Irish Water - Lead in Drinking Water Mitigation Plan

Screening for Appropriate Assessment

013 Portloman WTP - Ardonagh Reservoir WSZ (3200PUB1007)

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GLOSSARY OF TERMS & ABBREVIATIONS

Appropriate Assessment: An assessment of the effects of a plan or project on European Sites.

Biodiversity: Word commonly used for biological diversity and defined as assemblage of living organisms from all habitats including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part.

Birds Directive: Council Directive of 2nd April 1979 on the conservation of wild birds (79/409/EEC) as codified by Directive 2009/147/EC.

Geographical Information System (GIS): A GIS is a computer-based system for capturing, storing, checking, integrating, manipulating, analysing and displaying data that are spatially referenced.

Habitats Directive: European Community Directive (92/43/EEC) on the Conservation of Natural Habitats and of Wild Flora and Fauna and has been transposed into Irish law by the Planning and Development Act 2000 (as amended) and the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477/2011). It establishes a system to protect certain fauna, flora and habitats deemed to be of European conservation importance.

Mitigation measures: Measures to avoid/prevent, minimise/reduce, or as fully as possible, offset/compensate for any significant adverse effects on the environment, as a result of implementing a plan or project.

Natura 2000: European network of protected sites, which represent areas of the highest value for natural habitats and species of plants and animals, which are rare, endangered or vulnerable in the European Community. The Natura 2000 network of sites will include two types of area. Areas may be designated as Special Areas of Conservation (SAC) where they support rare, endangered or vulnerable natural habitats and species of plants or animals (other than birds). Where areas support significant numbers of wild birds and their habitats, they may become Special Protection Areas (SPA). SACs are designated under the Habitats Directive and SPAs are classified under the Birds Directive. In some situations, there may be overlap in extent of SAC and SPA.

Screening: The determination of whether implementation of a plan or project would be likely to have significant environmental effects on the Natura 2000 network.

Special Area for Conservation (SAC): An SAC designation is an internationally important site, protected for its habitats and species. It is designated, as required, under the EC Habitats Directive (1992).

Special Protection Area (SPA): An SPA is a site of international importance for breeding, feeding and roosting habitat for bird species. It is designated under the EC Birds Directive (1979).

Statutory Instrument: Any order, regulation, rule, scheme or byelaw made in exercise of a power conferred by statute.

1 INTRODUCTION

RPS was commissioned by Irish Water (IW) to undertake Screening for Appropriate Assessment (AA) for the proposed orthophosphate dosing (herein referred to as the proposed works) of drinking water supplied by Portloman Water Treatment Plant (WTP), Portloman, Co. Westmeath.

This report comprises information to support the Screening for AA in line with the requirements of Article 6(3) of the EU Habitats Directive (Directive 92/43/EEC) on the Conservation of Natural Habitats and of Wild Fauna and Flora (hereafter referred to as the Habitats Directive). The report assesses the potential for likely significant effects resulting from the additional phosphorus (P) load to environmental receptors, resulting from orthophosphate dosing being undertaken to mitigate against consumer exposure to lead in drinking water. It is therefore necessary to consider the sources, pathways and receptors in relation to added phosphorus.

1.1 PURPOSE OF THIS REPORT

The overall purpose of the Screening for AA, as a first step in determining the requirement for AA, is to determine whether the Project is likely to have a significant effect on any European Site within the zone of influence (ZoI) of the Water Supply Zone (WSZ), either individually or in combination with other plans or projects, in view of the site's conservation objectives. This Screening report complies with the requirements of Article 6 of the Habitats Directive transposed in Ireland principally through the Planning and Development Act 2000 (as amended) and the European Communities (Birds and Natural Habitats) Regulations, S.I. No. 477 of 2011 (as amended). In the context of the proposed project, the governing legislation is the EC Birds and Habitats Regulations 2011 (as amended).

1.2 THE PLAN

Irish Water, as the national public water utility, prepared a Lead in Drinking Water Mitigation Plan (LDWMP) in 2016 (here after referred to as the Plan). The Plan provides a framework of measures for implementation to effectively address the currently elevated levels of lead in drinking water experienced by some IW customers as a result of lead piping. The Plan was prepared in response to the recommendations in the *National Strategy to reduce exposure to Lead in Drinking Water* which was published by the Department of Environment, Community and Local Government[1] and Department of Health in June 2015.

The overall objective of the Plan is to effectively address the risk of failure to comply with the drinking water quality standard for lead due to lead pipework in as far as is practical within the areas of IW's responsibility. Lead in drinking water is derived from lead pipes that are still in place in the supply network. These pipes are mostly in old shared connections or in the short pipes connecting the (public) water main to the (private) water supply pipes (IW, 2016[2]). Problems can also be caused by lead leaching from domestic plumbing components made of brass and from lead-containing solder, with the most significant portion of the lead pipework lying outside of IW's ownership in private properties (IW, 2016). Lead can be dissolved in water as it travels through lead supply pipes and internal lead plumbing. When lead is in contact with water it can slowly dissolve, a process

[1] Now known as the Department of Housing, Planning and Local Government (DHPLG).
[2] Irish Water (IW) (2016) Lead in Drinking Water Mitigation Plan. https://www.water.ie/projects-plans/lead-mitigation-plan/Lead-in-Drinking-Water-Mitigation-Plan.pdf

known as plumbosolvency. The degree to which lead dissolves varies with the length of lead pipe, local water chemistry, temperature and the amount of water used at the property.

Health studies have identified risks to human health from ingestion of lead. In December 2013, the acceptable limit for lead in drinking water was reduced to 10 micrograms per litre (µg/l) as per the European Union (Drinking Water) Regulations. From 2003 to 2013, the limit was 25µg/l, which was a reduction on the previous limit (i.e. pre 2003) of 50µg/l.

The World Health Organisation (WHO), Environmental Protection Agency (EPA) and Health Service Executive (HSE) recommend lead pipe replacement (both lead service connections in the public supply, and lead supply pipes and internal plumbing in private properties) as the ultimate goal in reducing long-term exposure to lead. It is recognised that this will inevitably take a considerable period of time. In recognition of this, short to medium term proposals to mitigate the risk are being examined.

The Plan sets out the short, medium and longer term actions that IW intends to undertake, subject to the approval of the economic regulator, the Commission for Regulation of Utilities (CRU). It is currently estimated that 85% to 95% of properties meet the lead compliance standards when sampled at the customer's tap. The goal is to increase this compliance rate to 98% by end of 2021 and 99% by the end of 2027 (IW, 2016). This is subject to a technological alternative to lead replacement being deemed environmentally viable.

The permanent solution to the lead issue is to replace all water mains that contain lead. IW proposes that a national programme of replacement of public lead service pipes is required. However, replacing the public supply pipe or the private pipe on its own will not resolve the problem. Research indicates that unless both are replaced, lead levels in the drinking water could remain higher than the Regulation standards. Where lead pipework or plumbing fittings occur within a private property, it is the responsibility of the property owner to replace it.

The Plan assesses a number of other lead mitigation options available to IW. Other measures, including corrective water treatment in the form of pH adjustment and orthophosphate treatment, are being considered as an interim measure for the reduction of lead concentrations in drinking water in some WSZs.

IW proposes to introduce corrective water treatment at up to 400 water treatment plants. This would be rolled out over an accelerated 3-year programme, subject to site-specific environmental assessments. The corrective water treatment will reduce plumbosolvency risk over the short to medium term in high risk water supplies where it is technically, economically and environmentally viable to do so. This practice is now the accepted method of lead mitigation in many countries e.g. Great Britain and Northern Ireland. The dosing would be required to continue whilst lead pipework is still in use, subject to annual review on a scheme by scheme basis.

Orthophosphate is added in the form of Phosphoric acid, which is approved for use as a food additive (E338) in dairy, cereals, soft drinks, meat and cheese. The average adult person consumes between 1,000 and 1,500 milligrams (mg) of phosphorus every day as part of the normal diet. The quantity of orthophosphate that IW will be required to add to treated water is between 0.5 mg/l to 1.5 mg/l. At Portloman WTP orthophosphate will be added at a rate of 0.8 mg/l.

The typical concentration of phosphorus ingested from drinking 3 litres of water per day that has been treated with food grade phosphoric acid at 1.5 mg/l phosphorus, would be 4.5 milligrams.

The orthophosphate is dosed into the water at a rate which is dependent on raw water chemistry in a similar process to the addition of chlorine for disinfection. Orthophosphate dosing takes a period of 6-12 months to develop a full coating, after which dosing at typically 1.0 mg/l (one part per million; typical dosing amount, but varies depending on raw water) must be maintained in order to sustain the protective coating.

1.3 PROJECT BACKGROUND

Phosphorus has the potential to impact water quality status through the process of nutrient enrichment and promotion of excessive plant growth (eutrophication). It is therefore necessary to consider the risk of environmental impact and the pathways by which the added orthophosphate may reach environmental receptors potentially resulting in likely significant effects. To facilitate the assessment of the risk to the receiving environment an Environmental Assessment Methodology (EAM) has been developed based on a conceptual model of phosphorus transfer (from the water distribution and wastewater collection systems), using the source-pathway-receptor framework.

The first step of the EAM is to identify the European Sites that have a hydrological or hydrogeological connectivity to the WSZs affected by the proposed orthophosphate dosing. The EAM recognises that for those European Sites with nutrient sensitive Qualifying Interests (habitats and species) and connectivity to the WSZ, there is *potential* for effects. The project effects on these European Sites, and an evaluation as to whether these are potentially significant, are the subject of the Screening for AA. The Screening report applies the EAM as outlined in this document and assesses the potential for likely significant effects in the context of the Site Specific Conservation Objectives (SSCO) as published on the NPWS website.

The EAM process identified 87 European Sites with potential hydrological or hydrogeological connectivity to the WSZ:

- SAC sites: Danes Hole, Poulnalecka; Lough Gash Turlough; River Shannon Callows; Barroughter Bog; Cloonmoylan Bog; Derrycrag Wood Nature Reserve; Loughatorick South Bog; Pollnaknockaun Wood Nature Reserve; Mount Brandon; Slieve Bloom Mountains; Lough Ree; All Saints Bog and Esker; Charleville Wood; Clara Bog; Ferbane Bog; Fin Lough (Offaly); Mongan Bog; Moyclare Bog; Raheenmore Bog; Sharavogue Bog; Ballyduff/Clonfinane Bog; Kilcarren-Firville Bog; Garriskil Bog; Lough Ennell; Lough Owel; Scragh Bog; Clonaslee Eskers and Derry Bog; Ridge Road, SW of Rapemills; Silvermine Mountains; Glenomra Wood; Rosturra Wood; Liskeenan Fen; Pilgrim's Road Esker; White Lough, Ben Loughs and Lough Doo; Split Hills and Long Hill Esker; Boyne Coast and Estuary; Tralee Bay and Magharees Peninsula, West to Cloghane; Lough Bane and Lough Glass; Lough Lene; Bolingbrook Hill; Lisduff Fen; Lower River Shannon; Blasket Islands; Island Fen; Lough Derg, North-east Shore; Silvermines Mountains West; Magharee Islands; Kerry Head Shoal; River Boyne and River Blackwater; Slieve Bernagh Bog; Ballymore Fen; Ratty River Cave; Carn Park Bog; Crosswood Bog; Moneybeg and Clareisland Bogs; Ardagullion Bog; Mount Hevey Bog; Redwood Bog; Ardgraigue Bog; Wooddown Bog; Girley (Drewstown); and Derragh Bog.

- SPA sites: Mongan Bog; Lough Derravarragh; Lough Ennell; Glen Lough; Lough Iron; Lough Owel; Lough Derg (Shannon); Lough Kinale and Derragh Lough; Lough Ree; Lough Sheelin;

River Shannon and River Fergus Estuaries; Boyne Estuary; River Little Brosna Callows; Middle Shannon Callows; River Suck Callows; Garriskil Bog; Loop Head; Magharee Islands; Dovegrove Callows; Dingle Peninsula; Slieve Bloom Mountains; Slievefelim to Silvermines Mountains; Slieve Aughty Mountains; Kerry Head; and, River Boyne and River Blackwater.

Each of these European Sites includes habitats and / or species identified as nutrient sensitive. Following the precautionary principle the potential for likely significant effects arising from the proposed works requires assessment, due to the connectivity to each of the identified European Sites, in light of their nutrient sensitive Qualifying Interests.

2 APPROPRIATE ASSESSMENT METHODOLOGY

2.1 LEGISLATIVE CONTEXT

Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora better known as the "Habitats Directive" provides legal protection for habitats and species of European importance. Articles 3 to 9 provide the legislative means to protect habitats and species of Community interest through the establishment and conservation of an EU-wide network of sites known as Natura 2000. These are Special Areas of Conservation (SACs) designated under the Habitats Directive and Special Protection Areas (SPAs) designated under the Conservation of Wild Birds Directive (79/409/ECC) as codified by Directive 2009/147/EC.

The obligation to undertake appropriate assessment derives from Articles 6(3) and 6(4) of the Habitats Directive and both involve a number of steps and tests that need to be applied in sequential order. Article 6(3), which is concerned with the strict protection of sites, establishes the requirement for AA:

"Any plan or project not directly connected with or necessary to the management of the [European] site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subjected to appropriate assessment of its implications for the site in view of the site's conservation objectives. In light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public".

Article 6(4) states:

"If, in spite of a negative assessment of the implications for the [European] site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, Member States shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted".

The results of each step must be documented and recorded so there is full traceability and transparency of the decisions made.

Over time legal interpretation has been sought on the practical application of the legislation concerning AA, as some terminology has been found to be unclear. European and National case law has clarified a number of issues and some aspects of European Commission (EC) published guidance documents have been superseded by case law.

2.2 GUIDANCE FOR THE APPROPRIATE ASSESSMENT PROCESS

The assessment completed has had regard to the following legislation and guidance documents:

European and National Legislation:

- Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (also known as the 'Habitats Directive');
- Council Directive 2009/147/EC on the conservation of wild birds, codified version, (also known as the 'Birds Directive');
- European Communities (Birds and Natural Habitats) Regulations 2011 to 2015; and
- Planning and Development Act 2000 (as amended).

Guidance / Case Law:

- *Article 6 of the Habitats Directive – Rulings of the European Court of Justice*. Final Draft September 2014;
- *Appropriate Assessment of Plans and Projects in Ireland: Guidance for Planning Authorities.* DEHLG (2009, revised 10/02/10);
- *Assessment of Plans and Projects Significantly Affecting Natura 2000 sites: Methodological Guidance on the Provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC.* European Commission (2002);
- *Communication from the Commission on the Precautionary Principle*. European Commission (2000b);
- *EC study on evaluating and improving permitting procedures related to Natura 2000 requirements under Article 6.3 of the Habitats Directive 92/43/EEC*. European Commission (2013);
- *Guidance Document on Article 6(4) of the 'Habitats Directive' 92/43/EEC. Clarification of the concepts of: Alternative Solutions, Imperative Reasons of Overriding Public Interest, Compensatory Measures, Overall Coherence, Opinion of the Commission*. European Commission (2007); and
- *Managing Natura 2000 sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC*. European Commission (2000a).

Departmental/NPWS Circulars:

- *Appropriate Assessment under Article 6 of the Habitats Directive: Guidance for Planning Authorities.* Circular NPWS 1/10 and PSSP 2/10. (DEHLG, 2010);
- *Appropriate Assessment of Land Use Plans*. Circular Letter SEA 1/08 & NPWS 1/08;
- *Water Services Investment and Rural Water Programmes – Protection of Natural Heritage and National Monuments*. Circular L8/08;
- *Guidance on Compliance with Regulation 23 of the Habitats Directive.* Circular Letter NPWS 2/07; and
- *Compliance Conditions in respect of Developments requiring (1) Environmental Impact Assessment (EIA); or (2) having potential impacts on Natura 2000 sites*. Circular Letter PD 2/07 and NPWS 1/07.

2.3 STAGES OF APPROPRIATE ASSESSMENT

According to European Commission Methodological Guidance on the provisions of Article 6(3) and 6(4) of the Habitats Directive, the assessment requirements of Article 6 establish a four-staged approach as described below. An important aspect of the process is that the outcome at each successive stage determines whether a further stage in the process is required. The four stages are as follows:

- Stage 1 – Screening of the proposed plan or project for AA;
- Stage 2 – An AA of the proposed plan or project;
- Stage 3 – Assessment of alternative solutions; and
- Stage 4 – Imperative Reasons of Overriding Public Interest (IROPI)/ Derogation.

Stages 1 and 2 relate to Article 6(3) of the Habitats Directive; and Stages 3 and 4 to Article 6(4).

Stage 1: Screening for a likely significant effect

The aim of screening is to assess firstly if the plan or project is directly connected with or necessary to the management of European Site(s); or in view of best scientific knowledge, if the plan or project, individually or in combination with other plans or projects, is likely to have a significant effect on a European Site. This is done by examining the proposed plan or project and the conservation objectives of any European Sites that might potentially be affected. If screening determines that there is potential for significant effects or there is uncertainty regarding the significance of effects then it will be recommended that the plan is brought forward to full AA.

Stage 2: Appropriate Assessment (Natura Impact Statement or NIS):

The aim of stage 2 of the AA process is to identify any adverse impacts that the plan or project might have on the integrity of relevant European Sites. As part of the assessment, a key consideration is 'in combination' effects with other plans or projects. Where adverse impacts are identified, mitigation measures can be proposed that would avoid, reduce or remedy any such negative impacts and the plan or project should then be amended accordingly, thereby avoiding the need to progress to Stage 3.

Stage 3: Assessment of Alternative Solutions

If it is not possible during the stage 2 to reduce impacts to acceptable, non-significant levels by avoidance and/or mitigation, stage 3 of the process must be undertaken which is to objectively assess whether alternative solutions exist by which the objectives of the plan or project can be achieved. Explicitly, this means alternative solutions that do not have negative impacts on the integrity of a European Site. It should also be noted that EU guidance on this stage of the process states that, 'other assessment criteria, such as economic criteria, cannot be seen as overruling ecological criteria' (EC, 2002). In other words, if alternative solutions exist that do not have negative impacts on European Sites; they should be adopted regardless of economic considerations.

Stage 4: Imperative Reasons of Overriding Public Interest (IROPI)/Derogation

This stage of the AA process is undertaken where no alternative solutions exist and where adverse impacts remain. At this stage of the AA process, it is the characteristics of the plan or project itself

that will determine whether or not the competent authority can allow it to progress. This is the determination of 'over-riding public interest'.

It is important to note that in the case of European Sites that include in their qualifying features 'priority' habitats or species, as defined in Annex I and II of the Directive, the demonstration of 'over-riding public interest' is not sufficient and it must be demonstrated that the plan or project is necessary for 'human health or safety considerations'. Where plans or projects meet these criteria, they can be allowed, provided adequate compensatory measures are proposed. Stage 4 of the process defines and describes these compensation measures.

2.4 INFORMATION SOURCES CONSULTED

To inform the assessment for the project and preparation of this Screening report, the following key sources of information have been consulted, however it should be noted that this is not an exhaustive list and does not reflect liaison and/ or discussion with technical and specialist parties from IW, RPS, NPWS, IFI, EPA etc. as part of Plan development.

- Information provided by IW as part of the project;
- Environmental Protection Agency – Water Quality www.epa.ie and www.catchments.ie;
- Geological Survey of Ireland – Geology, Soils and Hydrogeology www.gsi.ie;
- Information on the conservation status of birds in Ireland (Colhoun & Cummins 2013);
- National Parks and Wildlife Service – online Natura 2000 network information www.npws.ie;
- National Biodiversity Action Plan 2017 - 2021 (DCHG 2017);
- Article 17 Overview Report Volume 1 (NPWS, 2013a);
- Article 17 Habitat Conservation Assessments Volume 2 (NPWS, 2013b);
- Article 17 Species Conservation Assessment Volume 3 (NPWS, 2013c);
- EPA Qualifying Interests database, (EPA, 2015) and updated EPA Characterisation Qualifying Interests database (EPA/RPS, September 2016);
- Draft River Basin Management Plan for Ireland 2018 - 2021 - www.housing.gov.ie;
- Ordnance Survey of Ireland – Mapping and Aerial photography www.osi.ie;
- National Summary for Article 12 (NPWS, 2013d); and
- Format for a Prioritised Action Framework (PAF) for Natura 2000 (2014) www.npws.ie/sites/default/files/general/PAF-IE-2014.pdf.

2.5 EVALUATION OF THE RECEIVING ENVIRONMENT

Ireland has obligations under EU law to protect and conserve biodiversity. This relates to habitats and species both within and outside designated sites. Nationally, Ireland has developed a National Biodiversity Plan (DCHG, 2017) to address issues and halt the loss of biodiversity, in line with international commitments. The vision for biodiversity is outlined: "*That biodiversity and ecosystems in Ireland are conserved and restored, delivering benefits essential for all sectors of society and that Ireland contributes to efforts to halt the loss of biodiversity and the degradation of ecosystems in the EU and globally*".

Ireland aims to conserve habitats and species, through designation of conservation areas under both European and Irish law. The focus of this Screening report is on those habitats and species designated pursuant to the EU Birds and EU Habitats Directives in the first instance, however it is recognised that wider biodiversity features have a supporting role to play in many cases if the integrity of designated sites is to be maintained/restored.

In relation to protected water-dependent habitats and species under the Birds and Habitats Directive, the river basin management planning process contributes towards achieving water related environmental supporting conditions that support Favourable Conservation Status. In preparing the draft RBMP (2018-2021) (DHPLG, 2017[3]) the characterisation assessment carried out by the EPA for these water dependent European Site protected areas has focussed on looking at the risks to the water standards/objectives established for the purpose of supporting Good Ecological Status (GES), or High Ecological Status (HES) where required. GES, which is the default objective of the WFD, is considered adequate for supporting many water dependent European Site protected areas where site specific environmental supporting conditions have not been defined within SSCOs by the NPWS. A number of lake habitats (e.g. oligotrophic lakes) and species (e.g. the freshwater pearl mussel) will require a more stringent environmental objective i.e. high status. Where this applies, this has been taken into account in the EAM and in this NIS.

2.5.1 Identification of European Sites

Current guidance (DEHLG, 2010) on the ZoI to be considered during the AA process states the following:

"A distance of 15km is currently recommended in the case of plans, and derives from UK guidance (Scott Wilson et al., 2006). For projects, the distance could be much less than 15km, and in some cases less than 100m, but this must be evaluated on a case-by-case basis with reference to the nature, size and location of the project, and the sensitivities of the ecological receptors, and the potential for in-combination effects".

As stated above, a buffer of 15km is typically taken as the initial ZoI extending beyond the reach of the footprint of a plan or project, although there may be scientifically appropriate reasons for extending this ZoI further depending on pathways for potential impacts. With regard to the current project, the 15km distance is considered unacceptable to screen all likely significant effects that might impact upon European Sites. This is primarily due to the need to consider all hydrological and hydrogeologically connected European Sites due to the potential for significant impacts on water quality. Therefore, the ZoI for this project includes all of the hydrologically connected surface water sub catchments and groundwater bodies (**Figure 4-2**).

2.5.2 Conservation Objectives

Article 6(3) of the Habitats Directive states that:

Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects,

[3] DHPLG (2017) Public consultation on The River Basin Management Plan for Ireland (2018-2021). Available at: http://www.housing.gov.ie/sites/default/files/public-consultation/files/draft_river_basin_management_plan_1.pdf

shall be subject to appropriate assessment of its implications of the site in view of the site's ***conservation objectives****.*

Qualifying Interests (QIs)/ Special Conservation Interests (SCIs) are annexed habitats and annexed species of community interest for which an SAC or SPA has been designated respectively. The Conservation Objectives (COs) for European Sites are set out to ensure that the QIs/ SCIs of that site are maintained or restored to a favourable conservation condition. Maintenance of favourable conservation condition of habitats and species at a site level in turn contributes to maintaining or restoring favourable conservation status of habitats and species at a national level and ultimately at the Natura 2000 Network level.

In Ireland 'generic' COs have been prepared for all European Sites, while 'site specific' COs have been prepared for a number of individual Sites to take account of the specific QIs/ SCIs of that Site. Both the generic and site specific COs aim to define favourable conservation condition for habitats and species at the site level.

Generic COs which have been developed by NPWS encompass the spirit of site specific COs in the context of maintaining and restoring favourable conservation condition as follows:

For SACs:

- '*To maintain or restore the favourable conservation condition of the Annex I habitats and/or Annex II species for which the SAC has been selected'.*

For SPAs:

- '*To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for the SPA*'.

Favourable Conservation status of a habitat is achieved when:

- Its natural range, and area it covers within that range, are stable or increasing;
- The specific structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future; and
- The conservation status of its typical species is "favourable".

Favourable Conservation status of a species is achieved when:

- Population dynamics data on the species concerned indicate that it is maintaining itself on a long term basis as a viable component of its natural habitats;
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long term basis.

A full listing of the COs and QIs/ SCIs for each European Site, as well as the attributes and targets to maintain or restore the QIs/ SCIs to a favourable conservation condition, are available from the NPWS website www.npws.ie. Web links for COs for the European Sites relevant for this Screening report, are included in **Appendix A**.

2.5.3 Existing Threats and Pressures to EU Protected Habitats and Species

Given the nature of the proposed project, a review has been undertaken of those QIs/SCIs with the greatest potential to be impacted by P loading. Information has been extracted primarily from a number of NPWS authored reports, including recently available statutory assessments on the conservation status of habitats and species in Ireland namely; *The status of EU protected Habitats and Species in Ireland* (NPWS 2013 a, b &c) and on information contained in Ireland's most recent Article 12 submission to the EU on *the Status and trends of Birds species* (NPWS 2013d). Water dependent species were deemed to be most at risk for impact, and the Water Framework Directive SAC water dependency list (NPWS, December 2015), was used as part of the criteria for screening in European Sites.

There are 60 habitats, 25 species and 68 bird species which are water dependent and / or where nutrients are a key pressure or threat and where compliance with the Environmental Quality Standards for nutrient levels (including orthophosphate) will contribute to achieving or maintaining favourable conservation status. These are listed in **Appendix B**.

3 DESCRIPTION OF THE PROJECT

3.1 DESCRIPTION OF PROPOSAL

Portloman WTP supplies six water supply zones (WSZs) in Westmeath: Frewin Hill High Level Reservoir (3200PUB1005); Ardonagh Reservoir (3200PUB1007); Horseleap P.W.S. (2500PUB1023); Frewin Hill Low Level Reservoir (3200PUB1006); Delvin Re-Chlorination Station (3200PUB1009); and, Kilbeggan Water Tower (3200PUB1012). The daily production and distribution input from Frewin Hill High Level Reservoir, exported to the five other WSZs, is 17,085 m^3/day of (64% of which is accounted for) serving a population of nearly 46,000 and also has a significant non-domestic demand. A fixed rate for water main leakage is assumed across all six WSZs. The WSZ boundaries cover a large rural area and a number of small towns that are served by agglomerations, the largest of which is Mullingar (D0008-01). Smaller agglomerations include: Kilbeggan (D0103-01), Rochfortbridge (D0101-01), Tyrellspass (D0099-01), Ballymore (D0509-01), Killucan (D0100-01), Kinnegad (D0104-01), Moate (D0097-01) and Multyfarnham Village (D0510-01). These agglomerations are all licenced in accordance with the requirements of the Waste Water Discharge (Authorisation) Regulations 2007 as amended and the impact of the orthophosphate dosing on the emission limit values and the receiving water body downstream of the point of discharge are assessed. There are smaller agglomerations with a population equivalent of less than 500, i.e. Milltown Pass and Castletown Geoghan and the estimated additional load from these plants from the orthophosphate dosing is considered at the water body level via the surface water pathways. The density of water mains is relatively low across the rural areas. There are an estimated 6,608 properties across the WSZs that are serviced by domestic waste water treatment systems (DWWTS) (see **Appendix C**). Orthophosphate dosing will be concentrated in Ardonagh Reservoir WSZ only.

Ardonagh Reservoir and Portloman WTP are located adjacent to Lough Owel in the subcatchments: Inny [Shannon] SC_030; Brosna SC_010; Boyne SC_030, SC_040, and SC_050; Deel [Raharney] (SC_010); and the catchments: Upper Shannon (26F); Lower Shannon (25A); and Boyne (07) catchments. The WSZ is potentially hydrologically or hydrogeologically connected to the following European Sites:

- SAC sites: Danes Hole, Poulnalecka; Lough Gash Turlough; River Shannon Callows; Barroughter Bog; Cloonmoylan Bog; Derrycrag Wood Nature Reserve; Loughatorick South Bog; Pollnaknockaun Wood Nature Reserve; Mount Brandon; Slieve Bloom Mountains; Lough Ree; All Saints Bog and Esker; Charleville Wood; Clara Bog; Ferbane Bog; Fin Lough (Offaly); Mongan Bog; Moyclare Bog; Raheenmore Bog; Sharavogue Bog; Ballyduff/Clonfinane Bog; Kilcarren-Firville Bog; Garriskil Bog; Lough Ennell; Lough Owel; Scragh Bog; Clonaslee Eskers and Derry Bog; Ridge Road, SW of Rapemills; Silvermine Mountains; Glenomra Wood; Rosturra Wood; Liskeenan Fen; Pilgrim's Road Esker; White Lough, Ben Loughs and Lough Doo; Split Hills and Long Hill Esker; Boyne Coast and Estuary; Tralee Bay and Magharees Peninsula, West to Cloghane; Lough Bane and Lough Glass; Lough Lene; Bolingbrook Hill; Lisduff Fen; Lower River Shannon; Blasket Islands; Island Fen; Lough Derg, North-east Shore; Silvermines Mountains West; Magharee Islands; Kerry Head Shoal; River Boyne and River Blackwater; Slieve Bernagh Bog; Ballymore Fen; Ratty River Cave; Carn Park Bog; Crosswood Bog; Moneybeg and Clareisland Bogs; Ardagullion Bog; Mount Hevey Bog; Redwood Bog; Ardgraigue Bog; Wooddown Bog; Girley (Drewstown); and Derragh Bog.
- SPA sites: Mongan Bog; Lough Derravarragh; Lough Ennell; Glen Lough; Lough Iron; Lough Owel; Lough Derg (Shannon); Lough Kinale and Derragh Lough; Lough Ree; Lough Sheelin; River Shannon and River Fergus Estuaries; Boyne Estuary; River Little Brosna Callows; Middle Shannon Callows; River Suck Callows; Garriskil Bog; Loop Head; Magharee Islands; Dovegrove Callows; Dingle Peninsula; Slieve Bloom Mountains; Slievefelim to Silvermines

3.2 CONSTRUCTION OF CORRECTIVE WATER TREATMENT WORKS

The corrective water treatment works at Portloman WTP will involve the provision of orthophosphate dosing, pH control works and associated safety equipment.

The Portloman (Frewin Hill) WTP has three rising mains leaving the plant where chemical injection occurs. One of these mains feeds directly to the Ardonagh Reservoir which then supplies Mullingar town where exceedances and large numbers of older properties are present and would be more at risk. The preferable and now proposed location for the orthophosphate dosing system at Portloman WTP is at the rising main described that is located within the confines of the existing WTP boundary, along the north-eastern bounds of the treatment building. The location of the works is shown on **Figure 3-1**.

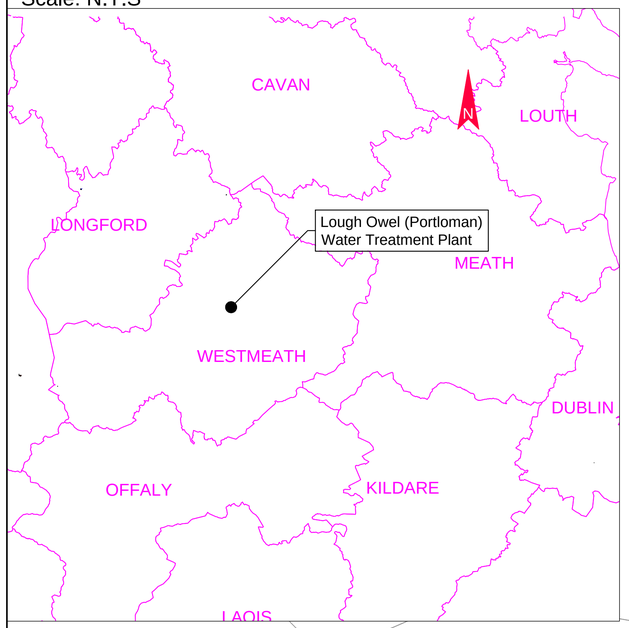
The implementation of orthophosphate dosing at the Portloman WTP will require the following elements:

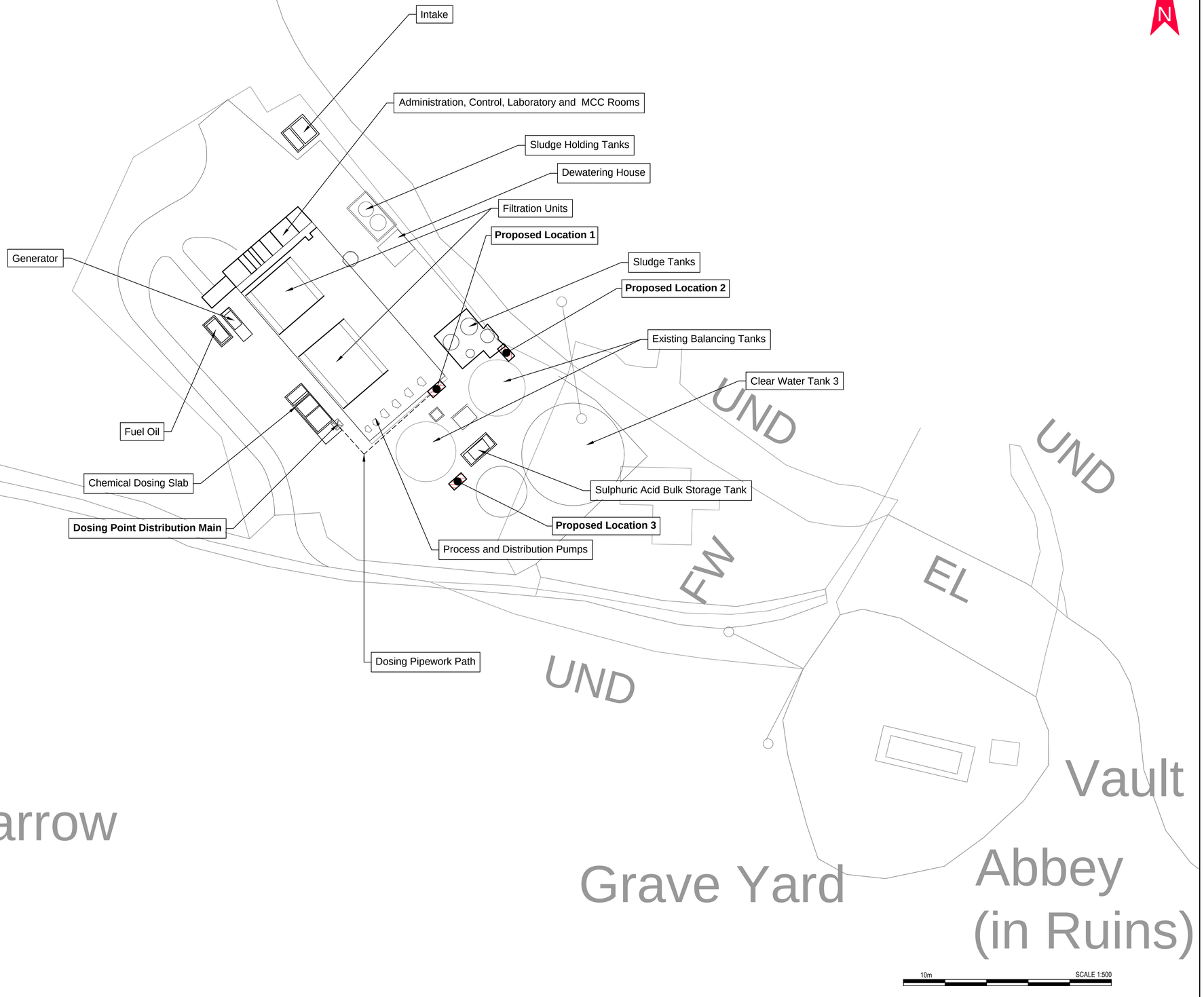
- Bulk Storage Tanks for phosphoric acid;
- Dosing pumps;
- Dosing pipework and carrier water pipework; and,
- Associated electrical installations.

CO. WESTMEATH

Lough Owel *(Portloman)* Water Treatment Plant

Scale: N.T.S





R:\MDW0766_Lead Mitigation Plan\8.0 Drawings\SK\MDW0766SK0000 Series.dwg

Client

UISCE ÉIREANN - IRISH WATER

No.	Date	Drn.	Chk.	Amendment / Issue	App
F01	AUG 18	JR	BL	ISSUED FOR INFORMATION	DC

RPS
West Pier Business Campus
Dun Laoghaire
Co Dublin
T +353 1 4882900
F +353 1 2835676
W www.rpsgroup.com/ireland
E ireland@rpsgroup.com

Drawn	JR
Checked	BL
Approved	DC
Date	MAY 19
Scale	1:500 @ A1
	1:1,000 @ A3

Project

LEAD MITIGATION PLAN

Figure 3.1

LOUGH OWEL (Portloman)
WATER TREATMENT PLANT - SITE LAYOUT

Job No.	File Ref.	Drg. No.	Rev.
MDW0766	MDW0766SK0000 Series.dwg	SK0013 WTP	F01

The bulk storage tanks (2 no. tanks, each with a working volume of 1500 l) will sit upon an above ground reinforced concrete plinth, designed to support the combined weight of the storage tanks, equipment and total volume of chemical to be stored **(Figure 3-2**).

Each storage tank will be self-bunded to accommodate greater than 110% of the tank working volume. The tanks shall conform to Irish Water design guidelines and will include the following environmental safety design features; level detection sensors, visual level indicators and alarms and a bund leak detection system. All materials and associated equipment, fixtures and fittings shall be compatible with 75% phosphoric acid.

Portloman WTP does not have final water pH correction as part of the treatment process at the plant; it however does have steady output pH of approximately 7.2 pH units. As there was not recommendation for any pH change for orthophosphate treatment no additional pH works are proposed as part of the Lead Mitigation project.

Dosing pipelines, carrier water pipework and electrical cables shall be installed within 100mm diameter ducts, placed in trenches constructed within existing made ground at the Portloman WTP. The ducts will be installed at approximately 700mm below ground level and following installation the trench will be backfilled and the surface reinstated to match the existing surface. Where pipework and cables are routed through existing structures, they shall be surface mounted within trunking.

A suitable kiosk will be installed on an above ground concrete plinth to house all electrical and control equipment required for the orthophosphate system. This control system will be incorporated into the existing Supervisory Control and Data Acquisition (SCADA) system on site. The proposed automation solution will be managed using a new Programmable Logic Computer (PLC) / Human Machine Interface (HMI) controller.

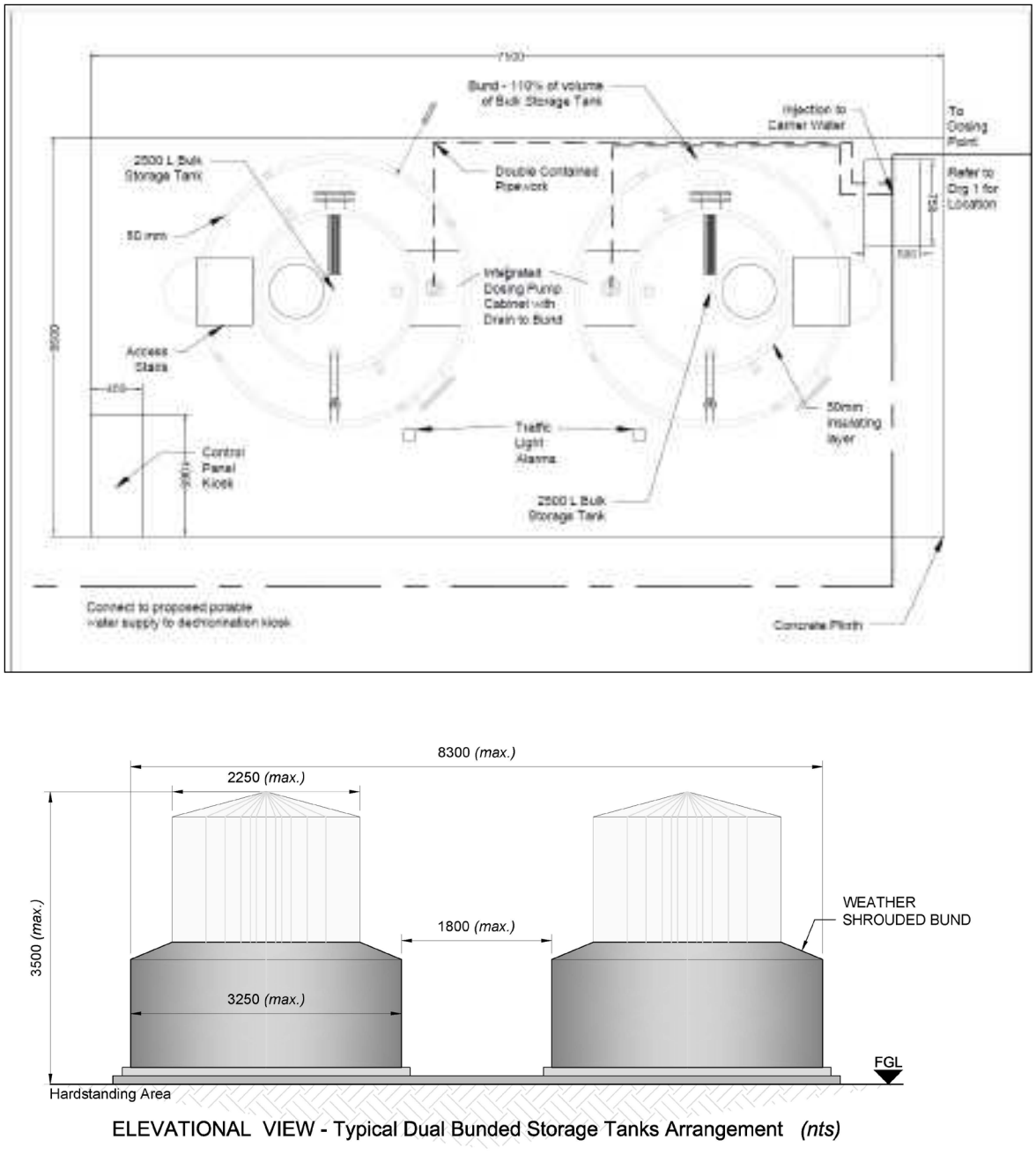


Figure 3-2: Plan and Elevation Drawings of a typical Orthophosphate Dosing Unit

3.3 CONSTRUCTION METHODOLOGY

The proposed works will be carried out by suitably qualified contractors. The proposed dosing unit will be located within the bounds of the existing Portloman WTP.

3.4 OPERATION OF CORRECTIVE WATER TREATMENT WORKS

The operational stage for the corrective water treatment works will be a part of the day to day activities of the WTP and will be operated in accordance with the SOPs.

The orthophosphate dosing system will be controlled by the site SCADA system, whereby, orthophosphoric acid will be dosed proportional to the flow of the water being distributed to the network. At Portloman WTP, orthophosphate will be added to treated water at a rate of 0.8 mg/l. The onsite storage tanks have been designed to provide 60 days of storage so it is anticipated that deliveries will be approximately once every two months. All deliveries will be via existing access roads within the boundary of the WTP.

3.5 LDWMP APPROACH TO ASSESSMENT

3.5.1 Work Flow Process

In line with the relevant guidance, the AA consists of three main steps:

- **Impact Prediction** – where the likely potential impacts of this project (impact source and impact pathways) are examined.
- **Assessment of Effects** - where the significance of project effects are assessed on the basis of best scientific knowledge (the EAM); in order to identify whether they are likely to give rise to likely significant effects on any European Sites, in view of their conservation objectives.

At the early stages of consideration, IW identified the risk of environmental impact and the pathways by which the added orthophosphate may reach and / or affect environmental receptors including European Sites. In order to carry out a robust and defensible environmental assessment and to ensure a transparent and consistent approach, IW devised a conceptual model based on the 'source – pathway – receptor' framework. This sets out a specific environmental risk assessment of any proposed orthophosphate treatment and provides a methodology to determine the risk to the receiving environment of this corrective water treatment.

This conceptual model, has been discussed with the EPA and has been developed using EPA datasets including the orthophosphate susceptibility output mapping for subsurface pathways; the nutrient risk assessment for water bodies; water quality information; available low flow estimation for gauged and ungauged catchments; and a new methodology which has been developed for the assessment of water quality risk from domestic wastewater treatment systems (DWWTS).

The EAM will be the basis of the decision support matrix to inform any programmes developed as part of the LDWMP. Further detail on the model is presented in **Section 3.5.2** below.

3.5.2 Environmental Assessment Methodology

The EAM has been developed based on a conceptual model of P transfer (see **Figure 3-3**), based on the source-pathway-receptor model, from the water distribution and wastewater collection systems.

- The source of phosphorus is defined as the orthophosphate dosing at the water treatment plants which will be dependent on the water chemistry of the raw water quality, the integrity of the distribution network and the extent of lead piping.
- Pathways include discharges from the wastewater collection system (WWTP discharges and intermittent discharges – Storm Water Overflows (SWOs), leakage from the distribution system and small point source discharges from DWWTSs.

- Receptors, refer to SACs and SPAs which may receive orthophosphate dosed water via the pathway examples outlined above. Receptors and their sensitivity, is of key consideration in the EAM. A water body may be more sensitive to additional phosphorus loadings where it has a low capacity for assimilating the load e.g. high status sites, such as the habitat of the freshwater pearl mussel or oligotrophic lakes. Where a SAC/SPA could be affected by dosing at more than one WSZ, the cumulative effects are considered in the EAM.

A flow chart of the methodology applied in the EAM is provided in **Figure 3-4** and illustrates the importance of the European Sites in the process; where nutrient sensitive qualifying features within the Natura 2000 network are hydrologically linked with the WSZ, then AA will be required in the first instance.

For each WSZ where orthophosphate treatment is proposed the conceptual model allows the quantification of loads in a mass balance approach to identify potentially significant pathways, as part of the risk assessment process. A summary report outlining the EAM results is available in **Appendix C**, which further outlines P dynamics and the consideration of P trends and capacity in receiving waters and the risk to water status from any increase in P load from orthophosphate dosing.

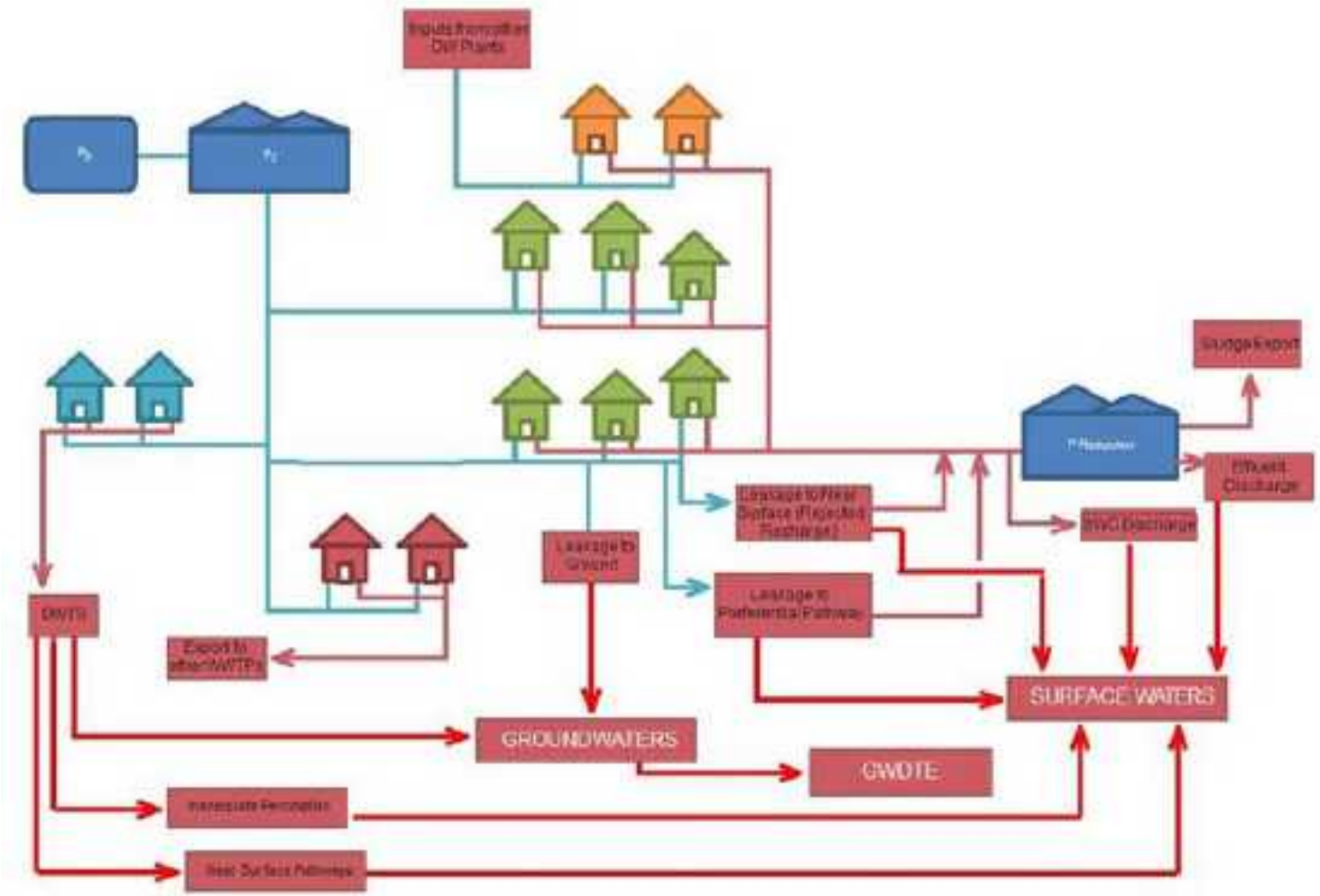


Figure 3-3: Conceptual Model of P Transfer

(Diagrammatic layout of P transfers from drinking water source (top left), through DW distribution (blue), wastewater collection (brown) and treatment systems to environmental receptors (red). P transfers that by-pass the WWTP (leakages, storm overflows, discharges to ground, and misconnections) are also indicated.)

