainage Maintenance Guidance Notes (10 Steps to Environmentally Friendly Maintenance)
- Lamprey SOP
- Crayfish SOP
- Otter SOP
- Mussel SOP
- Invasive Species SOP
- Zebra Mussel SOP

Cultural Heritage Guidance Notes

The Drainage Maintenance SEA process engaged an archaeologist to assist with the cultural heritage aspects and it entails a range of archaeological commitments which are new for drainage maintenance. As part of the formal consultations, National Monuments Service (NMS) have expressed a general level of agreement with OPW's approach as published through the SEA.

The required mitigation measures for Archaeology and Cultural Heritage can be divided into two distinct levels: managerial and resolution.

Managerial SOPs for Archaeology and Cultural Heritage

1. Appoint an experienced and qualified underwater archaeologist as project archaeologist to advise OPW and to manage the archaeological risk of the drainage programmes.

The OPW is committed to fund a National Study assessing the scale of archaeology and cultural heritage overlap along Arterial Drainage Schemes and determined the potential archaeological impacts caused by maintenance activities. The finding from the assessments will inform pilot studies and/or longer term programme and will determine if further assessment will be required.

Resolution SOPs for Archaeology and Cultural Heritage

SOPs for archaeological and cultural heritage assessment and resolution during an arterial drainage works programme should include:

1. The archaeologist will carry out desk-based research as part of the pre-works programme to record the known archaeological and cultural heritage assets within the drainage network. Desk-based work would include examination of the Sites and Monuments Record, the National Inventory of Architectural Heritage, the Historic Shipwreck Inventory; the Topographical Files of the National Museum of Ireland and the Excavations database. Desk-based work would also examine existing and historic cartographic information, landscape drawings and historic photographic sources, and place-name evidence, along with national and local published sources to gain robust insight to the history and development of activity along the river network where possible.

2. The archaeologist will carry out walkover inspection of the river network as part of the pre-works programme, to add a further level of baseline knowledge. Such work will record the location and extent of existing archaeological and cultural heritage features in relation to the proposed works programme, and will add new features to that record where evident.

3. From these assessments, pilot sites will be selected and the results will inform longer term programmes and will determine if further assessment will be necessary. A walkover inspection can be complemented with waded and/or underwater inspection by the archaeologist. Such work is licensed by the NMS.

4. The results of the above work will be collated into a project report that presents a narrative of development along the river network, includes an impact assessment that considers the impacts of the drainage works on known sites and

areas of archaeological and cultural heritage potential, and includes a set of recommendations that are aimed at managing the archaeological and cultural heritage risk within the constraints of the drainage project, and with a view to reducing the level of archaeological risk.

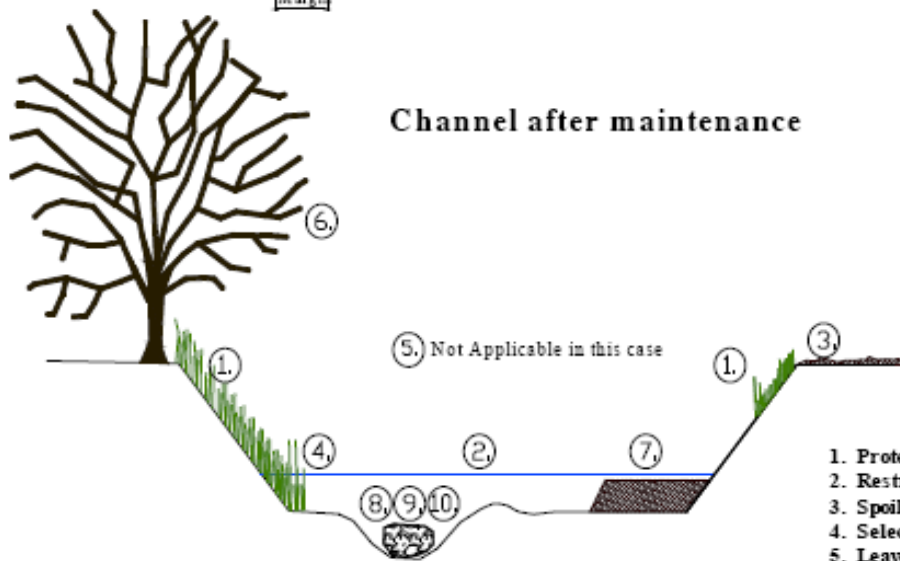
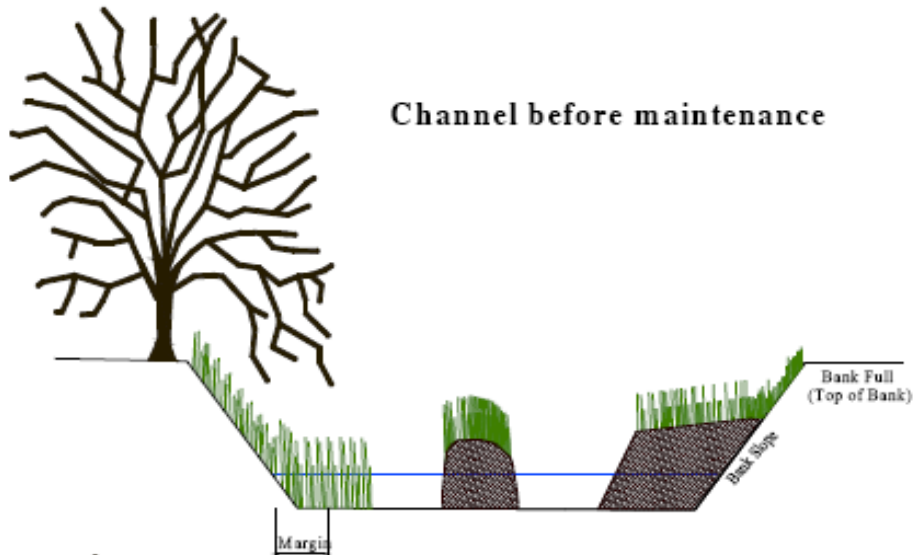
5. The archaeologist will maintain an active role throughout the works phase, to resolve archaeological and cultural heritage risks during the works phase.

6. A suitably qualified and experienced riverine and/or underwater archaeologist will be appointed during the works phase and tasked with resolving the archaeological and cultural heritage risks identified, and monitoring the works progress to record and resolve any new discoveries that might be made during the works programme.

Environmental Drainage Maintenance Guidance Notes



10 Steps to Environmentally Friendly Maintenance



1. Protect bank slopes
2. Restrict maintenance to channel
3. Spoil management
4. Selective vegetation removal
5. Leave section untouched
6. Management of trees
7. Manage berm to form two stage channel
8. Replace stones and boulders
9. Loosen gravel beds
10. Re-profile channel bed

Environmental Strategies for Channel Maintenance



1. Protect bank slopes

- 1.1 Do not disturb the non-working bank slope
- 1.2 Minimise any effect on working bank
- 1.3 Leave margin of vegetation at foot of each bank slope



2. Restrict maintenance to channel

- 2.1 Remove only necessary silt – **no new diggings**
- 2.2 Remove instream material only
- 2.3 Retain marginal vegetation
- 2.4 Check spoil regularly. *See Lamprey & Crayfish SOPs*

3. Spoil Management

- 3.1 Maximise spoil placement on bank full line or spoil heaps **and**
- 3.2 Minimise spoil placement on bank slopes
- 3.3 Spread spoil as thinly as possible
- 3.4 Allow water to drain out of bucket over the water – lets small fish, lamprey and crayfish escape



4. Selective Vegetation Removal

- 4.1 Retain a band of vegetation on both sides at water's edge
- 4.2 Selectively manage instream vegetation
- 4.3 Maximise use of weed-cutting bucket
- 4.4 Avoid maintenance in coarse fish channels from 1st April to 1st July



- 4.5 Retain 1/3 to 1/2 of instream floating type vegetation, such as *Ranunculus* (water crowfoot) – see photo to right



5. Leave sections untouched

- 5.1 If channel capacity is not affected, leave section alone



6. Management of Trees

- 6.1 Remove trees that are blocking the flow
- 6.2 Tree-cutting window 1st September to 28th February



6.3 Remove overhanging branches to known flood level

6.4 Use saw secateurs for removal, not excavator bucket

6.5 Manage Trees to reduce very heavy shading

6.6 Manage briars and scrub.
See Otter SOP



7. Manage berms to form two-stage channels

- 7.1 Retain berm where channel capacity is not affected
- 7.2 Remove top of berms to low flow levels
- 7.2 Remove vegetation and soil from gravel berms
- 7.3 Replace sod to the berm where feasible
- 7.4 Only narrow berms if 'excessively' wide for the channel (i.e. greater than a third of the channel width)



8. Replace stone and boulders

- 8.1 Reinststate boulders and gravels as removed by maintenance operations
- 8.2 Reinststate suitably sized boulders into channel from spoil heaps where feasible
- 8.3 Boulders should be placed at or below low flow level and spaced out

9. Work in gravel bed channels

- 9.1 Loosen or toss bed gravels to wash out fines
- 9.2 Only considered between 1st July and 30th September
- 9.3 No work in gravel bed / spawning channels in fisheries 'closed season'
Note: This varies locally check with local IFI



Environmental Strategies for Channel Maintenance



10.1 Excavate bed to form deeper pool areas and shallow riffles



10.2 Overdeepen the channel along one side and place spoil on opposite side –particularly on curves and bends

10.3 Use existing boulders to form simple low-level structures



10.4 Record where such works are carried out

BROOK, RIVER & SEA LAMPREY STANDARD OPERATING PROCEDURE - ARTERIAL DRAINAGE MAINTENANCE

Actions during Maintenance Operations

- Machine gangs to closely observe the spoil three times daily for Lamprey (and Crayfish).
- Where Lamprey encountered:
 - Contact area Foreman immediately.
 - Foreman to contact Engineering Staff in line with the Environmental Management Protocols.
 - Record the location and abundance of Lamprey on the time card.

Measures as directed by Foreman to minimise impact may include:

- Skip a defined stretch of channel.
- Confine maintenance to 2/3 of channel width leaving marginal vegetation and silt intact.
- Maximise use of weed cutting bucket particularly where aquatic vegetation removal is the primary objective.



Lamprey in the spoil

RIVER, BROOK & SEA LAMPREY IDENTIFICATION CARD

Lamprey and young eels can look very similar. These key identifying features can be used to distinguish the two species

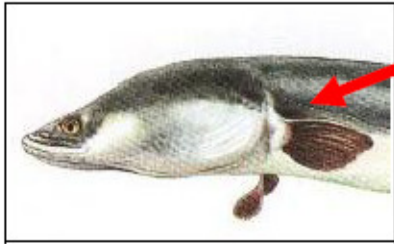


Gill Pores



Lamprey:

- Gill Pores (Holes)
- No Fins
- No Jaw
- Average length 8 to 15cm (3 to 6 inches)



No Gill pores

Eels: No Gill Pores

- Paired Fins
- Jawed Mouth
- Average length 65cm (26 inches)

Juvenile Lamprey:

- Juvenile Lampreys live in the sediment.
- It is in this juvenile phase that they can be removed from the sediment during maintenance.



Adult Lamprey:

- Largest is the Sea Lamprey species.
- Also are River and Brook Lamprey
- Length from 30 to 60cm (12 to 24 inches).



WHITE-CLAWED CRAYFISH STANDARD OPERATING PROCEDURE - ARTERIAL DRAINAGE MAINTENANCE

Actions during Maintenance Operations

- Machine gangs to closely observe the spoil three times daily for Crayfish (and Lamprey).
- Where Crayfish encountered:
 - Contact area Foreman immediately.
 - Foreman to contact Engineering Staff in line with the Environmental Management Protocols.
 - Record the location and abundance of Crayfish on the time card.

Measures as directed by Foreman to minimise impact may include:

- Skip a defined stretch of channel.
- Confine maintenance to 2/3 of channel width leaving marginal vegetation and silt intact.
- Maximise use of weed cutting bucket particularly where aquatic vegetation removal is the primary objective.



Crayfish in the spoil

Identification

- Resemble small lobsters.
- Colour varies from light to dark green-brown, with large front claws.
- Adults typically 7cm - 10cm (3" - 4") long.
- Juveniles can be as small as 2cm (1") long.
- Prefer channels with
 - dense weed cover (flaggers / watercelery) or
 - with a mixture of rocks / gravels that provide crevices for cover.



OTTER

STANDARD OPERATING PROCEDURE - ARTERIAL DRAINAGE MAINTENANCE

Week before Maintenance Operations begin:

- Operational staff will walkover works area one week in advance in conjunction with the PRA noting areas of dense cover with access directly to the water. (As identified during Otter Awareness Training)
- These areas of suitable cover should be avoided where feasible during maintenance.
- Suspected presence of an Otter holt to be reported immediately to area Foreman, who will contact Engineering Staff in line with the Environmental Management Protocols.
- Signs of Otter presence observed such as Spraints, Footprints or suspected Holts, to be recorded on the Weekly Record Cards.

Measures to minimise disturbance may include:

- Retain suitable cover where possible.
- Areas of dense scrub to be avoided by large plant.
- Skip stretch of channel in proximity of suspected holt.



Otters

- Widespread presence on OPW channels.
- Shy animals and not normally seen.
- Adults 1 metre long and weigh 10kg.
- Streamlined profile.

OTTER

Holts

- Usually well concealed.
- Typically burrows, or spaces under banks, tree roots or dense cover.



Spraints

- Found on rocks, paths, channel junctions.
- Dark, oily, sweet smelling.

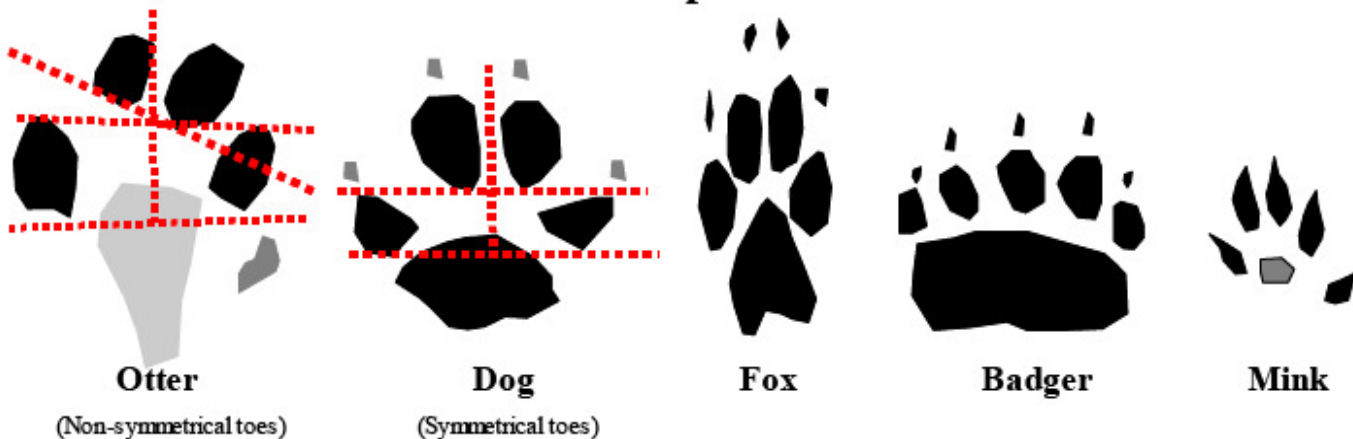


Suitable areas of cover

Dense bankside vegetation, particularly where there is direct covered access to the water.
Any isolated clumps of dense vegetation giving cover along an open length of channel.



Foot-prints



MUSSELS

STANDARD OPERATING PROCEDURE - ARTERIAL DRAINAGE MAINTENANCE

FRESH WATER PEARL MUSSELS

Before Maintenance Operations begin:

- Maintenance must not commence where a known population of Fresh Water Pearl Mussel exists (as listed in the Environmental Management Protocols).

- In the unlikely event of new population of Fresh Water Pearl Mussel being encountered during maintenance,
 - **All works must cease immediately.**
 - Contact area Foreman.
 - Record the location of Mussels on the time card.

Measures to minimise disturbance may include:

- Placing of straw bales to prevent movement of silt.
- Any exceptional / emergency works to be carried out in close consultation with the NPWS.
- For exceptional / emergency works e.g. fallen tree obstruction – these to be lifted clear of the channel to prevent disturbing the channel bed.

MUSSELS

Fresh Water Pearl Mussels (*Margaritifera margaritifera*)

- Shells very thick & heavy – shaped like a kidney.
- Shell colour is dark-brown – black, to blue & black.
- Adults range in length from approx. 6 cm – 12 cm (2.5 – 5 inches) and can live for over 100 years.
- Suitable rivers are reasonably fast flowing, with very clean, good quality water, gravel bed, preferably with large cobbles.



Not to be confused with Duck & Swan Mussel

- Egg-shaped shells 12 -16cm (5-6 inches) long.
- Thin shiny shells, usually brownish yellow with traces of green.
- Found in slow moving water.
- If encountered, contact area Foreman and return Mussels to channel.
- Record location of Mussels on time card



Measures to reduce the risk of spread of invasive species

All excavators, weed cutting boats, tractors, dumpers & other machinery employed on maintenance must be thoroughly cleaned down using a power washer unit prior to being;

- (a) transported by Low- Loader**
- (b) moving to another catchment within the Region**
- (c) moving to another Region.**

Notify your supervisor immediately if you see any of the invasive species listed.

Full details of all species are available in the CFB's Field guide to the Identification of Aquatic Invasive Species



Giant Hogweed

Found on the banks of many rivers throughout Ireland.

Can grow to a height of 4 metres.

Seeds are carried by water and spread very quickly.

!!!Avoid contact with the sap of this plant as it can cause extensive lesions or blistering of the skin.



Japanese Knotweed

Grows up to 2-3m in height along roadsides and river corridors throughout the country.

Even a tiny piece of this plant can produce a new plant.

Leaves are heart-shaped with a pale stripe down the centre.

In Summer cream flowers arise from the tips of the red-flecked stems.



Himalayan Balsam

Grows in dense strands up to 3m high, and is found widespread across Ireland along banks of rivers.

Seed pods explode scattering seeds.

Dies back in Autumn exposing bare banksides to erosion.

White or pink flowers, smooth hollow stem, oval shaped pointed leaves with jagged edges.



Curly waterweed – *Lagarosiphon major*

Found in lakes and slow flowing waterways up to 6m deep.

Spread by fragmentation from one watercourse to another on boat hulls, trailers, outboard motors or angling equipment.

Significant weed stands located in Lough Corrib.



Zebra Mussels

Distinctive stripy shell, very small (1-3cm).

Attach in clusters to hard surfaces – boats, pipes, buoys.

Refer to the [Zebra Mussel Standard Operating Procedure](#).

All photographs courtesy of Central Fisheries Board

ZEBRA MUSSEL

STANDARD OPERATING PROCEDURE - ARTERIAL DRAINAGE MAINTENANCE



Actions for Maintenance Operations

1) Zebra Mussels detected on site

- Where Zebra Mussels are found, remark on the extent of Mussels on the Weekly Report Card and notify the Foreman/Technician.
- Technicians/Engineers to notify Environment Section of location and grid reference.
- Environment Section to update the National Database.

2) Maintenance close to R. Shannon or infested lakes

- Where a machine is working close to the R. Shannon or an infested lake, ensure that prior to the machine transferring to a new site, buckets and tracks are thoroughly cleaned of any material such as silt or vegetation.
- Ganger / Driver to visually inspect the bucket, tracks and any equipment that was in the water to ensure no Mussels are present.

3) Maintenance close to outlets/inlets of any lakes

- Where a machine is working close to any lake, ensure that prior to machine transferring to a new site, buckets are clean of any material such as silt or vegetation.
- Ganger / Driver to visually inspect the bucket and other equipment that was in the water to ensure no Mussels are present.

4) Boats and other equipment

- Boats or other water based equipment that is to be transferred between river catchments should be thoroughly cleaned on the outside, drained of any bilge water and inspected for the presence of Mussels.
- If it's suspected that the equipment was in contact with Zebra Mussel waters, steam clean the hull and trailer and leave the boat or equipment out of water for four weeks prior to moving.

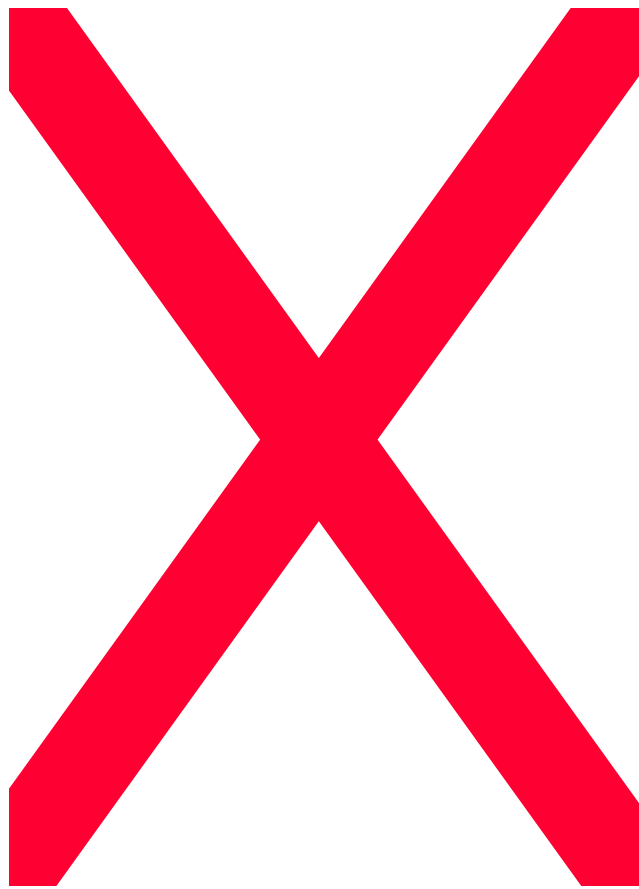
OPW Role

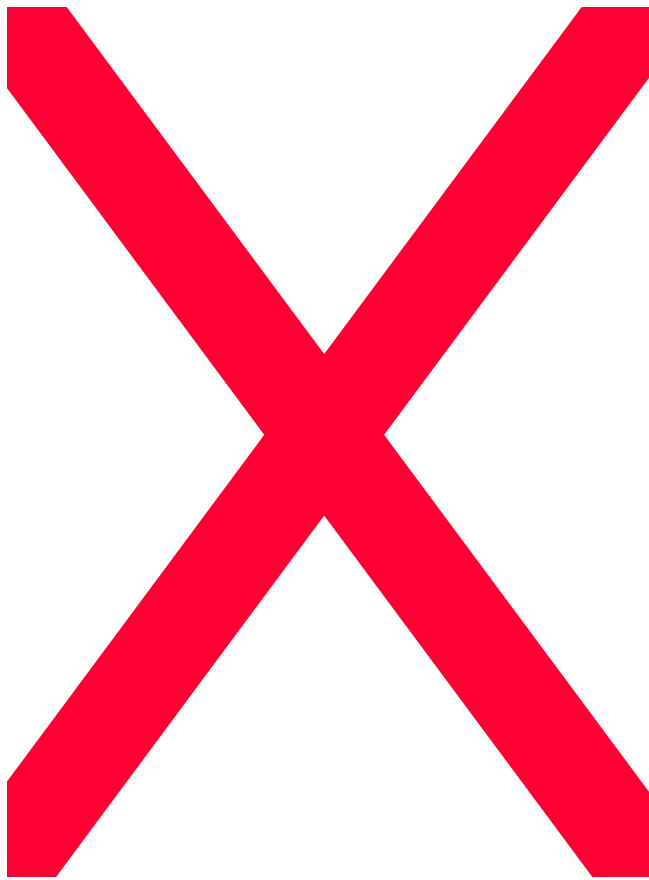
Although it is a relatively low risk, OPW could spread Zebra Mussels if aquatic vegetation or excavated material containing Mussels is inadvertently transported to another non-infested channel. Adult Mussels can survive for up to four weeks out of water hence its critical not to transport the same. Larvae are tiny and barely visible but will not survive on a machine bucket if there is no silt, stones or vegetation to shelter it.