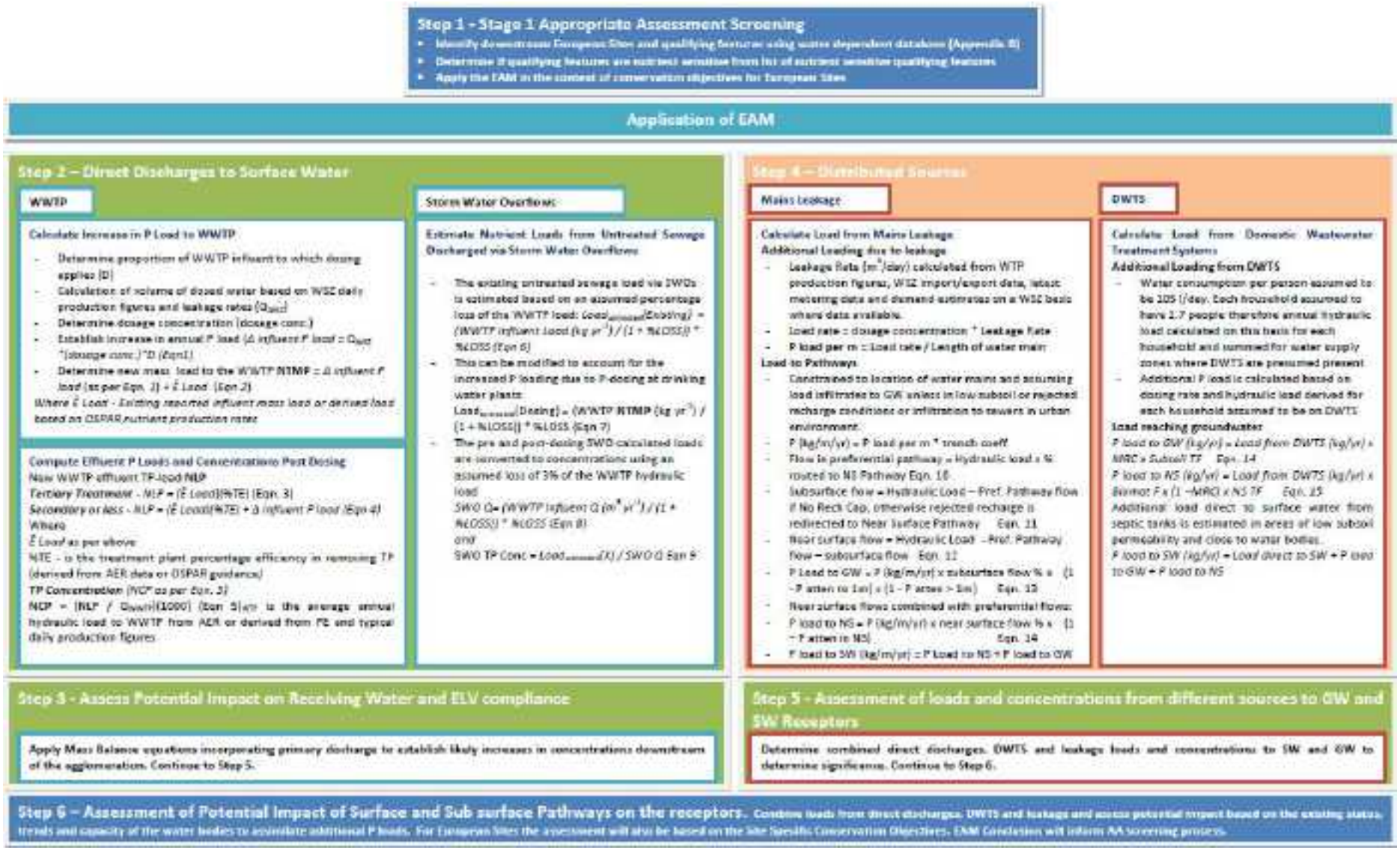


Figure 3-4: Stepwise Approach to the Environmental Assessment Methodology

4 PROJECT CONNECTIVITY TO EUROPEAN SITES

4.1 OVERVIEW OF THE PROJECT ZONE OF INFLUENCE

4.1.1 Construction Phase

The construction phase of the proposed project will take place within the confines of the existing Portloman WTP. The WTP is located directly adjacent to the boundary of Lough Owel SPA and Lough Owel SAC. Given the small-scale nature of construction works, the ZoI for the proposed works was considered to include the footprint of the existing Portloman WTP followed by a review of hydrological and hydrogeological connectivity between the proposed development site and European Sites. The European Sites within ZoI for the construction phase of the project are listed in **Table 4-1** and displayed in **Figure 4-1.**

Table 4-1: European Sites within the ZoI of the Proposed Project – Construction Phase

	Site Name	SAC / SPA Code	Direct Impact	Water Dependent Species / Habitats	Surface Water Connectivity	Groundwater Connectivity[4]	Potential Source Impact Pathway
1	Lough Owel SAC	000688	No	Yes	Yes- Potential overland flow	Yes (Lough Owel Fen and Mires)	Yes
2	Lough Owel SPA	004047	No	Yes	Yes- Potential overland flow	Yes (Lough Owel Fen and Mires)	Yes
3	Scragh Bog SAC	000692	No	Yes	No	Yes (Lough Owel Fen and Mires)	Yes

4.1.2 Operational Phase

The ZoI for the operational phase of the proposed project was determined by establishing the potential for hydrological and hydrogeological connectivity between the Portloman WTP and Ardonagh Reservoir WSZ and European Sites. The ZoI was therefore defined by the surface and groundwater bodies that are hydrologically and hydrogeologically connected with the Project.

In the EAM, all water bodies linked to the WSZ have been identified. Downstream water bodies to the estuary and coastal water bodies have also been identified. Groundwater bodies intersecting the WSZs, are also included in the ZoI. Hydrogeological linkages in karst areas have also been taken into account. European Sites within the ZoI are listed in **Table 4-2**: and are displayed in **Figure 4-1**.

[4] Portloman WTP overlies the the GWDTE Lough Owel Fen and Mires groundwater body (IE_SH_G_166). All European sites overlying or supporting connectivity to this groundwater body have been assessed to determine potential source pathway receptors.

Table 4-2: European Sites within the ZoI of the Proposed Project – Operational Phase

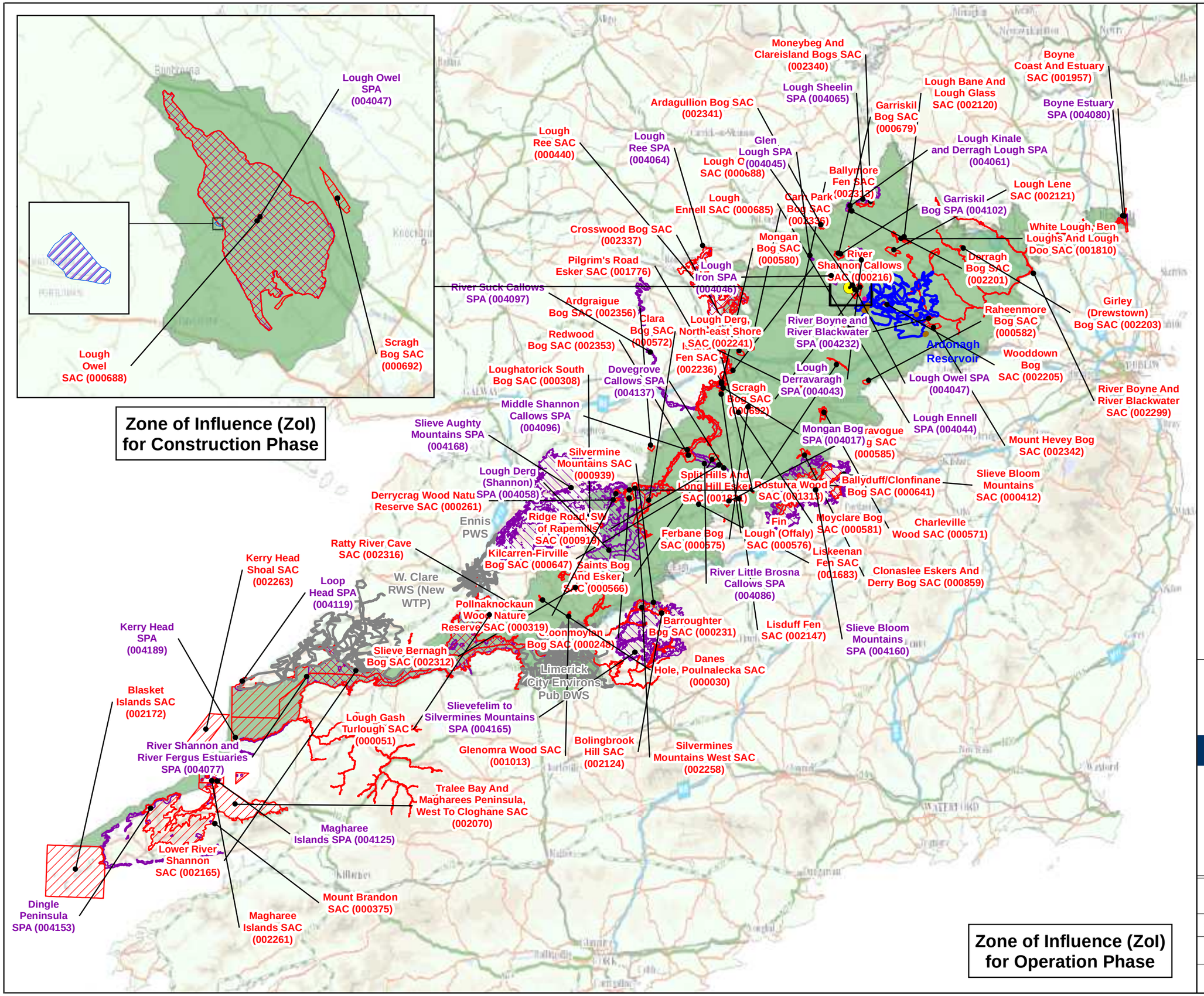
	Site Name	SAC / SPA Code	Water Dependent Species/ Habitats	Nutrient Sensitive Species/ Habitats	Surface Water Connectivity	Groundwater Connectivity	Potential Source Impact Pathway
1	Danes Hole, Poulnalecka	SAC 000030	Yes	Yes	No	No	No
2	Lough Gash Turlough	SAC 000051	Yes	Yes	No	No	No
3	River Shannon Callows	SAC 000216	Yes	Yes	Yes (Shannon Upper)	Yes (Inny)	Yes
4	Barroughter Bog	SAC 000231	Yes	Yes	No	No	No
5	Cloonmoylan Bog	SAC 000248	Yes	Yes	No	No	No
6	Derrycrag Wood Nature Reserve	SAC 000261	No	Yes	No	No	No
7	Loughatorick South Bog	SAC 000308	Yes	Yes	No	No	No
8	Pollnaknockaun Wood Nature Reserve	SAC 000319	No	Yes	No	No	No
9	Mount Brandon	SAC 000375	Yes	Yes	Yes (South-western Atlantic Seaboard)	No	Yes
10	Slieve Bloom Mountains	SAC 000412	Yes	Yes	No	No	No
11	Lough Ree	SAC 000440	Yes	Yes	Yes (Inny, Gaine)	Yes (Inny)	Yes
12	All Saints Bog and Esker	SAC 000566	Yes	Yes	No	No	No
13	Charleville Wood	SAC 000571	Yes	Yes	No	No	No
14	Clara Bog	SAC 000572	Yes	Yes	No	No	No
15	Ferbane Bog	SAC 000575	Yes	Yes	No	Yes (Clara)	Yes
16	Fin Lough (Offaly)	SAC 000576	Yes	Yes	No	No	No
17	Mongan Bog	SAC 000580	Yes	Yes	No	Yes (Inny)	Yes
18	Moyclare Bog	SAC 000581	Yes	Yes	No	Yes (Clara)	Yes
19	Raheenmore Bog	SAC 000582	Yes	Yes	No	No	No
20	Sharavogue Bog	SAC 000585	Yes	Yes	No	No	No
21	Ballyduff/Clonfinane Bog	SAC 000641	Yes	Yes	No	No	No
22	Kilcarren-Firville Bog	SAC 000647	Yes	Yes	No	No	No
23	Garriskil Bog	SAC 000679	Yes	Yes	Flood risk (Inny)	Yes (Inny)	Yes
24	Lough Ennell	SAC	Yes	Yes	Yes	Yes	Yes

	Site Name	SAC / SPA Code	Water Dependent Species/ Habitats	Nutrient Sensitive Species/ Habitats	Surface Water Connectivity	Groundwater Connectivity	Potential Source Impact Pathway
		000685			(Brosna)	(Clara)	
25	Lough Owel	SAC 000688	Yes	Yes	No	Yes (GWDTE Lough Owel)	Yes
26	Scragh Bog	SAC 000692	Yes	Yes	No	Yes (GWDTE Lough Owel)	Yes
27	Clonaslee Eskers and Derry Bog	SAC 000859	Yes	Yes	No	No	No
28	Ridge Road, SW of Rapemills	SAC 000919	No	Yes	No	No	No
29	Silvermine Mountains	SAC 000939	Yes	Yes	No	No	No
30	Glenomra Wood	SAC 001013	No	Yes	No	No	No
31	Rosturra Wood	SAC 001313	No	Yes	No	No	No
32	Liskeenan Fen	SAC 001683	Yes	Yes	No	No	No
33	Pilgrim's Road Esker	SAC 001776	No	Yes	No	Yes (Inny)	No
34	White Lough, Ben Loughs and Lough Doo	SAC 001810	Yes	Yes	No	Yes (Derravarragh)	Yes
35	Split Hills and Long Hill Esker	SAC 001831	No	Yes	Flood risk (Brosna)	Yes (Kilbeggan Gravels, Clara, Tullamore)	No
36	Boyne Coast and Estuary	SAC 001957	Yes	Yes	Yes (Boyne Estuary)	No	Yes
37	Tralee Bay and Magharees Peninsula, West to Cloghane	SAC 002070	Yes	Yes	Yes (South-western Atlantic Seaboard, Outer Tralee Bay, Brandon Bay)	No	Yes
38	Lough Bane and Lough Glass	SAC 002120	Yes	Yes	No	Yes (Athboy)	Yes
39	Lough Lene	SAC 002121	Yes	Yes	No	Yes (Derravarragh)	Yes
40	Bolingbrook Hill	SAC 002124	Yes	Yes	No	No	No
41	Lisduff Fen	SAC 002147	Yes	Yes	No	No	No
42	Lower River Shannon	SAC 002165	Yes	Yes	Yes (Shannon (Lower)	No	Yes
43	Blasket Islands	SAC 002172	Yes	Yes	Yes (South-western Atlantic Seaboard)	No	Yes
44	Island Fen	SAC 002236	Yes	Yes	No	No	No
45	Lough Derg, North-east Shore	SAC 002241	Yes	Yes	Yes (Shannon (Lower))	No	Yes

	Site Name	SAC / SPA Code	Water Dependent Species/ Habitats	Nutrient Sensitive Species/ Habitats	Surface Water Connectivity	Groundwater Connectivity	Potential Source Impact Pathway
46	Silvermines Mountains West	SAC 002258	Yes	Yes	No	No	No
47	Magharee Islands	SAC 002261	Yes	Yes	Yes (South-western Atlantic Seaboard)	No	Yes
48	Kerry Head Shoal	SAC 002263	Yes	Yes	Yes (South-western Atlantic Seaboard)	No	Yes
49	River Boyne and River Blackwater	SAC 002299	Yes	Yes	Yes (multi – within WSZ)	Yes (Athboy)	Yes
50	Slieve Bernagh Bog	SAC 002312	Yes	Yes	No	No	No
51	Ballymore Fen	SAC 002313	Yes	Yes	No	No	No
52	Ratty River Cave	SAC 002316	Yes	Yes	No	No	No
53	Carn Park Bog	SAC 002336	Yes	Yes	No	Yes (Inny)	Yes
54	Crosswood Bog	SAC 002337	Yes	Yes	No	Yes (Inny)	Yes
55	Moneybeg and Clareisland Bogs	SAC 002340	Yes	Yes	No	Yes (Inny)	Yes
56	Ardagullion Bog	SAC 002341	Yes	Yes	No	Yes (Inny)	Yes
57	Mount Hevey Bog	SAC 002342	Yes	Yes	No	Yes (GWDTE Mount Hevey Bog)	Yes
58	Redwood Bog	SAC 002353	Yes	Yes	No	No	No
59	Ardgraigue Bog	SAC 002356	Yes	Yes	No	No	No
60	Wooddown Bog [5]	SAC 002205	Yes	Yes	Flood risk (Riverstown)	Yes (Athboy)	Yes
61	Girley (Drewstown) Bog[6]	SAC 002203	Yes	Yes	No	Yes (Athboy)	Yes
62	Derragh Bog [7]	SAC 002201	Yes	Yes	No	Yes (Inny)	Yes
63	Mongan Bog	SPA 004017	Yes	Yes	No	Yes (Inny)	Yes
64	Lough Derravarragh	SPA 004043	Yes	Yes	Yes (Inny)	Yes (Inny, Derravarragh)	Yes
65	Lough Ennell	SPA 004044	Yes	Yes	Yes (Brosna)	Yes (Clara)	Yes
66	Glen Lough	SPA 004045	Yes	Yes	No	Yes (Inny)	Yes

[5] https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY000694.pdf
[6] https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY001580.pdf
[7] No Site Synopsis or SSCOs for this site.

	Site Name	SAC / SPA Code	Water Dependent Species/ Habitats	Nutrient Sensitive Species/ Habitats	Surface Water Connectivity	Groundwater Connectivity	Potential Source Impact Pathway
67	Lough Iron	SPA 004046	Yes	Yes	Yes	Yes (Inny)	Yes
68	Lough Owel	SPA 004047	Yes	Yes	No	Yes (GWDTE Lough Owel)	Yes
69	Lough Derg (Shannon)	SPA 004058	Yes	Yes	Yes	No	Yes
70	Lough Kinale and Derragh Lough	SPA 004061	Yes	Yes	No	Yes (Inny)	Yes
71	Lough Ree	SPA 004064	Yes	Yes	Yes (Inny)	Yes (Inny)	Yes
72	Lough Sheelin	SPA 004065	Yes	Yes	No	Yes (Inny)	Yes
73	River Shannon and River Fergus Estuaries	SPA 004077	Yes	Yes	Yes (Shannon (Lower))	No	Yes
74	Boyne Estuary	SPA 004080	Yes	Yes	Yes (Boyne Estuary)	No	Yes
75	River Little Brosna Callows	SPA 004086	Yes	Yes	No	No	No
76	Middle Shannon Callows	SPA 004096	Yes	Yes	Yes (Shannon (Upper))	Yes (Inny)	Yes
77	River Suck Callows	SPA 004097	Yes	Yes	No	No	No
78	Garriskil Bog	SPA 004102	Yes	Yes	Flood risk (Inny)	Yes (Inny)	Yes
79	Loop Head	SPA 004119	Yes	Yes	Yes (Mouth of the Shannon)	No	Yes
80	Magharee Islands	SPA 004125	Yes	Yes	Yes (South-western Atlantic Seaboard)	No	Yes
81	Dovegrove Callows	SPA 004137	Yes	Yes	No	No	No
82	Dingle Peninsula	SPA 004153	Yes	Yes	Yes (South-western Atlantic Seaboard)	No	Yes
83	Slieve Bloom Mountains	SPA 004160	Yes	Yes	No	No	No
84	Slievefelim to Silvermines Mountains	SPA 004165	Yes	Yes	No	No	No
85	Slieve Aughty Mountains	SPA 004168	Yes	Yes	No	No	No
86	Kerry Head	SPA 004189	Yes	Yes	Yes (South-western Atlantic Seaboard)	No	Yes
87	River Boyne and River Blackwater	SPA 004232	Yes	Yes	Yes (multi – within WSZ)	Yes (Athboy)	Yes



Legend

LEMA Emission Type

- Primary Discharge Point
- Storm Water Overflow
- Waste Water Treatment Plant
- Portloman WTP
- Water Supply Zone Boundary (WSZ)
- Additional WSZ considered for dosing
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Zone of Influence

Data Source:
Irish Water
NPWS (April 2018)
EPA

N

0 5 10 20 Kilometres

Client

Project: Lead Mitigation Plan
Corrective Water Treatment Works

Figure 4.1

Frewin Hill
High Level Reservoir and Related Water Supply Zones
European Sites within the ZoI of the Proposed Project

RPS

Scale: 1:1,000,000 @ A3	Date: 05/07/2018
File Ref: MDW0766Arc0005aF04	Map Projection: Irish National Grid (TM65)

4.2 IDENTIFICATION OF RELEVANT EUROPEAN SITES

For the construction and operational phase of the project, each European Site was assessed for the presence of water dependent habitats and species, their associated nutrient sensitivity, together with the hydrological/hydrogeological connectivity of each site to the proposed activities, and on this basis, the potential for risk from the proposed project was identified. For a potential risk to exist, a site must contain at least one water dependent and nutrient sensitive species, and be hydrologically/ hydrogeologically connected to the proposed works. A number of sites are excluded for further assessment at this stage; those sites included are detailed in **Table 4-3** and are displayed in **Figure 4-2**.

The construction phase of the proposed project will take place within the confines of the existing Portloman WTP. There is potential for surface water connectivity to the Lough Owel SAC and Lough Owel SPA. The WTP is located within the GWDTE Lough Owel Fen and Mires groundwater body (IE_SH_G_166) and there is potential hydrogeological connectivity between the proposed development site and the Scragh Bog SAC.

For the operational phase, Ardonagh Reservoir WSZ and Portloman WTP are located adjacent to Lough Owel in the sub-catchments: Inny [Shannon] SC_030; Brosna SC_010; Boyne SC_030, SC_040, and SC_050; Deel [Raharney] (SC_010); and the catchments: Upper Shannon (26F); Lower Shannon (25A); and Boyne (07) catchments.

A number of European Sites also occur in these subcatchments and catchments and are hydrologically connected to the WSZ via river and lake water bodies. The sites include: Lough Ree SAC and SPA; River Boyne and River Blackwater SAC and SPA; River Shannon Callows SAC and Middle Shannon Callows SPA; Lough Ennell SAC and SPA; and Lough Derravaragh SPA. Lough Ree SAC and Lough Ree SPA are located downstream of the WSZ, hydrologically connected by the Inny.

The zone of influence for this surface water pathway has been terminated at Inny_070 (IE_SH_26I010800) as the modelled post-dosing increase is not detectable (0.0000 mg/l) therefore there is no potential for likely significant effects downstream of that water body. Due to the hydrological connectivity between these European Sites and the WSZ, the remaining sites are included for further assessment in **Section 5** and **Section 6**.

The European Sites: Blasket Islands SAC; Kerry Head Shoal SAC; Lough Derg, North-East Shore SAC; Lower River Shannon SAC; Magharee Islands SAC; Mount Brandon SAC; Tralee Bay And Magharees Peninsula, West To Cloghane SAC; Dingle Peninsula SPA; Kerry Head SPA; Loop Head SPA; Lough Derg (Shannon) SPA; Magharee Islands SPA; River Shannon and River Fergus Estuaries SPA are located downstream of the Ardonagh WSZ. As the post-dosing increase in orthophosphate concentration in Shannon (Lower)_010 (IE_SH_25S012000), located upstream of these European Sites, is undetectable (i.e. 0.0000 mg/l), there is no potential for the transfer of impacts to sites and therefore they are excluded from further assessment. Similarly, the Boyne Coast and Estuary SAC and the Boyne Estuary SPA are located downstream of the WSZ. The post-dosing increase in orthophosphate concentration in the river water bodies upstream of the SAC and SPA are below 5% of the Good / High status boundary (0.00125 mg/l) and therefore, there is no potential for the transfer of impacts downstream to the Boyne Coast and Estuary SAC.

Lough Iron SPA is also hydrologically connected to the WSZ via Lough Derravarragh (IE_SH_708) and its outflow Inny_070 (IE_SH_26I010800). As the post-dosing increase in orthophosphate

concentration in Inny_070 (IE_SH_26I010800) is undetectable (i.e. 0.0000 mg/l) there is no potential for the transfer of impacts to Lough Iron SPA and the site is therefore excluded from further assessment.

In addition to those sites hydrologically connected to the WSZ, a number of European Sites are located adjacent to river water bodies affected by dosing at Portloman WTP. These include: Split Hills and Long Hill Esker SAC; Wooddown Bog SAC; Garriskil Bog SAC and SPA which are located adjacent to Brosna_060 (IE_SH_25B090400); Riverstown_010 (IE_EA_07R010090); and Inny_070 (IE_SH_26I010800), respectively. There is potential for the transfer of orthophosphate concentrations from the river water bodies to the European Sites during flood events. According to the OPW National Flood Hazard Mapping[8] there are no reported flood events at Riverstown_010 (IE_EA_07R010090) and Inny_070 (IE_SH_26I010800). However, there is a report of recurring flooding in the Brosna downstream of Split Hills and Long Hill Esker SAC at Coola Bridge, Kilbeggan, Co. Westmeath. It is reported that the River Brosna overflows its banks every year after heavy rain and the road is liable to flood. Further downstream at Brosna View Council Estate, Kilbeggan, the estate floods every year after heavy rainfall. The estate surface water discharges into the River Brosna and when the Brosna is high the water cannot discharge. Split Hills and Long Hill Esker SAC and Wooddown Bog SAC are included for further assessment on a precautionary basis as a result. For Garriskil Bog SAC and SPA however, the post-dosing increase in orthophosphate concentration in Inny_070 (IE_SH_26I010800) is undetectable (0.0000 mg/l) and therefore, there is no risk of a transfer of concentrations to the SAC and SPA thus, these sites are excluded from further assessment.

The Ardonagh Reservoir WSZ intersects six GWBs: Derravarragh (SH_G_077); Athboy (EA_G_001); GWDTE – Mount Hevey Bog (SAC002342) (EA_G_072); Clara (SH_G_240); Inny (SH_G_110); and, Waste Facility (W0071-02) (IE_EA_G_083). Groundwater flows through voids such as connected pore spaces in sand and gravel aquifers and through fissures, faults, joints and bedding planes in bedrock aquifers. Regional groundwater flows tend to follow the regional topography and generally discharge towards main surface water bodies including rivers, lakes and coastal water bodies. In areas of karstified limestones, high permeability zones give rise to rapid groundwater velocities with more complex flow directions, which may vary seasonally and are difficult to predict with certainty. In this case, the assumption is that groundwater flow direction is from areas of higher elevations to lower elevations, unless groundwater specific information indicates otherwise. Groundwater body specific information relating to flow and discharge is available from the GSI[9], and was consulted in making the assessment.

Derravarragh SH_G_077

Derravarragh (SH_G_077)[10] is a karstic GWB comprised of Derravaragh Cherts, which are considered to be a part of the Dinantian Upper Impure Limestone Group. This GWB will discharge to the surface water features overlying the GWB. Groundwater flows through fissures, joints, along bedding planes and conduits. Although a Dinantian Upper Impure Limestone, karstification has been recorded in the bedrock in this GWB. Karstification enlarges the fissures and joints by solution and can significantly enhance the permeability of the rock. The traced underground connection between Lough Lene and the springs at Fore at a rate of 80 m/hr demonstrates that rapid groundwater flow can occur within

[8] http://www.floodmaps.ie/View/Default.aspx
[9] https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/activities/understanding-ireland-groundwater/Pages/Groundwater-bodies.aspx
[10] https://jetstream.gsi.ie/iwdds/delivery/GSI_Transfer/Groundwater/GWB/DerravaraghGWB.pdf

the Derravaragh Cherts of this GWB. The fact that this flow path crosses a catchment and river basin boundary demonstrates that flow in karstic systems does not always follow the surface water catchment. Due to the karstification of the rock, the traced underground connection between Lough Lene and the springs at Fore, and the fact that Lough Owel and Lough Lene appear to be supported primarily by groundwater it appears that the Derravarragh Cherts support some regional groundwater flow. In the northeast of the body (northeast of White Lough) the bedrock is overlain by a potential locally important sand and gravel aquifer.

Groundwater and surface water are closely linked in this GWB. The presence of swallow-holes and springs, the lack of surface water input to Lough Owel and Lough Lene, and the groundwater tracing showing a connection between Lough Lene and the springs at Fore demonstrate that there is a direct link between the surface water and groundwater in this GWB. Any contamination of surface water can be rapidly transported into the groundwater system, and vice versa. There are important protected ecological areas e.g. fens and wet woodlands, surrounding the lakes in this GWB, which are considered to be dependent on groundwater. The lakes themselves, which are highly calcareous, support a rare range of aquatic lower plant (*Charophyte*) species.

The Ardonagh Reservoir WSZ intersects an area to the south-west of the GWB. Three European Sites also intersect the GWB: Lough Derravarragh SPA; White Lough, Ben Loughs and Lough Doo SAC and Lough Lene SAC. Lough Derravarragh SPA occurs adjacent to the WSZ to the south-west of the GWB while White Lough, Ben Loughs and Lough Doo SAC, and Lough Lene SAC are located to the north-east of the GWB. As flow paths in this GWB cross a catchment and river basin boundary, indicating that flow in karstic systems does not always follow the surface water catchment, and that the Derravaragh Cherts support some regional groundwater flow, it is possible for orthophosphate to be transported from the WSZ to these European Site and thus, they are included for further assessment in **Section 5** and **Section 6**.

Athboy EA_G_001

Athboy (EA_G_001)[11] is poorly productive bedrock GWB. Regional groundwater flow is from northwest to southeast, but locally, groundwater discharges to the streams and rivers crossing the aquifer. In some instances there may be discharge to the adjacent Trim GWB to the east. Discharge to rivers will be in the form of baseflow. There is direct discharge of groundwater to the surface at springs, 7 of which are recorded in the GSI karst database, and many others tend to be located along the banks of rivers. The specific yield data from various pumping tests in the area indicates that the aquifer is unconfined. Groundwater flow in the aquifer will generally take place in the upper 3 to 5 m of the bedrock where there has been weathering. In some local areas there may be the development of deeper flow through a network of connected fractures and fissures. In some instances these fractures become enlarged by solution to form karstic conduits, which can transport large quantities of water at high speeds. The typical groundwater flow path length is estimated at 0.75 km. In karstic areas there is a direct link between the surface and groundwater systems. There is evidence that in some areas of this GWB the limestone is karstified. Springs, swallow holes and caves are three typical karstic features present where groundwater and surface water are directly linked.

The Ardonagh Reservoir WSZ intersects the centre of the GWB. Six European Sites also intersect the GWB: Girley (Drewstown) Bog SAC; River Boyne and River Blackwater SAC; Wooddown Bog SAC; Lough Bane and Lough Glass SAC; White Lough, Ben Loughs and Lough Doo SAC; and River Boyne and River Blackwater SPA. Girley (Drewstown) Bog SAC is located approximately 10km up-gradient of

[11] https://jetstream.gsi.ie/iwdds/delivery/GSI_Transfer/Groundwater/GWB/AthboyGWB.pdf

the WSZ, a significant distance outside the typical groundwater flow path length of 0.75 km. Moreover, there are no karst features in the vicinity of the site. It is therefore excluded from further assessment. Wooddown Bog SAC and the River Boyne and River Blackwater SAC and SPA are directly intersected by the WSZ and therefore are included for further assessment in **Section 5** and **Section 6**. Lough Bane and Lough Glass SAC is located up gradient (north) of the WSZ and as regional groundwater flow is from northwest to southeast, the site is excluded from further assessment. White Lough, Ben Loughs and Lough Doo SAC is also located up gradient of the WSZ however, the site has previously been included due to its hydrogeological connectivity to Derravarragh (SH_G_077).

GWDTE – Mount Hevey Bog (SAC002342) (EA_G_072)

GWDTE – Mount Hevey Bog (SAC002342) (EA_G_072) is an isolated poorly productive bedrock GWB in the larger Athboy (EA_G_001) GWB. There is no site specific information on the GWB. As the GWB name suggests, a site within the GWB is designated under Habitats Directive, Mount Hevey Bog SAC. As the GWB is directly intersected by the WSZ, the SAC is included for further assessment in **Section 5** and **Section 6**.

Clara SH_G_240

Clara (SH_G_240)[12] is a poorly productive bedrock GWB. Groundwater discharges to gaining streams and rivers crossing the GWB, and to the small springs within the GWB. Groundwater flow occurs in fractures and faults. In the main, the rocks are dependent on fracturing and fissuring to enhance their permeability. Zones of high permeability can be encountered near fault zones and in areas of intensive fracturing. There may be limited karstification in the Upper Impure Limestones in the slightly more pure limestone zones. The Pure Unbedded Limestones may also have had their transmissivity enhanced further by dissolution of calcium carbonate along fracture, joint and bedding planes. There is probably an epikarstic layer of 1-2 m at the top of the pure unbedded limestones. Permeabilities in the upper few metres are often high although they decrease rapidly with depth. In general, groundwater flow is concentrated in the upper 15 m of the aquifer. Generally speaking, these rocks are unconfined where subsoils are thin or gravelly. Groundwater may be locally confined where it flows beneath the low permeability bases of the raised bogs as, for example, at Clara Bog. In the bedrock aquifers, groundwater flow paths are generally short, on the order of 30-300 m, with groundwater discharging to the streams and rivers that traverse the aquifer and to small springs. Local groundwater flows are determined by the local topography. There is no regional flow system in these aquifers. There are several locally important potential gravel aquifers and gravelly deposits overlying this bedrock GWB.

The streams and rivers crossing the aquifer are generally gaining, and groundwater comes to surface as springs. Due to the shallow groundwater flow in this aquifer the groundwater and surface waters are closely linked. There are several fens and wetlands in the area that are dependent on groundwater.

The Ardonagh Reservoir WSZ intersects a small area to the north-east of the GWB. Seven European Sites also intersect the GWB: Lough Ennell SAC; Split Hills and Long Hill Esker SAC; Ferbane Bog SAC; Moyclare Bog SAC; River Shannon Callows SAC; Middle Shannon Callows SPA; and Lough Ennell SPA. Lough Ennell SAC and SPA are located 235m from the WSZ and are also hydrologically connected to the WSZ via Brosna_030 (IE_SH_25B090100). The sites are therefore susceptible to orthophosphate

[12] https://jetstream.gsi.ie/iwdds/delivery/GSI_Transfer/Groundwater/GWB/ClaraGWB.pdf

inputs from both ground and surface water flow paths and are included for further assessment in **Section 5** and **Section 6**. Split Hills and Long Hill Esker SAC is located 14km from the WSZ. The qualifying interest Split Hills and Long Hill Esker SAC, semi-natural dry grasslands, is not a GWDTE and therefore will not be susceptible to orthophosphate inputs from groundwater sources. The site is however previously included for the potential for orthophosphate inputs from surface water sources. Ferbane Bog SAC and Moyclare Bog SAC are located approximately 40km and 43km from the WSZ, respectively. As flow paths are generally short in this GWB i.e. on the order of 30-300 m, these sites will not be impacted by dosing in the Ardonagh Reservoir WSZ and are therefore excluded from further assessment. The River Shannon Callows SAC and Middle Shannon Callows SPA are located approximately 50km from the WSZ and are also unlikely to be impacted by hydrogeological flows in the Clara (SH_G_240) GWB. However, the sites are previously screened for surface water connectivity to the WSZ.

Inny (SH_G_110)

The Inny (SH_G_110) is a poorly productive bedrock aquifer. It comprises a large area stretching from south Cavan and the eastern boundary of the Shannon River Basin District to Lough Ree. The River Inny runs south southeast through the centre of this groundwater body from Lough Sheelin in the northeast to Lough Ree in the southwest. Numerous rivers and streams flow off the higher ground in the northwest and southeast to the River Inny in the centre of the body. The main discharges will be local, to the River Inny and its tributaries crossing the groundwater body, and to Lough Ree in the southwest. Groundwater flow in this groundwater body will be of a local nature. Groundwater flow will be concentrated in fractured and weathered zones and in the vicinity of fault zones (these rocks do not exhibit intergranular permeability). Groundwater flow paths will be short, in general between 30 and 300 m, with groundwater discharging locally to rivers and streams. Most groundwater flow is likely to circulate in the upper tens of metres of bedrock, recharging and discharging in local zones. Groundwater and surface water interactions require special attention where terrestrial ecosystems are dependent on a sustainable balance between the two. A number of fens, bogs and lakes are recorded in this groundwater body which may have varying dependence on groundwater.

The WSZ intersects a small area to the south-east of this GWB. The European Sites that also intersect the GWB include: Moneybeg and Clareisland Bogs SAC; Carn Park Bog SAC; Ardagullion Bog SAC; Garriskil Bog SAC; Derragh Bog SAC; Mongan Bog SAC; River Shannon Callows SAC; Lough Ree SAC; Pilgrim's Road Esker SAC; Crosswood Bog SAC; Mongan Bog SPA; Lough Derravaragh SPA; Glen Lough SPA; Lough Iron SPA; Lough Kinale and Derragh Lough SPA; Lough Ree SPA; Lough Sheelin SPA; Middle Shannon Callows SPA and, Garriskil Bog SPA.

Moneybeg and Clareisland Bogs SAC; Derragh Bog SAC; Ardagullion Bog SAC; Lough Kinale and Derragh Lough SPA; Lough Sheelin SPA; Glen Lough SPA and Garriskil Bog SAC and SPA; and Lough Iron SPA are located up-gradient of the WSZ. There are no karst features connecting these sites to the WSZ. As flow paths in this GWB are generally between 30 and 300 m, these sites will not be susceptible to potential impacts from dosing in Ardonagh WSZ and therefore are excluded from further assessment.

Although the Inny GWB (SH_G_110) is characteristic of poorly productive bedrock, it is a large GWB that contains limestone and karst features. Mongan Bog SAC and SPA; Carn Park Bog SAC and Crosswood Bog SAC are located down-gradient of the WSZ. As flows in the GWB are towards Lough Ree in the south-west, there is potential for the transfer of orthophosphate to the European Sites down-gradient of the WSZ. Mongan Bog SAC and SPA; Carn Park Bog SAC and Crosswood Bog SAC

are therefore included for further assessment in **Section 5** and **Section 6**. Pilgrim's Road Esker SAC does not contain groundwater dependent QIs and therefore is not at risk from the transfer of orthophosphate following dosing of Ardonagh WSZ.

Lough Ree SAC and SPA are previously included due to its hydrological connection with the WSZ. Although the European Sites are located approximately 13km from the WSZ, groundwater sources may also contribute orthophosphate concentrations due to the presence of a karst feature, Lady Well Spring, located within the SAC/SPA complex. Similarly, the River Shannon Callows SAC and Middle Shannon Callows SPA located approximately 50km from the WSZ, include a number of karst features (Toberfinneen Spring; St. Kieran's Well; Clonmacnoise superficial solution features). Due to the potential for groundwater discharge via these features and the location of WSZ upstream of the sites, they are included for further assessment in **Section 5** and **Section 6**. Lough Iron SPA is also previously included due to its hydrological connection with the WSZ.

On this basis, three sites have been included for further assessment as a result of potential effect arising during construction phase in Section 5 below i.e. Lough Owel SAC, Lough Owel SPA and Scragh Bog SAC. Twenty-one European Sites have been included for further assessment for the operational phase in Sections 5 and 6 below i.e. Split Hills and Long Hill Esker SAC; Lough Lene SAC; Lough Owel SAC; Scragh Bog SAC; Lough Ree SAC; Mount Hevey Bog SAC; River Boyne and River Blackwater SAC; Wooddown Bog SAC; White Lough, Ben Loughs and Lough Doo SAC; River Shannon Callows SAC; Lough Ennell SAC; Carn Park Bog SAC; Crosswood Bog SAC; Mongan Bog SAC; Lough Derravaragh SPA; Lough Owel SPA; Lough Ennell SPA; River Boyne and River Blackwater SPA; Lough Ree SPA; Middle Shannon Callows SPA; and, Mongan Bog SPA.

Table 4-3: European Sites Hydrologically or Hydrogeologically Connected to or Downstream of the WTP and WSZ

Site Name	Site Code	Conservation Objectives Establishment Date	Feature Code	Qualifying Interests / Special Conservation Interests	Water Dependant Species / Habitats	Nutrient Sensitive Species / Habitats	Potential Hydrological / Hydrogeological Connectivity	Potential Source Pathway Receptor
Construction and Operational Phase								
Lough Owel	SAC 000688	3rd May 2018 Version 1.0	1092	White-clawed Crayfish (*Austropotamobius pallipes*)	Yes	Yes	Yes	Yes
			3140	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.	Yes	Yes		
			7140	Transition mires and quaking bogs	Yes	Yes		
			7230	Alkaline fens	Yes	Yes		
Scragh Bog	SAC 000692	31st May 2018 Generic Version 6.0	1065	Marsh Fritillary (*Euphydryas aurinia*)	Yes	No	Yes	Yes
			1393	Slender Green Feather-moss (*Drepanocladus vernicosus*)	Yes	No		
			7140	Transition mires and quaking bogs	Yes	Yes		
			7230	Alkaline fens	Yes	Yes		
Lough Owel	SPA 004047	21st Feb 2018 Generic Version 6.0	A056	Shoveler (*Anas clypeata*)	Yes	Yes	Yes	Yes
			A125	Coot (*Fulica atra*)	Yes	Yes		
Operation Phase Only								
Split Hills and Long Hill Esker	SAC 001831	20th Jun 2018 Generic Version 6.0	6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (* important orchid sites)	No	Yes	Yes	Yes
Lough Lene	SAC 002121	21st Feb 2018 Generic Version	1092	White-clawed Crayfish (*Austropotamobius pallipes*)	Yes	Yes	Yes	Yes

Site Name	Site Code	Conservation Objectives Establishment Date	Feature Code	Qualifying Interests / Special Conservation Interests	Water Dependant Species / Habitats	Nutrient Sensitive Species / Habitats	Potential Hydrological / Hydrogeological Connectivity	Potential Source Pathway Receptor
		6.0	3140	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.	Yes	Yes		
Lough Ree	SAC 000440	09 Aug 2016 Version 1.0	1355	Otter (*Lutra lutra*)	Yes	Yes	Yes	Yes
			3150	Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation	Yes	Yes		
			6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites)	No	Yes		
			7120	Degraded raised bogs still capable of natural regeneration	Yes	Yes		
			7230	Alkaline fens	Yes	Yes		
			8240	* Limestone pavements	No	Yes		
			91A0	Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles	No	Yes		
			91D0	* Bog woodland	Yes	Yes		
Mount Hevey Bog	SAC 002342	21 Mar 2016 Version 1.0	7110	* Active raised bogs	Yes	Yes	Yes	Yes
			7120	Degraded raised bogs still capable of natural regeneration	Yes	Yes		
			7150	Depressions on peat substrates of the *Rhynchosporion*	Yes	Yes		
River Boyne and River Blackwater	SAC 002299	21st Feb 2018 Generic Version 6.0	1099	River lamprey (*Lampetra fluviatilis*)	Yes	Yes	Yes	Yes
			1106	Atlantic salmon (*Salmo salar*) (only in fresh water)	Yes	Yes		
			1355	Otter (*Lutra lutra*)	Yes	Yes		
			7230	Alkaline fens	Yes	Yes		

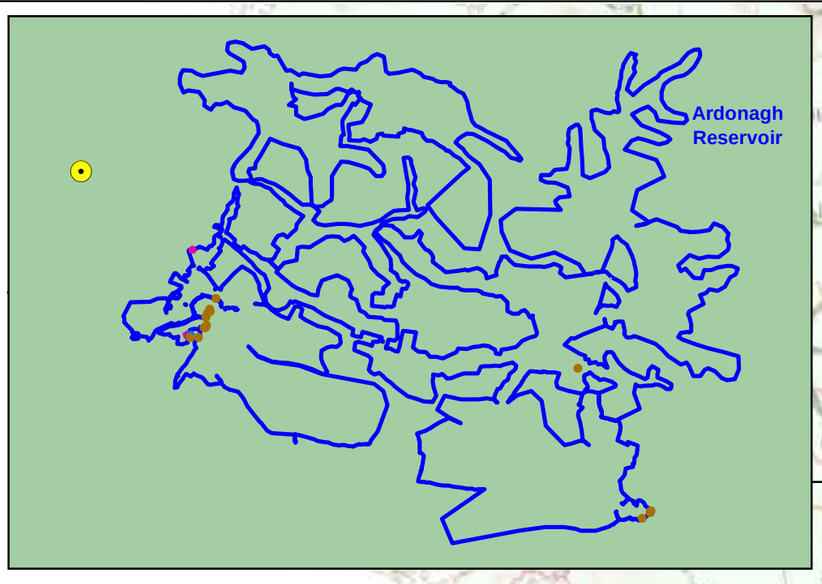
Site Name	Site Code	Conservation Objectives Establishment Date	Feature Code	Qualifying Interests / Special Conservation Interests	Water Dependant Species / Habitats	Nutrient Sensitive Species / Habitats	Potential Hydrological / Hydrogeological Connectivity	Potential Source Pathway Receptor
			91E0	* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)	Yes	Yes		
Wooddown Bog[13]	SAC 002205	21st Feb 2018 Generic Version 6.0	7110	* Active raised bogs	Yes	Yes	Yes	Yes
			7120	Degraded raised bogs still capable of natural regeneration	Yes	Yes		
			7150	Depressions on peat substrates of the *Rhynchosporion*	Yes	Yes		
White Lough, Ben Loughs and Lough Doo	SAC 001810	21st Feb 2018 Generic Version 6.0	1092	White-clawed Crayfish (*Austropotamobius pallipes*)	Yes	Yes	Yes	Yes
			3140	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.	Yes	Yes		
River Shannon Callows	SAC 000216	21st Feb 2018 Generic Version 6.0	1355	Otter (*Lutra lutra*)	Yes	Yes	Yes	Yes
			6410	*Molinia* meadows on calcareous, peaty or clayey-siltladen soils (*Molinia caeruleae*)	Yes	Yes		
			6510	Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)	No	Yes		
			8240	* Limestone pavements	No	Yes		
			91E0	* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)	Yes	Yes		
Lough Ennell	SAC 000685	12th Jan 2018 Generic Version 6.0	7230	Alkaline fens	Yes	Yes	Yes	Yes

[13] Wooddown Bog is a recently designated SAC. Qualifying Interests and Conservation Objectives are not yet published for the SAC. Wooddown Bog SAC was previously designated an Natural Heritage Area (NHA). The Qualifying Interests listed in Table 4.2 are derived from the information provided in the site synopsis for the NHA. https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY000694.pdf

Site Name	Site Code	Conservation Objectives Establishment Date	Feature Code	Qualifying Interests / Special Conservation Interests	Water Dependant Species / Habitats	Nutrient Sensitive Species / Habitats	Potential Hydrological / Hydrogeological Connectivity	Potential Source Pathway Receptor
Carn Park Bog	SAC 002336	23 Nov 2015 Version 1.0	7110	* Active raised bogs	Yes	Yes	Yes	Yes
			7120	Degraded raised bogs still capable of natural regeneration	Yes	Yes		
Crosswood Bog	SAC 002337	10 Feb 2016 Version 1.0	7110	* Active raised bogs	Yes	Yes	Yes	Yes
			7120	Degraded raised bogs still capable of natural regeneration	Yes	Yes		
Mongan Bog	SAC 000580	01 Apr 2016 Version 1	7110	* Active raised bogs	Yes	Yes	Yes	Yes
			7120	Degraded raised bogs still capable of natural regeneration	Yes	Yes		
			7150	Depressions on peat substrates of the *Rhynchosporion*	Yes	Yes		
Lough Derravaragh	SPA 004043	21st Feb 2018 Generic Version 6.0	A038	Whooper Swan (*Cygnus cygnus*)	Yes	Yes	Yes	Yes
			A059	Pochard (*Aythya ferina*)	Yes	Yes		
			A061	Tufted Duck (*Aythya fuligula*)	Yes	Yes		
			A125	Coot (*Fulica atra*)	Yes	Yes		
Lough Ennell	SPA 004044	21st Feb 2018 Generic Version 6.0	A059	Pochard (*Aythya ferina*)	Yes	Yes	Yes	Yes
			A061	Tufted Duck (*Aythya fuligula*)	Yes	Yes		
			A125	Coot (*Fulica atra*)	Yes	Yes		
River Boyne and River Blackwater	SPA 004232	21st Feb 2018 Generic Version 6.0	A229	Kingfisher (*Alcedo atthis*)	Yes	Yes	Yes	Yes
Lough Ree	SPA	21st Feb 2018	A004	Little Grebe	Yes	Yes	Yes	Yes

Site Name	Site Code	Conservation Objectives Establishment Date	Feature Code	Qualifying Interests / Special Conservation Interests	Water Dependant Species / Habitats	Nutrient Sensitive Species / Habitats	Potential Hydrological / Hydrogeological Connectivity	Potential Source Pathway Receptor
	004064	Generic Version 6.0		(*Tachybaptus ruficollis*)				
			A038	Whooper Swan (*Cygnus cygnus*)	Yes	Yes		
			A050	Wigeon (*Anas penelope*)	Yes	Yes		
			A052	Teal (*Anas crecca*)	Yes	Yes		
			A053	Mallard (*Anas platyrhynchos*)	Yes	Yes		
			A056	Shoveler (*Anas clypeata*)	Yes	Yes		
			A061	Tufted Duck (*Aythya fuligula*)	Yes	Yes		
			A065	Common Scoter (*Melanitta nigra*)	Yes	Yes		
			A067	Goldeneye (*Bucephala clangula*)	Yes	Yes		
			A125	Coot (*Fulica atra*)	Yes	Yes		
			A140	Golden Plover (*Pluvialis apricaria*)	Yes	Yes		
			A142	Lapwing (*Vanellus vanellus*)	Yes	Yes		
			A193	Common Tern (*Sterna hirundo*)	Yes	Yes		
Middle Shannon Callows	SPA 004096	21st Feb 2018 Generic Version 6.0	A038	Whooper Swan (*Cygnus cygnus*)	Yes	Yes	Yes	Yes
			A050	Wigeon (*Anas penelope*)	Yes	Yes		
			A122	Corncrake (*Crex crex*)	Yes	Yes		
			A140	Golden Plover	Yes	Yes		

Site Name	Site Code	Conservation Objectives Establishment Date	Feature Code	Qualifying Interests / Special Conservation Interests	Water Dependant Species / Habitats	Nutrient Sensitive Species / Habitats	Potential Hydrological / Hydrogeological Connectivity	Potential Source Pathway Receptor
				(*Pluvialis apricaria*)				
			A142	Lapwing (*Vanellus vanellus*)	Yes	Yes		
			A156	Black-tailed Godwit (*Limosa limosa*)	Yes	Yes		
			A179	Black-headed Gull (*Chroicocephalus ridibundus*)	Yes	Yes		
Mongan Bog	SPA 004017	21st Feb 2018 Generic Version 6.0	A395	Greenland White-fronted Goose (*Anser albifrons flavirostris*)	Yes	Yes	Yes	Yes



River Boyne and
River Blackwater
SPA (004232)

Lough Ree
SPA (004064)

Lough
Owel SPA
(004047)

River Boyne And
River Blackwater
SAC (002299)

Lough Derravaragh
SPA (004043)

Wooddown Bog
SAC (002205)

Mount
Hevey Bog
SAC (002342)

Scragh Bog
SAC (000692)

Lough
Ree SAC (000440)

Lough Owel
SAC (000688)

White Lough, Ben
Loughs And Lough
Doo SAC (001810)

River Shannon
Callows SAC
(000216)

Carn Park
Bog SAC
(002336)

Lough
Lene SAC
(002121)

Ardonagh
Reservoir

Lough Ennell
SAC (000685)

Lough
Ennell SPA (004044)

Mongan
Bog SAC
(000580)

Crosswood
Bog SAC
(002337)

Split Hills And
Long Hill Esker
SAC (001831)

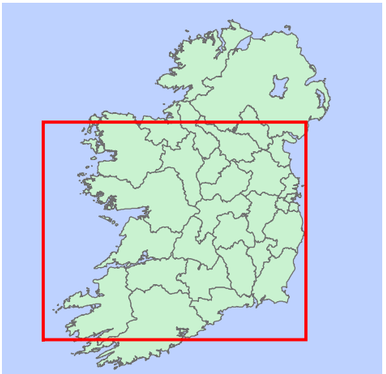
Mongan Bog
SPA (004017)

Middle Shannon
Callows SPA (004096)

Ennis
PWS

W. Clare
RWS (New
WTP)

Limerick City
Environs
Pub DWS



Legend

LEMA Emission Type

- Primary Discharge Point
- Storm Water Overflow
- Waste Water Treatment Plant
- Portloman WTP
- Water Supply Zone Boundary (WSZ)
- Additional WSZ considered for dosing
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Subcatchments intersecting Water Supply Zone(s) related to the WTP
- Zone of Influence

Data Source:
Irish Water
NPWS (April 2018)
EPA

N

0 5 10 20 Kilometres

Client

UISCE EIREANN NA HEIREANN WATER

Project Lead Mitigation Plan
Corrective Water Treatment Works

Figure 4.2

Frewin Hill
High Level Reservoir and Related Water Supply Zones
European Sites within the ZoI which are hydro(geo)logically connected

RPS

Scale: 1:1,000,000 @ A3	**Date:** 28/06/2018
File Ref: MDW0766Arc0005bF04	**Map Projection:** Irish National Grid (TM65)

5 EVALUATION OF POTENTIAL IMPACTS

5.1 CONTEXT FOR IMPACT PREDICTION

The methodology for the assessment of impacts is derived from the *Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites* (EC, 2002). When describing changes/activities and impacts on ecosystem structure and function, the types of impacts that are commonly presented include:

- Direct and indirect effects;
- Short and long-term effects;
- Construction, operational and decommissioning effects; and
- Isolated, interactive and cumulative effects.