Environmental Threat

Zebra Mussels are thumbnail-sized black & orange striped shellfish. They grow into dense clusters and attach to any underwater hard surface. They are an invasive species that damage the natural ecology of the infested waters. They expand into catchments through been transported by man's activities e.g. transferring fishing boats. Once in a particular lake or river, if conditions are favourable, they will multiply and spread with the currents. It is envisaged that they will keep expanding their territory unless man makes a concerted effort to prevent transport of the Mussels into non-infested waters.





Detail 3: Gravel Bed Detail

NOTES:

- Gravel bed should be 350mm-450mm deep
- Gravel bed should occupy the full channel cross section
- Gravel should be washed rounded stones of varying particle sizes as detailed in Table 1 for trout and Table 2 for salmon
- Sample existing spawning gravels to confirm similarity with gravels as supplied by quarry supplier

Table 1: Trout

Type	Grade	% Composition
Cobble	64-190 mm	0
Very coarse gravel	32-64 mm	30
Coarse gravel	16-32 mm	35
Medium gravel	8-16 mm	35

Trout: Percentage composition of gravel required

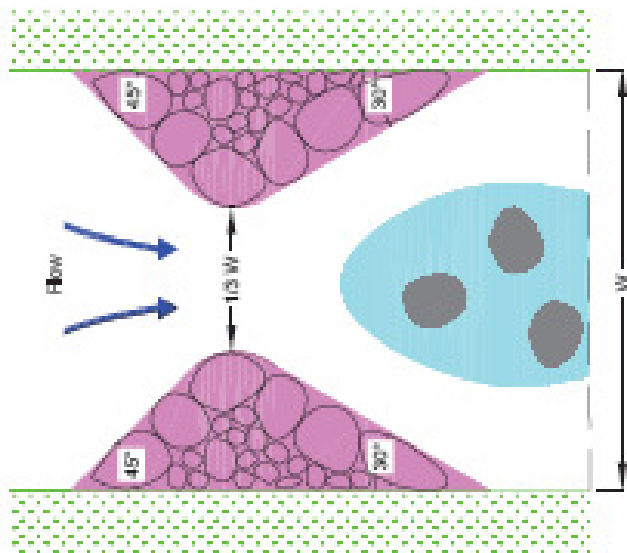
Table 2: Salmon

Type	Grade	% Composition
Cobble	64-190 mm	10
Very coarse gravel	32-64 mm	35
Coarse gravel	16-32 mm	25
Medium gravel	8-16 mm	30

Salmon: Percentage composition of gravel required

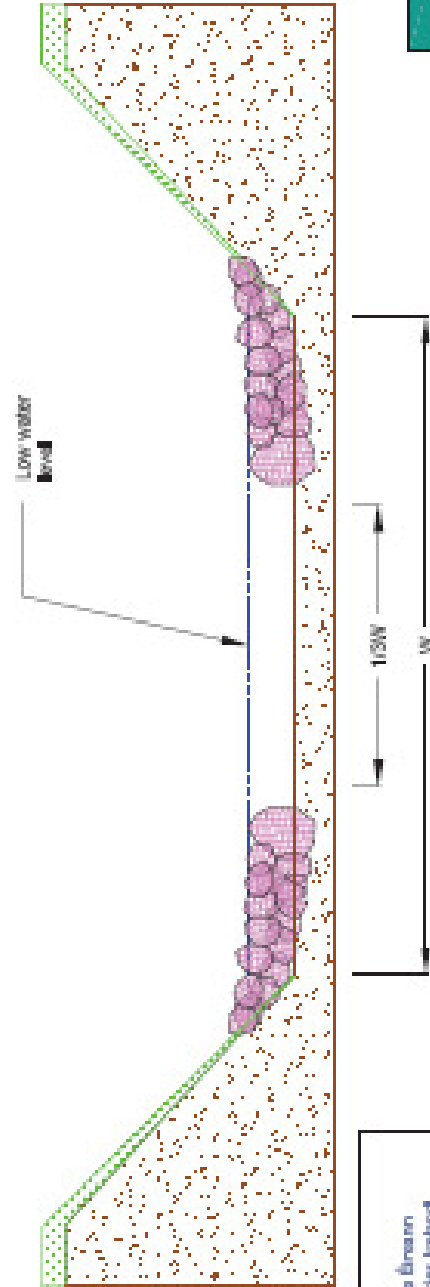


Detail 4: Paired Stone Deflectors

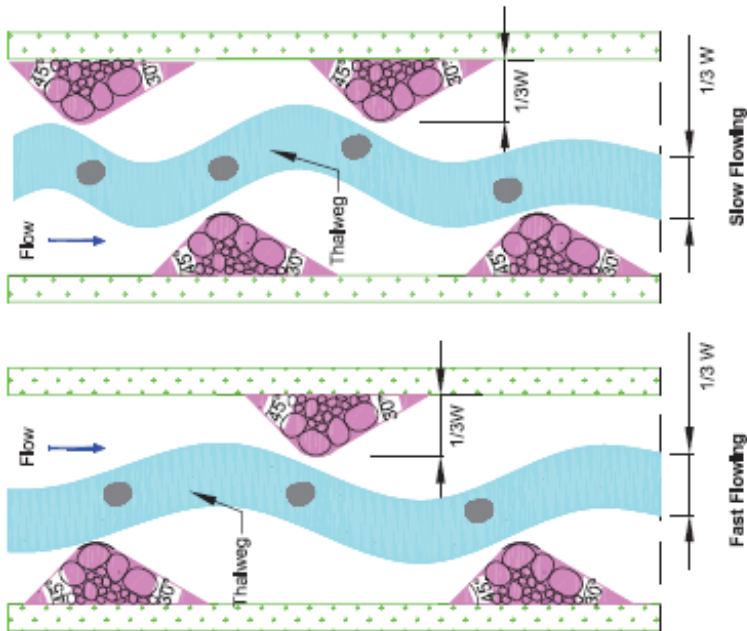


NOTES:

1. 45° angle on upstream slope
2. 30° angle on downstream slope
3. Deflector should slope down from bank
4. Stones at outer lip of deflector should be partially buried and the top of the stones should not be higher than low water level
5. These boulders should be the largest available to ensure they can withstand the energy in the channel
6. Use material excavated from pool to backfill deflectors. If no excess material is on site, backfill deflectors with broken stone
7. A space of $\frac{1}{3}W$ channel base-width should be left between the paired deflectors

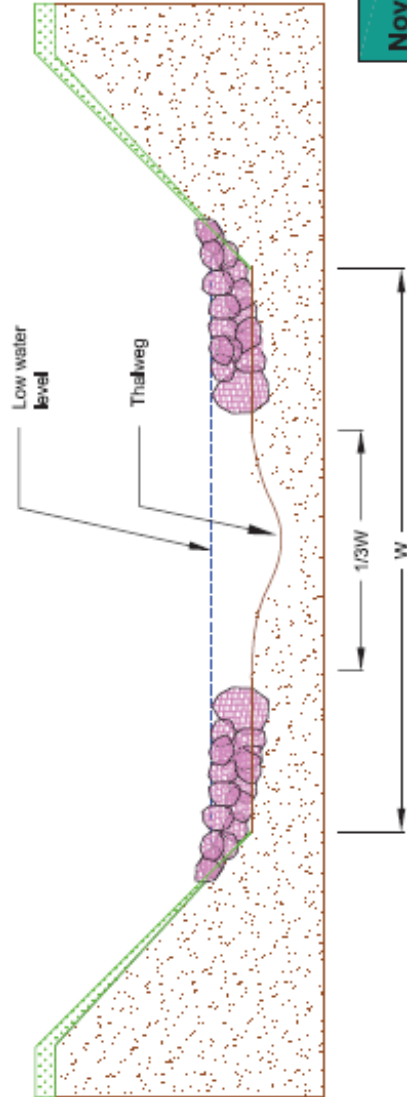


Detail 5: Alternating Stone Deflectors

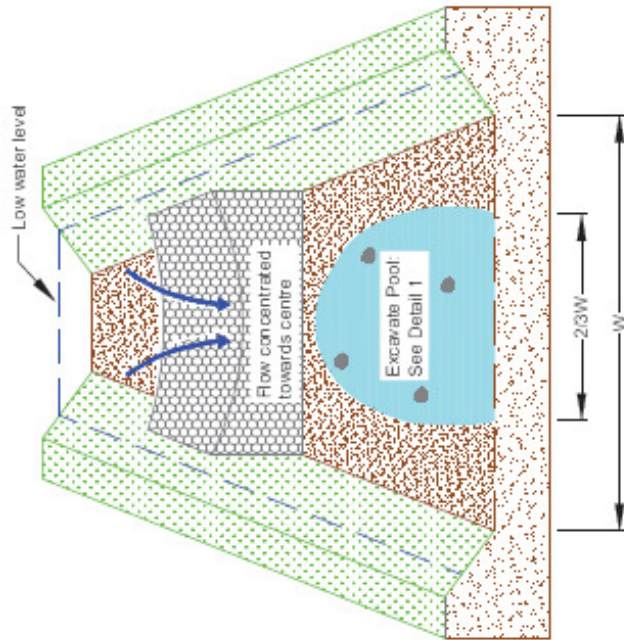


NOTES:

1. 45° degree angle on upstream slope.
2. 30° degree angle on downstream slope.
3. Deflector should slope down from bank.
4. Stones at outer tip of deflector should be partially buried and the top of the stones should not be higher than low water level.
5. Deflector width should be $1/3$ of channel base width.
6. In fast flowing rivers deflectors should not overlap.
7. In slow flowing wide channels deflectors should overlap.
8. Cover deflectors with scraw/vegetation where available.

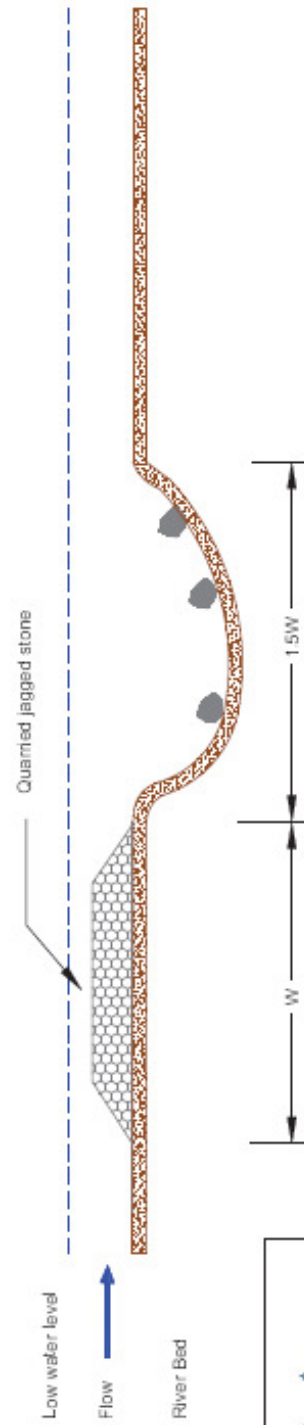


Detail 6: Rubble Mat

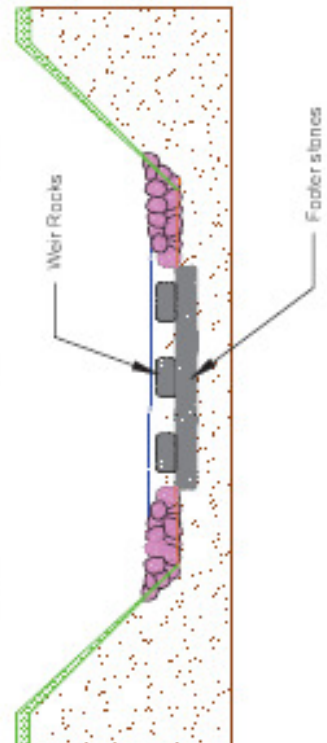
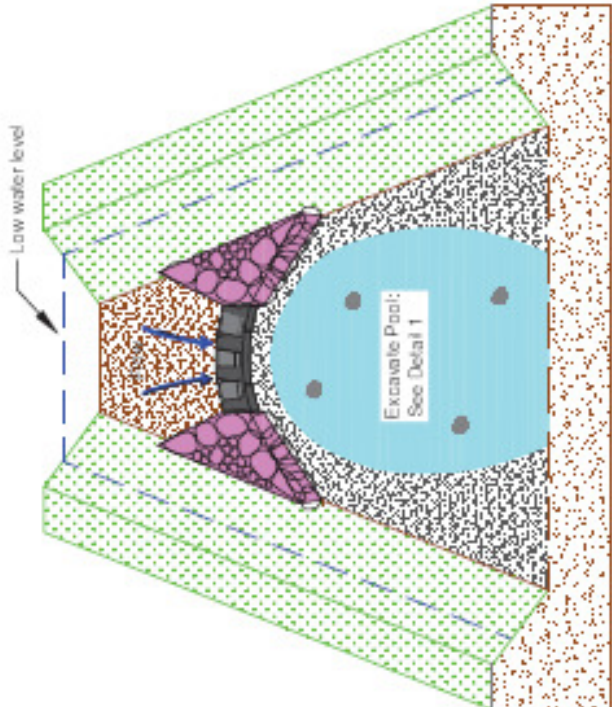


NOTES:

1. Rubble mat consists of broken quarried stone (150 - 250mm)
2. Rubble mat length equal to channel basewidth
3. Stone placed below low water level from bank to bank.
4. Gully should be made through the rubble mat concentrating flow towards centre of channel.
5. Excavate a pool downstream of the mat (See Detail 1: Centre Channel Pool)
6. Height of rubble mat will vary according to water depth - Follow IFI Design

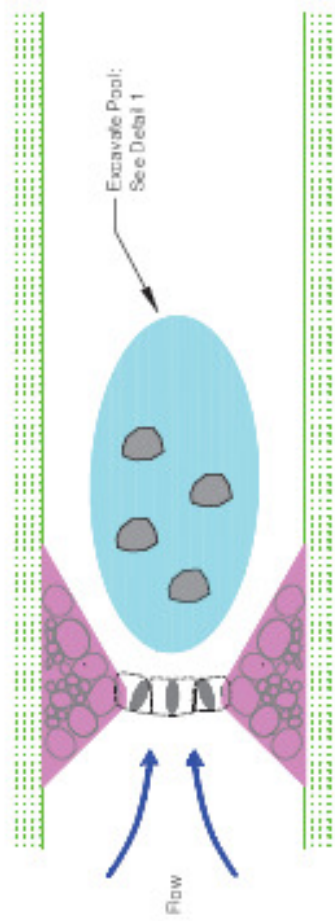


Detail 7: Vortex Stone Weir

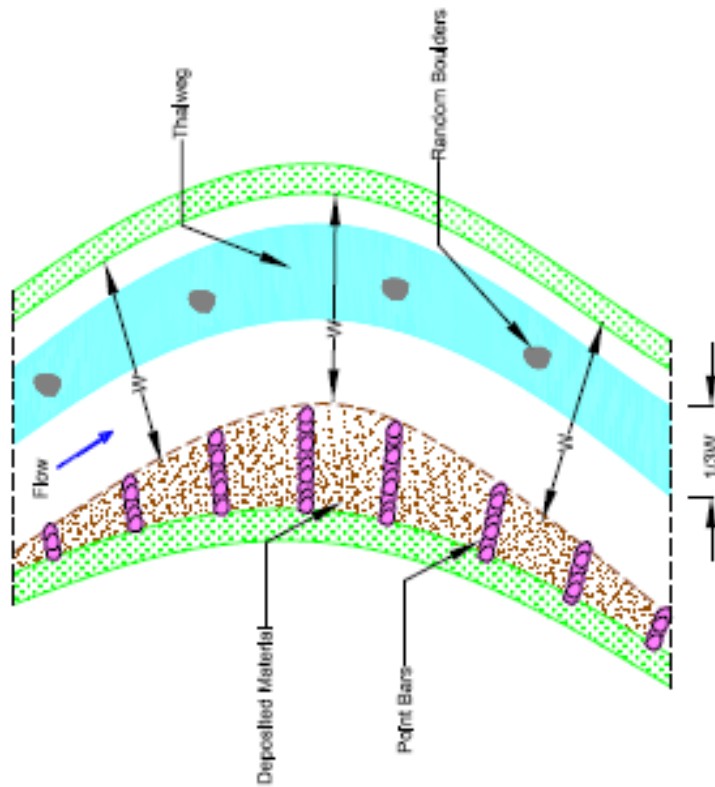


NOTES:

1. Stone deflectors or a series of rocks are built into both banks to direct flow towards centre of channel
2. A line of footer stones, arched upstream are buried across the central channel area. These footer stones to be buried so the surface is flush with bed of the channel
3. Three weir rocks are placed on top of the footer stones. The tops of these rocks are exposed by a few centimeters in low flow and are fully submerged in high flow.
4. Footer stones should ideally have a flat flagstone profile, which are larger than the weir stones and form a splash apron to prevent scour
5. Excavate a pod downstream of the weir (see Detail 1: Centre Channel Pool)



Detail 8: Point Bars



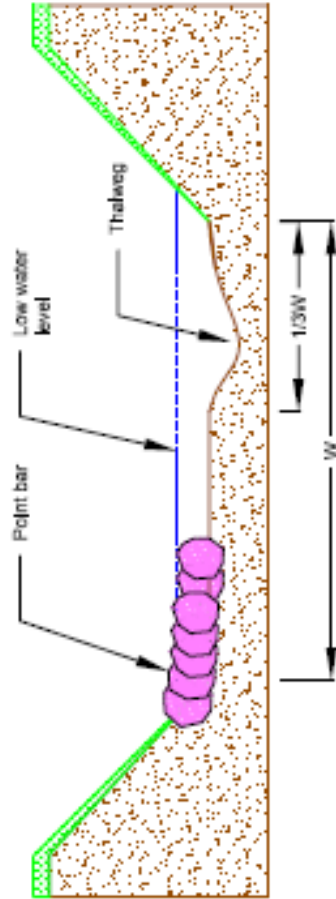
NOTES:

Deflector construction on banks:

1. Typically point bars should be constructed for approximately 1/3 channel basewidth
2. The outer lip of the point bars should form a contour which is parallel to the opposite bank
3. Typically point bars should be spaced approximately 10m apart and buff at right angles to the bank (See IFI design for spacing)
4. Excavate a trench along the line of the point bars. Boulders of approximately 0.5 tonnes should be placed into the trench so that they are partially buried into the trench
5. Slope each baffle such that the boulder closest the bank protrudes slightly above low water level and the boulder at the outer edge of the point bar should protrude slightly below low water level

Thalwegs

1. Place excavated material from the thalweg between the baffles
2. Place random boulders into the thalweg



4.0 Environmental Management System

Environmental River Enhancement Programme

The Arterial Drainage Maintenance Service of Engineering Services, OPW is carrying out the Environmental River Enhancement Programme (EREP). The enhancement works consist of both capital enhancement and enhanced maintenance. These works focus on river corridor improvements to salmonid channels with target specific actions on 100 kilometres of Scheme channel per annum, with pre and post measurement of biodiversity taking place on the channels in the relevant sub-catchments scheduled to benefit from these works. The identification of these channels, the carrying out of biodiversity assessments, the preparation of a five year programme of work and post biodiversity change assessments forms part of the work programme to be delivered by the service provider i.e. Inland Fisheries Ireland. It also involves making the assessment data available in a form that will allow completion of hydromorphological assessments.

The enhancement works are being carried out using OPW staff and machinery with the IFI's staff working alongside OPW supervisory staff. All materials required for the construction of in-stream structures, gravel and fencing is being supplied by OPW.

Environmental Training

Environmental training of all staff is an ongoing process. Technical and Operational Staff have completed formal training in environmental river maintenance in 2004, and again in 2010 which contained the more recent environmental practice. This training was developed and delivered by Inland Fisheries Ireland as part of the EREP. The training programme delivered included presentations in river corridor ecology, maintenance strategies involving both 'enhanced maintenance' and 'capital enhancement', and OPW's Environmental Management Protocols and SOPs.

The formal approach to EREP Training is complimented with on-site training. Regular site visits from IFI and OPW's Environment Section provide further guidance and advice to operational staff. Auditing of operational staff on the implementation of the Environmental Drainage Maintenance Guidance Notes (Ten Steps to Environmentally Friendly Maintenance) is also carried out under EREP.

In addition, other environmental training takes place as deemed beneficial, e.g. in 2008, the majority of operational staff were trained in Otter Awareness. This course, provided by the Department of Zoology, Trinity College Dublin, included presentations on otter ecology, and on-site identification of otter signs and suitable habitat.

In 2017, the OPW participated in an Environmental Flood Risk Management Course, Environmental Drainage Maintenance Course, and Environmental Pre-Works Inspections Course delivered by external environmental consultants.

Geographical Information Systems (GIS)

GIS systems are now a significant tool to manage both the existing and future environmental information and to this effect, the Drainage Maintenance Service has recently digitised the original Drainage Scheme maps. GIS systems allow the rapid and accurate transfer of geographical environmental data and it is hoped to contain all maintenance work programmes, fishery information such as spawning reaches, environmentally designated areas e.g. SACs, other sensitive sites such as habitats of protected species and general habitat information in this format.