5.2 IMPACT IDENTIFICATION

In considering the potential for impacts from implementation of the project, a "source–pathway–receptor" approach has been applied.

The AA has considered the potential for the following likely significant effects:

- Altered structure and functions relating to the physical components of a habitat ("structure") and the ecological processes that drive it ("functions"). For aquatic habitats these include attributes such as vegetation and water quality;
- Altered species composition due to changes in abiotic conditions such as water quality;
- Reduced breeding success (e.g. due to disturbance, habitat alteration, pollution) possibly resulting in reduced population viability; and
- Impacts to surface water and groundwater and the species they support (changes to key indicators).

5.2.1 Construction Phase

The source-pathway-receptor approach has identified a number of impact pathways associated with the construction of orthophosphate treatment works at Portloman WTP. These will be evaluated with regard to the potential for likely significant effects on European Sites. These are potential effects and in the absence of pathways (which is evaluated in **Section 5.3.1** below) the construction phase may not give rise to these effects.

- Sediment laden run-off from excavation areas (trenches for dosing pipelines, carrier water pipework and electrical cables) and the introduction of fine sediments to watercourses connected to the works area causing a deterioration in water quality;
- Dust and noise emissions from excavation (trenches for dosing pipelines, carrier water pipework and electrical cables and transportation of material and equipment close to watercourses causing a deterioration in water quality or disturbance to species (e.g. birds);

- Environmental incident or accident during the construction phase e.g. spillage of a contaminant such as diesel or phosphoric acid causing a deterioration in water quality; and
- Groundwater level drawdown through the excavation of trenches for dosing pipelines, carrier water pipework and electrical cables.

5.2.2 Operational Phase

The source-pathway-receptor approach has identified a number of impact pathways associated with the operation of orthophosphate treatment works at Portloman WTP. These will be evaluated with regard to the potential for likely significant effects on European Sites in relation to:

- Potential negative impacts on aquatic ecosystems through the increase of phosphorus into the aquatic habitats including streams, rivers, lakes, transitional and coastal water bodies. Excessive phosphate within a system may lead to eutrophication; associated impacts may include reduction in oxygen levels, reduction in species diversity and subsequent impacts on animal life;
- Impacts caused by the alteration of groundwater quality may have potential negative impacts on groundwater dependent ecosystems. Groundwater dependent habitats include both surface water habitats (e.g. hard oligo-mesotrophic lakes) and Groundwater Dependent Terrestrial Ecosystems (GWDTEs, e.g. alkaline fens). Any change in the water quality of these systems may have subsequent impacts for these habitats and species;
- The discharge of additional phosphorus loads to the environment (through surface and sub surface pathways) may have potentially negative impacts on nutrient sensitive species such as the freshwater pearl mussel, Atlantic salmon and the white-clawed crayfish. Any deterioration in the conservation status of these species would be considered a negative impact;
- Phosphorus in wastewater collection systems is the result of drinking water and derived from a number of other sources, including phosphorus imported from areas outside the agglomeration through import of sludges or leachates for treatment at the plant. The disposal and use of phosphorus removed in wastewater sludge is regulated (i.e. through nutrient management plans) and should not pose further threat of environmental impact;
- Leakage of phosphates from the drinking water supply network to the environment from use of orthophosphate;
- Direct discharges of increased phosphorus to water bodies from the wastewater treatment plant licensed discharges; and
- Potential discharges to water bodies of untreated effluent potentially high in orthophosphate from Storm Water Overflows (SWOs).

5.3 ASSESSMENT OF IMPACTS

Article 6 of the Habitats Directive states that:

Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications of the site in view of the site's conservation objectives.

The focus of this Screening to inform AA is the risk associated with the additional orthophosphate load due to orthophosphate dosing at Portloman WTP.

5.3.1 Construction Phase

The proposed location for the orthophosphate dosing system will be located within the confines of the existing WTP boundary situated on the north-eastern boundary of the existing treatment building. The assessment of impacts associated with the construction of the corrective water treatment works at Portloman WTP is presented in **Table 5-1** and is based on a desktop study using the following information:

- Design descriptions and drawings for the proposed corrective water treatment works at Portloman WTP;
- A review of hydrological connectivity between the proposed works and European Sites using the EPA Mapping Resources: http://gis.epa.ie/; www.Catchments.ie;
- Ordnance Survey Ireland Map viewer: http://maps.osi.ie/publicviewer/#V1,591271,743300,0,10; and
- Site synopses, conservation objectives and qualifying interest data for European Sites.

Table 5-1: Likely significant effects to European Sites arising as a result of the construction of the corrective water treatment works

Site Name (Code)	Contributing WB Code_Name	WB Type [14]	Evaluation of Potential Significant Effects
Lough Owel SAC (000688)	Lough Owel Fens and Mires (IE_SH_G_166)	GWB	The construction works will be located within the confines of the existing Portloman WTP. Portloman WTP is located directly adjacent to Lough Owel SAC and Lough Owel SAC. **Surface water** There are no surface water bodies within the confines of Portloman WTP. However, the WTP is located on the shore of Lough Owel SPA and Lough Owel SAC, separated by <20m (approx. 16m) of broadleaved woodland. There are no surface water features linking the WTP site to the nearby areas of Lough Owel, but there is the potential for release of construction related pollutants via overland flow due to the proximity of the plant to the lake. However, the proposed construction works are small scale in nature and will be undertaken on built land within the confines of the existing boundary of the Portloman WTP. The works will be localised and contained to the immediate development area which supports buildings and artificial surfaces. Works such as excavations will be contained to the defined working area and necessary works with cast in place concrete will be undertaken within sealed shuttered
Lough Owel SPA (004047)	Lough Owel Fens and Mires (IE_SH_G_166)	GWB	
Scragh Bog SAC (000692)	Lough Owel Fens and Mires (IE_SH_G_166)	GWB	

[14] Monitoring period is annual unless specified.

Site Name (Code)	Contributing WB Code_Name	WB Type [14]	Evaluation of Potential Significant Effects
			units. Such works practices will retain all potential construction related pollutants at source. Therefore, there is no potential for likely significant effects to these European Sites. **Groundwater** The WTP overlies the GWDTE-Lough Owel Fens and Mires (IE_SH_G_166) groundwater body, a localised groundwater body that encapsulates the Lough Owel lake water body and associated peatland and wetland habitats. Groundwater body specific information relating to flow and discharge is available from the GSI[15], and was consulted in making the assessment. GWDTE-Lough Owel Fens and Mires comprises poorly productive bedrock and is bordered primarily by Inny groundwater body (IE_SH_G_110) which is also poorly productive. Both Clara (IE_SH_G_240) and Derravarragh (IE_SH_G_077) groundwater bodies also border GWDTE-Lough Owel Fens and Mires (IE_SH_G_166) and are poorly productive and karst respectively. Lough Owel, the source of drinking water for the town of Mullingar, is a groundwater fed lake that lies partially within the by Inny groundwater body (IE_SH_G_110)[16]. While the source of most water in the lake is currently thought to be the Derryvarragh Cherts of the Derravarragh (IE_SH_G_077) groundwater body, some water is also likely to originate in the Lucan Formation of the Inny (IE_SH_G_110). Locally, groundwater flows at the Portloman WTP site are likely to adapt a preferential flow path to those nearby sections of Lough Owel. The dominant direction of flow within Inny (IE_SH_G_110) is towards the River Inny which traverses the groundwater body and south-west to Lough Ree. The excavation of trenches to install dosing pipelines, carrier water pipework and electrical cables to 700mm below ground level has the potential to interfere with the water table potentially causing groundwater drawdown. As the excavation works will not be extensive (up to c. 50m for pipework and to an approximate depth of 700mm) and will be situated upon made ground, interference with water table is unlikely to occur. Any interference would be localised, minor and temporary. As there is no information available for the GWDTE-Lough Owel

[15] https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/activities/understanding-ireland-groundwater/Pages/Groundwater-bodies.aspx
[16] GSI - Inny GWB: Summary of Initial Characterisation

Site Name (Code)	Contributing WB Code_Name	WB Type [14]	Evaluation of Potential Significant Effects
			Fens and Mires (IE_SH_G_166) groundwater body on GSI, it is assumed that the characteristics are similar in nature to the Inny (IE_SH_G_110) which borders the majority of the GWDTE. In general the effective thickness of this aquifer is likely to be about 15m, comprising a weathered zone of a few metres and a connected fractured zone beneath this[16]. Therefore, there is no potential for likely significant effects to the underlying groundwater body, the receiving surface water feature and subsequently those European Sites included for further assessment, as a result of the construction of the corrective water treatment works at Portloman WTP.

5.3.2 Operational Phase

In the case of the additional orthophosphate load due to dosing at Portloman WTP, the EAM conceptual model developed for orthophosphate transfer identified the surface and groundwater bodies that have the potential to be impacted by the orthophosphate dosing and for which hydrological or hydrogeological pathway to the European Sites exist. These water bodies are listed in **Table 5 2**. The table identifies the following:

- European Sites included for assessment;
- Water bodies hydrologically or hydrogeologically connected to the European Sites;
- Existing orthophosphate status and trend of each water body;
- The baseline orthophosphate concentration of each water body;
- 75% of the upper threshold;
- Cumulative orthophosphate load to surface from leakage, DWWTS and agglomerations;
- The modelled orthophosphate concentration following dosing at the WTP; and,
- The orthophosphate potential baseline concentration (mg/l) following dosing at the WTP.

The EAM has been undertaken assuming the capacity of a water body is a measure of its ability to absorb extra pressures before its indicative quality changes. In order to do this the indicative quality as presented in the EPA's WFD APP is used as the baseline concentration for the different monitoring points within a water body. For example, a river water body with Good orthophosphate indicative quality will have mean orthophosphate value in the range 0.025 to 0.035 mg/l. River water bodies with mean orthophosphate concentrations of 0.0275 mg/l have 75% capacity left, i.e. high capacity, while river water bodies with a mean of 0.0325 mg/l have lower capacity (25%) as the baseline concentrations are closer to the Good/Moderate indicative quality boundary.

When assessing the increase in orthophosphate concentrations as a result of proposed dosing, an increase which is <5% of the Good / High indicative quality boundary, i.e. 0.00125mg/l, is excluded from further assessment and is assumed to result in no significant impact to a water body. If the baseline orthophosphate concentration in addition to the potential increase in orthophosphate

concentration as a result of dosing is less than the 75% upper threshold of the indicative quality band for a water body, this also results in no significant impact.

For significance threshold band (i.e. 75% of the upper threshold for the indicative quality band) in transitional and coastal water bodies, a sliding linear scale is used depending on median salinity. The EAM determines if the dosing will result in a baseline concentration that exceeds the relevant 75% threshold for the indicative quality bands (based on salinities) in order to evaluate whether there could be an increased risk of deterioration in indicative quality.

Where a water body is unassigned and therefore does not have monitored orthophosphate concentrations or salinity levels, a conservative approach is used whereby the surrogate indicative quality is calculated based on inputting water bodies or pressures acting on the water body but the more conservative freshwater orthophosphate limits for the different indicative quality bands are applied[17].

Therefore, in assessing the additional loads from the proposed orthophosphate dosing, the capacity of the water body will be assessed. This information is available on the WFD App on a national basis using the "Distance to Threshold" parameter, where water bodies with high capacity are termed "Far" from the threshold and those with low capacity are "Near" the threshold.

It is predicted that orthophosphate dosing will not have a significant effect on water bodies (or the Conservation Objectives of a European Site) where it does not cause the P concentration to increase to a level within 25% of the remaining capacity left within the existing orthophosphate indicative quality band, i.e. cause a change in the distance to threshold from far to near. This assessment will be supported by trend analysis as outlined below to ensure the additional orthophosphate dosing and statistically significant trends for a water body will not result in deterioration in status by 2021 even where the distance to threshold is currently assessed to be far. Where the water body baseline indicative quality concentration is "Near" to the threshold before the effect of orthophosphate dosing is considered, this does not cause an automatic fail for this test. If the predicted increase in concentration due to orthophosphate is very low (i.e. below 5% of the Good/Moderate indicative quality this test will pass as the orthophosphate dosing itself can be defined as having no risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.

The identification of statistically and environmentally significant trends for water bodies is a specific requirement of the WFD and the Groundwater Daughter Directive. Guidance on trends in groundwater assessments (UKTAG 2009, EPA 2010) indicates that trends are environmentally significant if they indicate that the Good Ecological Status will not be achieved within two future river basin cycles, i.e. within the next 12 years. For surface water bodies, the environmental significance is evaluated until 2021 in the WFD App.

This test applies only when the trend for orthophosphate concentration for the water body is considered statistically significant in the WFD App. For surface water bodies, the predicted concentration for 2021 is given and the additional concentration due to orthophosphate dosing is added and assessed as appropriate. If the new calculated predicted concentration prevents the achievement of good indicative quality, then this test fails.

[17] The conservative thresholds in transitional and coastal water bodies for orthophosphate indicative quality in unassigned water bodies i.e. upper limits are: High 0.025 mg/l; Good 0.04 mg/l; Moderate 0.06 mg/l; Poor 0.09 mg/l; Bad – N/A. The higher range for transitional and coastal water bodies with a median salinity ≤ 17mg/l are: High 0.03 mg/l; Good 0.06 mg/l; Moderate 0.1 mg/l; Poor 0.2 mg/l; Bad N/A.

This assessment assumes a dosing rate of 0.8 mg/l.

An additional test for groundwater bodies states that downward trends should not be reversed as a result of pollution. This test applies to GWB with statistically significant trends according to the WFD App and the Sens Slope provided is used to assess direction and strength of trend. If the trend is negative and the predicted increase in orthophosphate concentration is lower than the absolute value of the Sens Slope, then the test passes.

The initial assessment is automated using existing WFD App data. If tests fail and more investigation is required, more recent data can be used and the assessment rerun. For example, if 2015 - 2017 concentrations for a river water body are available, the 2015 – 2017 average can be used instead of the 2014 baseline provided in the WFD App.

Table 5-2: Surface and Groundwater Bodies within the WSZ with a Hydrological or Hydrogeological Connection to European Sites

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
Split Hills and Long Hill Esker SAC (001831)	IE_SH_25B280390 Brosna_010	RWB	Good Downwards Far	0.029	0.033	10.5	0.0006	0.030 ‡	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090006 Brosna_020	RWB	*Poor*	0.029	0.033	7.2	0.0005	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090100 Brosna_030	RWB	Good Downwards Far	0.030	0.033	52.3	0.0010	0.031	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090200 Brosna_040	RWB	*Moderate*	*0.046*	*0.051*	*39.6*	*0.0002*	*0.046*	No risk of deterioration in the Ortho P indicative quality or of preventing

[18] Monitoring period is annual unless specified.
[19] Surrogate Indicative Quality in italic.
[20] Distance to threshold.
[21] Baseline year is 2021 for surface water bodies and 2016 for groundwater bodies.
[22] Surrogate concentration is given in italic mg/l
[23] Values above 5% of Good / High indicative quality boundary (0.00125 mg/l) for SW or 5% of Good / Fail indicative quality boundary (0.00175 mg/l) for GW highlighted in yellow.
[24] Green cells signify that there is no risk of deterioration in indicative quality of the water body following dosing at the WTP.

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
									the achievement of WFD objectives.
	IE_SH_25B090250 Brosna_050	RWB	Good Downwards Far	0.030	0.033	39.6	0.0003	0.031	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.030	0.033			0.031	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090400 Brosna_060	RWB	*Good*	*0.030*	*0.033*	*39.6*	*0.0002*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_G_240 Clara	GWB	*Good*	*0.018*	*0.026*	0.7	0.0000	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
Lough Lene SAC (002121)	IE_SH_G_077 Derravarragh	GWB	*Good*	*0.018*	*0.026*	*6.0*	*0.0002*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
Lough Owel SAC (000688)	IE_SH_G_077 Derravarragh	GWB	*Good*	*0.018*	*0.026*	*6.0*	*0.0002*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
Scragh Bog SAC (000692)	IE_SH_G_077 Derravarragh	GWB	*Good*	*0.018*	*0.026*	*6.0*	*0.0002*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
Lough Ree SAC (000440)	IE_SH_26I010800 Inny_070	RWB	*Good*	*0.030*	*0.033*	*9.1*	*0.0000*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26I011000 Inny_080	RWB	*Good*	*0.030*	*0.033*	*9.1*	*0.0000*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26I011150 Inny_090	RWB Multiple Monitoring Points	Good Downwards Far	0.030	0.033	0.0	0.0000	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.030	0.033			0.030	No risk of deterioration in the Ortho P indicative quality or of preventing

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
									the achievement of WFD objectives.
			Good Downwards Far	0.029	0.033			0.029	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26I011400 Inny_110	RWB	*Moderate*	*0.046*	*0.051*	*0.0*	*0.0000*	*0.046*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26G010100 Gaine_010	RWB	*Poor*	*0.077*	*0.087*	*4.7*	*0.0006*	*0.077*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26G010270 Gaine_020	RWB Multiple Monitoring Points	Good Downwards Far	0.030	0.033	1.2	0.0001	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.029	0.033			0.029	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
	IE_SH_G_110 Inny	GWB	*Good*	*0.018*	*0.026*	*23.4*	*0.0001*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
Mount Hevey Bog SAC (002342)	IE_EA_G_001 Athboy	GWB	*Good*	*0.018*	*0.026*	*51.3*	*0.0003*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
River Boyne and River Blackwater SAC (002299)	IE_EA_07K010060 Kinnegad_010	RWB	*Moderate*	*0.046*	*0.051*	*2.5*	*0.0002*	*0.046*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07K010100 Kinnegad_020	RWB	Good Downwards Far	0.029	0.033	4.0	0.0002	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07K010200 Kinnegad_030	RWB	High Downwards Far	*0.015*	*0.019*	17.3	0.0006	*0.016*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Near	0.033	0.033			0.033	No risk of deterioration in the Ortho P indicative quality or of preventing

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
									the achievement of WFD objectives.
	IE_EA_07R010090 Riverstown_010	RWB	High Downwards Near	0.020	0.019	31.9	0.0008	0.021	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07R010200 Riverstown_020	RWB	Good Downwards Far	0.029	0.033	6.6	0.0001	0.029	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			High Downwards Near	0.024	0.019			0.024	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.029	0.033			0.029	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07B340940 Ballyhaw_010	RWB	*Moderate*	*0.046*	*0.051*	*2.9*	*0.0004*	*0.046*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
	IE_EA_07D010080 Deel (Raharney)_020	RWB	*Good*	*0.030*	*0.033*	*2.3*	*0.0000*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07D010200 Deel (Raharney)_030	RWB	*Moderate*	*0.046*	*0.051*	*4.3*	*0.0001*	*0.046*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07D010300 Deel (Raharney)_040	RWB	*Good*	*0.030*	*0.033*	*20.0*	*0.0002*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07D010400 Deel (Raharney)_050	RWB	High Downwards Near	0.024	0.019	31.0	0.0002	0.024	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07D010600 Deel (Raharney)_060	RWB	*Good*	*0.030*	*0.033*	*11.3*	*0.0001*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07K330580 Killynan_010	RWB	*Good*	*0.030*	*0.033*	*1.7*	*0.0003*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
									objectives.
	IE_EA_07S020075 Stonyford_020	RWB	Good Downwards Far	0.030	0.033	0.5	0.0000	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.030	0.033			0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.029	0.033			0.029	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07S020400 Stonyford_040	RWB	Moderate	0.046	0.051	4.5	0.0001	0.046	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_G_001 Athboy	GWB	*Good*	*0.018*	*0.026*	*51.3*	*0.0003*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
Wooddown Bog SAC (002205)	IE_EA_07R010090 Riverstown_010	RWB	High Downwards Near	0.020	0.019	31.9	0.0008	0.021	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_G_001 Athboy	GWB	*Good*	*0.018*	*0.026*	*51.3*	*0.0003*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
White Lough, Ben Loughs and Lough Doo SAC (001810)	IE_EA_G_001 Athboy	GWB	*Good*	*0.018*	*0.026*	*51.3*	*0.0003*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_G_077 Derravarragh	GWB	*Good*	*0.018*	*0.026*	*6.0*	*0.0002*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
River Shannon Callows SAC (000216)	IE_SH_26G010100 Gaine_010	RWB	*Poor*	*0.077*	*0.087*	*4.7*	*0.0006*	*0.077*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26G010270 Gaine_020	RWB	Good Downwards Far	0.030	0.033	1.2	0.0001	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
									objectives.
			Good Downwards Far	0.029	0.033			0.029	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B280390 Brosna_010	RWB	Good Downwards Far	0.029	0.033	10.5	0.0006	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090006 Brosna_020	RWB	Good Far	0.029	0.033	7.2	0.0005	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090100 Brosna_030	RWB	Good Downwards Far	0.030	0.033	52.3	0.0010	0.031	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090200 Brosna_040	RWB	*Moderate*	*0.046*	*0.051*	*39.6*	*0.0002*	*0.046*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
	IE_SH_25B090250 Brosna_050	RWB	Good Downwards Far	0.030	0.033	39.6	0.0003	0.031	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.030	0.033			0.031	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090400 Brosna_060	RWB	*Good*	*0.030*	*0.033*	*39.6*	*0.0002*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090450 Brosna_070	RWB	Good Downwards Far	0.029	0.033	39.6	0.0002	0.029	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090600 Brosna_080	RWB	Good Downwards Near	0.024	0.019	39.6	0.0002	0.024	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			High Downwards Far	0.011	0.019			0.011	No risk of deterioration in the Ortho P indicative quality or of preventing

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
									the achievement of WFD objectives.
	IE_SH_25B090761 Brosna_100**	RWB	High Downwards Far	0.011	0.019	39.6	0.0001	0.011	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090950 Brosna_120**	RWB	High Downwards Far	0.010	0.019	39.6	0.0001	0.010	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25S012000 Shannon (Lower)_010**	RWB	High Downwards Far	0.010	0.019	39.6	0.0000	0.010	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26I010800 Inny_070	RWB	*Good*	*0.030*	*0.033*	*9.1*	*0.0000*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26I011000 Inny_080	RWB	*Good*	*0.030*	*0.033*	*9.1*	*0.0000*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
	IE_SH_26I011150 Inny_090	RWB	Good Downwards Far	0.030	0.033	0.0	0.0000	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.030	0.033			0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.029	0.033			0.029	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26I011400 Inny_110	RWB	*Moderate*	*0.046*	*0.051*	*0.0*	*0.0000*	*0.046*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_G_110 Inny	GWB	*Good*	*0.018*	*0.026*	*23.4*	*0.0001*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
Lough Ennell SAC (000685)	IE_SH_25B280390 Brosna_010	RWB	Good Downwards Far	0.029	0.033	10.5	0.0006	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing

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									the achievement of WFD objectives.
	IE_SH_25B090006 Brosna_020	RWB	Good Far	0.029	0.033	7.2	0.0005	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090100 Brosna_030	RWB	Good Downwards Far	0.030	0.033	52.3	0.0010	0.031	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090200 Brosna_040	RWB	*Moderate*	*0.046*	*0.051*	*39.6*	*0.0002*	*0.046*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_G_240 Clara	GWB	*Good*	*0.018*	*0.026*	*1.4*	*0.0000*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
Carn Park Bog SAC (002336)	IE_SH_G_110 Inny	GWB	*Good*	*0.018*	*0.026*	*23.4*	*0.0001*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
Crosswood Bog SAC (002337)	IE_SH_G_110 Inny	GWB	*Good*	*0.018*	*0.026*	*23.4*	*0.0001*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
Mongan Bog SAC (000580)	IE_SH_G_240 Clara	GWB	*Good*	*0.018*	*0.026*	*1.4*	*0.0000*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_G_110 Inny	GWB	*Good*	*0.018*	*0.026*	*23.4*	*0.0001*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
Lough Derravaragh SPA (004043)	IE_SH_26I010800 Inny_070	RWB	*Good*	*0.030*	*0.033*	*9.1*	*0.0000*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_G_077 Derravarragh	GWB	*Good*	*0.018*	*0.026*	*6.0*	*0.0002*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_G_110 Inny	GWB	*Good*	*0.018*	*0.026*	*23.4*	*0.0001*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
									objectives.
Lough Owel SPA (004047)	IE_SH_G_077 Derravarragh	GWB	*Good*	*0.018*	*0.026*	*6.0*	*0.0002*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
Lough Ennell SPA (004044)	IE_SH_25B280390 Brosna_010	RWB	Good Downwards Far	0.029	0.033	10.5	0.0006	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090006 Brosna_020	RWB	Good Far	0.029	0.033	7.2	0.0005	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090100 Brosna_030	RWB	Good Downwards Far	0.030	0.033	52.3	0.0010	0.031	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090200 Brosna_040	RWB	*Moderate*	*0.046*	*0.051*	*39.6*	*0.0002*	*0.046*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.

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	IE_SH_G_240 Clara	GWB	*Good*	*0.018*	*0.026*	*1.4*	*0.0000*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
River Boyne and River Blackwater SPA (004232)	IE_EA_07K010060 Kinnegad_010	RWB	*Moderate*	*0.046*	*0.051*	*2.5*	*0.0002*	*0.046*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07K010100 Kinnegad_020	RWB	Good Downwards Far	0.029	0.033	4.0	0.0002	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07K010200 Kinnegad_030	RWB	High Downwards Far	*0.015*	*0.019*	17.3	0.0006	*0.016*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Near	0.033	0.033			0.033	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07R010090 Riverstown_010	RWB	High Downwards Near	0.020	0.019	31.9	0.0008	0.021	No risk of deterioration in the Ortho P indicative quality or of preventing

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									the achievement of WFD objectives.
	IE_EA_07R010200 Riverstown_020	RWB	Good Downwards Far	0.029	0.033	6.6	0.0001	0.029	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			High Downwards Near	0.024	0.019			0.024	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.029	0.033			0.029	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07D010080 Deel (Raharney)_020	RWB	*Good*	*0.030*	*0.033*	*2.3*	*0.0000*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07D010200 Deel (Raharney)_030	RWB	*Moderate*	*0.046*	*0.051*	*4.3*	*0.0001*	*0.046*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.

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	IE_EA_07D010300 Deel (Raharney)_040	RWB	*Good*	*0.030*	*0.033*	*20.0*	*0.0002*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07D010400 Deel (Raharney)_050	RWB	High Downwards Near	0.024	0.019	31.0	0.0002	0.024	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07D010600 Deel (Raharney)_060	RWB	*Good*	*0.030*	*0.033*	*11.3*	*0.0001*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07K330580 Killynan_010	RWB	*Good*	*0.030*	*0.033*	*1.7*	*0.0003*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07S020075 Stonyford_020	RWB	Good Downwards Far	0.030	0.033	0.5	0.0000	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.030	0.033			0.030	No risk of deterioration in the Ortho P indicative quality or of preventing

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									the achievement of WFD objectives.
			Good Downwards Far	0.029	0.033			0.029	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_07S020400 Stonyford_040	RWB	Moderate	0.046	0.051	4.5	0.0001	0.046	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_EA_G_001 Athboy	GWB	*Good*	*0.018*	*0.026*	*51.3*	*0.0003*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
Lough Ree SPA (004064)	IE_SH_26I010800 Inny_070	RWB	*Good*	*0.030*	*0.033*	*9.1*	*0.0000*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26I011000 Inny_080	RWB	*Good*	*0.030*	*0.033*	*9.1*	*0.0000*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26I011150	RWB	Good Downwards	0.030	0.033	0.0	0.0000	0.030	No risk of deterioration in

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	Inny_090		Far						the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.030	0.033			0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.029	0.033			0.029	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26I011400 Inny_110	RWB	*Moderate*	*0.046*	*0.051*	*0.0*	*0.0000*	*0.046*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26G010100 Gaine_010	RWB	*Poor*	*0.077*	*0.087*	*4.7*	*0.0006*	*0.077*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26G010270 Gaine_020	RWB	Good Downwards Far	0.030	0.033	1.2	0.0001	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD

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									objectives.
			Good Downwards Far	0.029	0.033			0.029	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_G_110 Inny	GWB	*Good*	*0.018*	*0.026*	*23.4*	*0.0001*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
Middle Shannon Callows SPA (004096)	IE_SH_26G010100 Gaine_010	RWB	*Poor*	*0.077*	*0.087*	*4.7*	*0.0006*	*0.077*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26G010270 Gaine_020	RWB	Good Downwards Far	0.030	0.033	1.2	0.0001	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.029	0.033			0.029	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
	IE_SH_25B280390 Brosna_010	RWB	Poor Downwards Far	0.056	0.087	5.6	0.0003	0.057 ‡	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090006 Brosna_020	RWB	Good Far	0.029	0.033	7.2	0.0005	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090100 Brosna_030	RWB	Good Downwards Far	0.030	0.033	52.3	0.0010	0.031	The modelled concentration is >5% High/Good indicative quality boundary but is within 75% of the upper indicative quality threshold therefore there is no risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090200 Brosna_040	RWB	*Moderate*	*0.046*	*0.051*	*39.6*	*0.0002*	*0.046*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090250 Brosna_050	RWB	Good Downwards	0.030	0.033	39.6	0.0003	0.031	No risk of deterioration in the Ortho P indicative

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
			Far						quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.030	0.033			0.031	The post dosing conc. exceeds the 75% upper indicative quality threshold; however this is due to the baseline ortho P conc. The modelled conc. is 0.0003mg/l therefore there is no risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090400 Brosna_060	RWB	*Good*	*0.030*	*0.033*	*39.6*	*0.0002*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090450 Brosna_070	RWB	Good Downwards Far	0.029	0.033	39.6	0.0002	0.029	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090600 Brosna_080	RWB	Good Downwards Near	0.024	0.019	39.6	0.0002	0.024	No risk of deterioration in the Ortho P indicative quality or of preventing

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
									the achievement of WFD objectives.
			High Downwards Far	0.011	0.019			0.011	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090761 Brosna_100**	RWB	High Downwards Far	0.011	0.019	39.6	0.0001	0.011	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B090950 Brosna_120**	RWB	High Downwards Far	0.010	0.019	39.6	0.0001	0.010	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25S012000 Shannon (Lower)_010**	RWB	High Downwards Far	0.011	0.019	39.6	0.0000	0.011	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26I010800 Inny_070	RWB	*Good*	*0.030*	*0.033*	*9.1*	*0.0000*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
	IE_SH_26I011000 Inny_080	RWB	*Good*	*0.030*	*0.033*	*9.1*	*0.0000*	*0.030*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26I011150 Inny_090	RWB	Good Downwards Far	0.030	0.033	0.0	0.0000	0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.030	0.033			0.030	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Downwards Far	0.029	0.033			0.029	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_26I011400 Inny_110	RWB	*Moderate*	*0.046*	*0.051*	*0.0*	*0.0000*	*0.046*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_G_110 Inny	GWB	*Good*	*0.018*	*0.026*	*23.4*	*0.0001*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing

Site Name (Code)	Contributing WB Code_Name	WB Type[18]	Ortho P Indicative Quality[19] and Trends[20]	Baseline [21] Ortho P Conc.[22] (mg/l)	75% of Indicative Quality Upper Threshold (mg/l)	Total Ortho P load to SW from Leakage, DWWTS & Agglom. (kg/yr)	Modelled Increase in Conc.[23] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[24]	Evaluation
									the achievement of WFD objectives.
Mongan Bog SPA (004017)	IE_SH_G_240 Clara	GWB	*Good*	*0.018*	*0.026*	*1.4*	*0.0000*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_G_110 Inny	GWB	*Good*	*0.018*	*0.026*	*23.4*	*0.0001*	*0.018*	No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.

^ Effective Rainfall used to calculate concentration
‡ Load from WWTP / SWO following treatment included
* Ortho P status is not available and modelled concentration is below 5% of the Good / High status boundary, so no impact due to orthophosphate dosing is assumed.
**Additional modelling specific to the AA screening and river water bodies are not listen within the EAM report.

The assessment of discharges from the wastewater collection system and WWTPs and the loading from leakage and DWWTSs to lakes is based on the Vollenweider equation. This is an empirical equation which aims to predict the critical total P loading to a lake where eutrophic conditions can occur. It is calculated based on area, mean depth, and hydraulic outflow of lake (Vollenweider, 1968[25]) (**Table 5-3).**

[25] Vollenweider, R. A. (1968) *Scientific fundamentals of stream and lake eutrophication with particular reference to nitrogen and phosphorus*. OECD Technical Report DAF/DST/88. Organisation of Economic Cooperation and Development, Paris.

Table 5-3: Vollenweider assessment of lakes within the WSZ

Site Name (Code)	ContributingWB Code_Name	Parameter	TP Indicative Quality and Trends[26]	Baseline[27] Ortho P Conc.[28] (mg/l)	TP Total Dosing Load (kg/yr)	Est. Existing Areal Loading Based on Vollenweider ($mg/m^2/yr$)	Est. Post Dosing Areal Loading Based on Vollenweider ($mg/m^2/yr$)	Lc – Critical Load ($mg/m^2/yr$)	Evaluation %
Split Hills And Long Hill Esker SAC (001831)	IE_SH_25_188 Ennell Lough	TP	Good Downwards Far	0.019	39.6	272.3	275.67	239.1	1.3
Lough Ree SAC (000440)	IE_SH_708 Derravaragh (Lough)	TP	Good Downwards Far	0.014	9.8	743.9	745.0	673.5	0. 1
River Shannon Callows SAC (000216)	IE_SH_708 Derravaragh (Lough)	TP	Good Downwards Far	0.014	9.8	743.9	745.0	673.5	0.1
	IE_SH_25_188 Ennell Lough	TP	Good Downwards Far	0.019	39.6	272.3	275.67	239.1	1.3
Lough Ennell SAC (000685)	IE_SH_25_188 Ennell Lough	TP	Good Downwards Far	0.019	39.6	272.3	275.67	239.1	1.3
Lough Derravaragh SPA (004043)	IE_SH_708 Derravaragh (Lough)	TP	Good Downwards Far	0.014	9.8	743.9	745.0	673.5	0.1
Lough Ennell SPA (4044)	IE_SH_25_188 Ennell Lough	TP	Good Downwards Far	0.019	39.6	272.3	275.67	239.1	1.3

[26] Distance to Threshold. Surrogate indicative quality in *italic*.
[27] Baseline year is 2014.
[28] Surrogate concentrations given in *italic*.

Site Name (Code)	ContributingWB Code_Name	Parameter	TP Indicative Quality and Trends[26]	Baseline[27] Ortho P Conc.[28] (mg/l)	TP Total Dosing Load (kg/yr)	Est. Existing Areal Loading Based on Vollenweider ($mg/m^2/yr$)	Est. Post Dosing Areal Loading Based on Vollenweider ($mg/m^2/yr$)	Lc – Critical Load ($mg/m^2/yr$)	Evaluation %
Lough Ree SPA (004064)	IE_SH_708 Derravaragh (Lough)	TP	Good Downwards Far	0.014	9.8	743.9	745.0	673.5	0.1
Middle Shannon Callows SPA (004096)	IE_SH_708 Derravaragh (Lough)	TP	Good Downwards Far	0.014	9.8	743.9	745.0	673.5	0.1
	IE_SH_25_188 Ennell Lough	TP	Good Downwards Far	0.019	39.6	272.3	275.67	239.1	1.3

5.3.3 Assessment of Direct Impacts from WWTPs and Storm Water Overflows

The conceptual model developed for P transfer identifies a number of pathways by which orthophosphate can reach receptors. In the case of these pathways, factors contributing to the environmental risk are:

- the quantitative increase in P loading to wastewater collecting systems;
- the efficiency of P removal at WWTPs;
- the increased P loading to surface waters via storm water overflows; and
- the sensitivity of receptors.

For the purposes of assessing the potential impact on the receiving environment a number of scenarios have been assessed at the agglomerations which receive water from the WSZ (**Table 5-4**). The potential impact based on the existing situation prior to orthophosphate dosing is established and compared to the potential impact on the receiving waters post-dosing. In-combination impacts of the operation of the SWO and the continuous discharge from the WWTP were also assessed.

The pre-dosing scenario is based on a mass balance calculation of both the intermittent SWO discharges, in combination with the continuous discharge from the WWTP. A comparison of the pre- and post-dosing scenarios is made to identify changes in predicted concentrations downstream of the point of discharge. A summary of the results of impact of orthophosphate dosing downstream of each agglomeration is provided below.

Table 5-4 provides the data used for the WWTP continuous discharge, and the SWO intermittent discharge, to compare with the emission limit values (ELVs) from the waste water discharge licence (WWDL) (if it has been set) that are applicable to the agglomeration discharge to transitional waters or freshwaters. The resultant concentration in the waters downstream of the discharge point from the agglomerations is provided in **Table 5-5**, assuming low flows and therefore the SWOs are inactive**.**

The quantification of loads in a mass balance calculation was carried out using the standardised approach developed in the EAM which was devised using national data sets and applying a series of conservative and robust assumptions. The model was prepared in discussion with and utilises data supplied by the EPA, NPWS and the DHPLG to ensure that a robust model simulation is provided.

Table 5-4: Increased loading/concentration due to Orthophosphate Dosing – Dosing rate = 0.8mg/l

Agglomeration and Discharge Type	ELVs from WWDL (mg/l)		TP Load Kg/Yr	Ortho P concentration mg/l *TP – Ortho P Conversion factor varied for sensitivity analysis (40%, 50%, 68%)*		
				0.5	*0.4*	*0.68*
Mullingar Primary Discharge	0.20 (Ortho P) Compliant with ELV within the 2017 AER	**Existing**	560	0.07	0.06	0.10
		Post Dosing	560	0.07	0.06	0.10
Mullingar SWOs (4 No.)	n/a	**Existing**	408.0	1.78	1.43	2.43
		Post Dosing	487.2	2.13	1.70	2.90
Killucan Primary Discharge	2.0 (TP) Compliant with ELV within the 2017 AER	**Existing**	59	0.06	0.05	0.08
		Post Dosing	59	0.06	0.05	0.08
Killucan SWO (1 No.)	n/a	**Existing**	34.2	1.13	0.90	1.54
		Post Dosing	39.3	1.30	1.04	1.77
Kinnegad Primary Discharge	0.60 (Ortho P) Compliant with ELV within the 2017 AER	**Existing**	95	0.10	0.08	0.14
		Post Dosing	95	0.10	0.08	0.14
Kinnegad SWO (3 No.)	n/a	**Existing**	39.7	1.44	1.15	1.96
		Post Dosing	51.03	1.85	1.48	2.52

Table 5-5: Mass balance assessment based on 0.8 mg/l dosing using available background concentrations and low flow information (Assessment undertaken at 95%ile flows and assumes SWO will not be activated)

Agglom.	RWB Name_Code for Primary Discharge	Background Conc. (mg/l) (annual mean from AER u/s monitoring point)	Modelled Conc. Existing (mg/l)	Modelled Conc. Post Dosing (mg/l)	% Inc
Mullingar (D0008-01)	BROSNA_030 IE_SH_25B090100	0.029	0.036	0.036	1.9
Killucan (D0100-01)	RIVERSTOWN_020 IE_EA_07R010200	0.029	0.030	0.030	0.2
Kinnegad (D0104-01)	KINNEGAD_030 IE_EA_07K010200	0.029	0.032	0.033	1.0

* No P status assigned, surrogate status given.

Mullingar Agglomeration

Mullingar agglomeration discharges into Brosna_030 (IE_SH_25B090100) which is hydrologically connected to Lough Ennell SAC and SPA; River Shannon Callows SAC and the Middle Shannon Callows SPA. The modelled effluent concentrations for both existing and post-dosing scenarios are compliant with the orthophosphate ELV set in WWDL in the 2021 AER. Mullingar agglomeration receives tertiary treatment i.e. agglomeration receives tertiary treatment i.e. chemical dosing for orthophosphate removal. Tertiary treatment is assumed to remove any additional load in the effluent due to orthophosphate dosing. When mean flows are taken into account the increase in the receiving water is negligible (1.9 %) (**Table 5-5**). Therefore, there is no risk of failing to achieve WFD

objectives for the Brosna_030 (IE_SH_25B090100), and its hydrologically connected European Sites as a result of dosing at Portloman WTP.

Killucan Agglomeration

Killucan agglomeration discharges into Riverstown_020 (IE_EA_07R010200) which is hydrologically connected to the River Boyne and River Blackwater SAC and SPA. The modelled effluent concentrations for both existing and post-dosing scenarios are compliant with the Total Phosphorus ELVs set in WWDL in the 2021 AER. Killucan agglomeration receives tertiary treatment i.e. agglomeration receives tertiary treatment i.e. chemical dosing for orthophosphate removal. Tertiary treatment is assumed to remove any additional load in the effluent due to orthophosphate dosing. When mean flows are taken into account the increase in the receiving water is negligible (0.2%) (**Table 5-5**). Therefore, there is no risk of failing to achieve WFD objectives for the Riverstown_020 (IE_EA_07R010200), and its hydrologically connected European Sites as a result of dosing at Portloman WTP.

Kinnegad Agglomeration

Kinnegad agglomeration discharges to Kinnegad_030 (IE_EA_07K010200) which is hydrologically connected to the River Boyne and River Blackwater SAC and SPA. The modelled effluent concentrations for both existing and post-dosing scenarios are compliant with the orthophosphate ELVs set in WWDL in the 2017 AER. The monitoring in the 2021 AER notes two non-compliances for orthophosphate which were due to low dosing rates during the tertiary treatment process. Kinnegad agglomeration receives tertiary treatment i.e. chemical dosing for orthophosphate removal. Tertiary treatment is assumed to remove any additional load in the effluent due to orthophosphate dosing. When mean flows are taken into account the increase in the receiving water is negligible (1.0 %) (**Table 5-5**). Therefore, there is no risk of failing to achieve WFD objectives for the Kinnegad_030 (IE_EA_07K010200) and its hydrologically connected European Sites as a result of dosing at Portloman WTP.

5.3.4 Assessment of Indirect Impact from subsurface flow

5.3.4.1 Sub surface flows from leakage and DWWTP

Step 4 of **Appendix C** outlines the distributed inputs to river water bodies from sub-surface pathways. The modelled concentrations due to subsurface pathways are insignificant in all water bodies, i.e. < 0.00125 mg/l (5% of the High / Good indicative quality boundary for most surface water bodies.

5.3.4.2 Groundwater Assessment

Table 3 of **Appendix C** outlines the predicted loads and concentrations to GWBs connected to the WSZ. The susceptibility to GW is in general, moderate across the WSZ and the proportion of extreme vulnerability area is small; however, there are large areas of high vulnerability. In most cases, post-dosing orthophosphate increase in GWBs is low (i.e. < 5% of Good/Fail status boundary (0.00175 mg/l) and the Chemical Status for all GWBs is Good. Marlinstown Landfill Waste Facility (W0071-02) (IE_EA_G_083) is a small GWB delineated to separate adjacent GWBs from the local pressure. The load to this GWB is small but the modelled concentration is significant due to the low groundwater

flows in this small GWB. The chemical status is given as Poor (GW), but this is not likely to be due to orthophosphate. The WFD Risk Assessment under the RBMP Characterisaton process has classified the water body as Not at Risk for all WFD Objectives. Therefore, the Surrogate indicative quality is given as "Good" and this GWB won't impose any risk on the overlying WB (RIVERSTOWN_010) as this has Good Ortho phosphate indicative quality. The increase in orthophosphate concentration does not cause a breach of the 75% upper indicative quality threshold for orthophosphate There are no European Sites hydrogeologically connected to this GWB.

Therefore, there is no risk of deterioration in the orthophosphate indicative quality or of preventing the achievement of WFD objectives within the hydrogeologically connected groundwater bodies due to orthophosphate dosing.

5.3.4.3 Combined Assessment

Table 4.A of **Appendix C** provides details of the combined orthophosphate inputs to river water bodies from direct discharges, DWWTSs and leakage loads. All river water bodies are below 5% of the Good / High boundary (0.00125 mg/l) following the assessment of combined loads. Therefore there is no risk of deterioration in the orthophosphate indicative quality of all water bodies following dosing at Portloman WTP.

For two river water bodies, Riverstown_020 (IE_EA_07R010200) and Stonyford_040 (IE_EA_07S020400), the existing baseline concentration exceeded 75% of the upper indicative quality threshold for orthophosphate. However, the modelled post-dosing concentration was below 5% of the Good/High status boundary at 0.0004 mg/l and 0.0000 mg/l respectively and therefore dosing will not pose a risk of deterioration in indicative quality of the river water bodies identified in **Table 5-2**. The increased loads due to orthophosphate dosing are not predicted to be significant i.e. are <0.00125 mg/l (5% of High / Good indicative quality boundary) for the remaining waterbodies.

Table 4.B of **Appendix C** also provides details of the combined orthophosphate inputs to the lake water bodies. A Vollenweider assessment was undertaken for the lake water bodies where an increase in orthophosphate loading is expected. The lakes include: Ennell Lough (IE_SH_25_188); and, Derravaragh (Lough) (IE_SH_708). In all cases, orthophosphate dosing will not result in a significant impact on the trophic status of the lake water bodies. The areal loading in Ennell Lough and Derravaragh Lough are slightly over the critical load indicative of oligotrophic lakes however the percentage increase is less 1.5% and the OECD trophic status of the lake for the existing and post dosing situation borders on oligotrophic to mesotrophic. The dosing will not impact on the trophic status of the loughs.

There are no transitional or coastal water bodies directly affected by the WSZ.

5.3.5 Cumulative Impact Assessment

The cumulative loads to the Shannon Catchment (HAs 24, 25, 26, and 27) and Boyne Catchment (HA07) associated with the orthophosphate dosing have been assessed with the Portloman WTP. The common water bodies that are impacted by the WSZs supplied by these WTPs have been summarised in **Table 5-6** below.

- 005 Clareville WTP – Limerick City Water Supply

- 012 Tuam WTP – Tuam RWSS
- 017 Drumcliffe WTP - Ennis PWS
- 019 New Doolough WTP - W.Clare RWS (New WTP)
- 020 Catsle Lake WTP - Shannon/Sixmilebridge RWSS
- 021 Rossadrehid WTP – Galtee Regional
- 027 Athlone WTP – Athlone WSS
- 034 Lough Forbes WTP – Longford Central
- 040 Coolbawn – Nenagh RWSS
- 049 Ballany WTP – Ballany High Level Reservoir
- 058 Ballinasloe Town WTP - Ballinasloe Public Supply
- 068 Rockingham WTP - Boyle Regional WSS
- 081 Ballinagard Springs WTP - Roscommon Central Water Supply Scheme
- 128 Longford Springs WTP Future Supply - Castlerea WSS
- 140 Lisbrock WTP - SRRWSS Lisbrock
- 161 Freemount WTP – Zone 4 Allow Regional
- 178 Clavin's Bridge WTP – Kells/Oldcastle WS
- 184 Foileen WTP - CappamoreFoileen Water Supply
- 185 Ballinlough/ Loughglynn (Ballybane Springs) - Ballinlough/Loughglynn
- 190 Ironmills Pump Station - Ironmills
- 216 Kylebeg WTP – Borrisokane
- 237 Killadysert WTP - Killadysert PWS
- 238 Williamstown WTP - Williamstown PS3
- 246 Ballingarry Spring WTP - Ballingarry Water Supply
- 260 Kilcolman PS - Rathkeale Water Supply
- 267 Cloughjordan Pump Station – Cloughjordan
- 321 Ahascragh WTP - Ahascragh P.S.
- 355 Croom Bypass Pump Station - Croom Water Supply

Following dosing, the additional ortho P concentration in two surface waterbodies exceed the 5% Good/High indicative quality threshold (i.e. >0.00125mg/l). These are; BROSNA_020 (IE_SH_25B090006) and BROSNA_030 (IE_SH_25B090100). For both waterbodies, the potential baseline following dosing is within 75% of the upper indicative quality threshold and therefore there is no risk deterioration in the current moderate ortho P indicative quality and of the achievement of WFD objectives.