Ecological Impact Assessments

The annual Arterial Drainage Maintenance Programme is screened for potential impacts on Natura 2000 Sites. Channels identified as having the potential to impact on a Natura 2000 Sites are subject to Appropriate Assessment under Article 6(3) of the Habitats Directive. These Appropriate Assessments are carried out by external Ecological Consultants.

Recent practice for any new localised flood alleviation project is to carry out an Appropriate Assessment if the works overlap with a Natura 2000 Site or an ecological assessment if the works are not within a Natura 2000 Site but still need to have regard to the broader protected habitats and species such as Annex IV species, Wildlife Acts or Flora Protection Order.

Environmental Impact Assessments

. The most applicable class of development relevant to drainage maintenance and 'Designation' projects is in respect of Canalisation. The thresholds are where canalisation and flood relief works, where the immediate contributing sub-catchment would exceed 500 hectares or where more than 2 hectares of wetland would be affected or where the length of river channel on which works are proposed would be greater than 2 km.

Arterial drainage maintenance works are sub-threshold as the operations are maintaining the river corridor but are not canalising any new lengths.

Planning & Development

While there is an extensive range of Planning and Development legislation, the most applicable current legislation is the Planning and Development Regulations, 2001 and the Planning & Development Acts 2000 to 2010. This legislation exempts from planning permission, works under an Arterial Drainage Scheme. These drainage works and the associated maintenance, forming part of a scheme have been confirmed by a Minister and have gone through a public exhibition process in accordance with the Arterial Drainage Acts 1945 and 1995. The most recent environmental impact assessment Directive (2014/52/EC) was transposed into Irish legislation under the EU (Planning & Development) (Environmental Impact Assessment) Regulations, S.I. No. 296 of 2018.

5.0 Additional Mitigation Measures

The following additional mitigation measures have been recommended in the SEA Environmental Report for the Plan and have been included in the final description of activities.

Mitigation measures are included in the plan to prevent potential significant negative impacts on the environment. Based on the source/pathway/receptor concept where an environmental burden (e.g. water pollution, noise etc.) can impact on a receptor e.g. human, water, biodiversity or landscape via particular pathways, these significant impacts can be either mitigated at:

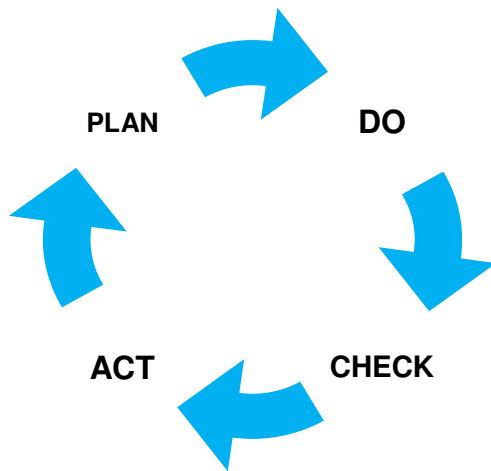
- Source e.g. avoid the impacts at source
- Pathway e.g. breaking the linkage between the source and the receptor
- Receptor e.g. compensate for the impact by providing an alternative

To negate or minimise these impacts, mitigation measures are set out in the following sections. In the absence of suitable site-specific mitigation measures, maintenance activities will impact negatively on the environment. A number of mitigation measures have been grouped into seven categories. Not all the recommended mitigation measures are appropriate for all catchments and they are in addition to the current Standard Operating Procedures (SOPs) and Environment Management Protocols. The selection of which mitigation measures apply to which catchments and maintenance works will be undertaken in the 6-year and annual maintenance planning process. The implementation of the recommended mitigation measures has the potential to significantly improve environmental and social performance of maintenance works.

5.1 Environmental Management System

Review of the SOP's and our understanding of the Maintenance Activities identified the benefits to the OPW of a simple environmental management system (EMS). While the EMS may not be certified to the ISO 14001 standard some of the overarching principles of the standard would be applicable and beneficial to the Maintenance Activities. An active EMS illustrates the concepts of continual improvement to Statutory Bodies and other interested stakeholders. It is proposed that the simple EMS would follow the basic principle of the ISO 14001 standard as illustrated in Figure 2.

Figure 2: Plan-Do-Act-Check principle of ISO 140001 standard



Using the principle of continuous improvement, a number of procedures that will be required to achieve this goal. Many of these procedures will require a revision to the current SOPs or the development of new SOPs which will be carried out in an ongoing basis. The SOPs should be controlled documents with the responsibility of one person to create, manage and update the procedures when necessary.

M1 - Improved Maintenance Planning (6-year and annual plans)

These mitigation measures are concerned with continuously improving the types of maintenance activity and the way in which these are specified for specific channels, embankments and structures. They also include recommendations for enhancing the consultation on the 6-year and annual maintenance programmes, sharing of information with stakeholders and incorporating third party information into the planning and decision-making process. There are many research projects, best practise examples, methods and guidance reports that can be applied to the planning of OPW maintenance activity in Ireland.

The measures should apply to maintenance of all drainage scheme channels, embankments and structures which the OPW has responsibility for. The processes developed should be shared with Local Authorities and other bodies responsible for flood risk, drainage and coastal protection asset management as national best practise and continuously improved as new information is available or processes develop.

Figure 3. Improved Maintenance Planning Mitigation Measures

Code	Mitigation Measure	Details and Example Applications	Timescale
M1a	Incorporate GIS data from other bodies in maintenance activity planning systems	Examples include: - National Road Network to ensure consideration of health & safety, and identify potential impacts on standard of national road network. - National Monuments Service SMR and NIAH database. - Protected and sensitive species and habitat data. - WFD status and hydromorphological pressure NPWS database IFI fisheries data - Presence of Invasive Species	Short-Term

Code	Mitigation Measure	Details and Example Applications	Timescale
M1b	To maintain, update and share GIS information on arterial drainage scheme channels, embankments and structures. Maintenance programmes to be made available, if possible in GIS format, but as a minimum with reference to GIS information.	<p>Maintenance plans are currently shared with relevant statutory bodies – IFI and NPWS.</p> <p>To enable other bodies and stakeholders to view maintenance programmes and understand maintenance responsibilities.</p> <p>To make it easy for others to understand the planning process.</p> <p>More informed consultation responses from stakeholders.</p> <p>An example is the publication of Environment Agency main river maintenance programmes for England¹.</p>	Short-term
M1c	Specific and targeted consultation on the annual maintenance plans with stakeholders for high risk or sensitive impacts, activities or locations.	<p>Maintenance plans are currently shared with Inland Fisheries Ireland, National Parks and Wildlife Service for consultation. They will also be shared with EPA Catchment Assessors for consultation.</p> <p>The OPW has a GIS system in place which contains details of sensitivities for channels based on current datasets to inform relevant consultation.</p> <p>The OPW are committed to create a barrier layer utilising fisheries source data.</p>	Short-Term to Long-Term (ongoing)
M1d	Cross-border consultation with relevant Northern Ireland bodies on the annual maintenance programmes.	Only relevant to maintenance programmes for catchments which overlap the boundary with Northern Ireland.	Short-Term to Long-Term (ongoing)
M1e	Planning for Appropriate Assessment project level AA Screening, consultation and license application routes for Wildlife Act and Habitats Directive.	This is to ensure timely development of detailed plans of works where Appropriate Assessment Screening, notifications or license applications will be likely. The Environmental Risk Assessment (ERA) process will be used to forward plan the requirement for site specific Appropriate Assessments. This will ensure that necessary surveys can be commissioned and completed in the correct season and allow works to progress, where appropriate, during the applicable timeframe. The correct timing of surveys is critical to the quality of the Appropriate Assessments and application for derogation licenses.	Short-Term
M1f	Refine the suite of maintenance activity types and methods.	<p>This is to allow for a broader suite of possible maintenance activities for selection, so potential impacts can be avoided or mitigated at the planning stage, by selecting the most appropriate environmentally sensitive maintenance method for specific local conditions.</p> <p>This will be delivered through new procedures in the OPW Environmental Drainage Maintenance Guidance (currently in development). These are being based upon national and international best practise.</p> <p>At the national planning stage, consideration for alternative approaches to activities should be considered such as Working with Natural Processes and the environmental conditions.</p>	Short-Term to Long-Term (ongoing)
M1g	Improved planning of maintenance activity, based on international best practice and tools to: a) incorporate hydromorphological assessment of channel type and conditions.	<p>This is to select, from the refined maintenance activities, what to specify for different catchment, channel and structure types.</p> <p>An ecological site walkover with an ecologist currently occurs on the most sensitive sites. of the planned works before they commence.</p> <p>The OPW is committed to developing and introducing a</p>	Short-Term to Long-Term (ongoing)

¹ <https://www.gov.uk/government/publications/river-and-coastal-maintenance-programme>

Code	Mitigation Measure	Details and Example Applications	Timescale
	<p>b) screen for archaeological and cultural heritage impacts.</p> <p>c) minimise the spread and colonisation of invasive species.</p> <p>d) minimise impacts on and enhance conditions for sensitive species and habitats.</p> <p>e) minimise impacts upon and enhance wetland and peatland ecosystems.</p> <p>f) consider aquifer type and status.</p>	<p>precautionary environmental risk assessment (ERA) in order to identify in a preliminary way areas of potential risk or ecological/environmental sensitivity. Pilot studies will be implemented and findings will inform future maintenance planning.</p> <p>The OPW is committed to developing archaeological risk assessment procedures at selected pilot study sites.</p> <p>Recommended appointment of an underwater archaeologist as project archaeologist to advise OPW and to manage the archaeological risk of the drainage programmes. The project archaeologist will liaise with the National Monuments Service (NMS), to agree the consents and scopes of work required on drainage programmes.</p> <p>Use of EPA fluvial geomorphological assessment based on MQI tool (in development), River Hydromorphology Assessment (RHAT)⁷ and other river restoration tools and guidelines (e.g. REFORM and River Restoration Centre).</p> <p>Screening of aquifer type to rule out where certain activities should not be undertaken. For example, karstic groundwater bodies can have high levels of connectivity between maintenance locations and sensitive wetland annexed priority habitats such as Turloughs. Further investigation could inform future studies, if unproductive aquifers and impermeable soils have potential for greater surface runoff or quick flow and so potential for direct links between maintenance locations and sensitive habitats and species.</p>	
M1h	Consult Irish Water, National Federation of Group Water Schemes and local planning authorities on 5-year and annual maintenance programmes to allow others to consider the implications of Combined Sewer Outfall and other significant surface water discharges to arterial drainage schemes.	The impact of changes in flow or level from maintenance activity on discharges and downstream quality should be considered by others.	Long-Term
M1i	Ongoing training and continuous staff development of management and engineers involved in planning and specifying maintenance activities.	Continuous staff development will be required to maintain skills and understanding as research evolves.	Short-term and Long-term (ongoing)

M2 - Improved Standard Operating Procedures and Environmental Protocols

These mitigation measures are focused on addressing concerns from key stakeholders on the methods and approach to undertaking specified maintenance activities. The intention of these recommendations is to further facilitate good environmental practices in the field. They focus on how maintenance activity is carried out once it has been specified for channels, embankments and flood relief schemes in the 6-year and annual programmes.

⁷ <https://www.daera-ni.gov.uk/sites/default/files/publications/doe/water-guidance-river-hydromorphology-assessment-technique-training-manual-version-2-2014.pdf>

These should be considered as continual improvement of existing procedures as opposed to new extra standards and guidelines to be followed.

Figure 4. Improved Standard Operating Procedures and Environmental Protocols Mitigation Measures

Code	Mitigation Measure	Details and Example Applications	Timescale
M2a	Draft SEA Environmental Report recommended a measure M2a, which following subsequent consultation has now been removed. Reference code retained for consistency and transparency between documents.		
M2b	Update Environmental Drainage Maintenance Guidance , to continuously improve and facilitate the undertaking of environmentally sensitive maintenance activity as specified out in 5-year and annual maintenance programmes.	<p>Specific improvements required at present to comply with environmental sensitivities include:</p> <ul style="list-style-type: none"> - Standards for design drawings and instructions, including detailed description of works and mitigation measures for appropriate assessments - Timing of surveys for appropriate assessments and license applications - Incorporation of current best practise and guidance into species specific EclAs - Consider findings of the Forestry and Freshwater Pearl Mussel Requirements - New EclAs for species and habitats not currently covered (e.g. riparian woodland, wetlands and peatlands) - Inclusion of when and how to consider ecological constraints of specified activities, - Invasive species controls and methods, - Maintenance and establishment of machine access corridors to be dealt with through Environmental Procedures (EPs) and Environmental Risk Assessment (ERA). - Inclusion of refined descriptions and approaches to maintenance activity types and methods (see recommended mitigation measure M1f). <p>Environmental assessment of the most sensitive locations of the planned works before they commence.</p> <p>The OPW is committed to developing and introducing a precautionary environmental risk assessment (ERA) in order to identify in a preliminary way areas of potential risk or ecological/environmental sensitivity. Pilot studies will be implemented and findings will inform future maintenance planning.</p>	Short-Term and Long-Term (ongoing)
M2c	Develop clear guidance and processes for identifying and protecting cultural heritage and archaeology features.	<p>Ensure that areas adjacent to the works are not of cultural, architectural, or archaeological significance. If so, appropriate measure and guidelines to be used in order to protect these. Such measures may include desk-based assessments and licensed (by DAHRRGA) on-site walkover and/or waded/underwater assessments and survey work to define further the nature and extent of the cultural heritage assets.</p> <p>New guidance to incorporate into updated SOPs and protocols to enable field operatives and engineers to protect known and likely unknown features.</p> <p>The OPW to fund a national study assessing the scale of</p>	Short-Term

Code	Mitigation Measure	Details and Example Applications	Timescale
		<p>archaeology and cultural heritage overlap along Arterial Drainage Schemes and determine the potential archaeological impacts caused by maintenance activities. The assessment will inform if further investigations will be required and the identification of pilot study sites.</p> <p>Investigative measures may include desk-based assessments, on-site walkover, waded/underwater survey work, to define further the nature and extent of the cultural heritage assets.</p> <p>New archaeological guidance will be incorporated into updated environmental procedures/protocols, to enable field operatives and engineers to protect known and likely unknown features.</p> <p>Refer to the Environmental Report for cultural heritage aspects this needs to cover.</p>	
M2d	Ongoing training and continuous staff development of field operatives, foremen and local engineers involved in undertaking maintenance activities.	Continuous staff development will be required to maintain skills and understanding as research and methods evolve.	Short-Term to Long-Term
M2e	Check and review Environmental Drainage Maintenance Guidance	An annual review of post-maintenance activities is recommended. These reports are to be reviewed annually and where the requirement for additional mitigation measures or a requirement for updated guidance is identified. The OPW or their agents should conduct an annual review of the guidance, in-house procedures with a view to updating them.	Short-Term to Long-Term

M3 - Monitoring of all maintenance activity, with continuous improvement through feedback into methods and approach

These mitigation measures address deficits in the range of robust scientific evidence of the potential impacts of maintenance activity. Further monitoring is required to develop evidence in relation to the direct impacts of a maintenance activity, the cumulative impacts of maintenance on multiple drainage schemes within or beyond a catchment, the in-combination effects of maintenance with other land uses and activities. It is also important to develop scientifically robust evidence on the recovery periods following different maintenance activities and the performance of mitigation measures employed. The findings of the recommended monitoring will feed into continuous improvement of the maintenance activity descriptions, development of maintenance programmes and standard operating procedures.

The monitoring will be based on a representative sample of all maintenance activity by the OPW and not limited to EREP schemes. If appropriate, and if it would add scientific value to the evidence base, other bodies who undertake watercourse or embankment maintenance could contribute.

Figure 5. Monitoring of Maintenance Activity Mitigation Measures

Code	Mitigation Measure	Details and Example Applications	Timescale
M3a	Monitoring of the effectiveness of invasive species control measures	Monitoring to understand the effectiveness of control measures applied to manage invasive species. The monitoring can be used to refine control measures.	Short-Term to Long-Term

Code	Mitigation Measure	Details and Example Applications	Timescale
		A pilot study will be undertaken to cover a number of sites to evaluate effectiveness.	(Ongoing)
M3b	Specific monitoring to build scientific evidence base of impact of different maintenance activities on specific species and habitats of interest to include: - Freshwater Pearl Mussel, - Salmon, - Lamprey, - Crayfish, - Otter, - Badger & other Mammals, - Kingfisher, - and others as appropriate.	This monitoring is to cover a representative sample of maintenance activity, not just EREP schemes. The objective is to build up a knowledge base to inform planning and provide robust scientific evidence for Appropriate Assessments. The knowledge base could be used to inform other bodies such as IFI. Various monitoring programmes (e.g. IFI annual reports on Environmental River Enhancement Programme) are currently in place and the OPW collates monitoring data.	Short-Term to Long-Term (Ongoing)
M3c	Specific monitoring of pathways to build scientific evidence base. Research into groundwater pathways to groundwater dependent habitats and species as a priority.	This monitoring is to cover a representative sample of maintenance activity where groundwater pathways may exist, not just EREP schemes. A pilot study in fen based SAC, in conjunction with specialist hydrogeology stakeholders, is being undertaken. . The objective is to build up a knowledge base to inform planning and provide robust scientific evidence for Appropriate Assessments.	Short-Term to Long-Term (Ongoing)
M3d	Collaborate with EPA on monitoring of hydromorphological conditions on Arterial Drainage Schemes.	The EPA undertakes monitoring and assessment of hydromorphology. The OPW will collaborate with the EPA to review the findings for Arterial Drainage Schemes to better understand the potential impacts. Monitoring through the hydromorphological review of 12 gravel traps on Arterial Drainage Schemes to cover water quality, siltation, hydrology, flow rates, scouring and bank erosion. The recovery of hydromorphological (focusing on local scour and deposition) conditions following maintenance activity shall be assessed in Dunmanway.	Short-Term to Long-Term (Ongoing)
M3e	Review existing and ongoing monitoring by the EPA and others to build scientific understanding of the in-combination and cumulative effects of maintenance activity	The OPW will report against the indicators in the EPA Water Quality in 2016 Indicators Report (EPA, 2018) for water quality related monitoring programme. The OPW will compare the national scores for all waterbodies with the score for waterbodies within Arterial Drainage Schemes. http://www.epa.ie/pubs/reports/water/waterqua/Water%20Quality%20in%202016%20An%20Indicators%20Report.pdf	Short-Term to Long-Term (Ongoing)
M3f	Specific monitoring to build scientific evidence base of impact of different maintenance activities on wetland and peatland ecosystems	Conduct the Tory Hill SAC and Ballymore Fen SAC pilot hydrogeological study and review of monitoring by others as part of the National Peatlands Strategy.	Short-Term to Long-Term (Ongoing)
M3g	Specific monitoring to build scientific evidence on the effectiveness of mitigation measures	Monitoring of flood relief schemes is carried out as part of the EIAR requirements and planning conditions. This information, such as siltation monitoring and impact of bank works, can build the scientific evidence base on the effectiveness of mitigation measures. These can be comparative and used to infer the effectiveness of drainage maintenance activity	Short-Term to Long-Term (Ongoing)

Code	Mitigation Measure	Details and Example Applications	Timescale
		mitigation. Inland Fisheries Ireland report on scientific research on environmental conditions of Arterial Drainage Schemes and Environmental River Enhancement Programme (EREP) schemes. This is developing the evidence base for the effectiveness of mitigation measures during maintenance works.	
M3h	Specific monitoring to build scientific evidence base of erosion/deposition/stabilisation factors at known cultural heritage sites and area of potential.	The monitoring would cover a representative sample of maintenance activity, to build up a knowledge base to inform maintenance planning and compliance with NMS requirements, and provide robust scientific evidence.	Short-Term to Long-Term (Ongoing)

M4 - Expansion of river restoration and environmental enhancement

These mitigation measures intend to maximise the benefit of proposed river restoration and environmental enhancement works currently carried out as part of the maintenance programmes under the Environmental River Enhancement Programme (EREP) projects.

The current scope of the EREP works are principally focused on fisheries and WFD criteria and by expanding the scope of the criteria can allow for more opportunities to restore river, coastal, estuarine and wetland environments. Links to the EU Floods Directive and WFD themes of natural flood management and working with natural processes should be explored as part of these recommendations. The REFORM programme deliverables include many tools and guidelines for identifying, planning, designing and implementing river restoration.

Figure 6. River Restoration and Environmental Enhancement Mitigation Measures

Code	Mitigation Measure	Details and Example Applications	Timescale
M4a	Expand the criteria for river restoration and enhancement of EREP works to include opportunities with other benefits, not just fisheries or salmonid potential.	There is an opportunity to broaden the scope of EREP projects to cover all environmental enhancements whilst not compromising land drainage or flood protection. In some cases, restoration could enhance land drainage and/or flood protection. The scope should also cover embankments and older flood relief schemes with potential for enhancement. This is inherent in the draft Environmental Drainage Maintenance Guidance (in development).	Long-Term
M4b	Identify strategic corridors and locations for protection of riparian and floodplain hedgerows and woodlands.	The walkover habitats surveys undertaken to feed into the Natura Impact Statements for each Arterial Drainage Scheme have mapped linear and area woodland and hedgerows to Fossitt habitat classifications. GIS analysis of these datasets, REFORM, MQI and RHAT information can be used to determine a strategic approach to woodland and hedgerow management and enhancement to cover: - identify locations of high value and protected woodland (e.g. alluvial woodland Annex I habitat). - identify woodland that could be critical to the habitat conditions of sensitive species (e.g. woodland near to Freshwater Pearl Mussel locations). - identify gaps or areas with little tree or hedgerow cover as	Long-Term

Code	Mitigation Measure	Details and Example Applications	Timescale
		<p>opportunities for creation or enhancement of such habitat. Specific focus on where buffer strips would be beneficial.</p> <p>- identify floodplain treelines and hedgerows which could manage flood risk and should be considered for protection as natural flood management assets.</p> <p>These could form a GIS screening layers to inform the approach to maintenance activities.</p> <p>Management of riparian trees and hedgerows are included in the draft Environmental Drainage Maintenance Guidelines (in development).</p>	

M5 - Climate Impacts

This mitigation measure relates to the continual reduction in greenhouse gas emissions and climate change impacts of drainage maintenance activities.

Arterial Drainage Maintenance Activities have limited potential for adaptation to climate change, as maintenance is focussed upon maintaining existing scheme design as per the Arterial Drainage Acts (1945 and 1995). Flood relief schemes and enhancement of drainage schemes are not maintenance activity, however do consider adaptation to future climate change.