The baseline concentration for the following river water bodies; BROSNA_080 (IE_SH_25B090600), INNY_060 (IE_SH_26I010700), DEEL (RAHARNEY)_050 (IE_EA_07D010400), one monitoring point in RIVERSTOWN_020 (IE_EA_07R010200) and the baseline sample concentrations for the following transitional water bodies; Upper Shannon Estuary IE_SH_060_0800 (summer and winter) and Boyne Estuary Plume Zone (IE_EA_010_0000) (winter) are above 75% of the upper orthophosphate indicative quality threshold. The modelled post dosing concentration is <5% of the Good/ High indicative quality threshold (i.e. <0.00125mg/l). For the remaining waterbodies the cumulative assessment has modelled that the given that additional increase in orthophosphate as a result of dosing are all <5% of the Good / High indicative quality boundary i.e. 0.00125mg/l. In addition, for the lake waterbodies dosing will result not impact upon the current trophic status. Therefore, dosing will not cause a deterioration in the orthophosphate indicative quality or prevent the achievement of the WFD objectives of the water bodies.

Table 5-6: Cumulative assessment of the increased loading and concentrations to receiving water bodies common to the WSZs within the Shannon and Boyne catchment

EU_CD / Name	WB Type/ Period	Ortho P Indicative quality and Trends (distance to threshold) Surrogate Indicative Quality indicated in *italic*	Baseline Year 2014 and Conc. Surrogate Conc. given in *italic* mg/l	75% of Ortho P indicative quality Upper threshold mg/l	Cumulative Ortho P load to SW from leakage, DWWTS & agglomerations kg/yr	Potential Increase in Ortho P Conc. using 30%ile flows mg/l	Ortho P Potential Baseline Conc. following dosing mg/l
IE_SH_25B090006 BROSNA_020	RWB	Good Far	0.029	0.033	17.7	0.0013	0.031
IE_SH_25B090100 BROSNA_030	RWB	Good Downwards Far	0.030	0.033	70.0	0.0032	0.033‡
IE_SH_25B090200 BROSNA_040	RWB	*Moderate*	*0.046*	*0.051*	*70.0*	*0.0004*	*0.046*
IE_SH_25B090250 BROSNA_050	RWB Multiple Monitoring Points	Good Downwards Far	0.030	0.033	70.0	0.0003	0.031‡
		Good Downwards Far	0.030	0.033			0.031‡
IE_SH_25B090400 BROSNA_060	RWB	*Good*	*0.030*	*0.033*	*70.0*	*0.0003*	*0.030*
IE_SH_25B090450 BROSNA_070	RWB	Good Downwards Far	0.029	0.033	70.0	0.0003	0.030‡
IE_SH_25B090600 BROSNA_080	RWB Multiple Monitoring Points	Good Downwards Near	0.024	0.019	70.1	0.0003	0.024
		High Downwards Far	0.011	0.019			0.011
IE_SH_26G010270 GAINE_020	RWB	Good Downwards Far	0.030	0.033	5.9	0.0005	0.031‡
IE_SH_26I010700 INNY_060	RWB	High Downwards Near	0.024	0.019	25.0	0.0001	0.024
IE_SH_26I010800 INNY_070	RWB	High Downwards Near	0.024	0.019	25.0	0.0001	*0.024* ‡
IE_SH_26I011000 INNY_080	RWB	*Moderate*	*0.046*	*0.051*	*55.5*	*0.0001*	*0.046*‡
IE_SH_26I011150 INNY_090	RWB Multiple Monitoring Points	Good Downwards Far	0.030	0.033	59.1	0.00001	0.030‡
		Good Downwards Far	0.030	0.033			0.030‡
		Good Downwards Far	0.029	0.033			0.029‡

EU_CD / Name	WB Type/ Period	Ortho P Indicative quality and Trends (distance to threshold) Surrogate Indicative Quality indicated in *italic*	Baseline Year 2014 and Conc. Surrogate Conc. given in *italic* mg/l	75% of Ortho P indicative quality Upper threshold mg/l	Cumulative Ortho P load to SW from leakage, DWWTS & agglomerations kg/yr	Potential Increase in Ortho P Conc. using 30%ile flows mg/l	Ortho P Potential Baseline Conc. following dosing mg/l
IE_SH_26I011350 INNY_100	RWB	High Upwards Far	0.016	0.019	59.1	0.0001	0.016‡
IE_SH_26I011400 INNY_110	RWB	*Moderate*	*0.046*	*0.051*	*59.1*	*0.0000*	*0.046‡*
IE_EA_07D010080 DEEL (RAHARNEY)_020	RWB	*Good*	*0.030*	*0.033*	*16.7*	*0.0003*	*0.030*
IE_EA_07D010200 DEEL (RAHARNEY)_030	RWB	*Good*	*0.030*	*0.033*	*22.7*	*0.0003*	*0.030*
IE_EA_07D010300 DEEL (RAHARNEY)_040	RWB	*Good*	*0.030*	*0.033*	*38.4*	*0.0004*	*0.030*
IE_EA_07D010400 DEEL (RAHARNEY)_050	RWB	High Downwards Near	0.024	0.019	84.1	0.0006	0.024
IE_EA_07D010600 DEEL (RAHARNEY)_060	RWB	High Far	0.011	0.019	88.5	0.0006	0.011
IE_EA_07D060030 D'ARCY'S CROSSROADS STREAM_010	RWB	*Moderate*	*0.046*	*0.051*	*1.6*	*0.0000*	*0.046*
IE_EA_07K010100 KINNEGAD_020	RWB	Good Downwards Far	0.029	0.033	6.6	0.0004	0.030
IE_EA_07K010200 KINNEGAD_030	RWB Multiple Monitoring Points	High Downwards Near	0.019	0.019	23.8	0.0008	0.020‡
		Good Downwards Near	0.033	0.033			0.034‡
IE_EA_07R010200 RIVERSTOWN_020	RWB Multiple Monitoring Points	Good Downwards Far	0.029	0.033	38.4	0.0008	0.030‡
		High Downwards Near	0.024	0.019			0.025‡
		Good Downwards Far	0.029	0.033			0.030‡
IE_EA_07S020075 STONYFORD_020	RWB Multiple Monitoring Points	Good Downwards Far	0.030	0.033	9.3	0.0003	0.030
		Good Downwards Far	0.030	0.033			0.030

EU_CD / Name	WB Type/ Period	Ortho P Indicative quality and Trends (distance to threshold) Surrogate Indicative Quality indicated in *italic*	Baseline Year 2014 and Conc. Surrogate Conc. given in *italic* mg/l	75% of Ortho P indicative quality Upper threshold mg/l	Cumulative Ortho P load to SW from leakage, DWWTS & agglomerations kg/yr	Potential Increase in Ortho P Conc. using 30%ile flows mg/l	Ortho P Potential Baseline Conc. following dosing mg/l
		Good Downwards Far	0.029	0.033			0.029
IE_EA_07S020400 STONYFORD_040	RWB	*Moderate*	*0.046*	*0.051*	*16.9*	*0.0002*	*0.046*
IE_SH_26B050180 BLACK (WESTMEATH)_020	RWB	*Moderate*	*0.046*	*0.051*	*3.6*	*0.0002*	*0.046*
IE_SH_26R030100 RIFFEY_010	RWB	*Moderate*	*0.046*	*0.051*	*6.8*	*0.0003*	*0.046*
Limerick Dock IE_SH_060_0900	TWB Summer	High Downwards Far	0.008	0.019	7516.7	0.001	0.009 ‡
	TWB Winter	High Upwards far	0.012	0.019			0.013 ‡
Upper Shannon Estuary IE_SH_060_0800	TWB Summer	High Upwards Near	0.020	0.019	8848.1	0.0010	0.021 ‡
	TWB Winter	High Downwards Far	0.011	0.019			0.012 ‡
Lower Shannon Estuary IE_SH_060_0300	TWB Summer	High Upwards Near	0.011	0.020	12412.9	0.0002	0.011
	TWB Winter	Good Upwards Far	0.025	0.036			0.025
Mouth of River Shannon IE_SH_060_000	CWB Summer	High Upwards Far	0.008	0.019	13317.6	0.0001	0.008
	CWB Winter	*Good*	*0.033*	*0.037*			*0.033*
IE_EA_010_0100 Boyne Estuary	TWB Summer	High Downwards Far	0.018	0.020	1669.3	0.0010	0.019
	TWB Winter	Good Upwards Far	0.030	0.036			0.031
IE_EA_010_0000 Boyne Estuary Plume Zone	TWB Summer	High Upwards Far	0.012	0.019	1669.3	0.0010	0.013
	TWB Winter	High Downwards Near	0.020	0.019			0.021

‡ Load from WWTP / SWO following treatment included

Table 5-7 Vollenweider assessment of cumulative loads to lakes within the WSZs

EU_CD / Name	Parameter	TP Indicative Quality and Trends (Distance to Threshold. *Surrogate Indicative Quality in italic*	Baseline 2014 Conc. Surrogate Conc given in *italic* mg/l	TP Total Dosing Load kg/yr	Estimated Existing Areal loading based on Vollenveider (mg/m2/yr)	Post Dosing Aerial Load (mg/m2/yr)	Lc (mg/m2/yr)	% Increase
IE_SH_26_708 Derravaragh (Lough)	TP	Good Downwards Far	0.014	48.5	743.9	750.0	673.5	0.8
IE_SH_25_191 (Derg TN & Derg HMWB combined)	TP	Good Upwards Far	0.020	1271.5	1105.9	1116.5	735.1	0.9

5.3.6 Conclusions

The modelled orthophosphate concentrations in river water bodies due to distributed inputs (subsurface and near surface pathways) is predicted to be below 5% of the Good / High status boundary for orthophosphate (i.e. 0.00125mg/l) for all river water bodies and the orthophosphate dosing will not have a significant impact.

In most cases, the post-dosing orthophosphate increase in GWBs is below 5% of Good/Fail status boundary and the Chemical Status for all GWBs is Good. The load to the GWB Marlinstown Landfill Waste Facility (W0071-02) (IE_EA_G_083) is small (2.5 kg/yr) but the modelled concentration does exceed 5% of the Good/Fail indicative quality boundary (0.0053 mg/l) due to the low groundwater flows in the GWB. The increase in orthophosphate concentration does not cause a breach of the 75% upper threshold for orthophosphate and this GWB does not underly any European Sites.

In the case of combined orthophosphate inputs to river water bodies from direct discharges, DWWTSs and leakage loads, the predicted increase in concetration for all river water bodies is below 5% of the Good / High status boundary for orthophosphate (i.e. 0.00125mg/l) for all river water bodies and the orthophosphate dosing will not have a significant impact of the affected water bodies.

Orthophosphate dosing will not result in a significant impact on the trophic status of Lough Ennell (IE_SH_25_188) and Derravaragh (Lough) (IE_SH_708). Both loughs are slightly over the critical load indicative of oligotrophic lakes however the percentage increase in orthophosphate is less than 1.5% and the OECD trophic status of the lake for the existing and post-dosing scenario. The dosing therefore, will not impact on the trophic status of the loughs.

The cumulative assessment of dosing at Portloman WTP together with other WTPs which may be subject to dosing in the same catchments, has demonstrated that there will not be a significant effect on receiving water bodies. These WTPs are also subject to their own Screening for AA.

Therefore, there is no risk of deterioration in the orthophosphate indicative quality of the water bodies as a result of the proposed project and the dosing will not prevent the achievement of the WFD objectives for these water bodies.

6 EVALUATION OF LIKELY SIGNIFICANT EFFECTS

6.1 CONSTRUCTION PHASE

Portloman WTP is not located within a European Site. There are no surface water bodies within the confines of Portloman WTP. The WTP adjoins Lough Owel SPA and Lough Owel SAC. There are no surface water features linking the WTP site to the nearby areas of Lough Owel, and the potential for release of construction related pollutants via overland flow was discussed in **Table 5-1**.

However, the proposed construction works are small scale in nature and will be undertaken within the confines of the existing built infrastructure associated with Portloman WTP. There will be no aspects of the proposed works that will result in the release of potential impacts sources identified in **Table 5-1**. The works will be localised and contained to the immediate development area which buildings and artificial surfaces. Works such as excavations will be contained to the defined working area and necessary works with cast in place concrete will be undertaken within sealed shuttered units. The required work methodology will retain all potential construction related pollutants at source. Therefore, there is no potential for likely significant effects to these European Sites.

The WTP overlies the Lough Owel Fens and Mires (IE_SH_G_166) groundwater body, a localised groundwater body that encapsulates the Lough Owel water body and associated peatland and wetland habitats. In the case of the Portloman site, the assumption is that groundwater flow direction is from areas of higher elevations to lower elevations; i.e. towards Lough Owel. The potential impacts as a result of the proposed works have been excluded in **Table 5-1**.

As the excavation works will not be extensive (up to c. 50m for pipework and to an approximate depth of 700mm) and will be situated upon made ground, interference with water table will be unlikely to occur. Any interference would be localised, minor and temporary. Therefore, there is no potential for likely significant effects to the underlying groundwater body, the receiving surface water feature and subsequently those European Sites included for further assessment, as a result of the construction of the corrective water treatment works at Portloman WTP.

6.2 OPERATIONAL PHASE

The key pressure associated with the proposed orthophosphate dosing is the potential for increased orthophosphate levels in the receiving waters and the potential to impact upon the qualifying interests (habitats and species) identified in **Table 4-3** that are both water dependent and nutrient sensitive (**Appendix B**). The potential for such impacts to give rise to likely significant effects on these habitats and species, in view of their conservation objectives, are assessed in detail below.

6.2.1 Split Hills and Long Hill Esker SAC 001831

6.2.1.1 (6210) Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (* important orchid sites)

Split Hills and Long Hill Esker is a 5 km long site which crosses the main Galway-Dublin road mid-way between Kilbeggan and Tyrrellspass in Co. Westmeath. It is a prominent feature on the local landscape. Split Hill and Long Hill Esker is one of the finest and longest wooded eskers in the country. It is also one of the few woodlands in the area and a fine geomorphological feature of great scenic

value. The presence of a species-rich ground flora, which includes a rare and legally protected plant species at its only known Irish location, makes this site of great botanical and ecological importance. The site also supports some excellent examples of calcareous grassland which is rich in orchids. The increasing rarity of this habitat (due to agricultural intensification) is recognised in that it is awarded priority status on Annex I of the E.U. Habitats Directive. The main threat to the esker is quarrying for sand and gravel. This activity already occurs on the site at several locations. Grazing is a critical factor affecting esker habitats, and getting a balance right is important. The presence of too many grazers causes damage to the ground vegetation in both woodlands and grasslands and prevents regeneration of woody species. However, if the grazing level is too low, grasslands are vulnerable to the encroachment of scrub at the expense of species which require open conditions. Fertiliser application, associated with agricultural improvement, also leads to a reduction in species-richness of grasslands (NPWS, 2013)[29]. There are no SSCOs[30] published for this site.

Table 5-2 and **Table 5-3** identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to Split Hills and Long Hill Esker SACand will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

- The river water bodies include: Brosna_010 (IE_SH_25B280390), Brosna_020 (IE_SH_25B090006), Brosna_030 (IE_SH_25B090100), Brosna_040 (IE_SH_25B090200), Brosna_050 (IE_SH_25B090250), and Brosna_060 (IE_SH_25B090400);
- The lake water body is: Ennell (IE_SH_25_188); and
- The groundwater body is: Clara (IE_SH_G_240).

The esker is not a water dependent habitat; however, the river water body Brosna_060 (IE_SH_25B090400) intersects the habitat and there is potential for the transfer of orthophosphate concentrations from the Brosna_060 (IE_SH_25B090400) to the nutrient sensitive habitat during flood events. According to the OPW National Flood Hazard Mapping[31] there is a report of recurring flooding in the Brosna downstream of Split Hills and Long Hill Esker SAC at Coola Bridge, Kilbeggan, Co. Westmeath. It is reported that the River Brosna overflows its banks every year after heavy rain and the road is liable to flood. Further downstream at Brosna View Council Estate, Kilbeggan, the estate floods every year after heavy rainfall. The estate surface water discharges into the River Brosna and when Brosna is high the water cannot discharge.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available flow data. Full details of the assessment are provided in **Appendix C**.

For all river water bodies, the modelled concentrations are below 5% of the Good / High status boundary. Modelled concentration range from 0.0002 mg/l in Brosna_040 (IE_SH_25B090200); and Brosna_060 (IE_SH_25B090400); 0.0003 mg/l Brosna_050 (IE_SH_25B090250) and 0.0006 mg/l in Brosna_010 (IE_SH_25B280390). In Brosna_020 (IE_SH_25B090006) and Brosna_030 (IE_SH_25B090100) the modelled concentrations are 0.0005 mg/l and 0.0010 mg/l respectively. Therefore, there is no risk of deterioration in the status of these water bodies as all modelled concentrations are all <0.00125 mg/l (Good / High status boundary) and the predicted

[29] NPWS 2013 Split Hills and Long Hill Esker SAC 001831 Site Synopsis
[30] NPWS 2018 Split Hills and Long Hill Esker SAC 001831 Conservation Objectives
[31] http://www.floodmaps.ie/View/Default.aspx

concentrations post dosing will not exceed the 75 % upper threshold of the respective indicative quality bands for each river.

The Vollenweider assessment undertaken for Lough Ennell (IE_SH_25_188) indicates that dosing at Portloman WTP will result in a 0.1% increase in the orthophosphate concentration of the water body. This will not result in a significant impact on the trophic status of the lake which remains within the critical loading for oligotrophic lakes.

The modelled orthophosphate concentration in the GWB Clara (IE_SH_G_240) is undetectable at 0.0000 mg/l. As this concentration is within 5% of the Good / Fail boundary (0.00175 mg/l) there is no risk of deterioration in the Good (surrogate) status of the water body.

As the habitat in question is intersected by the Brosna_060 (IE_SH_25B090400) which is at Good (surrogate) status and has an insignificant modelled post-doing concentration (0.0002 mg/l) and therefore is not at risk of deterioration in status. It is noted that the Brosna_010 (IE_SH_25B280390) to Brosna_050 (IE_SH_25B090250) upstream of this river water body, are all at Good status. For Brosna_010 (IE_SH_25B280390), Brosna_040 (IE_SH_25B090200) and Brosna_050 (IE_SH_25B090250) have modelled postdosing increases in concentration that are less than 5% of the Good / High boundary (0.00125 mg/l) threshold and represent an unmeasurable increase in orthophosphate concentration. For Brosna_020 (IE_SH_25B090060) and Brosna_030 (IE_SH_25B090100) the indicative quality does not exceed 75% of the upper status threshold and therefore they are currently not at risk of further deterioration. The small modelled increase in orthophosphate concentration does not change the risk of deterioration in this small river water body and therefore the achievement of the WFD objectives.

The SAC is linear and located perpendicular to the Brosna River traverses approximately 120m of the SAC at its narrow centre (SAC is >11 km wide); however as the habitat is not water dependent the potential for likely significant effects arises from potential flood events. Due to the terrestrial nature of the SAC and the recorded flood events occurring downstream of the site, in addition to the low modelled post-dosing increases in concentration as a result of dosing at Portloman WTP, it is not anticipated that the conservation of the QI will be affected as there will be no deterioration in the current status of the water bodies.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not prevent the restoration of the favourable conservation condition of the habitat.

6.2.2 Lough Lene SAC 002121

6.2.2.1 (3140) Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.

Lough Lene is situated 4 km north-east of Castlepollard in Co. Westmeath, and upstream of the Ardonagh WSZ. It is a deep (20m maximum depth), clear, hard-water lake with marl deposition (especially noticeable on the margins) (NPWS, 2013)[32]. There are no SSCOs for the habitat hard oligo-mesotrophic waters in Lough Lene SAC (NPWS, 2016)[33]. There is a general objective to

[32] NPWS 2013 Lough Lene SAC 002121 Site Synopsis
[33] NPWS 2016 Lough Lene SAC 002121 Conservation Objectives

maintain or restore the favourable conservation condition of the habitat. According to O'Connor (2015)[34] water quality is a key driver of lake ecology, and nutrient enrichment leading to eutrophication of freshwaters is one of the most significant environmental challenges globally. Annex I lake habitats are typically associated with high water quality and the absence of eutrophication impacts.

Nutrients are released to water from lands throughout a lake's catchment. Natural ecosystems are highly parsimonious in their use of nutrients however; maximising nutrient re-cycling and minimising losses, meaning that, under natural conditions, very small nutrient loads reach rivers and lakes from their catchments. Varied and widespread land-uses have, however, significantly disrupted natural processes and increased nutrient losses to water. Agriculture is the greatest exporter of phosphorus to surface waters in Ireland, followed by sewage discharges. Other important exporters of nutrients are industry, septic tanks (domestic wastewater treatment systems) and forestry.

High-risk pathways for nutrient loss to lake habitats include thin, highly-permeable soils and subsoils, overlying karstified limestone bedrock, with direct connections to the groundwater frequent (e.g. swallow holes, caves and turloughs)[35]. In this scenario, dissolved and particulate nutrients can be rapidly transferred to lakes via shallow to deep groundwater pathways. Groundwater pathways are associated with the hard-water lake habitat (3140), where groundwater springs and seepages emerge in lakes and/or in-flowing streams.

Nutrient enrichment (with phosphorus and/or nitrogen) can promote phytoplankton growth (as indicated by Chlorophyll *a* concentration) leading to shading and reduced light penetration. Nutrient enrichment can also favour epiphytic and epipelic algal communities (as indicated by phytobenthos status) or more competitive submerged macrophyte species (as indicated by macrophyte status), which can out-compete the high conservation value communities and species. Chlorophyll *a*, macrophyte, phytobenthos and phytoplankton composition all demonstrate biological responses to nutrient enrichment.

The best examples of the hard-water lake habitat 3140, including the majority of SACs selected for the habitat, are associated with karstified limestone, marl deposition and extremely low nutrients. For lakes in catchments dominated by shallow soils and subsoils and exposed limestone pavement (i.e. catchments with extreme groundwater vulnerability), the target is, therefore, high status. Coastal sub-types are thought likely to be naturally more productive and, therefore, a target of 'good status' is used. 'Good status' may also be set as the target in larger, more-mixed catchments with deeper soils and lower groundwater vulnerability, as these too may naturally be more productive (O'Connor, 2015).

Table 5-2 groundwater body which is hydrologically or hydrogeologically connected to Lough Lene SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

- The site is hydrogeologically connected to the WSZ via the GWB Derravarragh (IE_SH_G_077).

[34] O Connor, Á. (2015) Habitats Directive Annex I lake habitats: a working interpretation for the purposes of site-specific conservation objectives and Article 17 reporting. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Ireland.

[35] https://www.npws.ie/sites/default/files/publications/pdf/Lake_habitats_supporting_document_Nov_2015_V1.1_FINAL.pdf

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available flow data. Full details of the assessment are provided in **Appendix C**.

The assessment has modelled very low increases in orthophosphate for the groundwater body intersected by the WSZ. The assessment of the distance to threshold is based on the existing status of each water body, rather than the WFD environmental objective assigned to a given water body.

The modelled orthophosphate concentration in the GWB Derravarragh (IE_SH_G_077) is low, 0.0002 mg/l. As this concentration is within 5% of the Good / Fail boundary (0.00175 mg/l) there is no risk of deterioration in the Good status of the groundwater body.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not prevent the maintenance or restoration of the favourable conservation condition of the habitat.

6.2.2.2 (1092) White-clawed Crayfish (*Austropotamobius pallipes*)

Lough Lene had a notable population of white-clayed crayfish but the species disappeared from the site in 1987 following what is considered to have been an outbreak of crayfish fungus plague (*Aphanomyces astaci*). The species was re-introduced to the site and breeding was recorded in 1995 but this also was unsuccessful. The NPWS has a desire to see the white-clawed crayfish population re-established in Lough Lene should habitat conditions be assessed as suitable (NPWS, 2013[32]). There are no SSCOs for white-clawed crayfish in Lough Lene SAC (NPWS, 2016)[33]. However, white-clawed crayfish have a general water quality requirement for moderate to good water quality (i.e. Q3-4 or higher; NPWS, 2013)[36], therefore any reduction in water quality as a result of orthophosphate loading would be contrary to the conservation objectives for this species.

Table 5-2 groundwater body which hydrogeologically connected to Lough Lene SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

- The site is hydrogeologically connected to the WSZ via the GWB Derravarragh (IE_SH_G_077).

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available flow data. Full details of the assessment are provided in **Appendix C**.

The modelled orthophosphate concentration in the GWB Derravarragh (IE_SH_G_077) is low, 0.0002 mg/l. As this concentration is within 5% of the Good / Fail boundary (0.00175 mg/l) there is no risk of deterioration in the Good status of the groundwater body.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects

[36] NPWS (2013) The Status of EU Protected Habitats and Species in Ireland. Species Assessments Volume 3. Version 1.0. Unpublished Report, National Parks & Wildlife

on this species can be excluded. Furthermore, dosing will not prevent the maintenance or restoration of the favourable conservation condition of the species.

6.2.3 Lough Owel SAC 000688

6.2.3.1 (3140) Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.

Lough Owel is a large hard water lake located approximately 4 km north-west of Mullingar in Co. Westmeath, and west of the Ardonagh WSZ. It is a relatively shallow lake with a rocky, marl-covered bottom (NPWS, 2013)[37]. The SSCOs for the habitat hard oligo-mesotrophic waters in Lough Owel SAC (NPWS, 2018)[38] outline a target to maintain/restore the concentration of nutrients in the water column to sufficiently low levels to support the habitat and its typical species. The target for Lough Owel is WFD High status or oligotrophic. It is stated that the annual average TP concentration should be ≤10 µg/l and furthermore that where nutrient concentrations are lower than the targets, there should be no upwards trend in concentration. Lough Owel failed the target, having Good nutrient status in 2007-09 and 2010-12. High ammonia has also been reported for the lake.

According to O'Connor (2015[34]) water quality is a key driver of lake ecology, and nutrient enrichment leading to eutrophication of freshwaters is one of the most significant environmental challenges globally. Annex I lake habitats are typically associated with high water quality and the absence of eutrophication impacts. Nutrients are released to water from lands throughout a lake's catchment. Natural ecosystems are highly parsimonious in their use of nutrients however; maximising nutrient re-cycling and minimising losses, meaning that, under natural conditions, very small nutrient loads reach rivers and lakes from their catchments. Varied and widespread land-uses have, however, significantly disrupted natural processes and increased nutrient losses to water. Agriculture is the greatest exporter of phosphorus to surface waters in Ireland, followed by sewage discharges. Other important exporters of nutrients are industry, septic tanks (domestic wastewater treatment systems) and forestry.

High-risk pathways for nutrient loss to lake habitats include thin, highly-permeable soils and subsoils, overlying karstified limestone bedrock, with direct connections to the groundwater frequent (e.g. swallow holes, caves and turloughs)[39]. In this scenario, dissolved and particulate nutrients can be rapidly transferred to lakes via shallow to deep groundwater pathways. Groundwater pathways are associated with the hard-water lake habitat (3140), where groundwater springs and seepages emerge in lakes and/or in-flowing streams.

Nutrient enrichment (with phosphorus and/or nitrogen) can promote phytoplankton growth (as indicated by Chlorophyll a concentration) leading to shading and reduced light penetration. Nutrient enrichment can also favour epiphytic and epipelic algal communities (as indicated by phytobenthos status) or more competitive submerged macrophyte species (as indicated by macrophyte status), which can out-compete the high conservation value communities and species. Chlorophyll a, macrophyte, phytobenthos and phytoplankton composition all demonstrate biological responses to nutrient enrichment.

[37] NPWS 2013 Lough Owel SAC 000688 Site Synopsis
[38] NPWS 2018 Lough Owel SAC 000688 Conservation Objectives
[39] https://www.npws.ie/sites/default/files/publications/pdf/Lake_habitats_supporting_document_Nov_2015_V1.1_FINAL.pdf

The best examples of the hard-water lake habitat 3140, including the majority of SACs selected for the habitat, are associated with karstified limestone, marl deposition and extremely low nutrients. For lakes in catchments dominated by shallow soils and subsoils and exposed limestone pavement (i.e. catchments with extreme groundwater vulnerability), the target is, therefore, high status. Coastal sub-types are thought likely to be naturally more productive and, therefore, a target of 'good status' is used. 'Good status' may also be set as the target in larger, more-mixed catchments with deeper soils and lower groundwater vulnerability, as these too may naturally be more productive (O'Connor, 2015).

The GWB Lough Owel Fens and Mires (SAC000688 & SAC000692) is a GWDTE and underlies Lough Owel but does not instersect the WSZ. Derravarragh (IE_SH_G_077) is a karstic groundwater body that does inserset the WSZ and boarders the Lough Owel Fens and Mires GWB. Owing to the karstic nature of Derravarragh and close proximity to Lough Owel (<2.5km) the potential impacts to this ground water body are discussed below.

Lough Owel lies upstream of the Ardonagh WSZ, and the Brosna_010 river water body intersects both the lake and the WSZ. However, given that the lake is upstream, there is no potential for impact from hydrological pathways.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available flow data. Full details of the assessment are provided in **Appendix C**.

The modelled orthophosphate concentration in the groundwater body is insignificant i.e. 0.0002 mg/l. As the concentrations are within 5% of the Good / Fail boundary (0.00175 mg/l) there is no risk of deterioration in the Good indicative quality of the groundwater body and therefore there will be no impact to the Lough Owel GWDTE.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not prevent the maintenance the favourable conservation condition of the habitat.

6.2.3.2 (7140) Transition mires and quaking bogs

Two areas of wetland vegetation of particular interest occur at the north-west (Bunbrosna) and south-west (Tullaghan) of Lough Owel SAC. These areas contain a mosaic of vegetation types of varying degrees of wetness, with quaking bog, alkaline fen, wet grassland and wet woodland all present. In some places the quaking mire grades into alkaline fen (NPWS, 2013)[37]. Transition mires and quaking bogs are peat-forming communities developed at the surface of waters with little or moderate amounts of nutrients, with characteristics intermediate between rich (alkaline) and poor (acidic) fen types. For this reason, they are considered as a separate habitat but they may occur within, or on the fringes of other peat-forming systems. Transition mires and quaking bogs are usually associated with the wettest parts of a bog or fen and can be found in wet hollows, infilling depressions, or at the transition to areas of open water. The vegetation frequently forms a floating mat or surface scraw over saturated, spongy or quaking peat. Standing water may occur in pools or along seepage zones. The vegetation typically comprises species that are characteristic of bog, fen

and open water habitats[40]. Potential threats to the conservation interest of Lough Owel include the increasing level of water supply to Mullingar, overfishing, eutrophication caused by local farming practices and pressure from amenity uses such as boating and fishing (NPWS, 2013)[37].

The SSCOs for this habitat in Lough Owel SAC (NPWS, 2018)[38] outline that ecosystem function (water quality) should be maintained or where necessary restored to appropriate water quality to support the natural structure and functioning of the habitat.

The GWB Lough Owel Fens and Mires (SAC000688 & SAC000692) is a GWDTE and underlies Lough Owel but does not instersect the WSZ. Derravarragh (IE_SH_G_077) is a karstic groundwater body that does inserset the WSZ and boarders the Lough Owel Fens and Mires GWB. Owing to the karstic nature of Derravarragh and close proximity to Lough Owel (<2.5km) the potential impacts to this ground water body are discussed below.

Lough Owel lies upstream of the Ardonagh WSZ, and the Brosna_010 river water body intersects both the lake and the WSZ. However, given that the lake is upstream, there is no potential for impact from hydrological pathways.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available flow data. Full details of the assessment are provided in **Appendix C**.

The modelled orthophosphate concentration in the groundwater body is insignificant i.e. 0.0002 mg/l. As the concentrations are within 5% of the Good / Fail boundary (0.00175 mg/l) there is no risk of deterioration in the Good indicative quality of the groundwater body and therefore there will be no impact to the Lough Owel GWDTE.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not prevent the maintenance of the favourable conservation condition of the habitat.

6.2.3.3 (7230) Alkaline fens

Two areas of wetland vegetation of particular interest occur at the north-west (Bunbrosna) and south-west (Tullaghan) of Lough Owel SAC. These areas contain a mosaic of vegetation types of varying degrees of wetness, with quaking bog, alkaline fen, wet grassland and wet woodland all present. In places, the quaking mire grades into alkaline fen (NPWS, 2013)[37].

Fens are wetland systems with a permanently high water level at or just below its surface. The substrate is an alkaline or slightly acidic peat soil. The vegetation is usually rich in or dominated by sedges. They receive nutrients from sources other than precipitation, usually from upslope sources through drainage from surrounding mineral soils and from groundwater movement. In general they are poor in nitrogen and phosphorus, the latter of which tends to be the limiting nutrient in fen systems. Studies of wetlands in Western Europe frequently show that nutrient enrichment (with nitrogen and phosphorus) leads to changes in species composition, decline in overall plant species diversity, and loss of rare and uncommon species. Organic matter is often accumulated as peat

[40] http://www.wetlandsurveysireland.com/wetlands/factfile-6-fens-and-flushes/index.html

within a fen. A "poor" fen has very low concentrations of plant nutrients and floristically has similarities to a bog. A "rich" fen has relatively high concentrations of mineral nutrients, but is still characterised by the accumulation of peat (though this is likely to be primarily from the remains of plants other than sphagnum mosses, such as sedges and brown mosses). Where fens are characterised by alkaline conditions resulting from water draining from limestone and other calcareous soil formations, they are distinguished as "rich fen", though there is often a general understanding that a "fen" will be relatively eutrophic (nutrient rich) (Foss, 2007)[41].

The SSCOs for this habitat in Lough Owel SAC (NPWS, 2018)[38] include a targe to maintain or where necessary restore, appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitat. It states that fens receive natural levels of nutrients (e.g. iron, magnesium and calcium) from water sources but that they are generally poor in nitrogen and phosphorus, with phosphorus tending to be the limiting nutrient under natural conditions. Potential threats to the conservation interest of Lough Owel include the increasing level of water supply to Mullingar, overfishing, eutrophication caused by local farming practices and pressure from amenity uses such as boating and fishing (NPWS, 2013)[37].

The GWB Lough Owel Fens and Mires (SAC000688 & SAC000692) is a GWDTE and underlies Lough Owel but does not instersect the WSZ. Derravarragh (IE_SH_G_077) is a karstic groundwater body that does inserset the WSZ and boarders the Lough Owel Fens and Mires GWB. Owing to the karstic nature of Derravarragh and close proximity to Lough Owel (<2.5km) the potential impacts to this ground water body are discussed below.

Lough Owel lies upstream of the Ardonagh WSZ, and the Brosna_010 river water body intersects both the lake and the WSZ. However, given that the lake is upstream, there is no potential for impact from hydrological pathways.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available flow data. Full details of the assessment are provided in **Appendix C**.

The modelled orthophosphate concentration in the groundwater body is insignificant i.e. 0.0002 mg/l. As the concentrations are within 5% of the Good / Fail boundary (0.00175 mg/l) there is no risk of deterioration in the Good indicative quality of the groundwater body and therefore there will be no impact to the Lough Owel GWDTE.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not prevent the maintenance of the favourable conservation condition of the habitat.

6.2.3.4 (1092) White-clawed Crayfish (*Austropotamobius pallipes*)

White-clawed crayfish is found in Lough Owel SAC. The SSCOs for White-clawed crayfish in Lough Owel SAC (NPWS, 2018)[38] have a target which states that appropriate water quality must be maintained, particularly pH and nutrient levels, to support the natural structure and functioning of

[41] Foss, P.J. (2007) National Parks & Wildlife Service Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland 2007. Internal report for the National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Ireland.

the lake habitat 3140. As the White-clawed crayfish is tolerant of a whide range of water conditions (except for the poorest quality and most acid waters), no specific target has been set for the species as the target for habitat 3140 is more stringent than the species requires. White-clawed crayfish have a general water quality requirement for moderate to good water quality (i.e. Q3-4 or higher; NPWS, 2013)[42], therefore any reduction in water quality as a result of orthophosphate loading would be contrary to the conservation objectives for this species.

The GWB Lough Owel Fens and Mires (SAC000688 & SAC000692) is a GWDTE and underlies Lough Owel but does not instersect the WSZ. Derravarragh (IE_SH_G_077) is a karstic groundwater body that does inserset the WSZ and boarders the Lough Owel Fens and Mires GWB. Owing to the karstic nature of Derravarragh and close proximity to Lough Owel (<2.5km) the potential impacts to this ground water body are discussed below.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available flow data. Full details of the assessment are provided in **Appendix C**.

Lough Owel lies upstream of the Ardonagh WSZ, and the Brosna_010 river water body intersects both the lake and the WSZ. However, given that the lake is upstream, there is no potential for impact from hydrological pathways. In any case the modelled orthophosphate concentration in Brosna_010 (IE_SH_25B280390) is 0.0006 mg/l. As the increase in concentration is <5% of the High / Good indicative boundary (0.00125 mg/l), there is no risk of deterioration in the indicative quality of the water body (which is currently Poor). The small modelled increase in orthophosphate concentration does not increase the risk of deterioration in this river water body and therefore the achievement of the WFD objectives.

The modelled orthophosphate concentration in the groundwater body is insignificant i.e. 0.0002 mg/l. As the concentrations are within 5% of the Good / Fail boundary (0.00175 mg/l) there is no risk of deterioration in the Good indicative quality of the groundwater body and therefore there will be no impact to the Lough Owel GWDTE.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this species and its supporting habitat can be excluded. Furthermore, dosing will not prevent the maintenance of the favourable conservation condition of the species.

6.2.4 Scragh Bog SAC 000692

6.2.4.1 (7140) Transition mires and quaking bogs

Scragh Bog contains an excellent example of transition mire, an Annex I E.U. Habitats Directive habitat. The site supports a uniquely complete fauna of transition mire invertebrates, including a number of species which are extremely rare in Northern Europe. Among the aquatic/subaquatic insects, *Chrysops sepulchralis* (Order Diptera), *Tetanocera freyi* (Order Diptera) and *Coenagrion lunulatum* (Order Odonata) provide examples of rare Northern European species. Two other flies *Acrometopia wahlbergi* and *Platycheirus perpallidus* (both Order Diptera) are rare species more

[42] NPWS (2013) The Status of EU Protected Habitats and Species in Ireland. Species Assessments Volume 3. Version 1.0. Unpublished Report, National Parks & Wildlife

closely associated with mire vegetation. Most of the site is managed as a Nature Reserve. The outflow stream is included in the site, since interference with this outflow could damage the site hydrology. A small section at the bottom of a field to the south is also included - this area supports a species-rich marsh/wet grassland vegetation.

Transition mires and quaking bogs are peat-forming communities developed at the surface of waters with little or moderate amounts of nutrients, with characteristics intermediate between rich (alkaline) and poor (acidic) fen types. For this reason, they are considered as a separate habitat but they may occur within, or on the fringes of other peat-forming systems.

Transition mires and quaking bogs are usually associated with the wettest parts of a bog or fen and can be found in wet hollows, infilling depressions, or at the transition to areas of open water. The vegetation frequently forms a floating mat or surface scraw over saturated, spongy or quaking peat. Standing water may occur in pools or along seepage zones. The vegetation typically comprises species that are characteristic of bog, fen and open water habitats[43].

There are no SSCOs for the habitat in Scragh Bog SAC (NPWS, 2016)[44]. However, the site is known to be vulnerable to interference with its hydrology and eutrophication as a result of agricultural run-off from the surrounding land (NPWS, 2015)[45].

The GWB Lough Owel Fens and Mires (SAC000688 & SAC000692) is a GWDTE and Scragh Bog but does not instersect the WSZ. Derravarragh (IE_SH_G_077) is a karstic groundwater body that does inserset the WSZ and boarders the Lough Owel Fens and Mires GWB. Owing to the karstic nature of Derravarragh and close proximity to Lough Owel (2km) the potential impacts to this ground water body are discussed below.

There are is a hydrological pathway between the WSZ and Scragh Bog SAC via Lough Owel and the Brosna_010 river water body, however given that this bog lies upstream of the WSZ, there is no potential for impact from the proposed dosing at Portloman WTP.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available flow data. Full details of the assessment are provided in **Appendix C**.

The modelled orthophosphate concentration in the groundwater body is insignificant i.e. 0.0002 mg/l. As the concentrations are within 5% of the Good / Fail boundary (0.00175 mg/l) there is no risk of deterioration in the Good indicative quality of the groundwater body and therefore there will be no impact to the Lough Owel GWDTE.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not prevent the maintenance of the favourable conservation condition of the habitat.

[43] http://www.wetlandsurveysireland.com/wetlands/factfile-6-fens-and-flushes/index.html
[44] NPWS 2016 Scragh Bog SAC000692 Conservation Objectives
[45] NPWS 2015 Scragh Bog SAC 000692 Site Synopsis

6.2.4.2 (7230) Alkaline fens

Scragh Bog SAC comprises a wet transition fen with a floating root mat which has developed in a small oval-shaped depression. The fen is fed by weak surface springs and drains by an artificially defined outlet. The fen becomes open carr in the central area and in places grades into ombrotrophic bog. Fens are wetland systems with a permanently high water level at or just below its surface. The substrate is an alkaline or slightly acidic peat soil. The vegetation is usually rich in or dominated by sedges. They receive nutrients from sources other than precipitation, usually from upslope sources through drainage from surrounding mineral soils and from groundwater movement. In general they are poor in nitrogen and phosphorus, the latter of which tends to be the limiting nutrient in fen systems. Studies of wetlands in western Europe frequently show that nutrient enrichment (with nitrogen and phosphorus) leads to changes in species composition, decline in overall plant species diversity, and loss of rare and uncommon species. Organic matter is often accumulated as peat within a fen. A "poor" fen has very low concentrations of plant nutrients and floristically has similarities to a bog. A "rich" fen has relatively high concentrations of mineral nutrients, but is still characterised by the accumulation of peat (though this is likely to be primarily from the remains of plants other than sphagnum mosses, such as sedges and brown mosses). Where fens are characterised by alkaline conditions resulting from water draining from limestone and other calcareous soil formations, they are distinguished as "rich fen", though there is often a general understanding that a "fen" will be relatively eutrophic (nutrient rich) (Foss, 2007)[41].

There are no SSCOs for the habitat in Scragh Bog SAC (NPWS, 2016)[44]. However, the site is known to be vulnerable to interference with its hydrology and eutrophication as a result of agricultural run-off from the surrounding land (NPWS, 2015)[45].

The GWB Lough Owel Fens and Mires (SAC000688 & SAC000692) is a GWDTE and Scragh Bog but does not instersect the WSZ. Derravarragh (IE_SH_G_077) is a karstic groundwater body that does inserset the WSZ and boarders the Lough Owel Fens and Mires GWB. Owing to the karstic nature of Derravarragh and close proximity to Lough Owel (2km) the potential impacts to this ground water body are discussed below.

There are is a hydrological pathway between the WSZ and Scragh Bog SAC via Lough Owel and the Brosna_010 river water body, however given that this bog lies upstream of the WSZ, there is no potential for impact from the proposed dosing at Portloman WTP.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available flow data. Full details of the assessment are provided in **Appendix C**.

The modelled orthophosphate concentration in the groundwater body is insignificant i.e. 0.0002 mg/l. As the concentrations are within 5% of the Good / Fail boundary (0.00175 mg/l) there is no risk of deterioration in the Good indicative quality of the groundwater body and therefore there will be no impact to the Lough Owel GWDTE.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not prevent the maintenance of the favourable conservation condition of the habitat.

6.2.4.3 (1393) Slender Green Feather-moss (*Hamatocaulis vernicosus*)

Slender green feather moss (*Hamatocaulis vernicosus*[46]), also called shining sickle moss, is a medium-sized perennial moss with distinctively hooked shoot tips with branches that are held at around 90º to the stem. The leaves are strongly curved, are often longitudinally pleated and are frequently tinged with red at the bases. Male and female parts are found on different plants. Sporophytes have never been recorded in Ireland and are very rare across its distribution, maturing in summer where they do occur. No specialised asexual propagules are known, thus propagation and dispersal must be through fragmentation of the parent plant.

Slender green feather moss is a circumboreal species ranging from the Arctic, south to western, central and eastern Europe, Turkey, Caucasus, central Asia and northern USA, with a disjunct occurrence in the Dominican Republic. It is currently known from 11 localities in Ireland, with large populations in the lowlands (at Lough Corrib, Lough Mask and Scragh Bog) and smaller more scattered populations in the uplands (in Cos. Donegal, Mayo, Waterford and Cavan).

Slender green feather moss is found in intermediate fens and flushes where there is an influence of mineral-rich, but not calcium-rich, groundwater. In Ireland, it is found in somewhat base-rich springs in upland districts, while in the lowlands it generally occurs in spring-influenced sites in mildly basic small-sedge fens.

Although its population has almost certainly declined in historic times, due to loss of intact peatlands, recent surveys indicate that there continues to be sufficient good quality habitat to support the long term survival of the species. There are also no significant pressures currently impacting the species. Therefore the overall status is assessed as Favourable (NPWS, 2013[47]).

The GWB Lough Owel Fens and Mires (SAC000688 & SAC000692) is a GWDTE and Scragh Bog but does not instersect the WSZ. Derravarragh (IE_SH_G_077) is a karstic groundwater body that does inserset the WSZ and boarders the Lough Owel Fens and Mires GWB. Owing to the karstic nature of Derravarragh and close proximity to Lough Owel (2km) the potential impacts to this ground water body are discussed below.

There are is a hydrological pathway between the WSZ and Scragh Bog SAC via Lough Owel and the Brosna_010 river water body, however given that this bog lies upstream of the WSZ, there is no potential for impact from the proposed dosing at Portloman WTP.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available flow data. Full details of the assessment are provided in **Appendix C**.

The modelled orthophosphate concentration in the groundwater body is insignificant i.e. 0.0002 mg/l. As the concentrations are within 5% of the Good / Fail boundary (0.00175 mg/l) there is no risk of deterioration in the Good indicative quality of the groundwater body and therefore there will be no impact to the Lough Owel GWDTE.

[46] Previously known as *Drepanocladus vernicosus*

[47] NPWS (2013). The Status of Protected EU Habitats and Species in Ireland. Overview Volume 1. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland. Editor: Deirdre Lynn. https://www.npws.ie/sites/default/files/publications/pdf/Art17-Vol1-web.pdf

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this species can be excluded. Furthermore, dosing will not prevent the maintenance of the favourable conservation condition of the species.

6.2.5 Lough Ree SAC 000440

6.2.5.1 (3150) Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation

Lough Ree is the third largest lake in Ireland and is situated in an ice-deepened depression in Carboniferous limestone on the River Shannon system between Lanesborough and Athlone. The site spans Counties Longford, Roscommon and Westmeath. Some of its features (including the islands) are based on glacial drift. It has a very long, indented shoreline and hence has many sheltered bays. Although the main habitat, by area, is the lake itself, interesting shoreline, terrestrial and semi aquatic habitats also occur. The lake has been classified as mesotrophic in quality, but the size of the system means that a range of conditions prevail depending upon, for example, rock type. This gives rise to local variations in nutrient status and pH, which in turn results in variations in the phytoplankton and macrophyte flora. Therefore species indicative of oligotrophic, mesotrophic, eutrophic and base-rich situations occur. The water of Lough Ree tends to be strongly peat-stained, restricting macrophytes to depths of less than 2 m, and as a consequence, macrophytes are restricted to sheltered bays, where a typical Shannon flora occurs. Species present include Intermediate Bladderwort (*Utricularia intermedia*), pondweeds (*Potamogeton* spp.), Quillwort (*Isoetes lacustris*), Greater Duckweed (*Spirodela polyrhiza*), stoneworts (*Chara* spp., including *C. pedunculata*) and Arrowhead (*Sagittaria sagittifolia*). The latter is a scarce species which is almost confined in its occurrence to the Shannon Basin (NPWS, 2013)[48].

The SSCO (NPWS, 2016)[49] for the site includes a nutrient specific attribute and target. The target is to maintain the concentration of nutrients in the water column at sufficiently low levels to support the habitat and its typical species. As a relatively productive habitat, mesotrophic and WFD 'good' status (or better) targets apply. Where a lake has nutrient concentrations that are lower than these targets, there should be no decline within class, i.e. no upward trend in nutrient concentrations. For this habitat, the annual average total phosphorus (TP) concentration should be ≤20 µg/l TP. Average annual total ammonia concentrations should be ≤ 0.065 mg/l N and annual 95th percentile for total ammonia should be ≤0.140 mg/l N. Lough Ree had 33 µg/l TP in 1980/1981 and 47 µg/l in 1993/1994, but had good nutrient condition status in 2007-2009 and 2010-2012.

According to O'Connor (2015)[34], water quality is a key driver of lake ecology. Lakes have also been significantly impacted by anthropogenic activities, and eutrophication of freshwaters is one of the most significant environmental challenges globally. Annex I lake habitats are typically associated with high water quality and the absence of eutrophication impacts. This is demonstrated by naturally low dissolved nutrients, clear water and low algal growth. Nutrients are released to water from lands throughout a lake's catchment. Natural ecosystems are highly parsimonious in their use of nutrients however; maximising nutrient re-cycling and minimising losses, meaning that, under natural conditions, very small nutrient loads reach rivers and lakes from their catchments (Moss, 2008)[50]. Varied and widespread land-uses have, however, significantly disrupted natural processes and

[48] NPWS 2013 Lough Ree SAC 000440 Site Synopsis

[49] NPWS 2016 Lough Ree SAC 000440 Conservation Objectives.

[50] Moss, B. (2008) The kingdom of the shore: achievement of good ecological potential in reservoirs. *Freshwater Reviews* 1 (1): 29-42.

increased nutrient losses to water. Agriculture is the greatest exporter of phosphorus to surface waters in Ireland, followed by sewage discharges. Other important exporters of nutrients are industry, septic tanks (DWWTS) and forestry (O'Connor, 2015).

Nutrient enrichment in lentic environments increases primary production in phytoplankton, benthic, epiphytic and epipelic algae and in vascular plants (macrophytes). Contrary to the Habitats Directive description of the habitat as '*Naturally eutrophic lakes'*, Ireland does not have significant phosphorus-rich deposits, hence there are few, if any, lakes that can be characterised as naturally "eutrophic" in line with the standard OECD approach of using total phosphorus and chlorophyll *a* concentrations, and water transparency (OECD, 1982). It is possible that naturally eutrophic conditions do exist in some coastal freshwater lakes (these could perhaps be considered the 'freshwater extreme' of the coastal lagoon habitat), however such sites require further investigation. While further study of the habitat is required, it seems certain that the pondweed-rich variant found in Ireland requires mesotrophic waters, as defined by the OECD methods. 3150 lakes typically have well-developed reedswamp, fen and/or marsh communities around much of their shoreline. Wet woodland would have surrounded much of their shoreline in the past and has survived or re-colonised patches of many 3150 lake shores. Lakes with habitat 3150 are associated with catchments dominated by mineral soils and, hence, some of the most intensive agricultural lands in Ireland. Consequently, the habitat has been under pressure from eutrophication since the 1970s or before (O'Connor, 2015).

The OECD fixed boundary system for lakes has been a model for assessing lake water quality since its development (OECD, 1982). It uses total phosphorus (TP), chlorophyll *a* and transparency (Secchi disk depth) to assess eutrophication impacts. Phosphorus is generally considered to be the limiting nutrient in freshwaters; hence TP concentration is the chosen indicator for nutrient enrichment. Chlorophyll *a* is a measure of phytoplankton biomass, while Secchi disk depth is an indicator of the reduction in transparency and shading caused by phytoplankton. Lakes are categorised, from lowest to highest productivity, as ultra-oligotrophic, oligotrophic, mesotrophic, eutrophic and hyper-eutrophic (O'Connor, 2015).

O'Connor (2015)[34] suggests a target of 'good status' or better, is used for the rich pondweed lake habitat 3150, however, habitat sub-types with a range of variation in requirements may be identified over time. It is possible that some sub-types are tolerant of a degree of eutrophication, whilst others may require conditions that are close to the 'high-good' boundary. The specific targets for nutrient concentration vary among habitats and habitat sub-types. The target for habitat 3150 is at least mesotrophic or good status. These should be taken as indicative targets only and considerable among-site variability is likely. A precautionary approach must be adopted in setting lake-specific targets. There should be no decline within class, i.e. no upward trend in nutrient concentrations. No WFD environmental quality standards (EQS) have yet been set for total phosphorus in Irish lakes. Therefore, for rich pondweed lake habitat (3150) the target for this assessment is mesotrophic or good status, as a minimum, following O'Connor (2015)[34].

Table 5-2 and **Table 5-3** identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to Lough Ree SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

- The lake water body is: Derravaragh (IE_SH_26_708);
- The river water bodies are: Inny_070 (IE_SH_26I010800), Inny_080 (IE_SH_26I011000), Inny_090 (IE_SH_26I011150), Inny_110 (IE_SH_26I011400, Gaine_010 (IE_SH_26G010100) and Gaine_020 (IE_SH_26G010270); and

- The groundwater body is: Inny (IE_SH_G_110).

The habitat natural eutrophic lake occurs downstream of all river and lake water bodies identified in **Table 5-2** and **Table 5-3**

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available flows. Full details of the assessment are provided in **Appendix C**.

A Vollenweider assessment was undertaken for Derravaragh (Lough) (IE_SH_708) which will receive orthophosphate loads from dosing at Portloman WTP. The lake is slightly over the critical load indicative of oligotrophic lakes; however, the percentage increase in orthophosphate loading to the lake as a result of the orthophosphate dosing is 0.1% and the OECD trophic status of the lake for the existing and post-dosing scenario borders on oligotrophic to mesotrophic. The dosing therefore, will not impact on the Good status of the lake[51].

The modelled additional orthophosphate concentration following dosing in Inny_070 (IE_SH_26I010800), Inny_080 (IE_SH_26I011000), Inny_090 (IE_SH_26I011150) and Inny_110 (IE_SH_26I011400) is undetectable (0.0000) mg/l. The modelled post-dosing concentration in the Gaine_010 (IE_SH_26G010100) and Gaine_020 (IE_SH_26G010270) is 0.0006mg/l and 0.0001 mg/l respectively. As the modelled concentrations in all river water bodies is below 5% of the Good / High status boundary there is no risk of deterioration in the orthophosphate status of the water bodies.

The modelled post-dosing increase in orthophosphate concentration in the GWB Inny (IE_SH_G_110) is 0.0001 mg/l. This increase is below 5% of the Good / Fail status boundary (0.00175 mg/l) for orthophosphate and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not prevent the restoration of the favourable conservation condition of the habitat.

6.2.5.2 (6210) Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites)

Dry calcareous grassland occurs scattered around the lake shore. This supports typical species such as Yellow-wort (*Blackstonia perfoliata*), Carline Thistle (*Carlina vulgaris*) and Quaking-grass (*Briza media*). Orchids also feature in this habitat e.g. Bee Orchid (*Ophrys apifera*) and Common Spotted-orchid (*Dactylorhiza fuchsii*) (NPWS, 2013)[48]. Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco- Brometalia*) occurs in close association with other habitats, including other grassland habitats, outcropping rock, fen, swamp, heath and scrub. The Irish semi-natural grasslands survey (ISGS) (O'Neill *et al*., 2013)[52] surveyed several sites in the SAC; however, only two

[51] OECD Mesotrophic Status equates to WFD Good Status – see Table 9 of O'Connor (2015) https://www.npws.ie/sites/default/files/publications/pdf/Lake_habitats_supporting_document_Nov_2015_V1.1_FINAL.pdf

[52] O'Neill, F.H., Martin, J.R., Devaney, F.M. & Perrin, P.M. (2013) The Irish semi-natural grasslands survey 2007-2012. Irish Wildlife Manuals, No. 78. National Parks and Wildlife Service, Department of Arts, Heritage and the

of these (ISGS 259 and 2012) contained large enough discrete areas of this Annex I habitat to be mapped (0.25ha in total). There are likely to be further small areas of the habitat throughout the SAC.

Semi-natural dry grasslands are not considered water-dependent however, although they are considered nutrient sensitive (see **Appendix B**). There are no nutrient specific targets for the habitat in the SSCOs for the SAC (NPWS, 2016)[49] however; there is a target that negative indicator species collectively are not more than 20% cover, with cover by an individual species not more than 10%. According to O'Neill *et al*. (2013) the presence of negative species can indicate agricultural intensification, proximity of disturbed or agricultural habitats, and damaging activities including but not limited to drainage, dumping and afforestation. Given the proximity of the habitat to the lake water body IE_SH_26_750a_Ree (i.e. along the lake shore), there is potential for the orthophosphate concentration in the lake to reach the habitat during floods.

Table 5-2 and **Table 5-3** identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to Lough Ree SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

- The lake water body is: Derravaragh (IE_SH_26_708);
- The river water bodies are: Inny_070 (IE_SH_26I010800), Inny_080 (IE_SH_26I011000), Inny_090 (IE_SH_26I011150), Inny_110 (IE_SH_26I011400), Gaine_010 (IE_SH_26G010100) and Gaine_020 (IE_SH_26G010270); and
- The groundwater body is: Inny (IE_SH_G_110).

As described, only two locations throughout the SAC contain large enough discrete areas of this habitat to be mapped (0.25ha in total) but there are likely to be further small areas of the habitat throughout the SAC. Therefore, on a precautionary basis, it is assumed that all surface water bodies identified in **Table 5-2** and **Table 5-3** have the potential to interact with the habitat. In addition, the groundwater body IE_SH_G_110_Inny flows to the SAC and therefore has the potential to influence orthophosphate concentrations in the lake water body and its associated habitats.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

A Vollenweider assessment was undertaken for Derravaragh (Lough) (IE_SH_708) which will receive orthophosphate loads from dosing at Portloman WTP. The lake is slightly over the critical load indicative of oligotrophic lakes; however, the percentage increase in orthophosphate is 0.1% and the OECD trophic status of the lake for the existing and post-dosing scenario borders on oligotrophic to mesotrophic. The dosing therefore, will not impact on the Good status of the lake[53].

The modelled additional orthophosphate concentration following dosing in Inny_070 (IE_SH_26I010800), Inny_080 (IE_SH_26I011000), Inny_090 (IE_SH_26I011150) and Inny_110

Gaeltacht, Ireland. http://www.botanicalenvironmental.com/wp-content/uploads/2014/02/IWM-78-Irish-semi-natural-grassland-survey.pdf

[53] OECD Mesotrophic Status equates to WFD Good Status – see Table 9 of O'Connor (2015) https://www.npws.ie/sites/default/files/publications/pdf/Lake_habitats_supporting_document_Nov_2015_V1.1_FINAL.pdf

(IE_SH_26I011400) is undetectable (0.0000) mg/l. The modelled post-dosing concentration in the Gaine_010 (IE_SH_26G010100) and Gaine_020 (IE_SH_26G010270) is 0.0006 mg/l and 0.0001 mg/l respectively. As the modelled concentrations in all river water bodies is below 5% of the Good / High status boundary there is no risk of deterioration in the orthophosphate status of the water bodies.

The modelled post-dosing increase in orthophosphate concentration in the GWB Inny (IE_SH_G_110) is 0.0001 mg/l. This increase is below 5% of the Good / Fail status boundary (0.00175 mg/l) for orthophosphate and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not prevent the restoration of the favourable conservation condition of the habitat.

6.2.5.3 (7120) Degraded raised bogs still capable of natural regeneration and (91D0) Bog woodland

Lough Ree SAC includes small examples of raised bog which are of interest in that they show a natural transition through wet woodland and/or swamp to lakeshore habitats. Also present are examples of degraded raised bog capable of regeneration, with the most extensive areas occurring at Clooncraff/Clonlarge, along the north-western shores of the lake. In general the vegetation of these degraded areas is dominated by typical raised bog species such as Cross-leaved Heath (*Erica tetralix*), Heather (*Calluna vulgaris*), Hare's-tail Cottongrass (*Eriophorum vaginatum*), Bog Asphodel (*Narthecium ossifragum*) and Deergrass (*Scirpus cespitosus*). Typically the degraded bog areas have a low cover of peat-forming bog mosses (Sphagnum spp.) (NPWS, 2013)[48].

Active raised bog habitat on Clooncraff and Cloonlarge Bogs is estimated as 5.9ha in area in 2003. The area of degraded raised bog on the high bog has been modelled as 44.7ha. It is estimated that this entire area is potentially restorable to active raised bog by drain blocking. The total potential active raised bog on the high bog is therefore estimated to be 50.6ha. Ecohydrological assessments of the cutover estimates that an additional 19.5 ha of bog forming habitats could be restored. The long term target for active raised bog is therefore 70.1ha (NPWS, 2016)[49].

Associated with the extensive raised bog system at Clooncraff/Clonlarge are areas of bog woodland. At least two small areas of woodland occur on the raised bog domes. However it would appear that this habitat is in the early stages of development. The largest area is dominated by low trees of Downy Birch and Lodgepole Pine (*Pinus contorta*). Occasional trees of Scots Pine (*Pinus sylvestris*) also occur. The ground layer is wet and quaking with a lush carpet of mosses present, including various species of *Sphagnum, Pleurozium schreberi* and *Aulocomium palustre*. The main vascular plant species in the ground flora are Bog-rosemary (Andromeda polifolia), Cranberry (*Vaccinium oxycoccos*), Bog-myrtle (*Vaccinium myrtillus*), Hare's-tail Cottongrass and Deergrass. Bog woodland is of particular conservation importance and is listed with priority status on the E.U. Habitats Directive.

At St. John's Wood located on the western shore of Lough Ree, there is an interesting area of woodland that grows on cut-away peat. This is dominated by Downy Birch and Alder Buckthorn (*Frangula alnus*). The occurrence of the latter species in such abundance is unusual in Ireland

(NPWS, 2013)[48]. St John's Wood is stated to be one of the most important woodlands in Ireland; it is recognised as the largest and most natural woodland in the Midlands (Alexander, 2011)[54].

According to the SSCOs for the habitats degraded raised bog and bog woodland, they are regarded as a component of the active raised bog habitat (7110) and thus, the conservation objective and supporting document for active raised bog (7110) are also relevant to these habitats and common attributes have not been repeated here (NPWS, 2016)[49]. The SSCOs for the habitats (NPWS, 2016)[49] include a target for water quality. The target requires that water quality on the high bog and in transitional areas is close to natural reference conditions.

Water chemistry within raised bogs is influenced by atmospheric inputs (rainwater). However, within soak systems, water chemistry is influenced by other inputs such as focused flow or interaction with underlying substrates. Water chemistry in areas surrounding the high bog varies due to influences of different water types (bog water, regional groundwater and run-off from surrounding mineral lands) (NPWS, 2016)[49].

Ombrotrophic peat waters found on the surface of raised bogs are characterised by low pH values (pH < 4.5) and also have low values of Electrical Conductivity (EC). This is due to the fact that the raised bog system derives its mineral supply from precipitation, which is usually acidic and low in nutrients. Raised bog vegetation exchanges cations with protons to further reduce the pH. Hydrochemistry varies in the areas surrounding a raised bog. Locally, conditions may be similar to the high bog due to a dominance of water originating from the bog. However, elsewhere in the marginal areas, there may be increased mineral and nutrient content of the water due to regional groundwater influences, runoff from surrounding mineral soils, and the release of nutrients through oxidation of peat resulting from reduced water levels.

In 2015, the hydrochemistry of Clooncraff and Cloonlarge Bogs was recorded as having relatively low EC values in most areas of the cutover (generally < 100µS/cm) which indicates little groundwater influence as these values are similar to those of rain water, reflecting the inert properties of the peat. Elevated EC values were identified in the cutover drains to the south-east of the bog, adjacent to the narrow section of high bog remaining in this area. This suggests there may be some upwelling of groundwater in to these drains (NPWS, 2016)[55].

Table 5-2 and **Table 5-3** identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to Lough Ree SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

- The lake water body is: Derravaragh (IE_SH_26_708).
- The river water bodies are: Inny_070 (IE_SH_26I010800), Inny_080 (IE_SH_26I011000), Inny_090 (IE_SH_26I011150), Inny_110 (IE_SH_26I011400), Gaine_010 (IE_SH_26G010100) and Gaine_020 (IE_SH_26G010270); and
- The groundwater body is: Inny (IE_SH_G_110).

[54] Alexander, K. N. A. (2011) An invertebrate survey of Coill Eoin, St John's Wood, Co Roscommon. Irish Wildlife Manuals, No. 57. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Dublin, Ireland.

[55] NPWS 2016 Lough Ree SAC (Site code 000440) Conservation Objectives Supporting DOcumen - Raised Bog Habitats

The habitats degraded raised bog and bog woodland are located along the shore of the SAC. Due to their location on the lake shore there is potential for orthophosphate concentrations in the river and lake water bodies discharging to the SAC to reach the habitats during inundation. In addition, the groundwater body IE_SH_G_110_Inny flows to the SAC and therefore has the potential to influence orthophosphate concentrations in the lake water body and its associated habitats.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

A Vollenweider assessment was undertaken for Derravaragh (Lough) (IE_SH_708) which will receive orthophosphate loads from dosing at Portloman WTP. The lake is slightly over the critical load indicative of oligotrophic lakes; however, the percentage increase in orthophosphate is 0.1% and the OECD trophic status of the lake for the existing and post-dosing scenario borders on oligotrophic to mesotrophic. The dosing therefore, will not impact on the Good status of the lake[56].

The modelled additional orthophosphate concentration following dosing in Inny_070 (IE_SH_26I010800), Inny_080 (IE_SH_26I011000), Inny_090 (IE_SH_26I011150) and Inny_110 (IE_SH_26I011400) is undetectable (0.0000) mg/l. The modelled post-dosing concentration in the Gaine_010 (IE_SH_26G010100) and Gaine_020 (IE_SH_26G010270) is 0.0003 mg/l and 0.0001 mg/l respectively. As the modelled concentrations in all river water bodies is below 5% of the Good / High status boundary there is no risk of deterioration in the orthophosphate status of the water bodies.

The modelled post-dosing increase in orthophosphate concentration in the GWB Inny (IE_SH_G_110) is 0.0001 mg/l. This increase is below 5% of the Good / Fail status boundary (0.00175 mg/l) for orthophosphate and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not prevent the restoration of the favourable conservation condition of the habitat.

6.2.5.4 (7230) Alkaline fens

Lough Ree has a very long, indented shoreline and hence has many sheltered bays. Although the main habitat, by area, is the lake itself, interesting shoreline, terrestrial and semi-aquatic habitats also occur. Reedbeds of Common Reed (*Phragmites australis*) are an extensive habitat in a number of more sheltered places around the lake, but single-species 'swamps' consisting of such species as Common Club-rush (*Scirpus lacustris*), Slender Sedge (*Carex lasiocarpa*), Great Fen-sedge (*Cladium mariscus*) and two scarce species of sedge (*Carex appropinquata* and *C. elata*) also occur in suitable places. Some of these grade up into species-rich alkaline fen with Black Bog-rush (*Schoenus nigricans*) and Whorl-grass (*Catabrosa aquatica*), or freshwater marsh with abundant Water Dock (*Rumex hydrolapathum*) and Hemp-agrimony (*Eupatorium cannabinum*) (NPWS, 2013)[48].

[56] OECD Mesotrophic Status equates to WFD Good Status – see Table 9 of O'Connor (2015) https://www.npws.ie/sites/default/files/publications/pdf/Lake_habitats_supporting_document_Nov_2015_V1.1_FINAL.pdf

Fens are wetland systems with a permanently high water level at or just below its surface. The substrate is an alkaline or slightly acidic peat soil. The vegetation is usually rich in or dominated by sedges. They receive nutrients from sources other than precipitation, usually from upslope sources through drainage from surrounding mineral soils and from groundwater movement. In general they are poor in nitrogen and phosphorus, the latter of which tends to be the limiting nutrient in fen systems. Studies of wetlands in western Europe frequently show that nutrient enrichment (with nitrogen and phosphorus) leads to changes in species composition, decline in overall plant species diversity, and loss of rare and uncommon species. Organic matter is often accumulated as peat within a fen. A "poor" fen has very low concentrations of plant nutrients and floristically has similarities to a bog. A "rich" fen has relatively high concentrations of mineral nutrients, but is still characterised by the accumulation of peat (though this is likely to be primarily from the remains of plants other than sphagnum mosses, such as sedges and brown mosses). Where fens are characterised by alkaline conditions resulting from water draining from limestone and other calcareous soil formations, they are distinguished as "rich fen", though there is often a general understanding that a "fen" will be relatively eutrophic (nutrient rich) (Foss, 2007)[41].

The SSCOs for the habitat alkaline fens in Lough Ree SAC (NPWS, 2016)[49] include a nutrient specific target of appropriate water quality to support the natural structure and functioning of the habitat. Fens receive natural levels of nutrients (e.g. iron, magnesium and calcium) from water sources. However, they are generally poor in nitrogen and phosphorus with the latter tending to be the limiting nutrient.

Table 5-2 and **Table 5-3** identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to Lough Ree SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

- The lake water body is: Derravaragh (IE_SH_26_708).
- The river water bodies are: Inny_070 (IE_SH_26I010800); Inny_080 (IE_SH_26I011000); Inny_090 (IE_SH_26I011150); Inny_110 (IE_SH_26I011400); Gaine_010 (IE_SH_26G010100); Gaine_020 (IE_SH_26G010270).
- The groundwater body is: Inny (IE_SH_G_110).

The full extent of alkaline fens in the SAC is currently unknown. The main area is considered to occur in the vicinity of St. John's Wood, on the western side of the lake but there are likely to be additional areas around the lake. Alkaline fens occur in association with other habitats such as wet grassland and marsh (NPWS, 2016)[49]. Therefore, on a precautionary basis, it is assumed that all surface water bodies identified in **Table 5-2** and **Table 5-3** connected with this site have the potential to interact with the habitat. In addition, the groundwater body IE_SH_G_110_Inny flows to the SAC and therefore has the potential to influence orthophosphate concentrations in the lake water body and its associated habitats.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

A Vollenweider assessment was undertaken for Derravaragh (Lough) (IE_SH_708) which will receive orthophosphate loads from dosing at Portloman WTP. The lake is slightly over the critical load indicative of oligotrophic lakes; however, the percentage increase in orthophosphate is 0.1% and the

OECD trophic status of the lake for the existing and post-dosing scenario borders on oligotrophic to mesotrophic. The dosing therefore, will not impact on the Good status of the lake[57].

The modelled additional orthophosphate concentration following dosing in Inny_070 (IE_SH_26I010800), Inny_080 (IE_SH_26I011000), Inny_090 (IE_SH_26I011150) and Inny_110 (IE_SH_26I011400) is undetectable (0.0000) mg/l. The modelled post-dosing concentration in the Gaine_010 (IE_SH_26G010100) and Gaine_020 (IE_SH_26G010270) is 0.0003 mg/l and 0.0001 mg/l respectively. As the modelled concentrations in all river water bodies is below 5% of the Good / High status boundary there is no risk of deterioration in the orthophosphate status of the water bodies.

The modelled post-dosing increase in orthophosphate concentration in the GWB Inny (IE_SH_G_110) is 0.0001 mg/l. This increase is below 5% of the Good / Fail status boundary (0.00175 mg/l) for orthophosphate and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not result in deterioration of its favourable conservation condition.

6.2.5.5 (1355) Otter (*Lutra lutra*)

A review of the SSCOs (NPWS, 2016)[49] found no specific attributes or targets relating to water quality. The NPWS 'Threat Response Plan for the Otter' (NPWS, 2009[58]) which comprised a review of and response to the pressures and threats to otters in Ireland, categorised three principal risks to otters: i) habitat destruction and degradation; ii) water pollution; and, iii) accidental death and/or persecution. Water pollution may influence otters either indirectly or directly. Indirect effects include damage to food supply or habitat thus lowering the carrying capacity of an affected area. Direct effects impact the animal itself, resulting in either rapid death (acute toxicity) or in lowered fitness (sub-lethal toxicity), reducing the animal's ability to reproduce successfully or to survive in inclement conditions. The diet of the species varies locally and seasonally; however, it is dominated by fish, in particular salmonids, eels and sticklebacks in freshwater and crayfish locally. Poorly treated effluents can wipe out fish populations for long distances downstream of the discharge, making otherwise ideal habitat unsuitable for otter.

Table 5-2 and **Table 5-3** identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to Lough Ree SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

- The lake water body is: Derravaragh (IE_SH_26_708);
- The river water bodies are: Inny_070 (IE_SH_26I010800), Inny_080 (IE_SH_26I011000), Inny_090 (IE_SH_26I011150), Inny_110 (IE_SH_26I011400), Gaine_010 (IE_SH_26G010100) and Gaine_020 (IE_SH_26G010270); and

[57] OECD Mesotrophic Status equates to WFD Good Status – see Table 9 of O'Connor (2015) https://www.npws.ie/sites/default/files/publications/pdf/Lake_habitats_supporting_document_Nov_2015_V1.1_FINAL.pdf

[58] NPWS (2009) Threat Response Plan: Otter (2009-2011). National Parks & Wildlife Service, Department of the Environment, Heritage & Local Government, Dublin.

- The groundwater body is: Inny (IE_SH_G_110).

The extent of terrestrial otter habitat within the SAC includes all areas within a 10m terrestrial buffer along the shoreline and river banks. The extent of river habitat is calculated on the basis that otter will utilise freshwater habitats from estuary to headwaters, while the extent of lake habitat is based on the tendency of otter to forage within 80m of the shoreline (NPWS, 2016)[49]. Therefore, there is potential for otter to interact with all surface water bodies identified in **Table 5-2** and **Table 5-3.**

In addition, the groundwater bodies Inny (IE_SH_G_110) flows to SAC and therefore has the potential to influence orthophosphate concentrations in the lake water body and its associated QIs.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment results are provided in **Appendix C** and discussed above in **Section 5**.

A Vollenweider assessment was undertaken for Derravaragh (Lough) (IE_SH_708) which will receive orthophosphate loads from dosing at Portloman WTP. The lake is slightly over the critical load indicative of oligotrophic lakes; however, the percentage increase in orthophosphate is 0.1% and the OECD trophic status of the lake for the existing and post-dosing scenario borders on oligotrophic to mesotrophic. The dosing therefore, will not impact on the Good status of the lake[59].

The modelled additional orthophosphate concentration following dosing in Inny_070 (IE_SH_26I010800), Inny_080 (IE_SH_26I011000), Inny_090 (IE_SH_26I011150) and Inny_110 (IE_SH_26I011400) is undetectable (0.0000) mg/l. The modelled post-dosing concentration in the Gaine_010 (IE_SH_26G010100) and Gaine_020 (IE_SH_26G010270) is 0.0003 mg/l and 0.0001 mg/l respectively. As the modelled concentrations in all river water bodies is below 5% of the Good / High status boundary there is no risk of deterioration in the orthophosphate status of the water bodies.

The modelled post-dosing increase in orthophosphate concentration in the GWB Inny (IE_SH_G_110) is 0.0001 mg/l. This increase is below 5% of the Good / Fail status boundary (0.00175 mg/l) for orthophosphate and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on the fish species supported by the surface water bodies connected to the SAC, which comprise the main food source for the otter, can be excluded. Furthermore, dosing will not result in deterioration of its favourable conservation condition.

6.2.6 Mount Hevey Bog SAC 002342

6.2.6.1 (7110) Active raised bogs, (7120) Degraded raised bogs still capable of natural regeneration, (7150) Depressions on peat substrates of the *Rhynchosporion*

[59] OECD Mesotrophic Status equates to WFD Good Status – see Table 9 of O'Connor (2015) https://www.npws.ie/sites/default/files/publications/pdf/Lake_habitats_supporting_document_Nov_2015_V1.1_FINAL.pdf

Mount Hevey Bog is situated approximately 4km north-east of Kinnegad, in the townlands of Cloncrave, White Island, Aghamore, Kilwarden and Kilnagalliagh. The Meath-Westmeath County boundary runs through the centre of the bog. The site comprises a raised bog that includes both areas of high bog and cutover bog. The Dublin-Sligo railway runs through the northern part of the bog isolating two northern lobes. The northern lobes are adjacent to the Royal Canal. Active raised bog comprises areas of high bog that are wet and actively peat-forming, where the percentage cover of bog mosses (*Sphagnum* spp.) is high, and where some or all of the following features occur: hummocks, pools, wet flats, Sphagnum lawns, flushes and soaks. Degraded raised bog corresponds to those areas of high bog whose hydrology has been adversely affected by peat cutting, drainage and other land use activities, but which are capable of regeneration. The *Rhynchosporion* habitat occurs in wet depressions, pool edges and erosion channels where the vegetation includes White Beak-sedge (*Rhynchospora alba*) and/or Brown Beak-sedge (*R. fusca*), and at least some of the following associated species, Bog Asphodel (*Narthecium ossifragum*), sundews (*Drosera spp*.), Deergrass (*Scirpus cespitosus*) and Carnation Sedge (*Carex panicea*) (NPWS, 2014)[60]. Based on the close ecological relationship between these three habitat types, it is not necessary to set SSCOs for the habitats individually. It is considered that should favourable conservation condition for active raised bogs be achieved on the site, then, as a consequence, favourable conservation condition for degraded raised bog and depressions on peat substrate would also be achieved (NPWS, 2016)[61].

Ombrotrophic peat waters found on the surface of raised bogs are characterised by low pH values (pH < 4.5) (Moore & Bellamy 1974) and also have low values of electrical conductivity. This is due to the fact that the raised bog system derives its mineral supply from precipitation, which is usually acidic and low in nutrients. Raised bog vegetation exchanges cations with protons to further reduce the pH. Hydrochemistry varies in the areas surrounding a raised bog. Locally, conditions may be similar to the high bog due to a dominance of water originating from the bog. However, elsewhere in the marginal areas, there may be increased mineral and nutrient content of the water due to regional groundwater influences, runoff from surrounding mineral soils, and the release of nutrients through oxidation of peat resulting from reduced water levels. The hydrochemistry of Mount Hevey Bog has not been studied. The site-specific target for the attribute water quality is: *Water quality on the high bog and in transitional areas close to natural reference conditions* (NPWS, 2016[62]).

Table 5-2 identifies the groundwater body which is hydrogeologically connected to Mount Hevey SAC: and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

- The groundwater body hydrogeologically connected is: Athboy (IE_EA_G_001).

Mount Hevey SAC is located approximately 500m upstream of the Ardonagh Reservoir WSZ. Therefore, there is no potential for the transfer of orthophosphate from the WSZ to the SAC via hydrological pathways (which move in a downstream direction). There is however, potential for the transfer of orthophosphate via the GWB Athboy (IE_EA_G_001).

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

[60] NPWS 2014 Mount Hevey Bog SAC 002342 Site Synopsis
[61] NPWS 2016 Mount Hevey Bog SAC 002342 Conservation Objectives
[62] NPWS 2016 Mount Hevey Bog SAC (site code 002342) Conservatio Objectives Supporting Document - Raised Bog Habitats

The modelled post-dosing increase in orthophosphate concentration in the GWB Athboy (IE_EA_G_001) is 0.0003 mg/l. This increase is below 5% of the Good / Fail status boundary (0.00175 mg/l) and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment results, the additional orthophosphate loading from dosing at Portloman WTP will not result in likely significant effects to these habitats and will not prevent the restoration of the favourable conservation condition of the habitats.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on these bog habitats can be excluded. Furthermore, dosing will not prevent the restoration of the favourable conservation condition of the habitats.

6.2.7 River Boyne and River Blackwater SAC 002299

6.2.7.1 (7230) Alkaline fens

The River Boyne and River Blackwater SAC comprises the freshwater element of the River Boyne as far as the Boyne Aqueduct, the Blackwater as far as Lough Ramor and the Boyne tributaries including the Deel, Stoneyford and Tremblestown Rivers. These riverine stretches drain a considerable area of Meath and Westmeath, and smaller areas of Cavan and Louth (NPWS, 2014[63]). The site includes the Annex I habitat Alkaline fens. Fens are wetland systems with a permanently high water level at or just below its surface. The substrate is an alkaline or slightly acidic peat soil. The vegetation is usually rich in or dominated by sedges. They receive nutrients from sources other than precipitation, usually from upslope sources through drainage from surrounding mineral soils and from groundwater movement. In general they are poor in nitrogen and phosphorus, the latter of which tends to be the limiting nutrient in fen systems. Studies of wetlands in western Europe frequently show that nutrient enrichment (with nitrogen and phosphorus) leads to changes in species composition, decline in overall plant species diversity, and loss of rare and uncommon species. Organic matter is often accumulated as peat within a fen. A "poor" fen has very low concentrations of plant nutrients and floristically has similarities to a bog. A "rich" fen has relatively high concentrations of mineral nutrients, but is still characterised by the accumulation of peat (though this is likely to be primarily from the remains of plants other than sphagnum mosses, such as sedges and brown mosses). Where fens are characterised by alkaline conditions resulting from water draining from limestone and other calcareous soil formations, they are distinguished as "rich fen", though there is often a general understanding that a "fen" will be relatively eutrophic (nutrient rich) (Foss, 2007)[41].

In the River Boyne and River Blackwater SAC the main areas of alkaline fen are concentrated in the vicinity of Lough Shesk, Freehan Lough and Newtown Lough (NPWS, 2014[63]). The hummocky nature of the local terrain produces frequent springs and seepages which are rich in lime. A series of base-rich marshes have developed in the poorly-drained hollows, generally linked with these three lakes. Open water is usually fringed by Bulrush (*Typha latifolia*), Common Club-rush (*Scirpus lacustris*) or Common Reed (*Phragmites australis*), and this last species also extends shorewards where a dense stand of Great Fen-sedge (*Cladium mariscus*) frequently occurs. This in turn grades into a sedge and grass community (*Carex* spp. and Purple Moor-grass, *Molinia caerulea*), or one dominated by Black Bog-rush (*Schoenus nigricans*). An alternative aquatic/terrestrial transition is a floating layer of

[63] NPWS 2014 River Boyne and River Blackwater SAC 002299 Site Synopsis

vegetation. This is normally based on Bogbean (*Menyanthes trifoliata*) and Marsh Cinquefoil (*Potentilla palustris*). Other species gradually become established on this cover, especially plants tolerant of low nutrient status e.g. bog mosses (*Sphagnum* spp.). Diversity of plant and animal life is high in the fen and the flora includes many rarities. Of note is the abundance of aquatic stoneworts (*Chara* spp.) which are characteristic of calcareous wetlands (NPWS, 2014)[63]. There are no SSCOs in place for alkaline fens in the River Boyne and River Blackwater SAC (NPWS, 2016)[64].

Table 5-2 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to River Boyne and River Blackwater SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

In the case of the Boyne, additional water bodies at major confluences on the river are included until a potential orthophosphate concentration post dosing of 0.0000 mg/l is achieved. As the most downstream water body is evaluated in each case, this allows for demonstration of potential impacts:

- The river water bodies include: Kinnegad_010 (IE_EA_07K010060), Kinnegad_020 (IE_EA_07K010100), Kinnegad_030 (IE_EA_07K010200), Riverstown_010 (IE_EA_07R010090), Riverstown_020 (IE_EA_07R010200), Ballyhaw_010 (IE_EA_07B340940), Deel (Raharney)_020 (IE_EA_07D010080), Deel (Raharney)_030 (IE_EA_07D010200), Deel (Raharney)_040 (IE_EA_07D010300), Deel (Raharney)_050 (IE_EA_07D010400), Deel (Raharney)_060 (IE_EA_07D010600), Killynan_010 (IE_EA_07K330580), Stonyford_020 (IE_EA_07S020075) and Stonyford_040 (IE_EA_07S020400); and
- The groundwater body is: Athboy (IE_EA_G_001).

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

As stated in the site synopsis (NPWS, 2014[63]), the main areas of the habitat are located in the vicinity of Lough Shesk, Freehan Lough and Newtown Lough. Whilst there is hydrological connectivity between these three lakes and the WSZ, they are located upstream of the Stoneyford River which connects to the WSZ. They are hydrogeologally connected via the Athboy (IE_EA_G_001) groundwater body.

The modelled post-dosing orthophosphate concentrations in river water bodies hydrologically connected to the SAC are below 5% of the Good / High status boundary. Modelled concentrations range from 0.0000 mg/l in the Stonyford_020 (IE_EA_07S020075), and Deel (Raharney)_020 (IE_EA_07D010080) to 0.0006 mg/l in Kinnegad_030 (IE_EA_07K010200). There is no risk of deterioration in the orthophosphate status of the river water bodies as a result of dosing at Portloman WTP. The small modelled increases in orthophosphate concentration do not change the risk of deterioration in these river water bodies and therefore the achievement of the WFD objectives.

There are two monitoring points on Kinnegad_030 (IE_EA_07K010200):

[64] NPWS 2016 River Boyne and River Blackwater SAC 002299 Conservation Objectives

i. RS07K010150 KINNEGAD - 0.5km d/s St 0100 (d/s STW) - approximately 300m downstream of the Kinnegad WWTP discharge was at bad indicative quality based on the 2014 baseline. However monitoring data from 2019, 2020 and 2021 results in an improvement in the baseline to 0.033 mg/l, i.e., good indicative quality. Kinnegad WWTP is no longer regarded as a significant pressure in the EPA WFD App. The WWTP is compliant with the orthophosphate ELV and is therefore not a significant pressure for orthophosphate as demonstrated in the mass balance assessment in Table 2.
ii. RS07K010200 Kilwarden Br - approximately 2.5km downstream (but also downstream of 2 tributaries) is at Good Ortho P Indicative Quality.

The latter is the most downstream monitoring point that is representative of the subbasin. Ecological status for the river is moderate, but the orthophosphate conditions supporting the chemistry is reported as High. The modelled increase in concentration is below significant levels, which will not increase the risk of deterioration in orthophosphate indicative quality or prevent the achievement of the WFD objectives in this water body.

The modelled post-dosing increase in orthophosphate concentration in the GWB Athboy (IE_EA_G_001) is 0.0003 mg/l. This increase is below 5% of the Good / Fail status boundary (0.00175 mg/l) and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not prevent the maintenance or restoration of the favourable conservation condition of the habitat.

6.2.7.2 (91E0) Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)*

Alluvial forests occurs on heavy soils which are periodically inundated by the annual rise of river levels, but which are otherwise well drained and aerated during low water. Alluvial forests are a groundwater-dependent terrestrial ecosystem. Certain types of alluvial woodland are sensitive to changes in groundwater chemistry (e.g. nutrients, pH). Habitats most sensitive to changes in groundwater nutrient concentrations are those with direct inputs of groundwater and are low productivity systems. The sensitivity to changes in groundwater chemistry is largely based upon receptor sensitivity, incorporating aspects of the pathway susceptibility within the habitat (Kilroy *et al*., 2008)[65].

Wet woodland fringes many stretches of the Boyne (NPWS, 2014[63]). The Boyne River Islands are a small chain of three islands situated 2.5 km west of Drogheda. The islands were formed by the build-up of alluvial sediment in this part of the river where water movement is sluggish. All of the islands are covered by dense thickets of wet, willow (*Salix spp*.) woodland, with the following species occurring: Osier (*S. viminalis*), Crack Willow (*S. fragilis*), White Willow (*S. alba*), Purple Willow (*Salix purpurea*) and Rusty Willow (*S. cinerea subsp. oleifolia*). A small area of Alder (*Alnus glutinosa*) woodland is found on soft ground at the edge of the canal in the north-western section of the islands. Along other stretches of the rivers of the site, Rusty Willow scrub and pockets of wet

[65] Kilroy, G., Dunne, F., Ryan, J., O'Connor, A., Daly, D., Craig, M., Coxon, C., Johnston, P. and Moe, H. (2008) A Framework for the Assessment of Groundwater- Dependent Terrestrial Ecosystems under the Water Framework Directive. Environmental Research Centre Report.

woodland dominated by Alder have become established, particularly at the river edge of mature deciduous woodland. Ash (*Fraxinus excelsior*) and Downy Birch (*Betula pubescens*) are common in the latter, and the ground flora is typical of wet woodland with Meadowsweet (*Filipendula ulmaria*), Wild Angelica (*Angelica sylvestris*), Yellow Iris (*Iris pseudacorus*), horsetails (*Equisetum spp*.) and occasional tussocks of Greater Tussock-sedge (*Carex paniculata*) (NPWS, 2014)[63]. There are no SSCOs in place for alluvial forests in the River Boyne and River Blackwater SAC (NPWS, 2016)[64].

Table 5-2 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to River Boyne and River Blackwater SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

In the case of the Boyne, additional water bodies at major confluences on the river are included until a potential orthophosphate concentration post dosing of 0.0000 mg/l is achieved. As the most downstream water body is evaluated in each case, this allows for demonstration of potential impacts:

- The river water bodies include: Kinnegad_010 (IE_EA_07K010060), Kinnegad_020 (IE_EA_07K010100), Kinnegad_030 (IE_EA_07K010200), Riverstown_010 (IE_EA_07R010090), Riverstown_020 (IE_EA_07R010200), Ballyhaw_010 (IE_EA_07B340940), Deel (Raharney)_020 (IE_EA_07D010080), Deel (Raharney)_030 (IE_EA_07D010200), Deel (Raharney)_040 (IE_EA_07D010300), Deel (Raharney)_050 (IE_EA_07D010400), Deel (Raharney)_060 (IE_EA_07D010600, Killynan_010 (IE_EA_07K330580), Stonyford_020 (IE_EA_07S020075) and Stonyford_040 (IE_EA_07S020400); and
- The groundwater bodies include: Athboy (IE_EA_G_001.

The habitat alluvial forests is located downstream of the water bodies identified as connected to the site. The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

The modelled post-dosing orthophosphate concentrations in river water bodies hydrologically connected to the SAC are below 5% of the Good / High status boundary. Modelled concentrations range from 0.0000 mg/l in the Stonyford_020 (IE_EA_07S020075), and Deel (Raharney)_020 (IE_EA_07D010080) to 0.0006 mg/l in Kinnegad_030 (IE_EA_07K010200). There is no risk of deterioration in the orthophosphate status of the river water bodies as a result of dosing at Portloman WTP. The small modelled increases in orthophosphate concentration do not change the risk of deterioration in these river water bodies and therefore the achievement of the WFD objectives.

There are two monitoring points on Kinnegad_030 (IE_EA_07K010200):

i. RS07K010150 KINNEGAD - 0.5km d/s St 0100 (d/s STW) - approximately 300m downstream of the Kinnegad WWTP discharge was at bad indicative quality based on the 2014 baseline. However monitoring data from 2019, 2020 and 2021 results in an improvement in the baseline to 0.033 mg/l, i.e., good indicative quality. Kinnegad WWTP is no longer regarded as a significant pressure in the EPA WFD App. The WWTP is compliant with the orthophosphate ELV and is therefore not a significant pressure for orthophosphate as demonstrated in the mass balance assessment in Table 2.

ii. RS07K010200 Kilwarden Br - approximately 2.5km downstream (but also downstream of 2 tributaries) is at Good Ortho P Indicative Quality.

The latter is the most downstream monitoring point that is representative of the subbasin. Ecological status for the river is moderate, but the orthophosphate conditions supporting the chemistry is reported as High. The modelled increase in concentration is below significant levels, which will not increase the risk of deterioration in orthophosphate indicative quality or prevent the achievement of the WFD objectives in this water body.

The modelled post-dosing increase in orthophosphate concentration in the GWB Athboy (IE_EA_G_001) is 0.0003 mg/l. This increase is below 5% of the Good / Fail status boundary (0.00175 mg/l) and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not prevent the maintenance or restoration of the favourable conservation condition of the habitat.

6.2.7.3 (1099) River Lamprey (*Lampetra fluviatilis*) and (1106) Salmon (*Salmo salar*)

The Boyne and its tributaries form one of Ireland's premier game fisheries and the area offers a wide range of angling, from fishing for spring salmon and grilse (summer salmon) to seatrout fishing and extensive brown trout fishing. Atlantic Salmon (*Salmo salar*) use the tributaries and headwaters as spawning grounds. Although this species is still fished commercially in Ireland, it is considered to be endangered or locally threatened elsewhere in Europe and is listed on Annex II of the Habitats Directive. Atlantic Salmon run the Boyne almost every month of the year. The Boyne is most important as it represents an eastern river which holds large three-sea-winter fish from 20-30 lb. These fish generally arrive in February, with smaller spring fish (10 lb) arriving in April/May. The grilse come in July, water permitting. The river gets a further run of fish in late August and this run would appear to last well after the fishing season. The salmon fishing season lasts from 1st March to 30th September (NPWS, 2014)[63].

The Blackwater is a medium sized limestone river which is still recovering from the effects of the arterial drainage scheme of the 1970s. Salmon stocks have not recovered to the numbers that existed pre-drainage. The Deel, Riverstown, Stoneyford and Tremblestown Rivers are all spring-fed, with a continuous high volume of water. They are difficult to fish because some areas are overgrown, while others have been affected by drainage with resultant high banks (NPWS, 2014)[63]. There are no SSCOs published for River lamprey or Atlantic salmon in the River Boyne and River Blackwater SAC (NPWS 2016)[64].

Water quality is a particular threat to all fish fauna listed as qualifying interests. The latest Red List of Irish amphibians, reptiles and freshwater fish (King *et al*., 2011)[66] highlights the deterioration in water quality and ongoing point and diffuse sources of pollution as a key threat to these species and

[66] King, J.L., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., FitzPatrick, Ú., Gargan, P.G., Kelly, F.L., O'Grady, M.F., Poole, R., Roche, W.K. & Cassidy, D. (2011) Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

includes the potential effects from municipal discharges. Deterioration in water quality has the potential for a detrimental effect on spawning habitats, particularly where nutrient conditions result in excessive algal growth and macrophyte abundance, leading to smothering, shading effects, alteration of macroinvertebrate communities and silt deposition. Salmon requires a Q-value of at least 4, which equates to good ecological status.

Table 5-2 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to River Boyne and River Blackwater SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

In the case of the Boyne, additional water bodies at major confluences on the river are included until a potential orthophosphate concentration post dosing of 0.0000 mg/l is achieved. As the most downstream water body is evaluated in each case, this allows for demonstration of potential impacts:

- The river water bodies include: Kinnegad_010 (IE_EA_07K010060), Kinnegad_020 (IE_EA_07K010100), Kinnegad_030 (IE_EA_07K010200), Riverstown_010 (IE_EA_07R010090), Riverstown_020 (IE_EA_07R010200), Ballyhaw_010 (IE_EA_07B340940), Deel (Raharney)_020 (IE_EA_07D010080), Deel (Raharney)_030 (IE_EA_07D010200), Deel (Raharney)_040 (IE_EA_07D010300), Deel (Raharney)_050 (IE_EA_07D010400), Deel (Raharney)_060 (IE_EA_07D010600, Killynan_010 (IE_EA_07K330580), Stonyford_020 (IE_EA_07S020075) and Stonyford_040 (IE_EA_07S020400); and
- The groundwater bodies include: Athboy (IE_EA_G_001.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

As per the site synopsis (NPWS, 2014[63]), Atlantic salmon use the tributaries and headwaters of the Boyne as spawning grounds, and run the Boyne almost every month of the year. The Blackwater salmon stocks have not recovered to the numbers that existed prior to the arterial drainage scheme carried out in the 1970s. River Lamprey are known to be present in the lower reaches of the Boyne River. There is no hydrological connectivity between the WSZ and the River Blackwater, which confluences with the Boyne River downstream of the WSZ.

The modelled post-dosing orthophosphate concentrations in river water bodies hydrologically connected to the SAC are below 5% of the Good / High status boundary. Modelled concentrations range from 0.0000 mg/l in the Stonyford_020 (IE_EA_07S020075), and Deel (Raharney)_020 (IE_EA_07D010080) to 0.0006 mg/l in Kinnegad_030 (IE_EA_07K010200). There is no risk of deterioration in the orthophosphate status of the river water bodies as a result of dosing at Portloman WTP. The small modelled increases in orthophosphate concentration do not change the risk of deterioration in these river water bodies and therefore the achievement of the WFD objectives.

There are two monitoring points on Kinnegad_030 (IE_EA_07K010200):

i. RS07K010150 KINNEGAD - 0.5km d/s St 0100 (d/s STW) - approximately 300m downstream of the Kinnegad WWTP discharge was at bad indicative quality based on the 2014 baseline.

However monitoring data from 2019, 2020 and 2021 results in an improvement in the baseline to 0.033 mg/l, i.e., good indicative quality. Kinnegad WWTP is no longer regarded as a significant pressure in the EPA WFD App. The WWTP is compliant with the orthophosphate ELV and is therefore not a significant pressure for orthophosphate as demonstrated in the mass balance assessment in Table 2.

ii. RS07K010200 Kilwarden Br - approximately 2.5km downstream (but also downstream of 2 tributaries) is at Good Ortho P Indicative Quality.

The latter is the most downstream monitoring point that is representative of the subbasin. Ecological status for the river is moderate, but the orthophosphate conditions supporting the chemistry is reported as High. The modelled increase in concentration is below significant levels, which will not increase the risk of deterioration in orthophosphate indicative quality or prevent the achievement of the WFD objectives in this water body.

The modelled post-dosing increase in orthophosphate concentration in the GWB Athboy (IE_EA_G_001) is 0.0003 mg/l. This increase is below 5% of the Good / Fail status boundary (0.00175 mg/l) and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In relation to River lamprey, they are noted to be present in the lower stretches of the Boyne River, which is a significant distance downstream of the WSZ. Salmon run the entirety of the Boyne, to the headwaters and tributaries for spawning purposes. As discussed above, the potential increases in concentration in the river water bodies connected to the WSZ are all less than 0.00125 mg/l (5% of the Good / High boundary) and therefore represent and unmeasurable increase in orthophosphate concentration and there will be no risk of deterioration in the status of the water bodies in question.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on the water quality and habitats that support these species, can be excluded. Furthermore, dosing will not prevent the maintenance or restoration of the favourable conservation condition of the species.

6.2.7.4 (1355) Otter (*Lutra lutra*)

Otter can be found throughout the River Boyne and River Blackwater SAC. There are no SSCOs published for this SAC (NPWS, 2014)[63]. A search of other SACs containing this species show there are no water quality or nutrient specific targets, however, there is a target to ensure that there should be no significant decline in fish biomass (NPWS, 2016)[64]. The NPWS 'Threat Response Plan for the Otter' (NPWS 2009)[67], categorized three principal risks to otters: i) habitat destruction and degradation; ii) water pollution; and, iii) accidental death and/or persecution. Water pollution may influence otters either indirectly or directly. Indirect effects include damage to food supply or habitat thus lowering the carrying capacity of an affected area. Direct effects impact the animal itself, resulting in either rapid death (acute toxicity) or in lowered fitness (sub-lethal toxicity), reducing the animal's ability to reproduce successfully or to survive in inclement conditions. The diet of the species varies locally and seasonally; however, it is dominated by fish, in particular salmonids,

[67] NPWS 2009 Threat Response Plan: Otter Lutra lutra 2009-2011

eels and sticklebacks in freshwater and crayfish locally. Poorly treated effluents can wipe out fish populations for long distances downstream of the discharge, making otherwise ideal habitat unsuitable for otter.

Table 5-2 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to River Boyne and River Blackwater SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

In the case of the Boyne, additional water bodies at major confluences on the river are included until a potential orthophosphate concentration post dosing of 0.0000 mg/l is achieved. As the most downstream water body is evaluated in each case, this allows for demonstration of potential impacts:

- The river water bodies include: Kinnegad_010 (IE_EA_07K010060), Kinnegad_020 (IE_EA_07K010100), Kinnegad_030 (IE_EA_07K010200), Riverstown_010 (IE_EA_07R010090), Riverstown_020 (IE_EA_07R010200), Ballyhaw_010 (IE_EA_07B340940), Deel (Raharney)_020 (IE_EA_07D010080), Deel (Raharney)_030 (IE_EA_07D010200), Deel (Raharney)_040 (IE_EA_07D010300), Deel (Raharney)_050 (IE_EA_07D010400), Deel (Raharney)_060 (IE_EA_07D010600, Killynan_010 (IE_EA_07K330580), Stonyford_020 (IE_EA_07S020075) and Stonyford_040 (IE_EA_07S020400); and
- The groundwater bodies include: Athboy (IE_EA_G_001.