Figure 7. Climate Impact Mitigation Measures

Code	Mitigation Measure	Details and Example Applications	Timescale
M5a	Draft SEA Environmental Report recommended a measures M5a and M5b, which following subsequent consultation has now been removed. Reference code retained for consistency and transparency between documents.		
M5b			
M5a	Continuous improvement in the environmental performance of machinery and fleet, and materials used.	To reduce carbon emissions and also consider materials used in maintenance activities to reduce the life-cycle impacts of maintenance activity and EREP works.	Long-Term

M6 - Monitoring of environmental conditions

These mitigation measures relate to environmental monitoring and continued review of international science and best practice. The purpose is so that environmental change and land use change can be detected, and adjustments made to maintenance activities and plans in advance of problems. The monitoring is of use in justifying public expenditure and identifying early warning signs to trigger changes in drainage maintenance approaches or methods.

Figure 8. Environmental Monitoring Mitigation Measures

Code	Mitigation Measure	Details and Example Applications	Timescale
M6a	Modelling and monitoring of the benefits of maintenance activity	<p>A pilot study for the Cashen Estuary is proposed.</p> <p>This would consider hydrology, hydraulic, flood risk and agricultural productivity indicators. The findings would feed into the maintenance planning process and optimise expenditure, whilst complying with the Arterial Drainage Acts and avoiding compensation to</p>	Long-Term

Code	Mitigation Measure	Details and Example Applications	Timescale
		landowners.	
M6b	Regular review of recent scientific research in environmental impacts, catchment management and continuous improvement of procedures.	Scientific research is continuing to evolve and the OPW should frequently undertake a review of developments relevant to the maintenance of land drainage and flood relief schemes.	Long-Term
M6c	Link to Flood Risk Management Plan (CFRAM) monitoring	The monitoring of environmental change and flood risk should be linked to monitoring recommendations for Flood Risk Management Plans produced by the CFRAM projects.	Long-Term
M6d	Develop approach to reviewing existing datasets from EPA and NPWS that monitor catchment change (hydrology, hydromorphology and ecology)	The monitoring of key catchment indicators over time at a regional and local scale should be used to highlight key issues which maintenance activity could be influencing. Indicators of catchment change will include hydrology, ecology, hydromorphology (e.g. REFORM, MQI and RHAT), land use cover and land use management. The monitoring will use data from other such as EPA and NPWS..	Long-Term

M7 - Working with Natural Processes and Land Management Practices

These mitigation measures relate to the working with natural processes themes in the EU Floods Directive and Water Framework Directive. They also cover the alignment of maintenance activities with land use planning at the catchment and local scales.

Figure 9. Working with Natural Processes and Land Management Mitigation Measures

Code	Mitigation Measure	Details and Example Applications	Timescale
M7a	Align maintenance planning with catchment management planning	WFD River Basin Management Plans, CFRAM Flood Risk Management Plans and maintenance activities and plans to complement each other.	Long-Term
M7b	Refine maintenance activity in light of CFRAM hydraulic modelling and Flood Risk Management Plan measures	Use CFRAM findings to refine the maintenance programmes where relevant. Also consider Working with Natural Processes (for flow and sediment) recommendations in the Flood Risk Management Plans. A pilot study for use of hydraulic models to identify appropriate maintenance in Dunmanway is proposed. Development of embankment maintenance programme is influenced by CFRAM modelling and flood risk outputs.	Long-Term
M7c	Identify opportunities and constraints for where working with natural processes can contribute to maintenance activity.	This could be in the form of a catchment scale screening approach (e.g. SEPA and REFORM tools) to identify opportunities.	Long-Term

5.0. Monitoring Programme

A monitoring programme allows the actual impacts of the Programme to be tested against those that were predicted. It allows issues of concern to be identified and dealt with in a timely manner, and environmental baseline information to be gathered for future Programme reviews. Monitoring is carried out by reporting on the set of indicators and targets drawn up previously and used to describe the future trends in the baseline, which will enable future positive and negative impacts on the environment to be measured.

The monitoring programmes will encompass the National Arterial Drainage Maintenance Activities (2018 – 2021) and will likely be implemented at various stages of the programme. It would be practical to combine the monitoring of maintenance activity with the CFRAM programme monitoring and the Water Framework Directive where possible.

Monitoring of this Programme is made up of two components. The first addresses the on-site implementation of OPW's Environmental Management Protocols and Standard Operating Procedures. The second is a scientific monitoring programme, carried out under the EREP Scheme, assessing the impacts of routine maintenance and 'capital enhancement' projects on the river corridor biodiversity. In addition, the proposed mitigation measures in the previous chapter include proposed monitoring to build a scientific evidence base on:

- a) the impacts of the Arterial Drainage Maintenance Activities 2018 – 2021, and
- b) environmental change to assess how maintenance activities and the scheme elements should evolve and adapt over time.

The continued development of the scientific evidence base will be a valuable tool in the appropriate assessment of maintenance activities. The monitoring programme shall be aligned with the monitoring programme for other Plans and Programmes such as the CFRAM programme, WFD, and the EPA's fluvial geomorphological assessment programme. The similarity between many of the activities assessed here and the CFRAM Flood Risk Management Plan (FRMP) measures presents an opportunity for a cohesive approach to monitoring. In particular, this monitoring will inform the six-yearly update of the FRMPs as is a requirement of the EU Floods Directive.

Progress and findings of the monitoring activities over the 2018-2021 period shall be reported and published as part of the next cycle of the Strategic Environmental Assessment of maintenance activities.

Auditing

External auditing of operational staff, on the implementation of the Environmental Drainage Maintenance (EDM) Guidance Notes (Ten Steps to Environmentally Friendly Maintenance), is carried out by Inland Fisheries Ireland, as part of the EREP. These audits inform the OPW of the level of compliance with the Environmental Management Protocols and Standard

Operating Procedures, with particular focus on the EDM Guidance Notes. External auditing covers approximately one-third of OPW drainage machine crews annually.

Auditing (both internal and external) provides an opportunity to assess the level of compliance with Environmental Management Protocols and SOPs. It also allows for discussion on any difficulties encountered and experimental works that could be applied. The OPW Foreman is present throughout the audit along with the entire machine gang. A section of recently maintained channel is examined along with the next section to be maintained. This gives a good idea of pre-maintenance conditions and enables recommendations to be made about maintenance should proceed, should changes be required. The audit form is forwarded to the relevant Engineer within 14 days upon a satisfactory audit. If the audit highlights unsatisfactory compliance with the OPW Environmental Drainage Maintenance guidelines and SOPs the relevant OPW Engineer is notified within 24 hours.

A rating system was developed and is recorded in OPW's Internal Management System. Ratings are monitored by both IFI and OPW to identify any issues with particular machine crews, or any difficulties with particular aspects environmental maintenance.

Audit Ratings

Rating %	Category
0-50	Bad
51-59	Poor
60-70	Moderate
71-84	Good
85-100	Very Good

Audit results are reported to OPW Management Staff throughout the year and presented in the IFI's Annual EREP report. Presentations are delivered on the auditing and recommended improvements at an annual meeting had with IFI's EREP Team and OPW's Engineers, Technicians and Foremen.

Internal auditing is carried out by OPW's Environment Section. A number of OPW/IFI audits are carried out in tandem annually for standardisation purposes. A standard audit form is used by both IFI and OPW's Environment Section (**OPW Site Audit Form V.1**).

OPW Site Audit Form V.1

OPW Region:	<input type="text"/>	Scheme:	<input type="text"/>
Foreman:	<input type="text"/>	Channel: (name & code)	<input type="text"/>
Driver(s)	<input type="text"/>	Section: (chg-chg)	<input type="text"/>
Auditor:	<input type="text"/>	Date & Time:	<input type="text"/>
Site surveyed from:	LHB <input type="checkbox"/> RHB <input type="checkbox"/>	Photographs:	<input type="text"/>
GPS Ref:	<input type="text"/>	Water level:	<input type="text"/>
	<input type="text"/>	Machine number:	<input type="text"/>
	<input type="text"/>	Red book	present <input type="checkbox"/> absent <input type="checkbox"/>
	<input type="text"/>	Spill kit	present <input type="checkbox"/> absent <input type="checkbox"/>

Wetted/Base width (<1m, 1-3m, 3-6m, 6-10m, 10-15m, <15m)

Velocity rating (slow, moderate, fast, flood) Weather conditions:

Bed type

200m minimum **maintained** section walked? If not, what distance walked?

200m **unmaintained** section walked? If not, what distance walked?

Suitable habitat in reach?	YES	NO	Crayfish (in spoil)	Abundant <input type="checkbox"/>	Common <input type="checkbox"/>	Rare <input type="checkbox"/>
Annex spp./habitats (Recorded on site)			Lamprey (in spoil)	Abundant <input type="checkbox"/>	Common <input type="checkbox"/>	Rare <input type="checkbox"/>
	Abundant (>11 individuals), Common (5 - 10 individuals), Rare (1 - 4 individuals) per 5m ² of bank top					
			Floating-leaved vegetation	Abundant <input type="checkbox"/>	Common <input type="checkbox"/>	Rare <input type="checkbox"/>

Circle % cover in reach: Abundant (30-70% cover), Common (3-10% cover), Rare (< 3% cover)

Invasive Species Species Name:

% cover in reach: Abundant (30-70% cover), Common (3-10% cover), Rare (< 3% cover) Abundant Common Rare

Exercising Due Diligence (Skipped Section)

Maintenance Constraints:	Working Bank	Woodland	Tillage	Fencing
	Non Working Bank	Woodland	Tillage	Fencing

Comments on Audit Findings:

Outstanding Issues:

Result: _____

	Applicable	Compliant	Grade 1	Grade 2	Grade 3
1. PROTECTING BANK SLOPES		✓	%	%	%
1.1: Has the non-working bank been disturbed? (slope and Bankfull)	<input type="checkbox"/>	<input type="checkbox"/>	10-15	15-30	30-100
1.2: Has the working bank slope been disturbed? (mechanically)	<input type="checkbox"/>	<input type="checkbox"/>	15-30	30-60	60-100