The extent of otter habitat in the River Boyne and River Blackwater SAC has not been defined (NPWS, 2016)[64]. Taking a precautionary approach, potential impacts to otter are assessed on the basis that they will interact with all water bodies identified in **Table 5-2** which are hydrologically connected to the SAC. As the groundwater body Athboy (IE_EA_G_001) represents a potential source of orthophosphate to the river water bodies, it is also assessed.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

The modelled post-dosing orthophosphate concentrations in river water bodies hydrologically connected to the SAC are below 5% of the Good / High status boundary. Modelled concentrations range from 0.0000 mg/l in the Stonyford_020 (IE_EA_07S020075), and Deel (Raharney)_020 (IE_EA_07D010080) to 0.0006 mg/l in Kinnegad_030 (IE_EA_07K010200). There is no risk of deterioration in the orthophosphate status of the river water bodies as a result of dosing at Portloman WTP. The small modelled increases in orthophosphate concentration do not change the risk of deterioration in these river water bodies and therefore the achievement of the WFD objectives.

There are two monitoring points on Kinnegad_030 (IE_EA_07K010200):

i. RS07K010150 KINNEGAD - 0.5km d/s St 0100 (d/s STW) - approximately 300m downstream of the Kinnegad WWTP discharge was at bad indicative quality based on the 2014 baseline. However monitoring data from 2019, 2020 and 2021 results in an improvement in the baseline to 0.033 mg/l, i.e., good indicative quality. Kinnegad WWTP is no longer regarded as a significant pressure in the EPA WFD App. The WWTP is compliant with the

orthophosphate ELV and is therefore not a significant pressure for orthophosphate as demonstrated in the mass balance assessment in Table 2.

ii. RS07K010200 Kilwarden Br - approximately 2.5km downstream (but also downstream of 2 tributaries) is at Good Ortho P Indicative Quality.

The latter is the most downstream monitoring point that is representative of the subbasin. Ecological status for the river is moderate, but the orthophosphate conditions supporting the chemistry is reported as High. The modelled increase in concentration is below significant levels, which will not increase the risk of deterioration in orthophosphate indicative quality or prevent the achievement of the WFD objectives in this water body.

The modelled post-dosing increase in orthophosphate concentration in the GWB Athboy (IE_EA_G_001) is 0.0003 mg/l. This increase is below 5% of the Good / Fail status boundary (0.00175 mg/l) and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on the fish species supported by the surface water bodies connected to the SAC, which comprise the main food source for the otter, can be excluded. Furthermore, dosing will not prevent the maintenance or restoration of its favourable conservation condition.

6.2.8 Wooddown Bog SAC 002205

6.2.8.1 (7120) Degraded raised bogs still capable of natural regeneration

Wooddown Bog is a recently designated SAC and therefore there are no SSCOs published for the site (NPWS, 2018)[68]. Wooddown Bog was previously designated a National Heritage Area (NHA), and therefore has a published site synopsis for this site. According to the site synopsis, Wooddown Bog is situated approximately 4km east of Mullingar in the townlands of Curraghmore, Macetown and Wooddown in Co. Westmeath, and therefore intersects the Ardonagh WSZ. The site comprises a raised bog that includes both areas of high bog and cutover bog. The site consists of a Midlands Raised Bog type, which has developed in a basin. The bog has good hummock/hollow microtopography but few pools. There is a small soak area situated close to the northern edge of the high bog. This area also supports a low canopy of Downy Birch (*Betula pubescens*) woodland. A small fen is located to the south-west of the bog. The cutover supports humid grassland, Birch and Gorse (*Ulex europaeus*) scrub and woodland. There appears to be a flush on the cutover off the northern margin of the high bog. There are only a few pools on the bog, which is very dry. These pools support the bog moss *Sphagnum cuspidatum*, Common Cottongrass and White Beaked-sedge (*Rhynchospora alba*). To the south is an area of fen. Birch and mixed woodland occur on the north and north-east margin of the high bog on the cutover. The cutover, which contains areas of old peat cutting and active peat cutting, also supports Birch and Gorse scrub, flush vegetation, humid grasslands and forestry. Grassland is present on mineral soil to the west of the site. Current land-use on the site includes active peat-cutting in the north-east and south-east of the site. Afforestation occurs on high bog and cutover to the east and on cutover to the south-east. Areas of cutover have been reclaimed for agricultural purposes around the site. The grassland is used for grazing. Damaging activities associated with these land-uses include drainage and burning of the high bog.

[68] NPWS 2018 Wooddown Bog SAC 002205 Conservation Objectives

These are all activities that have resulted in loss of habitat and damage to the hydrological status of the site, and pose a continuing threat to its viability (NPWS, 2002[69]).

The NHA is of conservation significance for its raised bog habitat, a rare habitat in the E.U. and one that is becoming increasingly scarce and under threat in Ireland. It was one of a number of bogs included in a review of the raised bog natural heritage area network conducted in 2014 by NPWS[70]. Based on analysis undertaken in that review, the bog was placed in Category 1 i.e. one of the best NHA sites from an ecological and restoration potential perspective with relatively low levels of active turf-cutting. On the basis of the information presented in the NHA site synopsis it is assumed that the corresponding qualifying interests of the Wooddown Bog SAC include the following bog habitats: 7110 Active raised bog; 7120 Degraded raised bog still capable of natural regeneration; and, 7150 Depressions on peat substrates of the Rhynchosporion. Based on the close ecological relationship between these habitat types, it is not necessary to set SSCOs for the habitats individually. It is considered that should favourable conservation condition for active raised bogs be achieved on the site, then, as a consequence, favourable conservation condition for degraded raised bog and depressions on peat substrate would also be achieved.

According to the SSCOs for other SACs with 7110 Active raised bog habitats, the ombrotophic peat waters found on the surface of raised bogs are characterised by low pH values (pH < 4.5) and also have low values of electrical conductivity. This is due to the fact that the raised bog system derives its mineral supply from precipitation, which is usually acidic and low in nutrients. Raised bog vegetation exchanges cations with protons to further reduce the pH. Hydrochemistry varies in the areas surrounding a raised bog. Locally, conditions may be similar to the high bog due to a dominance of water originating from the bog. However, elsewhere in the marginal areas, there may be increased mineral and nutrient content of the water due to regional groundwater influences, run-off from surrounding mineral soils, and the release of nutrients through oxidation of peat resulting from reduced water levels. The SSCOs for these habitats includes a target for the attribute water quality i.e. *Water quality on the high bog and in transitional areas close to natural reference conditions* (NPWS, 2015)[71].

Table 5-2 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to Wooddown Bog SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

- The river water body is: Riverstown_010 (IE_EA_07R010090); and
- The groundwater body is: Athboy (IE_EA_G_001).

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

The modelled post-dosing orthophosphate concentrations in river water body Riverstown_010 (IE_EA_07R010090) is 0.0008 mg/l which is below the 5% Good / High status boundary. Therefore there is no risk of deterioration in the Good orthophosphate status of the water body as a result of dosing at Portloman WTP.

[69] NPWS 2002 Woodown Bog SAC 000694 Site Synopsis
[70] NPWS 2014 Review of Raised Bog Natural Heritage Area Network
[71] NPWS 2015 Carn Park SAC 002336 Conservation Objectives Supporting Document - Raised Bog Habitats

The modelled post-dosing increase in orthophosphate concentration in the GWB Athboy (IE_EA_G_001) is 0.0003 mg/l. This increase is below 5% of the Good / Fail status boundary (0.00175 mg/l) and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not prevent the maintenance or restoration of the favourable conservation condition of the habitat.

6.2.9 White Lough, Ben Loughs and Lough Doo SAC 001810

6.2.9.1 (3140) Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.

White Lough, Ben Loughs and Lough Doo SAC is comprised of four hard water lakes in a small, poorly-drained valley, 4km east of Castlepollard, Co. Westmeath. A curious feature of the site is the contrast between Lough Doo and the other loughs. Although they are in close proximity and are connected by a ditch, Lough Doo has a very limited aquatic and marginal flora while all the rest are colonised by a wide, dense fringe of Great Fen-sedge (*Cladium mariscus*) swamp. The bottom of Lough Doo is covered by an unusually extensive mat of stonewort species (*Chara spp*.), with a few sparse stands of Common Reed (*Phragmites australis*). The calcium-rich water has deposited marl on the lake bed and over the stoneworts themselves. The presence of stoneworts in such abundance is significant as many of these species are threatened by loss of habitat or by pollution (NPWS, 2013)[72].

There are no SSCOs for the habitat hard oligo-mesotrophic waters in White Lough Ben Loughs and Lough Doo SAC (NPWS, 2016)[73]. There is a general objective to maintain or restore the favourable conservation condition of the habitat. According to O'Connor (2015)[34] water quality is a key driver of lake ecology, and nutrient enrichment leading to eutrophication of freshwaters is one of the most significant environmental challenges globally. Annex I lake habitats are typically associated with high water quality and the absence of eutrophication impacts.

Nutrients are released to water from lands throughout a lake's catchment. Natural ecosystems are highly parsimonious in their use of nutrients however; maximising nutrient re-cycling and minimising losses, meaning that, under natural conditions, very small nutrient loads reach rivers and lakes from their catchments. Varied and widespread land-uses have, however, significantly disrupted natural processes and increased nutrient losses to water. Agriculture is the greatest exporter of phosphorus to surface waters in Ireland, followed by sewage discharges. Other important exporters of nutrients are industry, septic tanks (domestic wastewater treatment systems) and forestry.

High-risk pathways for nutrient loss to lake habitats include thin, highly-permeable soils and subsoils, overlying karstified limestone bedrock, with direct connections to the groundwater frequent (e.g. swallow holes, caves and turloughs). In this scenario, dissolved and particulate nutrients can be rapidly transferred to lakes via shallow to deep groundwater pathways. Groundwater pathways are associated with the hard-water lake habitat (3140), where groundwater springs and seepages emerge in lakes and/or in-flowing streams.

[72] NPWS 2013 White Lough, Ben Loughs and Lough Doo SAC 001810 Site Synopsis
[73] NPWS 2018 White Lough, Ben Loughs and Lough Doo SAC 001810 Conservation Objectives

Nutrient enrichment (with phosphorus and/or nitrogen) can promote phytoplankton growth (as indicated by chlorophyll *a* concentration) leading to shading and reduced light penetration. Nutrient enrichment can also favour epiphytic and epipelic algal communities (as indicated by phytobenthos status) or more competitive submerged macrophyte species (as indicated by macrophyte status), which can out-compete the high conservation value communities and species. Chlorophyll *a*, macrophyte, phytobenthos and phytoplankton composition all demonstrate biological responses to nutrient enrichment.

The best examples of the hard-water lake habitat 3140, including the majority of SACs selected for the habitat, are associated with karstified limestone, marl deposition and extremely low nutrients. For lakes in catchments dominated by shallow soils and subsoils and exposed limestone pavement (i.e. catchments with extreme groundwater vulnerability), the target is, therefore, high status. Coastal sub-types are thought likely to be naturally more productive and, therefore, a target of 'good status' is used. 'Good status' may also be set as the target in larger, more-mixed catchments with deeper soils and lower groundwater vulnerability, as these too may naturally be more productive (O'Connor, 2015).

Table 5-2 identifies the groundwater bodies which are hydrogeologically connected to White Lough, Ben Loughs and Lough Doo SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

The SAC is located upstream of the Ardonagh Reservoir WSZ and therefore is not at risk from the transfer of orthophosphate concentration via hydrological pathways.

- The groundwater bodies hydrogeologically connected are: Athboy (IE_EA_G_001) and Derravaragh (IE_SH_G_077).

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

The assessment has modelled very low increases in orthophosphate for the groundwater bodies intersected by the WSZ. The assessment of the distance to threshold is based on the existing status of each water body, rather than the WFD environmental objective assigned to a given water body.

The modelled post-dosing increase in orthophosphate concentration in the GWBs Athboy (IE_EA_G_001) and Derravaragh (IE_SH_G_077) is 0.0003 mg/l and 0.0002 mg/l, respectively. As both concentrations are below 5% of the Good / Fail status boundary (0.00175 mg/l), there is no risk of deterioration in the Good (surrogate in the case of Athboy) status of the GWBs as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not prevent the maintenance or restoration of the favourable conservation condition of the habitat.

6.2.9.2 (1092) White-clawed Crayfish (*Austropotamobius pallipes*)

The White-clawed crayfish, a species listed on Annex II of the E.U. Habitats Directive and protected under the Wildlife Act, 1976, has been recorded in White Lough, Ben Loughs and Lough Doo SAC. There are no SSCOs for the white-clawed crayfish in the SAC (NPWS, 2016)[73] however, White-clawed crayfish have a general water quality requirement of Moderate to Good water quality (i.e. Q3-4 or higher; NPWS, 2013)[74]. Therefore any reduction in water quality as a result of orthophosphate loading would be contrary to the conservation objectives for this species.

Table 5-2 identifies the groundwater bodies which are hydrogeologically connected to White Lough, Ben Loughs and Lough Doo SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

The SAC is located upstream of the Ardonagh Reservoir WSZ and there is no overlap between the WSZ and any tributary or river leading to these lakes (e.g. via the Lough Lene-Adeel Stream_010 or the Deel (Raharney) which flows towards the River Boyne). Therefore there is no risk of the transfer of orthophosphate via hydrological pathways.

- The groundwater bodies hydrogeologically connected are: Athboy (IE_EA_G_001) and Derravaragh (IE_SH_G_077).

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

The modelled post-dosing increase in orthophosphate concentration in the GWBs Athboy (IE_EA_G_001) and Derravaragh (IE_SH_G_077) is 0.0003 mg/l and 0.0002 mg/l, respectively. As both concentrations are below 5% of the Good / Fail status boundary (0.00175 mg/l), there is no risk of deterioration in the Good (surrogate in the case of Athboy) status of the GWBs as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this species and its supporting habitat can be excluded. Furthermore, dosing will not prevent the maintenance or restoration of the favourable conservation condition of the species.

6.2.10 River Shannon Callows SAC 000216

6.2.10.1 (6410) *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) and (6510) Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)

The River Shannon Callows SAC is mainly comprised of lowland wet grassland. Different plant communities occur depending on elevation, and therefore flooding patterns. Two habitats listed on Annex I of the Habitats Directive are well-represented within the site; *Molinia* meadows and lowland hay meadows (NPWS, 2013)[75]. Both habitats are considered semi-natural grassland. *Molinia*

[74] NPWS (2013) The Status of EU Protected Habitats and Species in Ireland. Species Assessments Volume 3. Version 1.0. Unpublished Report, National Parks & Wildlife
[75] NPWS 2013 River Shannon Callows SAC 000216 Site Synopsis

meadows represent wet meadows and pasture communities on clay, loam and humus-rich gley soils that are generally not fertilised (Martin *et al*., 2007)[76]. They are characterised by the presence of the Meadow Thistle (*Cirsium dissectum*) and Purple Moor-grass (*Molinia caerulea*) (NPWS, 2013). Lowland hay meadows are species-rich hay meadows on moderately fertile soils of river and tributary floodplains. Typical species of this habitat include Meadow Fescue (*Festuca pratensis*), Rough Meadow-grass (*Poa trivialis*), Downy Oat-grass (*Avenula pubescens*), Common Knapweed (*Centaurea nigra*), Ribwort Plantain (*Plantago lanceolata*) and Common Sorrel (*Rumex acetosa*). In places these two habitats grade into one another (NPWS, 2013)[75].

There are no SSCOs published for this SAC (NPWS 2018)[77]. A search of other SACs containing these habitats show there are no water quality or nutrient specific targets for these habitats. Semi-natural grasslands are an extremely vulnerable habitat in Ireland. Areas of semi-natural grassland that are accessible to machinery are particularly vulnerable to agricultural improvement. They are nutrient sensitive with the addition of fertiliser to semi-natural grasslands resulting in a change of sward composition and a loss of plant species diversity (Martin *et al*., 2007). While the conservation designation of these areas of callow grassland aids their conservation, it is the regular flooding of callow grasslands that has protected these habitats from pressures such as commercial development in the past, and will continue to contribute to their protection in the future (Martin *et al*., 2007).

Table 5-2 and **Table 5-3** identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to River Shannon Callows SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

The EAM process only considers river water bodies that intersect the WSZ. The load from upstream is however considered in downstream river water bodies. In the case of the Brosna and Inny, additional water bodies at major confluences on the river are included until a potential orthophosphate concentration post dosing of 0.0000 mg/l is achieved. As the most downstream water body is evaluated in each case, this allows for demonstration of potential impacts:

- The lake water bodies include: Derravaragh (IE_SH_26_708) and Ennell (IE_SH_25_188).
- The river water bodies include: Gaine_010 (IE_SH_26G010100), Gaine_020 (IE_SH_26G010270), Brosna_010 (IE_SH_25B280390), Brosna_020 (IE_SH_25B090006), Brosna_030 (IE_SH_25B090100), Brosna_040 (IE_SH_25B090200), Brosna_050 (IE_SH_25B090250), Brosna_060 (IE_SH_25B090400), Brosna_070 (IE_SH_25B090450), Brosna_080 (IE_SH_25B090600), Brosna_100 (IE_SH_25B090761), Brosna_120 (IE_SH_25B090950), Shannon (Lower)_010 (IE_SH_25S012000), Inny_070 (IE_SH_26I010800), Inny_080 (IE_SH_26I011000), Inny_090 (IE_SH_26I011150) and Inny_110 (IE_SH_26I011400); and
- The groundwater body is: Inny (IE_SH_G_110).

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

[76] Martin, J.R., Gabbett, M., Perrin, P.M., Delaney, A. (2007) Semi-natural grassland survey of Counties Roscommon and Offaly. Available at: https://www.npws.ie/sites/default/files/publications/pdf/Martin_et_al_2007_ISGS.pdf
[77] NPWS 2018 River Shannon Callows SAC 000216 Conservation Objectives

The habitats *Molinia* meadows and lowland hay meadows are located downstream of the WSZ and adjacent to the river water body Shannon (Lower)_010 (IE_SH_25S012000). This river water body receives inputs from all water bodies identified in **Table 5-2** and **Table 5-3** as hydrologically or hydrogeologically connected to the SAC and which also intersect the WSZ. *Molinia* meadows are also a groundwater dependent terrestrial ecosystem (GWDTE) and have low to moderate sensitivity to changes in groundwater quantity and quality[78].

A Vollenweider assessment was undertaken for Derravaragh (IE_SH_708) and Lough Ennell (IE_SH_25_188) both of which are expected to receive an increase in orthophosphate loading as a result of dosing at Portloman WTP. In both cases the orthophosphate dosing will not result in a significant impact on the trophic status of the lakes. Both loughs are slightly over the critical load indicative of oligotrophic lakes however the percentage increase in orthophosphate is 0.1% and 1.3% respectively and the OECD trophic status of the lake for the existing and post-dosing scenario borders on oligotrophic to mesotrophic. The dosing therefore, will not impact on the trophic status of the lakes.

For all river water bodies, the modelled additional concentrations in river water bodies are below 5% of the Good / High indicative quality boundary (i.e. <0.00125mg/l) and the predicted increase in concentration will not increase the risk of deterioration in the orthophosphate indicative quality of these river water bodies.

The modelled post-dosing increase in orthophosphate concentration in the GWB Inny (IE_SH_G_110) is 0.0001 mg/l. This increase is below 5% of the Good / Fail indicative quality boundary (0.00175 mg/l) for orthophosphate and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not prevent the maintenance or restoration of the favourable conservation condition of the habitat.

6.2.10.2 (91E0) Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)*

Alluvial forest is a priority habitat and a qualifying interest in the River Shannon Callows SAC. There are no SSCOs published for this SAC (NPWS 2018)[77]. A search of other SACs containing this habitat showed there is no water quality or nutrient specific target for this habitat. There is a target to maintain the appropriate hydrological regime necessary for maintenance of alluvial vegetation. Periodic flooding is essential to maintain alluvial woodlands along river floodplains. The supporting document for woodlands in the Lower Shannon SAC (NPWS 2012)[79] located downstream of the River Shannon Callows SAC, lists potential threats to this habitat type including an indirect threat from agriculture through fertiliser drift and water pollution, which may increase the trophic status of the wood leading to the stronger growth of nitrophilous species and loss of less vigorous species. However, as these are naturally eutrophic systems the impact is likely to be minimal. In addition,

78 http://www.wfdireland.net/Documents/Characterisation%20Report/Background%20Information/Review%20of%20Env%20Impacts/Groundwater%20Risk%20Assessment/GW11%20Guidance%20on%20Ecosystems.pdf

79 NPWS 2012 Lower River Shannon SAC 002165 Supporting Document -Woodland Habitat

discharge of sewage effluent and slurry will pollute the water and have an indirect impact on the woodlands.

Table 5-2 and **Table 5-3**identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to River Shannon Callows SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

The EAM process only considers river water bodies that intersect the WSZ. The load from upstream is however considered in downstream river water bodies. In the case of the Brosna and Inny, additional water bodies at major confluences on the river are included until a potential orthophosphate concentration post dosing of 0.0000 mg/l is achieved. As the most downstream water body is evaluated in each case, this allows for demonstration of potential impacts:

- The lake water bodies include: Derravaragh (IE_SH_26_708) and Ennell (IE_SH_25_188).
- The river water bodies include: Gaine_010 (IE_SH_26G010100), Gaine_020 (IE_SH_26G010270), Brosna_010 (IE_SH_25B280390), Brosna_020 (IE_SH_25B090006), Brosna_030 (IE_SH_25B090100), Brosna_040 (IE_SH_25B090200), Brosna_050 (IE_SH_25B090250), Brosna_060 (IE_SH_25B090400), Brosna_070 (IE_SH_25B090450), Brosna_080 (IE_SH_25B090600), Brosna_100 (IE_SH_25B090761), Brosna_120 (IE_SH_25B090950), Shannon (Lower)_010 (IE_SH_25S012000), Inny_070 (IE_SH_26I010800), Inny_080 (IE_SH_26I011000), Inny_090 (IE_SH_26I011150) and Inny_110 (IE_SH_26I011400); and
- The groundwater body is: Inny (IE_SH_G_110).

Alluvial forest in the River Shannon Callows SAC occurs on a series of alluvial islands just below the ESB weir near Meelick. Several of the islands are dominated by well-grown woodland consisting mainly of Ash (*Fraxinus excelsior*) and Willows (*Salix* spp.). The islands are prone to regular flooding from the river (NPWS, 2013[75]). The habitat is located downstream of the WSZ and the water bodies identified as connected to the site and intersected by the WSZ as listed in**Table 5-2** and **Table 5-3.**

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

A Vollenweider assessment was undertaken for Derravaragh (IE_SH_708) and Lough Ennell (IE_SH_25_188) both of which are expected to receive an increase in orthophosphate loading as a result of dosing at Portloman WTP. In both cases the orthophosphate dosing will not result in a significant impact on the trophic status of the lakes. Both loughs are slightly over the critical load indicative of oligotrophic lakes however the percentage increase in orthophosphate is 0.1% and 1.3% respectively and the OECD trophic status of the lake for the existing and post-dosing scenario borders on oligotrophic to mesotrophic. The dosing therefore, will not impact on the trophic status of the lakes.

For all river water bodies, the modelled additional concentrations in river water bodies are below 5% of the Good / High indicative quality boundary (i.e. <0.00125mg/l) and the predicted increase in concentration will not increase the risk of deterioration in the orthophosphate indicative quality of these river water bodies.

The modelled post-dosing increase in orthophosphate concentration in the GWB Inny (IE_SH_G_110) is 0.0001 mg/l. This increase is below 5% of the Good / Fail indicative quality boundary (0.00175 mg/l) for orthophosphate and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not prevent the maintenance or restoration of the favourable conservation condition of the habitat.

6.2.10.3 (1355) Otter (*Lutra lutra*)

The River Shannon Callows is a long and diverse site which consists of seasonally flooded, semi-natural, lowland wet grassland, along and beside the river between the towns of Athlone and Portumna. It is approximately 50km long and averages about 0.75km wide (reaching 1.5km wide in places). There are no SSCOs published for this SAC (NPWS 2018)[77]. A search of other SACs containing this species show there are no water quality or nutrient specific targets, however, there is a target to ensure that there should be no significant decline in fish biomass (NPWS, 2012)[80]. The NPWS 'Threat Response Plan for the Otter' (NPWS 2009)[81], categorized three principal risks to otters: i) habitat destruction and degradation; ii) water pollution; and, iii) accidental death and/or persecution. Water pollution may influence otters either indirectly or directly. Indirect effects include damage to food supply or habitat thus lowering the carrying capacity of an affected area. Direct effects impact the animal itself, resulting in either rapid death (acute toxicity) or in lowered fitness (sub-lethal toxicity), reducing the animal's ability to reproduce successfully or to survive in inclement conditions. The diet of the species varies locally and seasonally; however, it is dominated by fish, in particular salmonids, eels and sticklebacks in freshwater and crayfish locally. Poorly treated effluents can wipe out fish populations for long distances downstream of the discharge, making otherwise ideal habitat unsuitable for otter.

Table 5-2 and **Table 5-3**identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to River Shannon Callows SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

The EAM process only considers river water bodies that intersect the WSZ. The load from upstream is however considered in downstream river water bodies. In the case of the Brosna and Inny, additional water bodies at major confluences on the river are included until a potential orthophosphate concentration post dosing of 0.0000 mg/l is achieved. As the most downstream water body is evaluated in each case, this allows for demonstration of potential impacts:

- The lake water bodies include: Derravaragh (IE_SH_26_708) and Ennell (IE_SH_25_188).
- The river water bodies include: Gaine_010 (IE_SH_26G010100), Gaine_020 (IE_SH_26G010270), Brosna_010 (IE_SH_25B280390), Brosna_020 (IE_SH_25B090006), Brosna_030 (IE_SH_25B090100), Brosna_040 (IE_SH_25B090200), Brosna_050 (IE_SH_25B090250), Brosna_060 (IE_SH_25B090400), Brosna_070 (IE_SH_25B090450), Brosna_080 (IE_SH_25B090600), Brosna_100 (IE_SH_25B090761), Brosna_120 (IE_SH_25B090950), Shannon (Lower)_010 (IE_SH_25S012000), Inny_070

[80] NPWS 2012 Lower River Shannon SAC 002165 Conservation Objectives
[81] NPWS 2009 Threat Response Plan: Otter Lutra lutra 2009-2011

(IE_SH_26I010800), Inny_080 (IE_SH_26I011000), Inny_090 (IE_SH_26I011150) and Inny_110 (IE_SH_26I011400); and

- The groundwater body is: Inny (IE_SH_G_110).

The extent of otter habitat in the River Shannon Callows SAC has not been defined (NPWS 2016)[77]. A review of the extent of otter habitat in the Lower River Shannon SAC (located downstream of River Shannon Callows SAC) defines the extent of the terrestrial habitat as 10m along the shoreline (above the high water mark (HWM) and along river banks) and the extent of the freshwater habitat as the river length, on the basis that otters use freshwater habitats from estuary to headwaters. On this basis, and taking a precautionary approach, potential impacts to otter are assessed on the basis that they will interact with all water bodies identified in **Table 5-2** and **Table 5-3** as hydrologically connected to the River Shannon Callows SAC and intersecting the Ardonagh WSZ. As the groundwater body Inny (IE_SH_G_110) represents a potential source of orthophosphate it is also assessed.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

A Vollenweider assessment was undertaken for Derravaragh (IE_SH_708) and Lough Ennell (IE_SH_25_188) both of which are expected to receive an increase in orthophosphate loading as a result of dosing at Portloman WTP. In both cases the orthophosphate dosing will not result in a significant impact on the trophic status of the lakes. Both loughs are slightly over the critical load indicative of oligotrophic lakes however the percentage increase in orthophosphate is 0.1% and 1.3% respectively and the OECD trophic status of the lake for the existing and post-dosing scenario borders on oligotrophic to mesotrophic. The dosing therefore, will not impact on the trophic status of the lakes.

For all river water bodies, the modelled additional concentrations in river water bodies are below 5% of the Good / High indicative quality boundary (i.e. <0.00125mg/l) and the predicted increase in concentration as a result of corrective water treatment will not increase the risk of deterioration in the orthophosphate indicative quality of these river water bodies.

The modelled post-dosing increase in orthophosphate concentration in the GWB Inny (IE_SH_G_110) is 0.0001 mg/l. This increase is below 5% of the Good / Fail indicative quality boundary (0.00175 mg/l) for orthophosphate and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on the fish species supported by the surface water bodies connected to the SAC, which comprise the main food source for the otter, can be excluded. Furthermore, dosing will not prevent the maintenance or restoration of its favourable conservation condition.

6.2.11 Lough Ennell SAC 000685

6.2.11.1 (7230) Alkaline fens

Lough Ennell is a large, open, steep-sided lake, located 3 km south of Mullingar in Co. Westmeath, and therefore lies downstream of the Ardonagh WSZ on the River Brosna (NPWS, 2013)[82]. The lake bottom is of limestone with a marl deposit. The water is markedly alkaline and mesotrophic, possibly owing to effluents received from Mullingar town and to fertilizer inputs from farmland surrounding the lake. The River Brosna flows into the lake from the north at Butler's Bridge, and out from the south. Alkaline fen is also found on the lake shore, with species such as Grass-of-parnassus (*Parnassia palustris*), Marsh Pennywort (*Hydrocotyle vulgaris*) and Bottle Sedge (*Carex rostrata*). In wet marshy patches along the shore Marsh-marigold (*Caltha palustris*), Brookweed (*Samolus valerandi*) and Lesser Water-plantain (*Baldellia ranunculoides*) are common.

Fens are wetland systems with a permanently high water level at or just below its surface. The substrate is an alkaline or slightly acidic peat soil. The vegetation is usually rich in or dominated by sedges. They receive nutrients from sources other than precipitation, usually from upslope sources through drainage from surrounding mineral soils and from groundwater movement. In general they are poor in nitrogen and phosphorus, the latter of which tends to be the limiting nutrient in fen systems. Studies of wetlands in western Europe frequently show that nutrient enrichment (with nitrogen and phosphorus) leads to changes in species composition, decline in overall plant species diversity, and loss of rare and uncommon species. Organic matter is often accumulated as peat within a fen. A "poor" fen has very low concentrations of plant nutrients and floristically has similarities to a bog. A "rich" fen has relatively high concentrations of mineral nutrients, but is still characterised by the accumulation of peat (though this is likely to be primarily from the remains of plants other than sphagnum mosses, such as sedges and brown mosses). Where fens are characterised by alkaline conditions resulting from water draining from limestone and other calcareous soil formations, they are distinguished as "rich fen", though there is often a general understanding that a "fen" will be relatively eutrophic (nutrient rich) (Foss, 2007)[41].

The SSCOs for the habitat alkaline fens in Lough Ennell SAC (NPWS, 2018)[83] include a nutrient specific target to maintain appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitat. Fens receive natural levels of nutrients (e.g. iron, magnesium and calcium) from water sources. However, they are generally poor in nitrogen and phosphorus, with the latter tending to be the limiting nutrient under natural conditions.

Table 5-2 and **Table 5-3** identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to Lough Ennell SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

- The lake water body is: Ennell (IE_SH_25_188);
- The river water bodies include: Brosna_010 (IE_SH_25B280390), Brosna_020 (IE_SH_25B090006), Brosna_030 (IE_SH_25B090100) and Brosna_040 (IE_SH_25B090200); and
- The groundwater body is: Clara (IE_SH_G_240).

[82] NPWS 2013 Lough Ennell SAC 000685 Site Synopsis
[83] NPWS 2018 Lough Ennell SAC 000685 Conservation Objectives

The habitat alkaline fens is not mapped for Lough Ennell SAC (NPWS, 2018[83]). The habitat occurs in scattered areas around the shores of Lough Ennell and grades into reed swamp, freshwater marsh and wet woodland in places. It is best developed particularly at Robinstown, Derries, on the eastern side of the lake, and at the inlets and outlets of the River Brosna. Therefore, on a precautionary basis, it is assumed that all water bodies identified as hydrologically / hydrogeologically connected to the site have the potential to interact with the habitat.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

A Vollenweider assessment was undertaken for Ennell (IE_SH_25_188) which is expected to receive an increase in orthophosphate loading as a result of dosing at Portloman WTP. Orthophosphate dosing will not result in a significant impact on the trophic status of Ennell Lough (IE_SH_25_188) which remains within the critical loading for oligotrophic lakes following dosing. The potential increase in orthophosphate concentration post-dosing is 1.3%. Therefore there will be no risk of deterioration in the trophic status of Lough Ennell as a result of dosing.

There are four river water bodies that are hydrologically connected to the SAC. Brosna_010 (IE_SH_25B280390) to Brosna_040 (IE_SH_25B090200). All have a modelled additional concentration within 5% of the Good/High indicative quality boundary and the predicted increase in concentration as a result of corrective water treatment will not increase the risk of deterioration in the orthophosphate indicative quality of these river water bodies.

The modelled orthophosphate concentration in the GWB Clara (IE_SH_G_240) is 0.0000 mg/l. Therefore, there is no risk of deterioration in the Good (surrogate) status of the GWB.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on this habitat can be excluded. Furthermore, dosing will not result in deterioration of its favourable conservation condition.

6.2.12 Carn Park Bog SAC 002336

6.2.12.1 (7110) Active raised bogs*, (7120) Degraded raised bogs still capable of natural regeneration

Carn Park Bog is situated 8km east of Athlone, in the townlands of Tullywood, Carn Park, Cappaghbrack, Warren High and Moydrum, Co. Westmeath. The site comprises a raised bog that includes both areas of high bog and cutover bog. The margins of the site are bounded by roads on the north, west and southern margins and forestry on the east. Active raised bog comprises areas of high bog that are wet and actively peat forming, where the percentage cover of bog mosses (*Sphagnum* spp.) is high, and where some or all of the following features occur: hummocks, pools, wet flats, *Sphagnum* lawns, flushes and soaks. Degraded raised bog corresponds to those areas of high bog whose hydrology has been adversely affected by peat cutting, drainage and other land use activities, but which are capable of regeneration (NPWS, 2014)[84]. Based on the close ecological relationship between these two habitat types, it is not necessary to set SSCOs for the habitats

[84] NPWS 2014 Carn Park Bog SAC 002336 Site Synopsis

individually. It is considered that should favourable conservation condition for active raised bogs be achieved on the site, then, as a consequence, favourable conservation condition for degraded raised bog would also be achieved.

Ombrotophic peat waters found on the surface of raised bogs are characterised by low pH values (pH < 4.5) and also have low values of electrical conductivity. This is due to the fact that the raised bog system derives its mineral supply from precipitation, which is usually acidic and low in nutrients. Raised bog vegetation exchanges cations with protons to further reduce the pH. Hydrochemistry varies in the areas surrounding a raised bog. Locally, conditions may be similar to the high bog due to a dominance of water originating from the bog. However, elsewhere in the marginal areas, there may be increased mineral and nutrient content of the water due to regional groundwater influences, run-off from surrounding mineral soils, and the release of nutrients through oxidation of peat resulting from reduced water levels. The SSCOs for these habitats includes a target for the attribute water quality i.e. *Water quality on the high bog and in transitional areas close to natural reference conditions* (NPWS, 2015)[85].

Table 5-2 identifies the groundwater body which is hydrogeologically connected to Carn Park Bog SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

- The groundwater body hydrogeologically connected is: Inny (IE_SH_G_110).

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

The modelled post-dosing increase in orthophosphate concentration in the GWB Inny (IE_SH_G_110) is 0.0001 mg/l. This increase is below 5% of the Good / Fail status boundary (0.00175 mg/l) for orthophosphate and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on these bog habitats can be excluded. Furthermore, dosing will not prevent the restoration of the favourable conservation condition of the habitats.

6.2.13 Crosswood Bog SAC 002337

6.2.13.1 (7110) Active raised bogs*, (7120) Degraded raised bogs still capable of natural regeneration

Crosswood Bog is situated approximately 5km east of Athlone, Co. Westmeath, mainly in the townlands of Crosswood, Glenaghanvoneen and Creggan Lower. The site comprises a raised bog that includes both areas of high bog and cutover bog. The northern margin of the bog lies along the southern side of the Dublin-Galway railway line. Active raised bog comprises areas of high bog that are wet and actively peat-forming, where the percentage cover of bog mosses (*Sphagnum* spp.) is

[85] NPWS 2015 Carn Park Bog SAC (site code 002336) Conservation Objectives Supporting Document - Raised Bog Habitats

high, and where some or all of the following features occur: hummocks, pools, wet flats, *Sphagnum* lawns, flushes and soaks. Degraded raised bog corresponds to those areas of high bog whose hydrology has been adversely affected by peat cutting, drainage and other land use activities, but which are capable of regeneration. The site consists of a quaking bog, with a well-developed sequence of pools, hollows and hummocks and a flush supporting woodland. Cutover areas occur on all margins of the bog (NPWS, 2014)[86]. Based on the close ecological relationship between these habitat types, it is not necessary to set SSCOs for the habitats individually. It is considered that should favourable conservation condition for active raised bogs be achieved on the site, then, as a consequence, favourable conservation condition for the other habitat would also be achieved (NPWS, 2016)[87].

Ombrotophic peat waters found on the surface of raised bogs are characterised by low pH values (pH < 4.5) and also have low values of electrical conductivity. This is due to the fact that the raised bog system derives its mineral supply from precipitation, which is usually acidic and low in nutrients. Raised bog vegetation exchanges cations with protons to further reduce the pH. Hydrochemistry varies in the areas surrounding a raised bog. Locally, conditions may be similar to the high bog due to a dominance of water originating from the bog. However, elsewhere in the marginal areas, there may be increased mineral and nutrient content of the water due to regional groundwater influences, run-off from surrounding mineral soils, and the release of nutrients through oxidation of peat resulting from reduced water levels. The hydrochemistry of Crosswood Bog has not been studied in any detail. However, data suggests that it is likely local discharge of regional groundwater within perimeter drains where elevated EC was recorded. The SSCOs for these habitats includes a target for the attribute water quality i.e. *Water quality on the high bog and in transitional areas close to natural reference conditions* (NPWS, 2016)[87].

Table 5-2 identifies the groundwater body which is hydrogeologically connected to Crosswood Bog SAC and will receive inputs from the proposed orthophosphate dosing at Portloman WTP

- The groundwater body hydrogeologically connected is: Inny (IE_SH_G_110).

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

The modelled post-dosing increase in orthophosphate concentration in the GWB Inny (IE_SH_G_110) is 0.0001 mg/l. This increase is below 5% of the Good / Fail status boundary (0.00175 mg/l) for orthophosphate and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on these bog habitats can be excluded. Furthermore, dosing will not prevent the restoration of the favourable conservation condition of the habitats.

[86] NPWS 2014 Crosswood Bog SAC 002337 Site Synopsis
[87] NPWS 2016 Crosswood Bog SAC (site code 0002337) Conservation Objectives Supporting Document - Raised Bog Habitats

6.2.14 Mongan Bog SAC 000580

6.2.14.1 (7110) Active raised bogs*, (7120) Degraded raised bogs still capable of natural regeneration and (7150) Depressions on peat substrates of the *Rhynchosporion*

Mongan Bog is a midland raised bog of medium size situated immediately east of the monastic site of Clonmacnoise, Co. Offaly, and 12 km south of Athlone. It is situated in a basin, surrounded on 95% of its perimeter by high ground on mineral soil. At two points in the north it shares a common boundary with Pilgrim's Road Esker SAC. The site is designated for the Annex I habitats active raised bogs; degraded raised bogs and depressions on peat substrates. Active raised bog comprises areas of high bog that are wet and actively peat-forming, where the percentage cover of bog mosses (*Sphagnum* spp.) is high, and where some or all of the following features occur: hummocks, pools, wet flats, Sphagnum lawns, flushes and soaks. The high bog has a very well-developed micro-topography of hummocks, pools and lawns, with the active core area being particularly wet. A variety of vascular plants, bog mosses and other bryophytes are found. An unusually large number of hummocks, sometimes 1m high, largely composed of the moss *Leucobryum glaucum*, are widespread on the bog. Degraded raised bog corresponds to those areas of high bog whose hydrology has been adversely affected by peat cutting, drainage and other land use activities, but which are capable of regeneration. The *Rhynchosporion* habitat occurs in wet depressions, pool edges and erosion channels where the vegetation includes White Beak-sedge (*Rhynchospora alba*) and/or Brown Beak-sedge (*R. fusca*), and at least some of the following associated species, Bog Asphodel (*Narthecium ossifragum*), sundews (*Drosera* spp.), Deergrass (*Scirpus cespitosus*) and Carnation Sedge (*Carex panicea*) (NPWS, 2013)[88]. Based on the close ecological relationship between these three habitats types, it is not necessary to set SSCOs for all three habitats individually. It is considered that should favourable conservation condition for active raised bogs be achieved on the site, then, as a consequence, favourable conservation condition for the other two habitats would also be achieved (NPWS, 2016)[89]. Moreover, as the SAC adjoins Pilgrim's Road Esker SAC (001776) the COs for this site should be used in conjunction with those for the adjacent site as appropriate. No SSCOs have been established for Pilgrim's Road Esker SAC (001776).

Ombrotophic peat waters found on the surface of raised bogs are characterised by low pH values (pH < 4.5) and also have low values of electrical conductivity. This is due to the fact that the raised bog system derives its mineral supply from precipitation, which is usually acidic and low in nutrients. Raised bog vegetation exchanges cations with protons to further reduce the pH. Hydrochemistry varies in the areas surrounding a raised bog. Locally, conditions may be similar to the high bog due to a dominance of water originating from the bog. However, elsewhere in the marginal areas, there may be increased mineral and nutrient content of the water due to regional groundwater influences, run-off from surrounding mineral soils, and the release of nutrients through oxidation of peat resulting from reduced water levels. There is some evidence of calcareous regional groundwater influences in cutover areas surrounding the high bog. The site-specific target for the attribute water quality in Mongan Bog SAC is: *Water quality on the high bog and in transitional areas close to natural reference conditions* (NPWS, 2016)[89].

Table 5-2 identifies the groundwater bodies which are hydrogeologically connected to Mongan Bog SAC. and will receive inputs from the proposed orthophosphate dosing at Portloman WTP

[88] NPWS 2013 Mongan Bog SAC 000580 Site Synopsis
[89] NPWS 2016 Mongan Bog SAC (site code 000580) Conservation Objectives Supporting Document - Raised Bog Habitats

- The groundwater bodies hydrogeologically connected are: Inny (IE_SH_G_110) and Clara (IE_SH_G_240).

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available flows. Full details of the assessment are provided in **Appendix C**.

The modelled post-dosing increase in orthophosphate concentration in the Clara (IE_SH_G_240) is undetectable (0.0000mg/l) and the Inny (IE_SH_G_110) GWB is negligible (0.0001 mg/l). These increases are below 5% of the Good / Fail status boundary (0.00175 mg/l) for orthophosphate and therefore there is no risk of deterioration in the Good (surrogate) status of these GWBs as a result of dosing at Portloman WTP.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Portloman WTP, it has been demonstrated that the potential for likely significant effects on these bog habitats can be excluded. Furthermore, dosing will not prevent the restoration of the favourable conservation condition of the habitats.

6.2.15 Lough Derravaragh SPA 004043

Lough Derravaragh is located approximately 12 km north of Mullingar town in Co. Westmeath. It is a medium- to large-sized lake of relatively shallow water (maximum depth 23m). The lake extends along a south-east/north-west axis for approximately 8km. The Inny River, a tributary of the River Shannon, is the main inflowing and outflowing river. It is a typical limestone lake with water of high hardness and alkaline pH, and is classified as a mesotrophic system.

At the western end of the lake are extensive areas of swamp dominated by Common Reed (*Phragmites australis*). Elsewhere along the shore there is freshwater marsh vegetation dominated by sedges (*Carex* spp.) and tussock-forming grasses such as Tufted Hair-grass (*Deschampsia cespitosa*) and fescues (*Festuca* spp.), with a range of flowering herbs. The lakeshore is a mineral-rich substrate and several plant species of fen habitats occur in abundance, such as Black Bog-rush (*Schoenus nigricans*) and Long-stalked Yellow-sedge (*Carex lepidocarpa*). Deciduous woodland fringes the lake in some areas.

The site is an SPA of special conservation interest for the following species: Whooper Swan, Pochard, Tufted Duck and Coot. At times the site is used by the internationally important population of Greenland White-fronted Goose which is based in the region. Lough Derravaragh is a Ramsar Convention site (NPWS, 2014[90]).

All four SCIs designated in Lough Derravaragh SPA are considered nutrient sensitive and water dependent (see **Appendix B**). There are no SSCOs for the site; however, there is an overall objective to maintain or restore the favourable conservation condition of the bird species listed as SCIs for the SPA. To acknowledge the importance of Ireland's wetlands to wintering waterbirds, "Wetland and Waterbirds" may be included as a SCI for some SPAs that have been designated for wintering waterbirds and that contain a wetland site of significant importance to one or more of the species of SCIs. Thus, a second objective is included as follows: To maintain or restore the favourable

[90] NPWS 2014 Lough Derravarragh SPA 004043 Site Synopsis

conservation condition of the wetland habitat at Lough Derravaragh SPA as a resource for the regularly-occurring migratory waterbirds that utilise it (NPWS, 2016[91]).

In relation to protected water-dependent habitats and species under the Birds and Habitats Directives, the river basin management planning process contributes towards achieving water conditions that support Favourable Conservation Status. In preparing the draft RBMP (2018-2021) (DHPLG, 2018[92]) the risk assessment carried out by the EPA for these water dependent European Site protected areas has focused on looking at the risks to the water standards/objectives established for the purpose of supporting Good Ecological Status (GES). GES, which is the default objective of the WFD, is considered adequate for supporting many water dependent European Site protected areas where site specific environmental supporting conditions have not been defined within SSCOs by the NPWS. This is the case for all SPAs at present.

Table 5-2 and **Table 5-3** identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to Lough Derravaragh SPA and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

- The lake water body is: Derravaragh (Lough) (IE_SH_708);
- The river water body is: Inny_070 (IE_SH_26I010800); and
- The groundwater bodies are: Derravarragh (SH_G_077) and Inny (SH_G_110).

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

The assessment has modelled very low increases in orthophosphate for the groundwater bodies intersected by the WSZ. The assessment of the distance to threshold is based on the existing status of each water body, rather than the WFD environmental objective assigned to a given water body.

A Vollenweider assessment was undertaken for Derravaragh (Lough) (IE_SH_708) which will receive orthophosphate loads from dosing at Portloman WTP. The lake is slightly over the critical load indicative of oligotrophic lakes however the percentage increase in orthophosphate is 0.1% and the OECD trophic status of the lake for the existing and post-dosing scenario borders on oligotrophic to mesotrophic. The dosing therefore, will not impact on the Good status or mesotrophic condition of the lake[93].

The modelled post-dosing increase in orthophosphate concentration in the river water body Inny_070 (IE_SH_26I010800) following dosing at the Portloman WTP is 0.0000 mg/l. Therefore there is no risk of deterioration in the orthophosphate status of the Inny_070 (IE_SH_26I010800), which is currently at good ecological status.

[91] NPWS 2018 Lough Derravarragh SPA 004043 Conservation Objectives

[92] DHPLG (2018) The River Basin Management Plan for Ireland (2018-2021). Available at: https://www.housing.gov.ie/sites/default/files/publications/files/rbmp_report_english_web_version_final_0.pdf

[93] WFD Good Status equates to OECD Mesotrophic Status – see Table 9 of O'Connor (2015) https://www.npws.ie/sites/default/files/publications/pdf/Lake_habitats_supporting_document_Nov_2015_V1.1_FINAL.pdf

The modelled post-dosing increase in orthophosphate in Derravarragh (SH_G_077) and Inny (IE_SH_G_110) is 0.0002 mg/l and 0.0001 mg/l respectively. Both concentrations are below 5% of the Good / Fail status boundary and therefore there is no risk of deterioration in the Good status (surrogate status) in the case of these GWBs.

In light of the EAM assessment which has determined that there is no risk of deterioration in the water quality status of the water bodies that support the structure and function of the SPA; the additional loading from the orthophosphate dosing will therefore not significantly affect the maintenance or restoration of favourable conservation status of its SCIs, either in terms of individual bird species or wetland habitats.

6.2.16 Lough Owel SPA 004047

Lough Owel is a medium- to large-sized lake in Co. Westmeath, with a length of c. 6km and a maximum width of 3 km. It is fed by a number of small streams and the main outflow is to the Royal Canal. Water is relatively shallow, with a maximum depth of 22m. Overlying Carboniferous limestone, Lough Owel is one of the most important examples of a limestone lake in the Midlands. The water is moderately hard, alkaline and virtually colourless. The lake appears to be relatively unproductive with low levels of orthophosphate and moderate chlorophyll concentrations. The lake is classified as a mesotrophic system and its water quality status has been stable in recent years i.e. good ecological status.

Aquatic vegetation includes a number of stoneworts (*Chara* spp., notably *C. denudata* and *C. tomentosa* which are Red Data Book species). The rocky nature of the shoreline has given rise to marginal vegetation which is patchy and sparse. Apart from some reedswamp formed by Common Reed (*Phragmites australis*) and Common Clubrush (*Scirpus lacustris*), shoreline vegetation is dominated by occasional patches of Alder (*Alnus glutinosa*). Areas of marsh and fen occur above the shoreline in the northern and south-western corners of the lake. Several small islands occur in the southern sector.

The site is an SPA of special conservation interest for the following species: Shoveler and Coot. Lough Owel supports nationally important populations of the two species. It is also notable as it is used as a roost site on occasion by the internationally important Midlands Greenland White-fronted Goose flock. Lough Owel is a Ramsar Convention site (NPWS, 2014[94]).

Both SCIs designated in Lough Owel SPA are considered nutrient sensitive and water dependent (see **Appendix B**). There are no SSCOs for the site; however, there is an overall objective to maintain or restore the favourable conservation condition of the bird species listed as SCIs for the SPA. To acknowledge the importance of Ireland's wetlands to wintering waterbirds, "Wetland and Waterbirds" may be included as a SCI for some SPAs that have been designated for wintering waterbirds and that contain a wetland site of significant importance to one or more of the species of SCIs. Thus, a second objective is included as follows: To maintain or restore the favourable conservation condition of the wetland habitat at Lough Owel SPA as a resource for the regularly-occurring migratory waterbirds that utilise it (NPWS, 2016[95]).

[94] NPWS 2014 Lough Owel SPA 004047 Site Synopsis
[95] NPWS 2018 Lough Owel SPA 004047 Conservation Objectives

In relation to protected water-dependent habitats and species under the Birds and Habitats Directives, the river basin management planning process contributes towards achieving water conditions that support Favourable Conservation Status. In preparing the draft RBMP (2018-2021) (DHPLG, 2018[92]) the risk assessment carried out by the EPA for these water dependent European Site protected areas has focussed on looking at the risks to the water standards/objectives established for the purpose of supporting Good Ecological Status (GES). GES, which is the default objective of the WFD, is considered adequate for supporting many water dependent European Site protected areas where site specific environmental supporting conditions have not been defined within SSCOs by the NPWS. This is the case for all SPAs at present.

The GWB Lough Owel Fens and Mires (SAC000688 & SAC000692) is a GWDTE and underlies Lough Owel but does not instersect the WSZ. Derravarragh (IE_SH_G_077) is a karstic groundwater body that does inserset the WSZ and boarders the Lough Owel Fens and Mires GWB. Owing to the karstic nature of Derravarragh and close proximity to Lough Owel (<2.5km) the potential impacts to this ground water body are discussed below.

Lough Owel lies upstream of the Ardonagh WSZ, and the Brosna_010 river water body intersects both the lake and the WSZ. However, given that the lake is upstream, there is no potential for impact from hydrological pathways.

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available flow data. Full details of the assessment are provided in **Appendix C**.

The modelled orthophosphate concentration in the groundwater body is insignificant i.e. 0.0002 mg/l. As the concentrations are within 5% of the Good / Fail boundary (0.00175 mg/l) there is no risk of deterioration in the Good indicative quality of the groundwater body and therefore there will be no impact to the Lough Owel GWDTE.

In light of the EAM assessment which has determined that there is no risk of deterioration in the water quality status of the water bodies that support the structure and function of the SPA; the additional loading from the orthophosphate dosing will therefore not significantly effect the maintenance or restoration of favourable conservation status of its SCIs, either in terms of individual bird species or wetland habitats.

6.2.17 Lough Ennell SPA 004044

Lough Ennell is a large, limestone lake located south of Mullingar in Co. Westmeath. It is approximately 6.5km in length and 2km wide. The River Brosna is the principal inflowing and outflowing river. It is a relatively shallow lake, with a maximum depth of *c*. 30m. The water is hard, with low colour and markedly alkaline pH. The lake is classified as a mesotrophic system though it has been eutrophic in the past. The lake bottom is limestone with a marl deposit.

The site is an SPA of special conservation interest for the following species: Pochard, Tufted Duck and Coot. The site is also utilised by an internationally important population of non-migratory Mute

Swan. The occurrence of Golden Plover in the vicinity of the lake is of note as this species is listed on Annex I of the E.U. Birds Directive. Lough Ennell is a Ramsar Convention Site (NPWS, 2014)[96].

All three SCIs designated in Lough Ennell SPA are considered nutrient sensitive and water dependent (see **Appendix B**). There are no SSCOs for the site; however, there is an overall objective to maintain or restore the favourable conservation condition of the bird species listed as SCIs for the SPA. To acknowledge the importance of Ireland's wetlands to wintering waterbirds, "Wetland and Waterbirds" may be included as a SCI for some SPAs that have been designated for wintering waterbirds and that contain a wetland site of significant importance to one or more of the species of SCIs. Thus, a second objective is included as follows: To maintain or restore the favourable conservation condition of the wetland habitat at Lough Ennell SPA as a resource for the regularly-occurring migratory waterbirds that utilise it (NPWS, 2016)[97].

In relation to protected water-dependent habitats and species under the Birds and Habitats Directives, the river basin management planning process contributes towards achieving water conditions that support Favourable Conservation Status. In preparing the draft RBMP (2018-2021) (DHPLG, 2018)[92] the risk assessment carried out by the EPA for these water dependent European Site protected areas has focussed on looking at the risks to the water standards/objectives established for the purpose of supporting Good Ecological Status (GES). GES, which is the default objective of the WFD, is considered adequate for supporting many water dependent European Site protected areas where site specific environmental supporting conditions have not been defined within SSCOs by the NPWS. This is the case for all SPAs at present.

Table 5-2 and **Table 5-3** identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to Lough Ennell SPA and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

- The lake water body is: Ennell (IE_SH_25_188);
- The river water bodies include: Brosna_010 (IE_SH_25B280390), Brosna_020 (IE_SH_25B090006), Brosna_030 (IE_SH_25B090100) and Brosna_040 (IE_SH_25B090200); and
- The groundwater body is: Clara (IE_SH_G_240).

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

A Vollenweider assessment was undertaken for Ennell (IE_SH_25_188) which is expected to receive an increase in orthophosphate loading as a result of dosing at Portloman WTP. Orthophosphate dosing will not result in a significant impact on the trophic status of Ennell Lough (IE_SH_25_188) which remains within the critical loading for oligotrophic lakes following dosing. The potential increase in orthophosphate concentration post-dosing is 1.3%. Therefore there will be no risk of deterioration in the trophic status of Lough Ennell as a result of dosing.

There are four river water bodies that are hydrologically connected to the SAC. Brosna_010 (IE_SH_25B280390) to Brosna_040 (IE_SH_25B090200). All have a modelled additional

[96] NPWS 2014 Lough Ennell SPA 004044 Site Synopsis
[97] NPWS 2018 Lough Ennell SPA 004044 Conservation Objectives

concentration within 5% of the Good/High indicative quality boundary and the predicted increase in concentration as a result of corrective water treatment will not increase the risk of deterioration in the orthophosphate indicative quality of these river water bodies.

The modelled orthophosphate concentration in the GWB Clara (IE_SH_G_240) is 0.0000 mg/l. Therefore, there is no risk of deterioration in the Good (surrogate) status of the GWB.

In light of the EAM assessment which has determined that there is no risk of deterioration in the water quality status of the water bodies that support the structure and function of the SPA; the additional loading from the orthophosphate dosing will therefore not significantly effect the maintenance or restoration of favourable conservation status of its SCIs, either in terms of individual bird species or wetland habitats.

6.2.18 River Boyne and River Blackwater SPA 004232

The River Boyne and River Blackwater SPA is a long, linear site that comprises stretches of the River Boyne and several of its tributaries. Although most of the site is in Co. Meath, it extends into Cavan, Louth and Westmeath also. It includes the following river sections: the River Boyne from the M1 motorway bridge, west of Drogheda, to the junction with the Royal Canal, west of Longwood, Co Meath; the River Blackwater from its junction with the River Boyne in Navan to the junction with Lough Ramor in Co. Cavan; the Tremblestown River/Athboy River from the junction with the River Boyne at Kilnagross Bridge west of Trim to the bridge in Athboy, Co. Meath; the Stoneyford River from its junction with the River Boyne to Stonestown Bridge in Co. Westmeath; the River Deel from its junction with the River Boyne to Cummer Bridge, Co. Westmeath. The site includes the river channel and marginal vegetation. Most of the site is underlain by Carboniferous limestone but Silurian quartzite also occurs in the vicinity of Kells and Carboniferous shales and sandstones close to Trim.

The site is an SPA of special conservation interest for the following species: Kingfisher. Other species which occur within the site include Mute Swan, Teal, Mallard, Cormorant, Grey Heron, Moorhen, Snipe and Sand Martin (NPWS, 2010)[98].

All SCIs designated in the River Boyne and River Blackwater SPA are considered nutrient sensitive and water dependent (see **Appendix B**). There are no SSCOs for the site; however, there is an overall objective to maintain or restore the favourable conservation condition of the bird species listed as SCIs for the SPA (NPWS, 2016)[99].

In relation to protected water-dependent habitats and species under the Birds and Habitats Directives, the river basin management planning process contributes towards achieving water conditions that support Favourable Conservation Status. In preparing the draft RBMP (2018-2021) (DHPLG, 2018)[92] the risk assessment carried out by the EPA for these water dependent European Site protected areas has focussed on looking at the risks to the water standards/objectives established for the purpose of supporting Good Ecological Status (GES). GES, which is the default objective of the WFD, is considered adequate for supporting many water dependent European Site protected areas where site specific environmental supporting conditions have not been defined within SSCOs by the NPWS. This is the case for all SPAs at present.

[98] NPWS 2010 River Boyne and River Blackwater SPA 004232 Site Synopsis
[99] NPWS 2018 River Boyne and Rver Blackwater SPA 004232 Conservation Objectives

Table 5-2 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to River Boyne and River Blackwater SPA and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

In the case of the Boyne, additional water bodies at major confluences on the river are included until a potential orthophosphate concentration post dosing of 0.0000 mg/l is achieved. As the most downstream water body is evaluated in each case, this allows for demonstration of potential impacts:

- The river water bodies include: Kinnegad_010 (IE_EA_07K010060), Kinnegad_020 (IE_EA_07K010100), Kinnegad_030 (IE_EA_07K010200), Riverstown_010 (IE_EA_07R010090), Riverstown_020 (IE_EA_07R010200), Ballyhaw_010 (IE_EA_07B340940), Deel (Raharney)_020 (IE_EA_07D010080), Deel (Raharney)_030 (IE_EA_07D010200), Deel (Raharney)_040 (IE_EA_07D010300), Deel (Raharney)_050 (IE_EA_07D010400), Deel (Raharney)_060 (IE_EA_07D010600, Killynan_010 (IE_EA_07K330580), Stonyford_020 (IE_EA_07S020075) and Stonyford_040 (IE_EA_07S020400); and
- The groundwater body is: Athboy (IE_EA_G_001).

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

The modelled post-dosing orthophosphate concentrations in river water bodies hydrologically connected to the SAC are below 5% of the Good / High status boundary. Modelled concentrations range from 0.0000 mg/l in the Stonyford_020 (IE_EA_07S020075), and Deel (Raharney)_020 (IE_EA_07D010080) to 0.0006 mg/l in Kinnegad_030 (IE_EA_07K010200). There is no risk of deterioration in the orthophosphate status of the river water bodies as a result of dosing at Portloman WTP. The small modelled increases in orthophosphate concentration do not change the risk of deterioration in these river water bodies and therefore the achievement of the WFD objectives.

There are two monitoring points on Kinnegad_030 (IE_EA_07K010200):

i. RS07K010150 KINNEGAD - 0.5km d/s St 0100 (d/s STW) - approximately 300m downstream of the Kinnegad WWTP discharge was at bad indicative quality based on the 2014 baseline. However monitoring data from 2019, 2020 and 2021 results in an improvement in the baseline to 0.033 mg/l, i.e., good indicative quality. Kinnegad WWTP is no longer regarded as a significant pressure in the EPA WFD App. The WWTP is compliant with the orthophosphate ELV and is therefore not a significant pressure for orthophosphate as demonstrated in the mass balance assessment in Table 2.
ii. RS07K010200 Kilwarden Br - approximately 2.5km downstream (but also downstream of 2 tributaries) is at Good Ortho P Indicative Quality.

The latter is the most downstream monitoring point that is representative of the subbasin. Ecological status for the river is moderate, but the orthophosphate conditions supporting the chemistry is reported as High. The modelled increase in concentration is below significant levels, which will not increase the risk of deterioration in orthophosphate indicative quality or prevent the achievement of the WFD objectives in this water body.

The modelled post-dosing increase in orthophosphate concentration in the GWB Athboy (IE_EA_G_001) is 0.0003 mg/l. This increase is below 5% of the Good / Fail status boundary (0.00175 mg/l) and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment which has determined that there is no risk of deterioration in the water quality status of the water bodies that support the structure and function of the SPA; the additional loading from the orthophosphate dosing will therefore not significantly effect the maintenance or restoration of favourable conservation status of its SCIs.

6.2.19 Lough Ree SPA 004064

Situated on the River Shannon between Lanesborough and Athlone, Lough Ree is the third largest lake in the Republic of Ireland. It lies in an ice-deepened depression in Carboniferous Limestone. Some of its features (including the islands) are based on glacial drift. The main inflowing rivers are the Shannon, Inny and Hind, and the main outflowing river is the Shannon. The greater part of Lough Ree is less than 10m in depth, but there are six deep troughs running from north to south, reaching a maximum depth of about 36m just west of Inchmore. The lake has a very long, indented shoreline and hence has many sheltered bays. It also has a good scattering of islands, most of which are included in the site.

The site is an SPA under the Birds Directive, of special conservation interest for the following species: Whooper Swan, Wigeon, Teal, Mallard, Shoveler, Tufted Duck, Common Scoter, Goldeneye, Little Grebe, Coot, Golden Plover, Lapwing and Common Tern. The E.U. Birds Directive pays particular attention to wetlands and, as these form part of this SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds (NPWS, 2015)[100].

All 13 SCIs designated in Lough Ree SPA are considered nutrient sensitive and water dependent (see **Appendix B**). There are no SSCOs for the site; however, there is an overall objective to maintain or restore the favourable conservation condition of the bird species listed as SCIs for the SPA. To acknowledge the importance of Ireland's wetlands to wintering waterbirds, “Wetland and Waterbirds” may be included as a SCI for some SPAs that have been designated for wintering waterbirds and that contain a wetland site of significant importance to one or more of the species of SCIs. Thus, a second objective is included as follows: To maintain or restore the favourable conservation condition of the wetland habitat at Lough Ree SPA as a resource for the regularly-occurring migratory waterbirds that utilise it (NPWS, 2016)[101].

In relation to protected water-dependent habitats and species under the Birds and Habitats Directives, the river basin management planning process contributes towards achieving water conditions that support Favourable Conservation Status. In preparing the draft RBMP (2018-2021) (DHPLG, 2018)[92] the risk assessment carried out by the EPA for these water dependent European Site protected areas has focussed on looking at the risks to the water standards/objectives established for the purpose of supporting Good Ecological Status (GES). GES, which is the default objective of the WFD, is considered adequate for supporting many water dependent European Site protected areas where site specific environmental supporting conditions have not been defined within SSCOs by the NPWS. This is the case for all SPAs at present.

[100] NPWS 2015 Lough Ree SPA 004064 Site Synopsis
[101] NPWS 2016 Lough Ree SPA 004064 Conservation Objectives

Table 5-2 and **Table 5-3** identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to Lough Ree SPA and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

- The lake water body is: Derravaragh (IE_SH_26_708);
- The river water bodies are: Inny_070 (IE_SH_26I010800), Inny_080 (IE_SH_26I011000), Inny_090 (IE_SH_26I011150), Inny_110 (IE_SH_26I011400, Gaine_010 (IE_SH_26G010100) and Gaine_020 (IE_SH_26G010270); and
- The groundwater body is: Inny (IE_SH_G_110).

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

A Vollenweider assessment was undertaken for Derravaragh (Lough) (IE_SH_708) which will receive orthophosphate loads from dosing at Portloman WTP. The lake is slightly over the critical load indicative of oligotrophic lakes; however, the percentage increase in orthophosphate is 0.1% and the OECD trophic status of the lake for the existing and post-dosing scenario borders on oligotrophic to mesotrophic. The dosing therefore, will not impact on the Good status of the lake[102].

The modelled additional orthophosphate concentration following dosing in Inny_070 (IE_SH_26I010800), Inny_080 (IE_SH_26I011000), Inny_090 (IE_SH_26I011150) and Inny_110 (IE_SH_26I011400) is undetectable (0.0000) mg/l. The modelled post-dosing concentration in the Gaine_010 (IE_SH_26G010100) and Gaine_020 (IE_SH_26G010270) is 0.0003 mg/l and 0.0001 mg/l respectively. As the modelled concentrations in all river water bodies is below 5% of the Good / High status boundary there is no risk of deterioration in the orthophosphate status of the water bodies.

The modelled post-dosing increase in orthophosphate concentration in the GWB Inny (IE_SH_G_110) is 0.0001 mg/l. This increase is below 5% of the Good / Fail status boundary (0.00175 mg/l) for orthophosphate and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment which has determined that there is no risk of deterioration in the water quality status of the water bodies that support the structure and function of the SPA; the additional loading from the orthophosphate dosing will therefore not significantly effect the maintenance or restoration of favourable conservation status of its SCIs, either in terms of individual bird species or wetland habitats.

6.2.20 Middle Shannon Callows SPA 004096

The Middle Shannon Callows SPA is a long and diverse site which extends for approximately 50km from the town of Athlone to the town of Portumna; it lies within Counties Galway, Roscommon, Westmeath, Offaly and Tipperary. The site averages about 0.75km in width though in places is up to 1.5km wide. Water levels on the site are greatly influenced by the very small fall between Athlone and Portumna and by the weir at Meelick. The site has extensive areas of callow, or seasonally

[102] OECD Mesotrophic Status equates to WFD Good Status – see Table 9 of O'Connor (2015) https://www.npws.ie/sites/default/files/publications/pdf/Lake_habitats_supporting_document_Nov_2015_V1.1_FINAL.pdf

flooded, semi-natural, lowland wet grassland, along both sides of the river. There are seven bird species of SCI; Whooper Swan, Wigeon, Corncrake, Golden Plover, Lapwing, Black-tailed Godwit and Black-headed Gull. It is also of SCI for holding an assemblage of over 20,000 wintering waterbirds and wetland habitat.

The callow grasslands provide optimum feeding grounds for various species of waterfowl, while many of the birds also roost or rest within the site. Black-tailed Godwit, a very rare breeding species in Ireland, nests or attempts to nest in small numbers each year within the site. A further scarce breeding species, Shoveler, also nests in small numbers each year. The Middle Shannon Callows SPA supports a breeding population of Corncrake. They require the cover of tall vegetation throughout their breeding cycle and are strongly associated with meadows which are harvested annually, where they nest and feed. Annual cutting of these meadows creates a sward which is easy for the birds to move through.

All SCIs are considered nutrient sensitive (**Appendix B**) and water dependent. There are no SSCOs for this SPA (NPWS 2018)[103] however, there is an overall objective to maintain or restore the favourable conservation condition of the bird species listed as SCIs for this SPA. In addition, wetlands form part of this SPA and there is an objective to maintain or restore the favourable conservation condition of the wetland habitat at Middle Shannon Callows SPA as a resource for the regularly-occurring migratory waterbirds that utilise it.

In relation to protected water-dependent habitats and species under the Birds and Habitats Directives, the river basin management planning process contributes towards achieving water conditions that support Favourable Conservation Status. In preparing the draft RBMP (2018-2021) (DHPLG, 2018)[92] the risk assessment carried out by the EPA for these water dependent European Site protected areas has focussed on looking at the risks to the water standards/objectives established for the purpose of supporting Good Ecological Status (GES). GES, which is the default objective of the WFD, is considered adequate for supporting many water dependent European Site protected areas where site specific environmental supporting conditions have not been defined within SSCOs by the NPWS. This is the case for all SPAs at present.
Table 5-2 and **Table 5-3** identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to Middle Shannon Callows SPA and will receive inputs from the proposed orthophosphate dosing at Portloman WTP:

The EAM process only considers river water bodies that intersect the WSZ. The load from upstream is however considered in downstream river water bodies. In the case of the Brosna and Inny, additional water bodies at major confluences on the river are included until a potential orthophosphate concentration post dosing of 0.0000 mg/l is achieved. As the most downstream water body is evaluated in each case, this allows for demonstration of potential impacts:

- The lake water bodies include: Derravaragh (IE_SH_26_708) and Ennell (IE_SH_25_188).
- The river water bodies include: Gaine_010 (IE_SH_26G010100), Gaine_020 (IE_SH_26G010270), Brosna_010 (IE_SH_25B280390), Brosna_020 (IE_SH_25B090006), Brosna_030 (IE_SH_25B090100), Brosna_040 (IE_SH_25B090200), Brosna_050 (IE_SH_25B090250), Brosna_060 (IE_SH_25B090400), Brosna_070 (IE_SH_25B090450), Brosna_080 (IE_SH_25B090600), Brosna_100 (IE_SH_25B090761), Brosna_120 (IE_SH_25B090950), Shannon (Lower)_010 (IE_SH_25S012000), Inny_070

[103] NPWS 2018 Middle Shannon Callows SPA Conservation Objectives

(IE_SH_26I010800), Inny_080 (IE_SH_26I011000), Inny_090 (IE_SH_26I011150) and Inny_110 (IE_SH_26I011400); and

- The groundwater body is: Inny (IE_SH_G_110).

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

A Vollenweider assessment was undertaken for Derravaragh (IE_SH_708) and Lough Ennell (IE_SH_25_188) both of which are expected to receive an increase in orthophosphate loading as a result of dosing at Portloman WTP. In both cases the orthophosphate dosing will not result in a significant impact on the trophic status of the lakes. Both loughs are slightly over the critical load indicative of oligotrophic lakes however the percentage increase in orthophosphate is 0.1% and 1.3% respectively and the OECD trophic status of the lake for the existing and post-dosing scenario borders on oligotrophic to mesotrophic. The dosing therefore, will not impact on the trophic status of the lakes.

For all river water bodies, the modelled additional concentrations in river water bodies are below 5% of the Good / High indicative quality boundary (i.e. <0.00125mg/l) and the predicted increase in concentration as a result of corrective water treatment will not increase the risk of deterioration in the orthophosphate indicative quality of these river water bodies.

The modelled post-dosing increase in orthophosphate concentration in the GWB Inny (IE_SH_G_110) is 0.0001 mg/l. This increase is below 5% of the Good / Fail indicative quality boundary (0.00175 mg/l) for orthophosphate and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment which has determined that there is no risk of deterioration in the water quality status of the water bodies that support the structure and function of the SPA; the additional loading from the orthophosphate dosing will not result in likely significantly effects or prevent the maintenance or restoration of favourable conservation status of its SCIs, either in terms of individual bird species or wetland habitats.

6.2.21 Mongan Bog SPA 004017

Mongan Bog is a midland raised bog of medium size situated immediately east of the monastic site of Clonmacnoise, Co. Offaly, and 12km south of Athlone. It is situated in a basin, surrounded on part of its perimeter by high ground on mineral soil. The bog has a well-developed microtopography of hummocks, pools and lawns. Species such as Ling Heather (*Calluna vulgaris*), Cross-leaved Heath (*Erica tetralix*), cottongrasses (*Eriophorum angustifolium, E. vaginatum*), Carnation Sedge (*Carex panicea*) and White Beak-sedge (*Rhynchospora alba*) are common. A good variety of bog mosses (*Sphagnum* spp.) and other bryophytes are found. Strips of cut-away bog, part of which is colonised by willows (*Salix* spp.) and birch (*Betula* sp.) scrub, occur along the margins of the peat dome.

At the time this site was identified for SPA designation it was being utilised by Greenland White-fronted Goose from the internationally important River Suck population. Although Greenland White-fronted Goose does not currently utilise the site, this species is regarded as a special conservation interest for this SPA. The cutaway area of bog provides habitat for a range of bird species, including

birds of prey, thrushes, warblers and finches. A study of the birds of Mongan Bog in 1985 recorded Mallard, Snipe, Skylark and Meadow Pipit breeding on the peat dome. Mongan Bog is owned by An Taisce (the National Trust) and is a Ramsar Convention site, a Biogenetic Reserve and a Statutory Nature Reserve (NPWS, 2014)[104].

Greenland White-fronted Goose is considered nutrient sensitive and water dependent (see **Appendix B**). There are no SSCOs for the site; however, there is an overall objective to maintain or restore the favourable conservation condition of the bird species listed as SCIs for the SPA (NPWS, 2016)[105].

In relation to protected water-dependent habitats and species under the Birds and Habitats Directives, the river basin management planning process contributes towards achieving water conditions that support Favourable Conservation Status. In preparing the draft RBMP (2018-2021) (DHPLG, 2018)[92] the risk assessment carried out by the EPA for these water dependent European Site protected areas has focussed on looking at the risks to the water standards/objectives established for the purpose of supporting Good Ecological Status (GES). GES, which is the default objective of the WFD, is considered adequate for supporting many water dependent European Site protected areas where site specific environmental supporting conditions have not been defined within SSCOs by the NPWS. This is the case for all SPAs at present.

Table 5-2 identifies the groundwater bodies which are hydrogeologically connected to Mongan Bog SPA and will receive inputs from the proposed orthophosphate dosing at Portloman WTP

- The groundwater bodies hydrogeologically connected are: Inny (IE_SH_G_110) and Clara (IE_SH_G_240).

The EAM has assessed the potential for impact on water quality and nutrient conditions and has based this assessment on a conservative basis using all available riverine flows. Full details of the assessment are provided in **Appendix C**.

The modelled post-dosing increase in orthophosphate concentration in the Clara (IE_SH_G_240) is undetectable (0.0000mg/l) whilst in the Inny (IE_SH_G_110) GWB it is negligible (0.0001 mg/l). This increase is below 5% of the Good / Fail status boundary (0.00175 mg/l) for orthophosphate and therefore there is no risk of deterioration in the Good (surrogate) status of the GWB as a result of dosing at Portloman WTP.

In light of the EAM assessment which has determined that there is no risk of deterioration in the water quality status of the water bodies that support the structure and function of the SPA; the additional loading from the orthophosphate dosing will therefore not result in likely significant effects or prevent the maintenance or restoration of favourable conservation status of its SCIs.

[104] NPWS 2014 Mongan Bog SPA 004017 Site Synopsis
[105] NPWS 2018 Mongan Bog SPA 004017 Conservation Objectives

6.3 ASSESSMENT OF IN-COMBINATION EFFECTS WITH OTHER PLANS OR PROJECTS

In order to ensure all potential impacts upon European Sites within the project's ZoI were considered, including those direct and indirect impacts that are a result of cumulative or in-combination impacts, the following steps were completed:

1. Identify projects/ plans which might act in combination: identify all possible sources of effects from the project or plan under consideration, together with all other sources in the existing environment and any other effects likely to arise from other proposed projects or plans;
2. Impacts identification: identify the types of impacts that are likely to affect aspects of the structure and functions of the site vulnerable to change;
3. Define the boundaries for assessment: define boundaries for examination of cumulative effects; these will be different for different types of impact and may include remote locations;
4. Pathway identification: identify potential cumulative pathways (e.g., via water, air, etc.; accumulations of effects in time or space);
5. Prediction: prediction of magnitude/ extent of identified likely cumulative effects, and
6. Assessment: comment on whether or not the potential cumulative impacts are likely to be significant.

A search of Westmeath County Council planning enquiry system was conducted for developments that may have in-combination effects on European Sites with the ZoI. Plans and projects relevant to the area were searched in order to identify any elements of the plans and projects that may act cumulatively or in-combination with the proposed development.

Based on this search and the Project Teams knowledge of the study area a list of those projects and plans which may potentially contribute to cumulative or in-combination impacts with the proposed project was generated as listed in **Table 6-1** below.

Table 6-1: In-Combination Impacts with Other Plans, Programmes and Policies

Plan / Programme/Policy	Key Types of Impacts	Potential for In-combination Effects and Mitigation
Westmeath County Development Plan 2021 - 2027 **Objectives** **Natura 2000 Sites** **CPO 12.4** Protect and conserve Special Areas of Conservation, candidate Special Areas of Conservation, Special Protection Areas and candidate Special Protection Areas, designated under the EU Birds and Habitats Directives respectively. **CPO 12.5** Ensure that no plans, programmes, etc. or projects giving rise to significant cumulative, direct, indirect or secondary impacts on European Sites arising from their size or scale, land take, proximity, resource requirements, emissions (disposal to land, water or air), transportation requirements, duration of construction, operation, decommissioning or from any other effects shall be permitted on the basis of this Plan (either individually or in combination with other plans, programmes, etc. or projects). **Water Services** **CPO 10.72**: Support Irish Water in the implementation of their capital investment programme to ensure the timely delivery of water and waste-water infrastructure for the County **CPO 10.73**: Collaborate with Irish Water in relation to the preparation of their Investment Plans in order to align the supply of water services with the County Settlement Hierarchy. **CPO 10.74** Ensure the efficient and sustainable use and development of water resources and water services infrastructure, in order to manage and conserve water resources in a manner that supports a healthy society, economic development requirements and a cleaner environment. **CPO 10.75** Assist Irish Water in their commitment to water conservation and support efforts to tackle leakage through find and fix (active leakage control) and water mains rehabilitation. **CPO 10.76** Support Irish Water in the implementation of Capital Projects to strengthen the Regional Water Supply Scheme, subject to environmental assessment.	▪ N/A	The County Development Plan emphasises the objectives for water services in the county which include the enhancement and improved quality of the service to its consumers. The plan also outlines the importance of compliance with the provisions of the WFD. There is no potential for cumulative impacts with this plan.

Plan / Programme/Policy	Key Types of Impacts	Potential for In-combination Effects and Mitigation
CPO 10.77 Support the implementation of the Water Supply Project for the Eastern and Midland Region, subject to environmental assessment. **CPO 10.78** Support the implementation of the Rural Water Programme. **CPO 10.79** Minimise wastage of water supply and promote water conservation measures by requiring, where appropriate, water conservation measures and the installation of water meters in all new developments. **CPO 10.80** Ensure that delivery and phasing of water services are subject to the required appraisal, planning and environmental assessment processes and avoid adverse impacts on the integrity of the Natura 2000 network. **CPO 10.81** Protect, safeguard and strictly control development within the water catchment areas of Lough Owel and Lough Lene, and other major sources of public water supply that would give rise to pollution of these water sources. **CPO 10.82** Ensure that new development proposals connect into the existing public water mains, where available. **Water Quality and Groundwater Protection** **CPO 10.83** Support the implementation of the relevant recommendations and measures as outlined in the relevant River Basin Management Plan 2018-2021, and associated Programme of Measures, or any such plan that may supersede same during the lifetime of the plan. Development proposals shall not have an unacceptable impact on the water environment, including surface waters, groundwater quality and quantity, river corridors and associated woodlands. **CPO 10.84** Collaborate with Irish Water in contributing towards compliance with the European Union (Drinking Water) Regulations Drinking Water Regulations 2014 (as amended) and compliance of water supplies with the parameters identified in these Regulations. **CPO 10.85** Contribute towards, as appropriate, the protection of existing and potential water resources, and their use by humans and wildlife, including rivers, streams, wetlands, groundwater and associated habitats and species in accordance with the requirements and guidance in the EU Water Framework Directive 2000 (2000/60/EC), the European Union (Water Policy) Regulations 2003 (as amended), the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended), the Groundwater Directive 2006/118/EC and the European Communities Environmental Objectives (groundwater) Regulations 2010 (as amended) and other relevant EU		

Plan / Programme/Policy	Key Types of Impacts	Potential for In-combination Effects and Mitigation
Directives, including associated national legislationand policy guidance (including any superseding versions of same). **CPO 10.86** In conjunction with Irish Water, have regard to the EPA 2019 publication "Drinking Water Report for Public Water Supplies 2018" (and any subsequent update) in the establishment and maintenance of water sources in the County. **CPO 10.87** In conjunction with Irish Water, support recommendations made by the EPA arising from any failure to meet drinking water standards and any enlistment on the EPA's Remedial Action List. **CPO 10.88** Ensure that in assessing applications for developments, that consideration is had to the impact on the quality of surface waters having regard to targets and measures set out in the River Basin Management Plan for Ireland 2018-2021 and any subsequent local or regional plans. **CPO 10.89** Ensure that development would not have an unacceptable impact on water quality and quantity including surface water, ground water, designated source protection areas, river corridors and associated wetlands. **CPO 10.90** Discourage the over-concentration of individual septic tanks and treatment plants to minimise the risk of groundwater pollution. **CPO 10.91** Support the preparation and development of Water Safety Plans / Drinking Water Protection Plans and Source Protection Plans to protect sources of public water supply, in accordance with the requirements of the Water Framework Directive. **CPO 10.92** New development proposals shall ensure that full consideration is given to the level of investment that will be required in the provision of water services, particularly in environmentally sensitive areas to ensure that the provision of water services does not negatively impact on habitat quality, species diversity or other environmental considerations.		
River Basin Management Plan For Ireland 2022 – 2027 The Third Cycle Draft River Basin Management Plan 2022-2027 Consultation Report has been published. This report presents a summary of the issues raised in the submissions reviewed from the public consultation on the draft River Basin Management Plan for Ireland 2022-2027. The 3rd cycle of River Basin Management Plan (RBMP) for the period of 2022-2027 is currently being prepared by Department of Housing, Local Government and Heritage (DHLGH) in line with the EU Water Framework	▪ N/A	The objectives of the RBMP are to • Prevent deterioration; • Restore good status; • Reduce chemical pollution; and • Achieve water related protected areas objectives

Plan / Programme/Policy	Key Types of Impacts	Potential for In-combination Effects and Mitigation
Directive (WFD) (2000/60/EC). The document (Chapter 3) sets out the condition of Irish waters and a summary of status for all monitored waters in the 2013 – 2018 period, including a description of the changes since 2007 – 2009 and 2010-2015. A large number of river waterbodies are still declining and unless this is addressed, sustained and progressive improvements in water quality will be difficult to achieve. Overall, 53% of surface waters are in good or high ecological status while the remaining 47% are in unsatisfactory ecological status. For groundwater bodies, 92% are in good chemical and quantitative status. Chapter 3 of the RBMP presents results of the catchment characterisation process, which identifies the significant pressures on each water body that is *At Risk* of not meeting the environmental objectives of the WFD. Importantly, the assessment includes a review of trends over time to see if conditions were likely to remain stable, improve or deteriorate by 2027. This work was presented in the RBMP for 4,842 water bodies nationally. 1,603 water bodies were classed *At Risk* or 33%. An assessment of significant environmental pressures found that agriculture was the most significant pressure in 1,000 water bodies that are *At Risk*. Urban waste water, hydromorphology and forestry were also significant pressures amongst others.		The implementation of the RBMP seeks compliance with the environmental objectives set under the plan, which will be documented for each water body. This includes compliance with the European Communities (Surface Waters) Regulations S.I. No. 272 of 2009 (as amended). The implementation of this plan will have a positive impact on biodiversity and the Project will not affect the achievement of the RBMP objectives given the detailed assessment of the effects of dosing on water body environmental objectives under the EAM.
Catchment based Flood Risk Assessment and Management (CFRAM) Programme, under the Floods Directive The Office of Public Works (OPW) is responsible for the implementation of the Floods Directive 2007/60/EC which is being carried out through a Catchment based Flood Risk Assessment and Management (CFRAM) Programme. As part of the directive Ireland is required to undertake a Preliminary Flood Risk Assessment, to identify areas of existing or potentially significant future flood risk and to prepare flood hazard and risk maps for these areas. Following this, flood risk management plans are developed for these areas setting objectives for managing the flood risk and setting out a prioritised set of measures to achieve the objectives. The CFRAM programme is currently being rolled out and Draft Flood Risk Management Plans have been prepared. These plans have been subject AA.	▪ Habitat loss or destruction; ▪ Habitat fragmentation or degradation; ▪ Alterations to water quality and/or water movement; ▪ Disturbance; ▪ In-combination impacts within the same scheme	CFRAM Studies and their product Flood Risk Management Plans, will each undergo appropriate assessment. Any future flood plans will have to take into account the design and implementation of water management infrastructure as it has the potential to impact on hydromorphology and potentially on the ecological status and favourable conservation status of water bodies. The establishment of how flooding may be contributing to deterioration in water quality in areas where other relevant pressures are absent is a significant consideration in terms of achieving the objectives of the WFD. The AA of the plans will need to consider the potential for impacts from hard engineering solutions and how they might affect hydrological connectivity and hydromorphological

Plan / Programme/Policy	Key Types of Impacts	Potential for In-combination Effects and Mitigation
		supporting conditions for protected habitats and species. There is no potential for cumulative impacts with the CFRAMS programme as no infrastructure is proposed as part of this project.
Foodwise 2025 Foodwise 2025 strategy identifies significant growth opportunities across all subsectors of the Irish agri-food industry. Growth Projection includes increasing the value added in the agri-food, fisheries and wood products sector by 70% to in excess of €13 billion.	▪ Land use change or intensification ▪ Water pollution ▪ Nitrogen deposition ▪ Disturbance to habitats / species	Foodwise 2025 was subject to its own AA[106]. Growth is to be achieved through sustainable intensification to maximise production efficiency whilst minimising the effects on the environment however there is increased risk of nutrient discharge to receiving waters and in turn a potential risk to biodiversity and Europe Sites if not controlled. With the required mitigation in the Food Wise Plan, no significant in-combination impacts are predicted. Mitigation measures included cross compliance with 13 Statutory Management Requirements, EIA Agricultural Regulations 2011, GLAS, and AA Screening of licencing and permitting in the forestry and seafood sectors.
Rural Development Programme 2014 – 2020 The agricultural sector is actively enhancing competitiveness whilst trying to achieve more sustainable management of natural resources. The common set of objectives, principles and rules through which the European Union co-ordinates support for European agriculture is outlined in the Rural Development Programme (RDP) 2014-2020 under the Common Agricultural Policy. The focus of the programme is to assist with the sustainable development of rural communities and while improvements are sought in relation to water management. Within the RDP are two targeted agri-environment schemes; Green Low Carbon Agri-Environment Scheme (GLAS) and Targeted Agriculture Modernisation Scheme (TAMS). They provide the	• Overgrazing; • Land use change or intensification; • Water pollution; • Nitrogen deposition; • Disturbance to habitats / species;	The RDP for 2014 – 2020 has been subject to SEA[107], and AA[108]. The AA assessed the potential for impacts from the RDP measures e.g. for the GLAS scheme to result in inappropriate management prescriptions; minimum stocking rates under the Areas of Natural Constraints measure leading to overgrazing in sensitive habitats with dependent species, and TAMS supporting intensification. Mitigation included project specific AA for individual building, tourism or agricultural reclamation projects, consultations with key stakeholders during detailed measure development, and site-based monitoring of the effects of RDP measures. With such

[106] http://www.agriculture.gov.ie/media/migration/foodindustrydevelopmenttrademarkets/agri-foodandtheeconomy/foodwise2025/environmentalanalysis/AgriFoodStrategy2025NISDRAFT300615.pdf
[107] https://www.agriculture.gov.ie/media/migration/ruralenvironment/ruraldevelopment/ruraldevelopmentprogramme2014-2020/StrategEnvironmAssessSumState090615.pdf
[108] https://www.agriculture.gov.ie/media/migration/agarchive/ruralenvironment/preparatoryworkfortherdp2014-2020/RDP20142020DraftAppropriateAssessmentReport160514.pdf

Plan / Programme/Policy	Key Types of Impacts	Potential for In-combination Effects and Mitigation
role of a supportive measure to improve water quality and thus provide direct benefits in achieving the measures within the RBMP. The achievement of the objectives outlined within GLAS, to improve water quality, mitigate against climate change and promote biodiversity will be of direct positive benefit in achieving the measures within the RBMP and the goals of the Natura Directives. The scheme has an expected participation for 2014-2020 of 50,000 farmers which have to engage in specific training and tasks in order to receive full payment. Farmers within the scheme must have a nutrient management plan which is a strategy for maximising the return from on and off-farm chemical and organic fertilizer resources. This has a direct positive contribution towards protecting water bodies from pollution through limiting the amount of fertiliser that is placed on the land. The scheme prioritises farms in vulnerable catchments with 'high status' water bodies and also focuses on educating farmers on best practices to try and improve efficiency along with environmental outcomes. The TAMS scheme is open to all farmers and is focused on supporting productive investment for modernisation. This financial grant for farmers is focused on the pig and poultry sectors, dairy equipment and the storage of slurry and other farmyard manures. Within the TAMS scheme are two further schemes; the Animal Welfare, Safety and Nutrient Storage Scheme and the Low Emission Slurry Spreading Scheme. Both schemes are focused on productivity for farmers but have the ability to contribute towards a reduction in point and diffuse source pollution through improved nutrient management.		measures in place, it was concluded that there would be no significant in-combination impacts on Natura 2000 sites.
National Nitrates Action Programme Article 28 of the Good Agricultural Practice Regulations, in line with the Nitrates Directive (91/676/EEC), requires the Minister for Housing, Local Government and Heritage, in consultation with the Minister for Agriculture, Food and the Marine, to review the Nitrates Action Programme every four years. Ireland has published the Fifth Nitrates Action Programme on the 11th March 2022. The Programme sets out new measures that have been introduced since the Fourth Programme. This iteration of the NAP is developed in the context of significantly greater environmental ambition in the Programme for Government and at EU level. The key issues considered in the fifth iteration of	▪ Land use change or intensification; ▪ Water pollution; ▪ Nitrogen deposition; • Disturbance to habitats / species.	In accordance with the Directive 2001/42/EC on the assessment of effects of certain plans and programmes, as transposed into Irish law, a Strategic Environmental Assessment (SEA) is being undertaken and an Environmental Report has been prepared. Appropriate Assessment under EU Directive 92/43/EEC, as transposed into Irish law, is also being undertaken and a Natura Impact Statement (NIS) has been prepared It concluded that the NAP was an environmental programme which imposes environmental constraints on all agricultural systems in the state.

Plan / Programme/Policy	Key Types of Impacts	Potential for In-combination Effects and Mitigation
the NAP include: ▪ Better Policy Alignment; ▪ Compliance and Enforcement; ▪ Climate Action Measures. ▪ Biodiversity Measures; and Nitrates Derogation.		Consultation and submission on the 5th NAP have been considered in the SEA Statement and the Natura Impact Statement of the adopted fifth Nitrates Action Programme. These documents provide information on the decision-making process and documents how environmental considerations, the views of consultees/stakeholders and the recommendations of the SEA Environmental Report and the assessment carried out under Article 6 of the Habitats Directive have influenced the final adopted Plan. Adherence to the recommendations in these documents and incorporation into he Plan will ensure that there is no potential for cumulative impacts with the proposed project.
Forest Policy Review: Forests, Products and People – A Renewed Vision (2014) / Forestry Programme 2014 - 2020 Ireland's forestry sector is striving to increase forestry cover and one of the recommended policy actions in the Forest Policy Review: Forests, Products and People – A Renewed Vision (2014) is to increase the level of afforestation annually over time and support afforestation and mobilisation measures under the Forestry Programme 2014-2020. Two key objectives within the Forestry Programme 2014-2020 that will influence the RBMP are to increase Ireland's forest cover to 18% and to establish 10,000 ha of new forests and woodlands per annum. As part of this programme there are a number of schemes that promote sustainable forest management and they include the Afforestation Scheme, the Woodland Improvement Scheme, the Forest Road Scheme and the Native Woodland Conservation Scheme. Under the Native Woodland Conservation Scheme funding is provided to restore existing native woodland which promotes Ireland's native woodland resource and associated biodiversity. Native woodlands provide wider ecosystem functions and services which once restored can contribute to the protection and enhancement of water quality and aquatic habitats. New guidance and plans are also being developed to address forestry adjacent to water bodies,	• Habitat loss or destruction; • Habitat fragmentation or degradation; • Water quality changes; • Disturbance to species.	Ireland's Forestry Programme 2014 – 2020 has undergone AA[110]. A key recommendation is that all proposed forestry projects should be subject to an assessment of their impacts and the proximity of Natura 2000 habitats and species should be taken into account when proposals are generated. In-combination effects will therefore be assessed at the project specific scale. Adherence to this recommendation will ensure that there is no potential for cumulative impacts with the proposed project.

[110] https://www.agriculture.gov.ie/media/migration/forestry/publicconsultation/newforestryprogramme2014-2020/nis/ForestryProgrammeNaturalImpactStatement290914.pdf

Plan / Programme/Policy	Key Types of Impacts	Potential for In-combination Effects and Mitigation
Freshwater Pearl Mussel Plans for 8 priority catchments and a Hen Harrier Threat Response Plan (NPWS). The mitigation measures within these plans will be particularly important in terms of protecting sensitive habitats and species from such forestry increases.		
Water Services Strategic Plan (WSSP, 2015) Irish Water has prepared a Water Services Strategic Plan (WSSP, 2015), under Section 33 of the Water Service No. 2 Act of 2013 to address the delivery of strategic objectives which will contribute towards improved water quality and WFD requirements. The WSSP forms the highest tier of asset management plans (Tier 1) which Irish Water prepare and it sets the overarching framework for subsequent detailed implementation plans (Tier 2) and water services projects (Tier 3). The WSSP sets out the challenges we face as a country in relation to the provision of water services and identifies strategic national priorities. It includes Irish Water's short, medium and long term objectives and identifies strategies to achieve these objectives. As such, the plan provides the context for subsequent detailed implementation plans (Tier 2) which will document the approach to be used for key water service areas such as water resource management, wastewater compliance and sludge management. The WSSP also sets out the strategic objectives against which the Irish Water Capital Investment Programme is developed. The current version of the CAP outlines the proposals for capital expenditure in terms of upgrades and new builds within the Irish Water owned asset and this is a significant piece of the puzzle in terms of the expected improvements from the RBMP.	• Habitat loss and disturbance from new / upgraded infrastructure; • Species disturbance; • Changes to water quality or quantity; • Nutrient enrichment /eutrophication.	The overarching strategy was subject to Appropriate Assessment and highlighted the need for additional plan/project environmental assessments to be carried out at the tier 2 and tier 3 level. Therefore, no likely significant in-combination effects are envisaged.
National Wastewater Sludge Management Plan (2016) The National Wastewater Sludge Management Plan was prepared in 2015, outlining the measures needed to improve the management of wastewater sludge.	• Habitat loss and disturbance from new / upgraded infrastructure; • Species disturbance; • Changes to water quality or quantity; • Nutrient enrichment /eutrophication.	The plan was subject to both AA and SEA and includes a number of mitigation measures which were identified in relation to transport of materials, land spreading of sludge and additional education and research requirements. This plan does not specifically address domestic wastewater loads, only those relating to Irish Water facilities. In relation to the plan as it stands, no in-combination effects are expected with the implementation of proposed mitigation measures.
National Water Resources Plan (in prep.) This Framework will deliver a sustainable water supply on a catchment and	• Increased abstractions leading	The plan will seek to develop sustainable water supplies but must consider particularly critical drought periods when

Plan / Programme/Policy	Key Types of Impacts	Potential for In-combination Effects and Mitigation
water resource zone basis, meeting growth and demand requirements through drought and critical periods. The resources plan will need to take account of WFD objectives and the programme of measures proposed in the relevant catchments and water resource zones. Specific measures in the plan with relevance to Irish Water include those for urban wastewater and urban runoff and also as part of other measures in relation to the lead in drinking water.	to changes / pressure on existing hydrology / hydrogeological regimes.	assimilation capacity for diffuse runoff may be reduced. The potential for in-combination impacts are unclear as the plan is not sufficiently developed at this stage.
Planning Applications There are a number of planning applications pending or recently approved within the ZoI. The Westmeath County Council planning systems were searched for applications predominately in Mullingar town. The applications are primarily for the construction of new infrastructure or renovations to existing infrastructure. In the case of new infrastructure these included the construction of agricultural buildings; domestic dwellings, a 20 no. residential unit, production and recovery facility for producing solvents from waste/recovered materials, telecommunications support structure and, extension to a planning approval solar farm.	• Habitat loss and disturbance from new / upgraded infrastructure; • Species disturbance; • Changes to water quality or quantity; • Nutrient enrichment /eutrophication.	Adherence to the overarching policies and objectives of the Westmeath County Development Plans will ensure that local planning applications and subsequent grant of planning will comply with the core strategy of proper planning and sustainability, including consideration of the requirements of relevant environmental Directives. There is no potential for likely significant effects in-combination effects.
Integrated Pollution Control (IPC) Licensing Under the Industrial Emissions Directive 2010/75/EU and Environmental Protection Agency Act, 1992 (as amended) industrial activities (e.g. pharmaceutical) are licenced by the EPA to prevent or reduce emissions to air, water and land, reduce water and use energy/resources efficiently. An IPC licence is a single integrated licence which covers all emissions from the facility and its environmental management. All related operations that the licence holder carries in connection with the activity are controlled by this licence. There is currently one active IPC facility in the Ardonagh WSZ.	▪ Changes to water quality or quantity; ▪ Nutrient enrichment /eutrophication.	The EPA is responsible for monitoring emissions and dealing with any infringements on IPC licences. All emissions must be within set limits which must not be contravened. Limits are set for phosphorus where relevant. Compliance with the limits set for phosphorus will ensure that there will be no significant in-combination impacts on Natura 2000 sites.

7 SCREENING CONCLUSION STATEMENT

This Screening to inform the AA process has considered whether the proposed construction works and operational orthophosphate dosing at the Portloman WTP that supplies the Ardonagh Reservoir WSZ, in combination with other plans or projects, is likely to have a significant effect on European Sites.

The appraisal undertaken in this Screening assessment has been informed by an EAM (see **Appendix C**) with reference to qualifying interests/special conservation interests for the European Sites potentially affected by the proposed project, in order to provide a scientific basis for the evaluations.

During the construction phase of the corrective water treatment works at Portloman WTP, the potential for direct, indirect and cumulative impacts affecting European Sites within the ZoI including Lough Owel SPA, Lough Owel SAC and Scragh Bog SAC have been assessed. There will be no significant direct, indirect or cumulative impacts that will result in likely significant effects to the qualifying interests/special conservation interests of the European Sites within the ZoI.

During the operational phase, the potential for direct, indirect and cumulative impacts affecting Split Hills and Long Hill Esker SAC; Lough Lene SAC; Lough Owel SAC; Scragh Bog SAC; Lough Ree SAC; Mount Hevey Bog SAC; River Boyne and River Blackwater SAC; Wooddown Bog SAC; White Lough, Ben Loughs and Lough Doo SAC; River Shannon Callows SAC; Lough Ennell SAC; Carn Park Bog SAC; Crosswood Bog SAC; Mongan Bog SAC; Lough Derravaragh SPA; Lough Owel SPA; Lough Ennell SPA; River Boyne and River Blackwater SPA; Lough Ree SPA; Middle Shannon Callows SPA; and, Mongan Bog SPA, have been assessed. Due to the low orthophosphate inputs following dosing at Portloman WTP and no risk of deterioration in the status of the receiving water bodies, there will be no significant direct, indirect or cumulative impacts that have the potential to significantly affect the qualifying interests/special conservation interests of the European Sites within the study area. This is concluded with regard to the range, population densities and overall conservation status of the habitats and species for which these sites are designated (i.e. conservation objectives).

The screening has been carried out on the basis of the information presented in the Project Description. It has been concluded that the project it is not connected or necessary to the management of any European Site. It can be concluded on the basis of objective scientific information and in view of best scientific knowledge, the proposed orthophosphate dosing and associated construction works at the Portloman WTP; individually or in combination with other plans or projects, will not have a significant effect on any European Sites. Therefore, AA is not required.

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APPENDIX A

European Sites

A full listing of the COs and QIs/ SCIs for each European Site, as well as the attributes and targets to maintain or restore the QIs/ SCIs to a favourable conservation condition, are available from the NPWS website www.npws.ie. Links to the COs for the European Sites relevant to this Screening are provided below.