		Compliant	Grade 1	Grade 2	Grade 3															
4. Vegetation Management	Applicable	<input checked="" type="checkbox"/>	%	%	%															
Timing																				
4.1 Outside coarse fish spawning season (April 1st to July 1st) <i>If Relevant</i>					<input type="checkbox"/>															
Tall Reeds/Flaggers																				
4.2 Is vegetation management Interfering with nesting birds (March 1st to Aug 3 1st: Wildlife Act)	Relevant	<input checked="" type="checkbox"/>	YES	NO																
4.3 Is maintenance opening the centre of the channel ONLY? (maximum open area is 75-80% of width)			80-70	70-50	<50															
4.4: Where crayfish are present, are additional wider areas of vegetation being retained? (1/3 channel width retained)				20-15	<10															
4.5: Where lamprey are present, are additional wider areas of vegetation being retained?(1/3 channel width retained)				20-15	<10															
Floating-leaved vegetation (Annex habitat)																				
Ranunculus sp. (% cover =)	Pondweed sp. (% cover =)																			
4.6: Is maintenance attempting to remove floating pondweed with the normal bucket?			NO	YES																
4.7: Is floating leave pondweed being skipped/retained? (Retain 50-33% of total reach)			33 - 25	25-15	<15															
4.8: Is ranunculus being retained/skipped in the Channel? (Retain 50-33% of total reach)			33 - 25	25-15	<15															
Water celery/cress:																				
4.9: Is the driver skimming off water celery vegetation only?	100-60		60-40	<40																
4.10: Is there an avoidance of digging the channel bed?			60-40	<40																
4.11: Is the driver trying to retain water celery on margins?	100-60		60-40	<40																
4.12: The driver is implementing enhanced maintenance in a channel with <1m base width																				
Weed-cutting boat/bucket																				
4.13: Is it cutting the channel centre vegetation ONLY? (maximum open area is 75-80% of width)			70-50	50-30	<30															
5. Skipping Sections (Where appropriate)																				
5.1: Were appropriate sections skipped?	Applicable	<input checked="" type="checkbox"/>	YES																	
5.2: Reason for skipping: <table border="0" style="width: 100%;"> <tr> <td><input type="checkbox"/> Power cables</td> <td><input type="checkbox"/> Good Gradient</td> <td><input type="checkbox"/> Lamprey/Crayfish present</td> </tr> <tr> <td><input type="checkbox"/> Maintenance not required</td> <td><input type="checkbox"/> Gravel section</td> <td><input type="checkbox"/> Otter holt</td> </tr> <tr> <td><input type="checkbox"/> Kingfisher/ Swan nest</td> <td><input type="checkbox"/> Wetlands - Bogs, Fens & Turloughs</td> <td><input type="checkbox"/> Mature tree line</td> </tr> <tr> <td><input type="checkbox"/> Swan & Duck Mussels</td> <td><input type="checkbox"/> Invasive Plants Species</td> <td><input type="checkbox"/> Freshwater Pearl Mussel</td> </tr> <tr> <td></td> <td></td> <td><input type="checkbox"/> Channel not accessible</td> </tr> </table> Other (list):						<input type="checkbox"/> Power cables	<input type="checkbox"/> Good Gradient	<input type="checkbox"/> Lamprey/Crayfish present	<input type="checkbox"/> Maintenance not required	<input type="checkbox"/> Gravel section	<input type="checkbox"/> Otter holt	<input type="checkbox"/> Kingfisher/ Swan nest	<input type="checkbox"/> Wetlands - Bogs, Fens & Turloughs	<input type="checkbox"/> Mature tree line	<input type="checkbox"/> Swan & Duck Mussels	<input type="checkbox"/> Invasive Plants Species	<input type="checkbox"/> Freshwater Pearl Mussel			<input type="checkbox"/> Channel not accessible
<input type="checkbox"/> Power cables	<input type="checkbox"/> Good Gradient	<input type="checkbox"/> Lamprey/Crayfish present																		
<input type="checkbox"/> Maintenance not required	<input type="checkbox"/> Gravel section	<input type="checkbox"/> Otter holt																		
<input type="checkbox"/> Kingfisher/ Swan nest	<input type="checkbox"/> Wetlands - Bogs, Fens & Turloughs	<input type="checkbox"/> Mature tree line																		
<input type="checkbox"/> Swan & Duck Mussels	<input type="checkbox"/> Invasive Plants Species	<input type="checkbox"/> Freshwater Pearl Mussel																		
		<input type="checkbox"/> Channel not accessible																		
6. Tree Management																				
Applicable <input checked="" type="checkbox"/> % % %																				
Timing																				
6.1 Appropriate tree management is only permissible from September 1st to February 28th under the Wildlife Act					<input type="checkbox"/>															
Tree cutting																				
6.2 What is the purpose of the tree cutting?	Conveyance <input type="checkbox"/>	habitat enhancement <input type="checkbox"/>	access <input type="checkbox"/>	Other (list)																
6.3 What equipment is being used?	Secateurs <input type="checkbox"/>	chain saw <input type="checkbox"/>	hand saw <input type="checkbox"/>	Tree shears <input type="checkbox"/>	Machine bucket <input type="checkbox"/>															
6.4 How much tree cover is being retained on the banks in the channel reach?			70-50	50-25	<25															
removing fallen/low trees <input type="checkbox"/> opening sections over riffles <input type="checkbox"/> Selective tree cutting <input type="checkbox"/> opening limited sections for access <input type="checkbox"/>																				
Other (list):																				
6.5: Is tree cutting retaining the variety of trees present/diversity?																				
6.6: Is tree cutting retaining a diversity of bankside vegetation? (trees/Scrub/Shrub)																				
6.7: Manage scrub - Otter & Birds SOP			80-70	70-50																
6.8: Woody habitat placed in field / bank slope/top as wildlife refuges?																				
6.9: Avoidance of damage to tree cover during the closed season																				
7. Berm Management																				
Applicable <input checked="" type="checkbox"/> Infrastructure <input type="checkbox"/>																				
7.1: Retain berms (no maintenance)																				
7.2 Managed to the basic berm protocol?			80-70	70-50	<50															
7.3 Berm re-sodding done where appropriate (berm width / sod character)																				
Gravel Berm																				
7.4: How gravel berm has been managed?			moderate	poor	bad															
gravel drawn to bank toe <input type="checkbox"/> gravel removed from channel <input type="checkbox"/> Gravel used downstream in channel <input type="checkbox"/>																				
Other (list):																				
8. Replacing stone and boulders back in the channel																				
Applicable <input checked="" type="checkbox"/> % % %																				
8.1: Are materials being returned to the channel (boulders/cobble/gravel) from diggings?				70-50	<50															
8.2: Is readily available and appropriately sized stone from adjoining locations being placed into the channel?			60-40	<40																
8.3: Is there a reason for not placing stone material into the channel, if stone available?			No																	
If Yes (List):																				
9. Gravel Bed Channels																				
Applicable <input checked="" type="checkbox"/> % % %																				

9.1: Is instream maintenance taking place between 1st July and 30th September, without consultation with IFI?					
9.2: Loosen or toss bed gravels to wash out fines			70-40	<40	
9.3: Are measures present to prevent sediment and silt flowing downstream between Autumn-Spring?					

	Applicable	Compliant	Grade 1	Grade 2	Grade 3
10. New Excavations in the channel - simple structures		✓	%	%	%
10.1: Is the bed being excavated to form deeper pool areas and shallow riffles?			70-50	<50	
10.2: Is the channel being deepened on one side and spoil placed on the opposite side?			70-50	<50	
Opportunity to use existing spoil to form simple structures?		✓	%	%	%
10.3. Alternating/ paired deflectors			70-50	<50	
Rubble mat					
Simple weir					
Random boulder array					

Count No of Applicable Steps:

Scoring for Applicable sections: Totals:

< 4 Steps	Total Marks	Total score
1 Yellow = -15		
1 Orange = -30		
1 Red = -70		
Total Negative Mark		
1 Green = +15%		
Total Positive Mark		

To Calculate Score: 100 - (Total Negative Mark + Total Positive Mark)
 This score represents % compliance (a negative is possible)
Example: No of Sections: 6. Scores: 1 Orange, 2 yellow and 1 Green Mark
 (1 orange = -25, 2 yellow = -20, 1 green = +10, ∴ Total = -35
 100 - 35 = 65

Total Score
 Compliance =

Ratings
 0 - 50 = Bad
 51 - 59 = Poor
 60 - 70 = Moderate
 71 - 84 = Good
 85 - 100 = Very good

Between 5 - 7 Steps	Total Marks	Total score
1 Yellow = -10		
1 Orange = -25		
1 Red = -70		
Total Negative Mark		
1 Green = +10%		
Total Positive Mark		

Total Score
 Compliance =

Between 8 - 10 Steps	Total Marks	Total score
1 Yellow = -10		
1 Orange = -20		
1 Red = -70		
Total Negative Mark		
1 Green = +10%		
Total Positive Mark		

Total Score
 Compliance =

Additional Comments:

Scientific Monitoring

The EREP biological monitoring programme assesses the impacts of routine maintenance and 'capital enhancement' projects on the river corridor biodiversity. Fish, flora, birds, macro-invertebrates, lamprey and crayfish are monitored across a selection of sites. The physical changes in the channels are also monitored. Monitoring of these aspects have been ongoing to varying degrees as a component to the EREP project. Results have showed considerable variance and for some elements, difficult to show definitive trends. Monitoring is reviewed periodically and altered as required.

River Corridor Biodiversity

EREP monitoring to date has indicated that often changes seen across the whole site can be interlinked. Enhancement of the physical regime can greatly improve channel diversity, through the creation of riffle/glide/pool sequences, addition of spawning gravels and bank protection.

Physical changes to the channel often result in changes in the floral communities, as a more diverse bed material is available. Species such as *Ranunculus* and *Scirpus* tend to favour gravelly bed material will softer sediment attracts species like *Sparganium*.

Changes to the aquatic, marginal and riparian vegetation can often result in changes to the invertebrate communities. Increased vegetation cover and diversity often correspond with increased invertebrate diversity and abundance.

Physical Monitoring

Physical monitoring includes pre and post works monitoring of a number of variables. Variables measured include bank-full width, wetted width, channel length, depth velocity and canopy cover.

The Water Framework Directive (WFD) requires information on hydromorphological conditions, along with biological quality and physio-chemical conditions, in order to determine the ecological status of any given water-body. A classification of 'High Ecological Status' cannot be assigned to a water-body unless the hydromorphological conditions are high also. If the hydromorphological condition of a water-body has not been determined and the system has been subject to drainage, then that catchment is deemed to be "probably at risk". Therefore, the EREP has included monitoring of hydromorphology in its monitoring programme.

The River Hydromorphology Assessment Technique (RHAT) monitoring system has been approved as the appropriate method to determine hydromorphological status of a channel and is being used for WFD monitoring.

RHAT is used to monitor hydromorphological condition of a selection of channels under EREP. The data collected will feed back to the Environmental Protection Agency (EPA) and contribute to the overall national assessments on channel morphology.

Developments in the best practise for hydromorphological assessment, such as the MQI method of assessment, may require updates to the procedures employed by the OPW.

Floral Monitoring

Three vegetation types are surveyed under the floral monitoring programme. These include:

- Aquatic (in-channel) vegetation
- Marginal vegetation
- Riparian vegetation

A walkover survey of the entire site is used to compile a species inventory of riparian and in-stream species. Quantitative assessments are also carried out within the sites. Tree surveys also form part of this monitoring process and include information of composition and abundance of tree cover.

Macro-invertebrate Monitoring

The macro-invertebrate communities of a river respond quickly to change and are a good reflection of conditions in the short term. Their assemblages reflect changes in habitat as well as changes in water quality, as most species have a preference for either fast or slow flowing water, sheltered or exposes areas and silt or cobbles. Sampling is carried out at both experimental and control sites, and a species inventory list compiled.

Fish Sampling

While the primary focus for the EREP fish stock survey is on salmon and brown trout, data from all species encountered during surveys are recorded. Data collected provides information on population, distribution, age-structure for any species encountered.

Bird Population Studies

Bird surveys are carried out a selection of sites, using standard survey methods used by Bird Watch Ireland and other relevant agencies. The key objectives of the bird studies are to:

- Record the abundance, species richness and distribution of bird species in OPW channels, and
- Assess the impacts of drainage and drainage maintenance on bird species based on this data.

To this end, surveying is conducted on:

- Various habitat types within the river corridor.
- Sites pre and post maintenance.
- Non-drained channels and drained channels

Lamprey & Crayfish Studies

OPW funded studies to examine the effects of Arterial Drainage Maintenance operations on lamprey and white-clawed crayfish have been ongoing since 2006. Ecological Impact Assessments (EclA) were carried out on both species, by the then Central Fisheries Board. Further research was recommended in these EclAs, which resulted in the continuation of studies of both species as

part of the EREP. Surveying of both species includes monitoring of population size and age structure, prior to, and in a series of years post maintenance.