Site Name (Code)	Conservation Objectives Source
Split Hills and Long Hill Esker SAC (001831)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO001831.pdf
Lough Lene SAC (002121)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002121.pdf
Lough Owel SAC (000688)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000688.pdf
Scragh Bog SAC (000692)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000692.pdf
Lough Ree SAC (000440)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000440.pdf
Mount Hevey Bog SAC (002342)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002342.pdf
River Boyne and River Blackwater SAC (002299)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002299.pdf
Wooddown Bog SAC (002205)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002205.pdf
White Lough, Ben Loughs and Lough Doo SAC (001810)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO001810.pdf
River Shannon Callows SAC (000216)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000216.pdf
Lough Ennell SAC (000685)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000685.pdf
Carn Park Bog SAC (002336)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002336.pdf
Crosswood Bog SAC (002337)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002337.pdf
Mongan Bog SAC (000580)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000580.pdf
Lough Derravaragh SPA (004043)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004043.pdf
Lough Owel SPA (004047)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004047.pdf
Lough Ennell SPA (004044)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004044.pdf
River Boyne and River Blackwater SPA (004232)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004232.pdf
Lough Ree SPA (004064)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004064.pdf
Middle Shannon Callows SPA (004096)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004096.pdf
Mongan Bog SPA (004017)	https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004017.pdf

APPENDIX B

Nutrient Sensitive Qualifying Interests

Water dependant and nutrient sensitive SAC species

Code	Qualifying Interest	Water dependant	Nutrient sensitive
1013	Whorl snail (*Vertigo geyeri*)	Yes	Yes
1014	Whorl snail (*Vertigo angustior*)	Yes	Yes
1016	Whorl snail (*Vertigo moulinsiana*)	Yes	Yes
1024	Kerry Slug (*Geomalacus maculosus*)	No	Yes
1029	Freshwater Pearl mussel (*Margaritifera margaritifera*)	Yes	Yes
1065	Marsh Fritillary (*Euphydryas aurinia*)	Yes	No
1092	White-clawed crayfish (*Austropotamobius pallipes*)	Yes	Yes
1095	Sea lamprey (*Petromyzon marinus*)	Yes	Yes
1096	Brook lamprey (*Lampetra planeri*)	Yes	Yes
1099	River lamprey (*Lampetra fluviatilis*)	Yes	Yes
1103	Twaite shad (*Alosa fallax*)	Yes	Yes
1106	Atlantic salmon (*Salmo salar* (freshwater only))	Yes	Yes
1303	Lesser Horseshoe bat (*Rhinolophus hipposideros*)	No	Yes
1349	Bottlenose dolphin (*Tursiops truncatus*)	Yes	Yes
1351	Harbour porpoise (*Phocoena phocoena*)	Yes	Yes
1355	Otter (*Lutra lutra*)	Yes	Yes
1364	Grey seal (*Halichoerus grypus*)	Yes	Yes
1365	Common seal (*Phoca vitulina*)	Yes	Yes
1393	Shining sickle moss (*Drepanocladus vernicosus*)	Yes	No
1395	Petalwort (*Petalophyllum ralfsii*)	Yes	Yes
1421	Killarney fern (*Trichomanes speciosum*)	Yes	Yes
1528	Marsh saxifraga (*Saxifraga hirculus*)	Yes	Yes
1833	Slender naiad (*Najas flexilis*)	Yes	Yes
1990	Nore freshwater pearl mussel (*Margaritifera durrovensis*)	Yes	Yes
5046	Killarney shad (*Alosa fallax killarnensis*)	Yes	Yes

Water dependant and nutrient sensitive SAC habitats

Code	Qualifying Interest	Water dependant	GWDTE	Nutrient sensitive
1110	Sandbanks which are slightly covered by sea water all the time	Yes		Yes
1130	Estuaries	Yes		Yes
1140	Mudflats and sandflats not covered by seawater at low tide	Yes		Yes
1150	Coastal lagoons	Yes		Yes
1160	Large shallow inlets and bays	Yes		Yes
1170	Reefs	Yes		Yes
1180	Submarine structures made by leaking gases	No		No
1210	Annual vegetation of drift lines	Yes		Yes
1220	Perennial vegetation of stony banks	Yes		No
1230	Vegetated sea cliffs of the Atlantic and Baltic coasts	Yes		Yes
1310	Salicornia and other annuals colonising mud and sand	Yes		Yes
1320	Spartina swards (*Spartinion maritimae*)	No		No
1330	Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	Yes	Yes	Yes
1410	Mediterranean salt meadows (*Juncetalia maritimi*)	Yes	Yes	Yes
1420	Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)	Yes		Yes
2110	Embryonic shifting dunes	Yes		Yes
2120	Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)	Yes		Yes
2130	Fixed coastal dunes with herbaceous vegetation (grey dunes)	Yes		Yes
2140	Decalcified fixed dunes with Empetrum nigrum	Yes		Yes
2150	Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)	Yes		Yes
2170	Dunes with Salix repens ssp. argentea (*Salicion arenariae*)	Yes	Yes	Yes
2190	Humid dune slacks	Yes	Yes	Yes
21A0	Machairs (* in Ireland)	Yes	Yes	Yes
3110	Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)	Yes		Yes
3130	Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or Isoeto-Nanojuncetea	Yes		Yes
3140	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.	Yes		Yes
3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation	Yes		Yes
3160	Natural dystrophic lakes and ponds	Yes		Yes
3180	Turloughs	Yes	Yes	Yes
3260	Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	Yes		Yes

Code	Qualifying Interest	Water dependant	GWDTE	Nutrient sensitive
3270	Rivers with muddy banks with *Chenopodion rubri* p.p. and Bidention p.p. vegetation	Yes	Yes	Yes
4010	Northern Atlantic wet heaths with Erica tetralix (Flushes only)	Yes	Yes	Yes
4030	European dry heaths	No		Yes
4060	Alpine and Boreal heaths	No		No
5130	Juniperus communis formations on heaths or calcareous grasslands	No		No
6130	Calaminarian grasslands of the *Violetalia calaminariae*	No (flood risk)*		Yes
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites)	No (flood risk)*		Yes
6230	Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)	No		No
6410	Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)	Yes	Yes	Yes
6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	Yes	Yes	Yes
6510	Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)	No (flood risk)*		Yes
7110	Active raised bogs	Yes	Yes	Yes
7120	Degraded raised bogs still capable of natural regeneration	Yes	Yes	Yes
7130	Blanket bogs (* if active bog)	Yes	Yes	Yes
7140	Transition mires and quaking bogs	Yes	Yes	Yes
7150	Depressions on peat substrates of the Rhynchosporion	Yes	Yes	Yes
7210	Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*	Yes	Yes	Yes
7220	Petrifying springs with tufa formation (*Cratoneurion*)	Yes	Yes	Yes
7230	Alkaline fens	Yes	Yes	Yes
8110	Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*)	No		No
8120	Calcareous and calcshist screes of the montane to alpine levels (*Thlaspietea rotundifolii*)	No		No
8210	Calcareous rocky slopes with chasmophytic vegetation	No		No
8220	Siliceous rocky slopes with chasmophytic vegetation	No		No
8240	Limestone pavements	No		Yes
8310	Caves not open to the public	Yes	Yes	Yes
8330	Submerged or partially submerged sea caves	Yes		Yes
91A0	Old sessile oak woods with Ilex and Blechnum in the British Isles	No		Yes

Code	Qualifying Interest	Water dependant	GWDTE	Nutrient sensitive
91D0	Bog woodland	Yes	Yes	Yes
91E0	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)	Yes	Yes	Yes
91J0	Taxus baccata woods of the British Isles	No		No

*While this habitat is determined to be non-water dependent, it is incuded in the assessment in terms of flood risk only

Water dependant and nutrient sensitive SPA birds

Code	Species of special conservation interest	Water dependant	Nutrient sensitive
A001	Red-throated Diver (*Gavia stellata*)	Yes	Yes
A003	Great Northern Diver (*Gavia immer*)	Yes	Yes
A004	Little Grebe (*Tachybaptus ruficollis*)	Yes	Yes
A005	Great Crested Grebe (*Podiceps cristatus*)	Yes	Yes
A009	Fulmar (*Fulmarus glacialis*)	Yes	Yes
A013	Manx Shearwater (*Puffinus puffinus*)	Yes	Yes
A014	Storm Petrel (*Hydrobates pelagicus*)	Yes	Yes
A015	Leach's Storm-petrel (*Oceanodroma leucorhoa*)	Yes	Yes
A016	Gannet (*Morus bassanus*)	Yes	Yes
A017	Cormorant (*Phalacrocorax carbo*)	Yes	Yes
A018	Shag (*Phalacrocorax aristotelis*)	Yes	Yes
A028	Grey Heron (*Ardea cinerea*)	Yes	Yes
A037	Bewick's Swan (*Cygnus columbianus bewickii*)	Yes	Yes
A038	Whooper Swan (*Cygnus cygnus*)	Yes	Yes
A043	Greylag Goose (*Anser anser*)	Yes	Yes
A045	Barnacle Goose (*Branta leucopsis*)	Yes	Yes
A046	Light-bellied Brent Goose (*Branta bernicla hrota*)	Yes	Yes
A048	Shelduck (*Tadorna tadorna*)	Yes	Yes
A050	Wigeon (*Anas penelope*)	Yes	Yes
A051	Gadwall (*Anas strepera*)	Yes	Yes
A052	Teal (*Anas crecca*)	Yes	Yes
A053	Mallard (*Anas platyrhynchos*)	Yes	Yes
A054	Pintail (*Anas acuta*)	Yes	Yes
A056	Shoveler (*Anas clypeata*)	Yes	Yes
A059	Pochard (*Aythya ferina*)	Yes	Yes
A061	Tufted Duck (*Aythya fuligula*)	Yes	Yes
A062	Scaup (*Aythya marila*)	Yes	Yes
A063	Eider (*Somateria mollissima*)	Yes	Yes
A065	Common Scoter (*Melanitta n*igra)	Yes	Yes
A067	Goldeneye (*Bucephala clangula*)	Yes	Yes
A069	Red-breasted Merganser (*Mergus serrator*)	Yes	Yes
A082	Hen Harrier (*Circus cyaneus*)	Yes	Yes
A098	Merlin (*Falco columbarius*)	Yes	Yes
A103	Peregrine (*Falco peregrinus*)	Yes	Yes
A122	Corncrake (*Crex crex*)	Yes	Yes
A125	Coot (*Fulica atra*)	Yes	Yes
A130	Oystercatcher (*Haematopus ostralegus*)	Yes	Yes
A137	Ringed Plover (*Charadrius hiaticula*)	Yes	Yes

Code	Species of special conservation interest	Water dependant	Nutrient sensitive
A140	Golden Plover (*Pluvialis apricaria*)	Yes	Yes
A141	Grey Plover (*Pluvialis squatarola*)	Yes	Yes
A142	Lapwing (*Vanellus vanellus*)	Yes	Yes
A143	Knot (*Calidris canutus*)	Yes	Yes
A144	Sanderling (*Calidris alba*)	Yes	Yes
A148	Purple Sandpiper (*Calidris maritima*)	Yes	Yes
A149	Dunlin (*Calidris alpina*) (non-breeding)	Yes	Yes
A156	Black-tailed Godwit (*Limosa limosa*)	Yes	Yes
A157	Bar-tailed Godwit (*Limosa lapponica*)	Yes	Yes
A160	Curlew (*Numenius arquata*)	Yes	Yes
A162	Redshank (*Tringa totanus*)	Yes	Yes
A164	Greenshank (*Tringa nebularia*)	Yes	Yes
A169	Turnstone (*Arenaria interpres*)	Yes	Yes
A179	Black-headed Gull (*Larus ridibundus*)	Yes	Yes
A182	Common Gull (*Larus canus*)	Yes	Yes
A183	Lesser Black-backed Gull (*Larus fuscus*)	Yes	Yes
A184	Herring Gull (*Larus argentatus*)	Yes	Yes
A188	Kittiwake (*Rissa tridactyla*)	Yes	Yes
A191	Sandwich Tern (*Sterna sandvicensis*)	Yes	Yes
A192	Roseate Tern (*Sterna dougallii*)	Yes	Yes
A193	Common Tern (*Sterna hirundo*)	Yes	Yes
A194	Arctic Tern (*Sterna paradisaea*)	Yes	Yes
A195	Little Tern (*Sterna albifrons*)	Yes	Yes
A199	Guillemot (*Uria aalge*)	Yes	Yes
A200	Razorbill (*Alca torda*)	Yes	Yes
A204	Puffin (*Fratercula arctica*)	Yes	Yes
A229	Kingfisher (*Alcedo atthis*)	Yes	Yes
A346	Chough (*Pyrrhocorax pyrrhocorax*)	Yes	Yes
A395	Greenland White-fronted Goose (*Anser albifrons flavirostris*)	Yes	Yes
A466	Dunlin (*Calidris alpina schinzii*) (breeding)	Yes	Yes

APPENDIX C

EAM Summary Report

Irish Water - Lead in Drinking Water Mitigation Plan

Environmental Assessment Methodology (EAM) Summary Report 013 Portloman WTP – Ardonagh Reservoir (3200PUB1007)

National Lead in Water Mitigation Strategy

Environmental Assessment Methodology Report: 013 Portloman WTP – Ardonagh Reservoir (3200PUB1007)

Document Control Sheet

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013 Portloman WTP - Ardonagh Reservoir (3200PUB1007)

Supporting spreadsheet: 013 Portloman WTP – Ardonagh Reservoir rev19

This EAM report should be read in conjunction with the Irish Water Lead in Drinking Water Mitigation Plan – Environmental Assessment Methodology report (MDE1218Rp0005 F02).

Portloman WTP supplies six water supply zones (WSZs) in Westmeath. The daily production and distribution input from Frewin Hill High Level Reservoir, exported to the five other WSZs, is 17,085 m^3/day of (64% of which is accounted for, with the remainder assumed to be lost through leakage) serving a population of approximately 46,000. Targeted dosing has been recommended in the Plumbosolvency Control Implementation Plan (013 – Portloman WTP) at Ardonagh Reservoir to target Mullingar in particular. This EAM report therefore considers the impact of dosing in the Ardonagh Reservoir WSZ (3200PUB1007) only. The accounted for Water (AFW) for Ardonagh Reservoir is 7376 m^3/day. As the distribution input for this WSZ is not available, the AFW rate of 64% for all water supplied to Portloman is used to provide an estimate, resulting in an assumed distribution input of 11,454 m3/day. The non-domestic demand is 30% of the assumed distribution input for Ardonagh Reservoir.

The WSZ boundary is served by three agglomerations with a population equivalent of greater than 500; Mullingar (D0008-01), Killucan (D0100-01) and Kinnegad (D0104-01). These agglomerations are all licenced in accordance with the requirements of the Waste Water Discharge (Authorisation) Regulations 2007 as amended. The impact of the orthophosphate dosing on the emission limit values and the receiving water body downstream of the point of discharge are assessed. There is a also an agglomeration, Raharney (A0006-01) with a population equivalent of less than 500; the estimated additional load from this plant due to orthophosphate dosing is considered at the water body level via the surface water pathways. There are an estimated 2,666 properties across the WSZs that are serviced by DWWTS.

This assessment has been undertaken for the WSZ in isolation. However, if corrective water treatment is proposed for WTPs in the same catchment area, the cumulative impact from the combined loads to downstream water bodies are assessed (see Recommendations and Tables 5.A and 5.B).

Water Supply Zone	**Ardonagh Reservoir (3200PUB1007)** **See Figure 4.1 / 4.2 of the AA Screening for a map of the WSZ and ZoI**	
Step 1 Appropriate Assessment Screening	**European Sites within Zone of Influence**	
	SACs	
	Ardagullion Bog Charleville Wood Derragh Bog Garriskil Bog SAC Lough Lene Lough Ree Lough Ennell Lough Owel	Moneybeg And Clareisland Bogs Scragh Bog Split Hills and Long Hill Esker Girley (Drewstown) Bog River Shannon Callows Lough Bane And Lough Glass River Boyne and River Blackwater
	SPAs	

	Garriskill Bog SPA Glen Lough SPA Lough Derravaragh SPA Lough Ennell SPA Lough Iron SPA Lough Kinale and Derragh Lough Lough Owel SPA	Lough Ree SPA Lough Sheelin Middle Shannon Callows River Boyne and River Blackwater Mongan Bog SPA
	Nutrient Sensitive Qualifying Interests present – Yes **Appropriate Assessment Required – see AA screening report for details**	

Step 2 – Direct Inputs to Surface Water

Table 1: Increased loading/concentration to agglomerations due to Orthophosphate Dosing – Dosing rate = 0.8 mg/l

Agglomeration and discharge type	ELV (ortho- P unless otherwise stated) from WWDL (mg/l)	Scenario	TP Load kg/yr	Ortho P concentration mg/l *TP – Ortho P Conversion factor varied for sensitivity analysis (40%, 50%, 68%)*		
				0.5	***0.4***	***0.68***
Kinnegad Primary Discharge	**0.6**	**Existing**	95	0.10	0.08	0.14
		Post Dosing	95	0.10	0.08	0.14
Kinnegad SWOs (3 no)	**n/a**	**Existing**	39.7	1.44	1.15	1.96
		Post Dosing	51.03	1.85	1.48	2.52
Killucan Primary Discharge	**2**	**Existing**	59	0.06	0.05	0.08
		Post Dosing	59	0.06	0.05	0.08
Killucan SWOs (1 no)	**n/a**	**Existing**	34.2	1.13	0.90	1.54
		Post Dosing	39.32	1.30	1.04	1.77
Mullingar Primary Discharge	**0.2**	**Existing**	560	0.07	0.06	0.10
		Post Dosing	560	0.07	0.06	0.10
Mullingar SWOs (4no)	**n/a**	**Existing**	408.0	1.78	1.43	2.43
		Post Dosing	487.17	2.13	1.70	2.90

Note: Effluent concentrations are modelled to be compliant with orthophosphate ELVs set in WWDL (D0008, D0100 and D0104) for both existing and post dosing concentrations. The measured effluent concentrations were compliant with ELVs as reported in the 2020 AERs.
As Kinnegad WWTP (D0104), Killucan (D0100) and Mullingar (D0008) receive tertiary treatment, i.e. chemical dosing for nutrient removal, and are compliant with the WWDL ELVs the additional P loading to the plants can be dealt with and managed within the treatment process therefore there is no impact on the existing effluent quality.

Step 3 – Potential impact of Direct Inputs on Receiving Water Bodies

Table 2: Mass balance assessment based on 0.8 mg/l dosing using available background concentrations and mean flow information

Agglom.	RWB Name / Code	Backgroud Conc. (mg/l) (annual mean from AER u/s monitoring point)	Modelled conc existing (mg/l)	Modelled Conc Post Dosing (mg/l)	% Inc
Kinnegad	KINNEGAD_030 IE_EA_07K010200	0.0293	0.032	0.033	1.0
Killucan	RIVERSTOWN_020 IE_EA_07R010200	0.0293	0.030	0.030	0.2
Mullingar	BROSNA_030 IE_SH_25B090100	0.0293	0.036	0.036	1.9

Surface Assessment

Mullingar (IE_SH_25B090100) – This plant uses tertiary treatment so there is negligible impact due to orthophosphate dosing (Table 7). The modelled effluent concentrations are compliant with ELVs set for this agglomeration. SWOs do not result in a significant impact on the receiving waters.

Killucan (IE_EA_07R010200) – This plant uses tertiary treatment so there is negligible impact due to orthophosphate dosing (Table 11). The effluent concentrations are compliant with ELVs set for this agglomeration.

Kinnegad (IE_EA_07K010200) – This plant uses tertiary treatment so there is negligible impact due to orthophosphate dosing (Table 13). The modelled effluent concentrations are compliant with ELVs.

In all cases the treatment process at the agglomerations adequately deals with the existing orthophosphate load from dosing as demonstrated in the modelled ELV compliance. The impact of the activation of SWOs at higher flows is not exacerbated by the orthophosphate dosing.

Step 4 Distributed Inputs to River Water Bodies

Subsurface Assessment

Impact from orthophosphate dosing on surface waters due to distributed inputs (subsurface and near surface pathways) is predicted to be insignificant (below 5% of the Good / High boundary for orthophosphate, or 0.00125mg/l) for most river waterbodies with highest increase equal to 0.0008 mg/l, taking place at RIVERSTOWN_010 (IE_EA_07R010090).

Step 5 and 6: Combined Inputs to Groundwater Bodies

Groundwater Bodies as receptors connected to WSZ

The predicted increase in concentrations for GWB from the WSZs are insignificant (below 5% of the Good / Fail Ortho P Indicative boundary for groundwater), except for Marlinstown Landfill Waste Facility (W0071-02) (IE_EA_G_083) (Table 3). The susceptibility to GW is in general moderate across the WSZs, the proportion of extreme vulnerability area is small, but there are large areas of high vulnerability.

In one case, Derravarragh (IE_SH_G_077) the baseline concentration is above 75% of the upper threshold for Good Ortho P indicative quality. However, the modelled increase in concentration is well below 5% of the Good / Fail boundary (0.00175 mg/l), so would be insignificant.

Table 3: Increased loadings and concentrations in Groundwater bodies ***(note: where existing monitoring data is not available, a surrogate indicative quality is derived from chemical statusthe initial characterisation of the WB, and the mid-range of that indicative quality is used as Baseline Concentration)***

EU_CD / Name	Ortho-P Indicative Quality and Trends, Distance to Threshold. [Surrogate indicatve quality given in *italic*]	Baseline Ortho P Conc. mg/l [Surrogate Conc given in *italic*]	75% of Ortho P indicative quality upper threshold mg/l	Ortho P Total GW Dosing Load kg/yr	Potential Increase in Ortho P Conc. due to Dosing mg/l	Ortho P Potential Baseline Conc. following dosing mg/l	Notes
IE_EA_G_001 Athboy	*Good*	*0.018*	*0.026*	*51.3*	*0.0003*	*0.018*	
IE_SH_G_077 Derravarragh	*Good*	*0.018*	*0.026*	*6.0*	*0.0002*	*0.018*	
IE_SH_G_110 Inny	*Good*	*0.018*	*0.026*	*23.4*	*0.0001*	*0.018*	
IE_SH_G_166 GWDTE- Lough Owel Fens & Mires (SAC000688 & SAC000692) Derravarragh 2	*Good*	*0.018*	*0.026*	*0.0*	*0.0000*	*0.018*	
IE_SH_G_232 Tullamore	Good Upwards Far	0.005	0.026	0.0	0.0000	0.005	
	Good Upwards Far	0.005	0.026			0.005	
	Good Upwards Far	0.005	0.026			0.005	
IE_SH_G_240 Clara	*Good*	*0.018*	*0.026*	*1.4*	*0.0000*	*0.018*	
IE_SH_G_242 Kilbeggan Gravels	*Good*	*0.018*	*0.026*	*0.0*	*0.0000*	*0.018*	
IE_SH_G_253 Gageborogh-Brosna Gravels Group 1	*Good*	*0.018*	*0.026*	*0.0*	*0.0000*	*0.018*	
IE_EA_G_072 GWDTE-Mount Hevey Bog (SAC002342)	*Good*	*0.018*	*0.026*	*0.0*	*0.0000*	*0.018*	
IE_EA_G_083 Marlinstown Landfill Waste Facility (W0071-02)	*Good*	*0.018*	*0.026*	*2.5*	*0.0053*	*0.023*	
IE_SH_G_246 Athlone Gravels	*Good*	*0.018*	*0.026*	*0.0*	*0.0000*	*0.018*	

Marlinstown Landfill Waste Facility (W0071-02) (IE_EA_G_083) is a small GWB delineated to define a specific local pressure. The load is small, but the modelled increase in concentration is significant due to the low groundwater flows in this small water body. The chemical status is given as Poor (GW), but this is not related to

	orthophosphate. The WFD Risk Assessment under the RBMP Characterisaton process has classified the water body as Not at Risk for all WFD Objectives and the groundwater chemical status test for the impact of groundwaer on surface water ecological status passes for the 2016 – 2021 iteration. Therefore the Surrogate indicative quality is given as "Good" and this GWB won't impose any risk on the overlying WB (RIVERSTOWN_010) as this has High Ortho P indicative quality. No impact due to orthophosphate dosing is expected on these GWBs.
Step 5 and 6: Combined Inputs to Surface Water Bodies	**Combined Assessment** The combined impact from surface water and subsurface pathways due to orthophosphate dosing are insignificant (below 5% of the Good / High Ortho P Indicative Quality boundary for rivers – 0.00125 mg/l) or have no potential to cause failure to achieve WFD objectives (Table 4.A). Exceptions are discussed below. The combined modelled increase in concentration in BROSNA_030 (IE_SH_25B090100) is just below the 5% of the Good / High indicative quality boundary (0.0010 mg/l) and does not cause the baseline to increase above 75% of the upper threshold for Good Orthophosphate indicative quality. The additional impact from Mullingar SWOs therefore will not cause risk of deterioration in orthophosphate indicative quality or preventing the achievement of the WFD objectives for IE_SH_25B090100. The river RIVERSTOWN_010 (IE_EA_07R010090) exhibits a statistically significant downward trend that is environmentally significant as the predicted trend has resulted in an improvement in the ortho P indicative quality. The modelled increase in concentration is not significant (0.0004 mg/l), hence orthophosphate dosing will not have a significant impact on achieving WFD objectives in this waterbody. There are two monitoring points on Kinnegad_030 (IE_EA_07K010200): • RS07K010150 KINNEGAD - 0.5km d/s St 0100 (d/s STW) - approximately 300m downstream of the Kinnegad WWTP discharge was at bad indicative quality based on the 2014 baseline. However monitoring data from 2019, 2020 and 2021 results in an improvement in the baseline to 0.033 mg/l, i.e., good indicative quality. Kinnegad WWTP is no longer regarded as a significant pressure in the EPA WFD App. The WWTP is compliant with the orthophosphate ELV and is therefore not a significant pressure for orthophosphate as demonstrated in the mass balance assessment in Table 2. • RS07K010200 Kilwarden Br - approximately 2.5km downstream (but also downstream of 2 tributaries) is at Good Ortho P Indicative Quality. The latter is the most downstream monitoring point that is representative of the subbasin. Ecological status for the river is moderate, but the orthophosphate conditions supporting the chemistry is reported as High. The modelled increase in concentration is below significant levels, which will not increase the risk of deterioration in orthophosphate indicative quality or prevent the achievement of the WFD objectives in this water body.

Table 4.A: Increased loading and concentrations to water bodies connected to the WSZs ***(note: where existing monitoring data is not available, a surrogate indicative quality is derived from ecological status of the WB or Ortho P indicative quality / Ecological status of the upstream and downstream WBS, the mid-range of that indicative quality is used as Baseline Concentration)***

EU_CD / Name	Ortho-P Indicative Quality and Trends (Distance to Threshold. *Surrogate Indicative Quality in italic*	Baseline Conc. *Surrogate Conc. given in italic* mg/l	75% of ortho P indicative quality Upper threshold mg/l	Ortho P Total Dosing Load kg/yr	Potential Increase in Ortho P Conc. due to Dosing mg/l	Ortho P Potential Baseline Conc. following dosing mg/l	Notes
IE_EA_07C040050 CASTLEJORDAN_010	Good Downwards Far	0.029	0.033	0.0	0.0000	0.029	‡ *
	Good Downwards Far	0.029	0.033			0.029	*
	Good Downwards Far	0.029	0.033			0.029	
IE_EA_07C040100 CASTLEJORDAN_020	*Good*	*0.030*	*0.033*	*0.0*	*0.0000*	*0.030*	
IE_EA_07K010060 KINNEGAD_010	*Moderate*	*0.046*	*0.051*	*2.5*	*0.0002*	*0.046*	
IE_EA_07M040400 MILLTOWNPASS_010	High Downwards Near	0.020	0.019	0.0	0.0000	0.020	*
IE_EA_07R010090 RIVERSTOWN_010	High Downwards Near	0.020	0.019	31.9	0.0008	0.021	*
IE_EA_07R040300 ROCHFORTBRIDGE STREAM_010	*Moderate*	*0.046*	*0.051*	*0.0*	*0.0000*	*0.046*	
IE_EA_07Y020070 YELLOW (CASTLEJORDAN)_010	High Moderate Far	0.013	0.019	0.0	0.0000	0.013	
IE_SH_25B090006 BROSNA_020	Good Far	0.029	0.033	7.2	0.0005	0.030	
IE_SH_25B090100 BROSNA_030	Good Downwards Far	0.030	0.033	52.3	0.0010	0.031	‡
IE_SH_25B090200 BROSNA_040	*Moderate*	*0.046*	*0.051*	*39.6*	*0.0002*	*0.046*	
IE_SH_25B090250 BROSNA_050	Good Downwards Far	0.030	0.033	39.6	0.0003	0.031	‡ *
	Good Downwards Far	0.030	0.033			0.031	

	IE_SH_25B090400 BROSNA_060	*Good*	*0.030*	*0.033*	*39.6*	*0.0002*	*0.030*	
	IE_SH_25B090450 BROSNA_070	Good Downwards Far	0.029	0.033	39.6	0.0002	0.029	ǂ *
	IE_SH_25B090600 BROSNA_080	Good Downwards Near	0.024	0.019	39.6	0.0002	0.024	*
		High Downwards Far	0.011	0.019			0.011	*
	IE_SH_25B280390 BROSNA_010	Good Downwards Far	0.029	0.033	10.5	0.0006	0.030	^
	IE_SH_25D050400 DYSART STREAM (LOUGH ENNELL)_010	*Moderate*	*0.046*	*0.051*	*0.0*	*0.0000*	*0.046*	
	IE_SH_25D160150 DUNBODEN PARK STREAM_010	*Moderate*	*0.046*	*0.051*	*0.0*	*0.0000*	*0.046*	
	IE_SH_25G010100 GAGEBOROUGH_010	*Moderate*	*0.046*	*0.051*	*0.0*	*0.0000*	*0.046*	
	IE_SH_25G010300 GAGEBOROUGH_020	*Good*	*0.030*	*0.033*	*0.0*	*0.0000*	*0.030*	
	IE_SH_25G010500 GAGEBOROUGH_030	High Downwards Far	0.009	0.019	0.0	0.0000	0.009	*
	IE_SH_25M010500 MONAGHANSTOWN_010	Moderate	0.046	0.051	0.0	0.0000	0.046	
	IE_SH_25S040500 SYONAN CASTLE STREAM_010	*Moderate*	*0.046*	*0.051*	*0.0*	*0.0000*	*0.046*	
	IE_SH_25T450930 TONAPHORT_010	Unassigned	0.000	0.000	0.0	0.0000	0.000	
	IE_SH_25Y080860 Cornaher_010	*Good*	*0.030*	*0.033*	*0.0*	*0.0000*	*0.030*	
	IE_SH_26G010100 GAINE_010	*Poor*	*0.077*	*0.087*	*4.7*	*0.0006*	*0.077*	
	IE_SH_26G010270 GAINE_020	Good Downwards Far	0.030	0.033	1.2	0.0001	0.030	ǂ *
		Good Downwards Far	0.029	0.033			0.029	*
	IE_SH_26I011000 INNY_080	*Good*	*0.030*	*0.033*	*9.1*	*0.0000*	*0.030*	
	IE_SH_26I011150 INNY_090	Good Downwards Far	0.030	0.033	0.0	0.0000	0.030	

		Good Downwards Far	0.030	0.033			0.030	*
		Good Downwards Far	0.029	0.033			0.029	
	IE_SH_26R010300 RATH 26_020	Moderate	0.046	0.051	0.0	0.0000	0.046	
	IE_EA_07B340940 BALLYHAW_010	*Moderate*	*0.046*	*0.051*	*2.9*	*0.0004*	*0.046*	
	IE_EA_07D010080 DEEL (RAHARNEY)_020	*Good*	*0.030*	*0.033*	*2.3*	*0.0000*	*0.030*	
	IE_EA_07D010200 DEEL (RAHARNEY)_030	*Moderate*	*0.046*	*0.051*	*4.3*	*0.0001*	*0.046*	
	IE_EA_07D010300 DEEL (RAHARNEY)_040	*Good*	*0.030*	*0.033*	*20.0*	*0.0002*	*0.030*	
	IE_EA_07D010400 DEEL (RAHARNEY)_050	High Downwards Near	0.024	0.019	31.0	0.0002	0.024	
	IE_EA_07D010600 DEEL (RAHARNEY)_060	*Good*	*0.030*	*0.033*	*11.3*	*0.0001*	*0.030*	
	IE_EA_07D060030 D'ARCY'S CROSSROADS STREAM_010	High Downwards Far	0.010	0.019	0.0	0.0000	0.010	*
	IE_EA_07K010100 KINNEGAD_020	Good Downwards Far	0.029	0.033	4.0	0.0002	0.030	*
	IE_EA_07K010200 KINNEGAD_030	High Downwards Far	*0.015*	*0.019*	17.3	0.0006	*0.016*	‡
		Good Downwards Near	0.033	0.033			0.033	
	IE_EA_07K330580 KILLYNAN_010	*Good*	*0.030*	*0.033*	*1.7*	*0.0003*	*0.030*	
	IE_EA_07R010200 RIVERSTOWN_020	Good Downwards Far	0.029	0.033	6.6	0.0001	0.029	‡ *
		High Downwards Near	0.024	0.019			0.024	*

		Good Downwards Far	0.029	0.033			0.029	
	IE_EA_07S020075 STONYFORD_020	Good Downwards Far	0.030	0.033	0.5	0.0000	0.030	
		Good Downwards Far	0.030	0.033			0.030	*
		Good Downwards Far	0.029	0.033			0.029	*
	IE_EA_07S020400 STONYFORD_040	Moderate	0.046	0.051	4.5	0.0001	0.046	
	IE_SH_25B160400 BALLYNAGRENIA STREAM_010	Moderate	0.046	0.051	0.0	0.0000	0.046	
	IE_SH_25M050400 MOATE STREAM_010	High Downwards Far	0.009	0.019	0.0	0.0000	0.009	‡ *
		Good Downwards Far	0.029	0.033			0.029	*
		Good Upwards Far	0.029	0.033			0.029	
	IE_SH_26B050180 BLACK (WESTMEATH)_020	*Moderate*	*0.046*	*0.051*	*0.0*	*0.0000*	*0.046*	
	IE_SH_26C080860 Coolnagun Stream_010	*Good*	*0.030*	*0.033*	*0.0*	*0.0000*	*0.030*	
	IE_SH_26C250420 CLONTYMULLAN_26_010	*Good*	*0.030*	*0.033*	*0.0*	*0.0000*	*0.030*	
	IE_SH_26D060100 DUNGOLMAN_010	*Good*	*0.030*	*0.033*	*0.0*	*0.0000*	*0.030*	
	IE_SH_26D060200 DUNGOLMAN_020	*Good*	*0.030*	*0.033*	*0.0*	*0.0000*	*0.030*	
	IE_SH_26D060400 DUNGOLMAN_030	Good Downwards Far	0.030	0.033	0.0	0.0000	0.030	‡
	IE_SH_26F370890 FERSKILL_010	*Good*	*0.030*	*0.033*	*0.0*	*0.0000*	*0.030*	

IE_SH_26I010700 INNY_060	High Downwards Near	0.024	0.019	0.0	0.0000	0.024	
IE_SH_26I010800 INNY_070	*Good*	*0.030*	*0.033*	*9.1*	*0.0000*	*0.030*	
IE_SH_26I011400 INNY_110	*Moderate*	*0.046*	*0.051*	*0.0*	*0.0000*	*0.046*	
IE_SH_26M120080 MULLENMEEHAN STREAM_010	*Good*	*0.030*	*0.033*	*0.0*	*0.0000*	*0.030*	
IE_SH_26R030100 RIFFEY_010	*Good*	*0.030*	*0.033*	*0.0*	*0.0000*	*0.030*	

‡ Load from WWTP / SWO following treatment included
* Trend is Statistically Significant.
^ Effective Rainfall used to calculate concentration
MP: multiple Monitoring Points given for waterbody

Table 4.B: Vollenweider assessment of Lakes within the WSZs

EU_CD / Name	Parameter	TP Indicative Quality and Trends (Distance to Threshold. Surrogate indicative quality in *italic*	Baseline Conc. Surrogate Conc given in *italic* mg/l	TP Total Dosing Load kg/yr	Estimated Existing Areal loading based on Vollenweider (mg/m2/yr)	Post Dosing Aerial Load (mg/m2/yr)	Lc (mg/m2/yr)	% Increase
IE_SH_25_188 Ennell Lough	TP	Good Downwards Far	0.019	39.6	272.3	275.67	239.1	1.3
IE_SH_26_708 Derravaragh (Lough)	TP	Good Downwards Far	0.014	9.8	743.9	745.0	673.5	0.1

The Vollenweider assessment has been undertaken for those lake water bodies where an increase in the loading is expected. In all cases the orthophosphate dosing will result in an insignificant impact on the trophic status of the lake. The areal loading in Ennell Lough and Derravaragh Lough are slightly over the critical load indicative of oligotrophic lakes however the percentage increase for both is less than 1.5% and the OECD trophic status of the lake for the existing and post dosing situation borders on oligotrophic to mesotrophic. The dosing will not impact on the trophic status of the loughs.

Owel Main (IE_SH_26_703) is upstream of the Ardonagh Reservoir WSZ, so not impacted by Ortho P dosing from the reservoir.

Summary and Mitigation Proposed	Considering Ardonagh Reservoir WSZ, the modelled increases in load and concentrations to both groundwater and surface water receptors do not cause a risk to WFD objectives. Orthophosphate dosing is predicted to have insignificant impact on all waterbodies. No impact on groundwater bodies is predicted due to orthophosphate dosing. The fate of all P loads from the Ardonagh Reservior WSZ are depicted in Figure 1. The load from this WSZ has a small impact on the Boyne Estuary, Upper Shannon and Lower Shannon. The cumulative impacts on Shannon Catchment (HAs 24, 25, 26, and 27) associated with phosphate dosing from following additional WTPs are assess in combination with Portloman WTP and summarised in Table 5.A and Table 5.B below. Additional loads due to dosing in the Boyne catchment (HA7) are also included. • 005 Clareville WTP – Limerick City Water Supply • 012 Tuam WTP – Tuam RWSS • 017 Drumcliffe WTP - Ennis PWS • 019 New Doolough WTP - W.Clare RWS (New WTP) • 020 Castle Lake WTP - Shannon/Sixmilebridge RWSS • 021 Rossadrehid WTP – Galtee Regional • 027 Athlone WTP – Athlone WSS • 034 Lough Forbes WTP – Longford Central • 040 Coolbawn – Nenagh RWSS • 049 Ballany WTP – Ballany High Level Reservoir • 058 Ballinasloe Town WTP - Ballinasloe Public Supply • 068 Rockingham WTP - Boyle Regional WSS • 081 Ballinagard Springs WTP - Roscommon Central Water Supply Scheme • 128 Longford Springs WTP Future Supply - Castlerea WSS • 140 Lisbrock WTP - SRRWSS Lisbrock • 161 Freemount WTP – Zone 4 Allow Regional • 178 Clavin's Bridge WTP – Kells/Oldcastle WS • 184 Foileen WTP - CappamoreFoileen Water Supply • 185 Ballinlough/ Loughglynn (Ballybane Springs) - Ballinlough/Loughglynn • 190 Ironmills Pump Station - Ironmills • 216 Kylebeg WTP – Borrisokane • 237 Killadysert WTP - Killadysert PWS • 238 Williamstown WTP - Williamstown PS3 • 246 Ballingarry Spring WTP - Ballingarry Water Supply • 260 Kilcolman PS - Rathkeale Water Supply • 267 Cloughjordan Pump Station – Cloughjordan • 321 Ahascragh WTP - Ahascragh P.S. • 355 Croom Bypass Pump Station - Croom Water Supply In table Table 5.A, two rivers are highlighted where the predicted increase in concentration due to dosing is above significant levels, namely BROSNA_020 (IE_SH_25B090006) and BROSNA_030 (IE_SH_25B090100). However, the increase does not raise the predicted baseline above 75% of the upper threshold for indicative quality for either waterbody.

The areal loading in Lough Derg and Derravaragh Lough are slightly over the critical load indicative of oligotrophic lakes however the percentage increase is low and a OECD trophic status of the lakes for the existing and post dosing situation does not result in any change with the lakes still demonstrating oligotrophic to mesotrophic conditions. The dosing will not impact on the trophic status of the loughs.

Table 5.A: Cumulative assessment of the increased loading and concentrations to receiving water bodies common to the WSZs within the Shannon and Boyne catchments ***(note: where existing monitoring data is not available, a surrogate indicative quality is derived from ecological status of the WB or Ortho P indicative quality / Ecological status of the upstream and downstream WBS, the mid-range of that indicative quality is used as Baseline Concentration)***

EU_CD / Name	Ortho P Indicative quality and Trends (distance to threshold) Surrogate Indicative Quality indicated in *italic*	Baseline Conc. Surrogate Conc. given in *italic* mg/l	75% of Ortho P indicative quality Upper threshold mg/l	Cumulative Ortho P load to SW from leakage, DWWTS & agglomerations kg/yr	Potential Increase in Ortho P Conc. using 30%ile flows mg/l	Ortho P Potential Baseline Conc. following dosing mg/l	Notes
IE_SH_25B090006 BROSNA_020	Good Far	0.029	0.033	17.7	0.0013	0.031	
IE_SH_25B090100 BROSNA_030	Good Downwards Far	0.030	0.033	70.0	0.0032	0.033	‡
IE_SH_25B090200 BROSNA_040	*Moderate*	*0.046*	*0.051*	*70.0*	*0.0004*	*0.046*	
IE_SH_25B090250 BROSNA_050	Good Downwards Far	0.030	0.033	70.0	0.0003	0.031	‡ *
	Good Downwards Far	0.030	0.033			0.031	‡
IE_SH_25B090400 BROSNA_060	*Good*	*0.030*	*0.033*	*70.0*	*0.0003*	*0.030*	
IE_SH_25B090450 BROSNA_070	Good Downwards Far	0.029	0.033	70.0	0.0003	0.030	‡ *
IE_SH_25B090600 BROSNA_080	Good Downwards Near	0.024	0.019	70.1	0.0003	0.024	*
	High Downwards Far	0.011	0.019			0.011	*
IE_SH_26G010270 GAINE_020	Good Downwards Far	0.030	0.033	5.9	0.0005	0.031	‡ *
IE_SH_26I010700 INNY_060	High Downwards Near	0.024	0.019	25.0	0.0001	0.024	
IE_SH_26I010800 INNY_070	*Moderate*	*0.046*	*0.051*	*55.5*	*0.0001*	*0.046*	

	IE_SH_26I011000 INNY_080	*Good*	*0.030*	*0.033*	*59.1*	*0.0001*	*0.030*	ǂ
	IE_SH_26I011150 INNY_090	Good Downwards Far	0.030	0.033	59.1	0.0001	0.030	ǂ MP1
		Good Downwards Far	0.030	0.033			0.030	ǂ MP2
		Good Downwards Far	0.029	0.033			0.029	ǂ MP3
	IE_SH_26I011350 INNY_100	High Upwards Far	0.016	0.019	59.1	0.0001	0.016	ǂ *
	IE_SH_26I011400 INNY_110	*Moderate*	*0.046*	*0.051*	*59.1*	*0.0000*	*0.046*	ǂ
	IE_EA_07D010080 DEEL (RAHARNEY)_020	*Good*	*0.030*	*0.033*	*16.7*	*0.0003*	*0.030*	
	IE_EA_07D010200 DEEL (RAHARNEY)_030	*Good*	*0.030*	*0.033*	*22.7*	*0.0003*	*0.030*	
	IE_EA_07D010300 DEEL (RAHARNEY)_040	*Good*	*0.030*	*0.033*	*38.4*	*0.0004*	*0.030*	
	IE_EA_07D010400 DEEL (RAHARNEY)_050	High Downwards Near	0.024	0.019	84.1	0.0006	0.024	
	IE_EA_07D010600 DEEL (RAHARNEY)_060	High Far	0.011	0.019	88.5	0.0006	0.011	
	IE_EA_07D060030 D'ARCY'S CROSSROADS STREAM_010	*Moderate*	*0.046*	*0.051*	*1.6*	*0.0000*	*0.046*	
	IE_EA_07K010100 KINNEGAD_020	Good Downwards Far	0.029	0.033	6.6	0.0004	0.030	*
	IE_EA_07K010200 KINNEGAD_030	High Downwards Near	0.019	0.019	23.8	0.0008	0.020	ǂ
		Good Downwards Near	0.033	0.033			0.034	
	IE_EA_07R010200 RIVERSTOWN_020	Good Downwards Far	0.029	0.033	38.4	0.0008	0.030	ǂ *
		High Downwards Near	0.024	0.019			0.025	*
		Good Downwards Far	0.029	0.033			0.030	
	IE_EA_07S020075 STONYFORD_020	Good Downwards Far	0.030	0.033	9.3	0.0003	0.030	
		Good Downwards Far	0.030	0.033			0.030	*

	Good Downwards Far	0.029	0.033			0.029	*
IE_EA_07S020400 STONYFORD_040	*Moderate*	*0.046*	*0.051*	*16.9*	*0.0002*	*0.046*	
IE_SH_26B050180 BLACK (WESTMEATH)_020	*Moderate*	*0.046*	*0.051*	*3.6*	*0.0002*	*0.046*	
IE_SH_26R030100 RIFFEY_010	*Moderate*	*0.046*	*0.051*	*6.8*	*0.0003*	*0.046*	
IE_SH_060_0900 Limerick Dock	High (S) Downwards Far	0.008	0.019	7516.7	0.0010	0.009 ‡	‡
	High (W) Upwards Far	0.012	0.019			0.013 ‡	
IE_SH_060_0800 Upper Shannon Estuary	High (S) Upwards Near	0.020	0.019	8848.1	0.0010	0.021 ‡	‡
	High (W) Downwards Far	0.011	0.019			0.012 ‡	
IE_SH_060_0300 Lower Shannon Estuary	High (S) Upwards Near	0.011	0.020	12412.9	0.0002	0.011	‡
	Good (W) Upwards Far	0.025	0.036			0.025	
IE_SH_060_000 Mouth of River Shannon	High (S) Upwards Far	0.008	0.019	13317.6	0.0001	0.008	‡
	Good (W)	*0.033*	*0.037*			*0.033*	
IE_EA_010_0100 Boyne Estuary	High (S) Downwards Far	0.018	0.020	1669.3	0.0010	0.019	
	Good (W) Upwards Far	0.030	0.036			0.031	
IE_EA_010_0000 Boyne Estuary Plume Zone	High (S) Upwards Far	0.012	0.019	1669.3	0.0010	0.013	
	High (W) Downwards Near	0.020	0.019			0.021	

MP: multiple Monitoring Points given for waterbody
* Trend is Statistically Significant.
** 2014 Baseline is inconsistent with Upper and Lower Thresholds for the given Ortho P indicative quality as reported in the WFD App
‡ Load from WWTP / SWO following treatment included
(S) = Summer monitoring period, (W) = Winter monitoring period

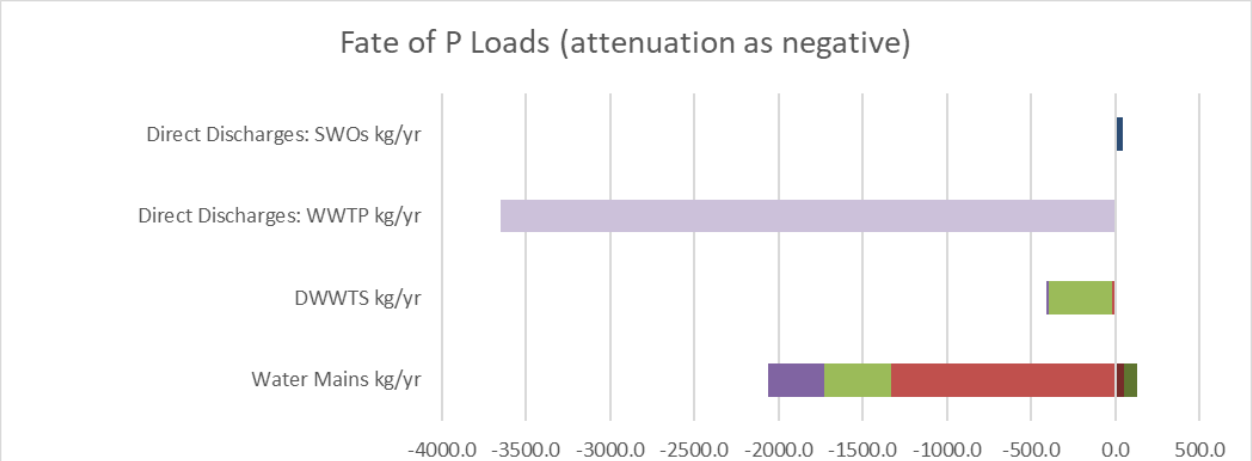
Table 5.B: Vollenweider assessment of cumulative loads to lakes within the WSZs

EU_CD / Name	Parameter	TP Indicative Quality and Trends (Distance to Threshold. *Surrogate Indicative Quality in italic*	Baseline Conc. Surrogate Conc given in *italic* mg/l	TP Total Dosing Load kg/yr	Estimated Existing Areal loading based on Vollenveider (mg/m2/yr)	Post Dosing Aerial Load (mg/m2/yr)	Lc (mg/m2/yr)	% Increase
IE_SH_26_708 Derravaragh (Lough)	TP	Good Downwards Far	0.014	48.5	743.9	750.0	673.5	0.8
IE_SH_25_191 (Derg TN & Derg HMWB combined)	TP	Good Upwards Far	0.020	1271.5	1105.9	1116.5	735.1	0.9

The cumulative assessment has demonstrated that there will be not be a significant impact on the receiving waters and the dosing will not cause deterioration in orthophosphate indicative quality or prevent the achievement of the WFD objectives.

MITIGATION OPTION: None required

RAG STATUS – GREEN



	Water Mains kg/yr	DWWTS kg/yr	Direct Discharges: WWTP kg/yr	Direct Discharges: SWOs kg/yr
Load attenuated in Preference (inadequate percolation) pathway	-1.0	-0.2		
Load attenuated in Near Surface Pathway	-1331.7	-18.2		
Load attenuated in 1m below trench	-394.5	-377.4		
Load attenuated in Subsurface Pathway	-334.5	-11.4		
Load intercepted by gravity main in Preference Pathway	0.0			
Load intercepted by gravity main in Near Surface Pathway	1.7			
Load reaching SW direct or via Preference (inadequate percolation) Pathway	1.1	0.0	4.2	47.9
Load reaching SW via Near Surface Pathway	46.8	6.1		
Load reaching SW via Subsurface Pathway	84.0	0.6		
Load treated in WWTP			-3653.6	

Figure 1 – Fate of orthophosphate loads modelled for Ardonagh Reservoir WSZ due to dosing by source type, indicating levels of attenuation in pathways and relative impact on the surface water receptor.