Irish Water-Lead in Drinking Water Mitigation Plan

Screening for Appropriate Assessment

005 Clareville WTP (Limerick City) (1900PUB1032)

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005 Clareville WTP (Limerick City) (1900PUB1032) WSZ

Document Control Sheet

Client:	Irish Water
Project Title:	Lead in Drinking Water Mitigation Plan
Document Title:	Screening for Appropriate Assessment 005 Clareville WTP (Limerick City) (1900PUB1032)
Document No:	MDW0766Rp_5.3_Screening_005_Clareville (P1)_F01

Text Pages:	92	Appendices:	3

Rev	Status	Date	Author(s)		Reviewed By		Approved By	
A01	Draft	20/04/2023	MM		IP		MM	
F01	Draft	20/04/2023	MM		IP		MM	

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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 Clareville WTP to Limerick City and the WSZs related to a number of WTPs that are due to be rationalised to Clareville, namely: Adare PWS, Croom PWS and Pallasgreen Water Supply.

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 known as

[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

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 Clareville WTP orthophosphate will be added at a rate of 1.5 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 37 European Sites with potential hydrological or hydrogeological connectivity to the WSZ:

- SAC sites: Askeaton Fen Complex SAC (2279), Barrigone SAC (432), Blasket Islands SAC (2172), Bolingbrook Hill SAC (2124), Clare Glen SAC (930), Curraghchase Woods SAC (174), Danes Hole, Poulnalecka SAC (30) Glen Bog SAC (1430), Glendree Bog SAC (1912), Glenomra Wood SAC (1013), Glenstal Wood SAC (1432), Keeper Hill SAC (1197), Kerry Head Shoal SAC (2263), Lough Gash Turlough SAC (51), Loughatorick South Bog SAC (308), Lower River Shannon SAC (2165), Lower River Suir SAC (2137), Magharee Islands SAC (2261), Mount Brandon SAC (375), Newgrove House SAC (2157), Old Domestic Buildings, Rylane SAC (2314), Philipston Marsh SAC (1847), Pollagoona Bog SAC (2126), Ratty River Cave SAC (2316), Silvermine Mountains SAC (939), Silvermines Mountains West SAC (2258), Slieve Bernagh Bog SAC (2312), Tory Hill SAC (439), Tralee Bay and Magharees Peninsula, West to Cloghane SAC (2070).
- SPA sites: Dingle Peninsula SPA (4153), Kerry Head SPA (4189), Loop Head SPA (4119), Lough Derg (Shannon) SPA (4058), Magharee Islands SPA (4125), River Shannon and River Fergus Estuaries SPA (4077), Slieve Aughty Mountains SPA (4168), Slievefelim to Silvermines Mountains SPA (4165).

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, 2019a);
- Article 17 Habitat Conservation Assessments Volume 2 (NPWS, 2019b);
- Article 17 Species Conservation Assessment Volume 3 (NPWS, 2019c);
- EPA Qualifying Interests database, (EPA, 2015) and updated EPA Characterisation Qualifying Interests database (EPA/RPS, September 2016);
- 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

Clareville WTP supplies Limerick City and the WSZs related to a number of WTPs that are due to be rationalised to Clareville, namely: Adare PWS, Croom PWS and Pallasgreen Water Supply. The distribution input for Limerick City Water Supply is 45,948 m3/day (65% of which is accounted for, with the remainder assumed to be lost through leakage) serving a population of approximately 130,500 in 2023.

The area is served by Adare (D0312), Caherconlish (D0308), Castletroy (D0019), Croom (D0307), Limerick (Bunlicky) (D0013) and Pallasgreen (D0503) WWTPs which are 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 are two WWTP with a population equivalent of less than 500, namely Ballycannon (A0081) and Banogue (A0215). The estimated additional load from this agglomeration due to the orthophosphate dosing is considered at the water body level via the surface water pathways. It is estimated that there are 5,942 properties across the WSZ that are serviced by a DWWTS.

Clareville WTP and water supply zones are located adjacent to River Shannon and Estuary in the subcatchments: Clareville WTP and water supply zones are located adjacent to River Shannon and Estuary in the subcatchments: Ballynaclogh_SC_010, Shannon[Lower]_SC_100, Greanagh_SC_010, Shannon[Lower]_SC_090, Maigue_SC_040, Mulkear_SC_010, Mulkear_SC_020, Owenogarney_SC_020, Drumcomoge_SC_020, Shannon[Lower]_SC_080, Maigue_SC_050, Kileengarrif_SC_010, and the catchments: Lower Shannon (25); Shannon Estuary South (24) and Shannon Estuary North (27). The WSZ is potentially hydrologically or hydrogeologically connected to the following European Sites:

- SAC sites: Askeaton Fen Complex SAC (2279), Barrigone SAC (432), Blasket Islands SAC (2172), Bolingbrook Hill SAC (2124), Clare Glen SAC (930), Curraghchase Woods SAC (174), Danes Hole, Poulnalecka SAC (30) Glen Bog SAC (1430), Glendree Bog SAC (1912), Glenomra Wood SAC (1013), Glenstal Wood SAC (1432), Keeper Hill SAC (1197), Kerry Head Shoal SAC (2263), Lough Gash Turlough SAC (51), Loughatorick South Bog SAC (308), Lower River Shannon SAC (2165), Lower River Suir SAC (2137), Magharee Islands SAC (2261), Mount Brandon SAC (375), Newgrove House SAC (2157), Old Domestic Buildings, Rylane SAC (2314), Philipston Marsh SAC (1847), Pollagoona Bog SAC (2126), Ratty River Cave SAC (2316), Silvermine Mountains SAC (939), Silvermines Mountains West SAC (2258), Slieve Bernagh Bog SAC (2312), Tory Hill SAC (439), Tralee Bay and Magharees Peninsula, West to Cloghane SAC (2070).

- SPA sites: Dingle Peninsula SPA (4153), Kerry Head SPA (4189), Loop Head SPA (4119), Lough Derg (Shannon) SPA (4058), Magharee Islands SPA (4125), River Shannon and River Fergus Estuaries SPA (4077), Slieve Aughty Mountains SPA (4168), Slievefelim to Silvermines Mountains SPA (4165).

3.2 CONSTRUCTION OF CORRECTIVE WATER TREATMENT WORKS

The corrective water treatment works at Clareville WTP are already operational and therefore there is no potential impact from the construction of the corrective water treatment works. This AA screening has been prepared to assess whether the rationalisation of additional WSZs to the Clareville WTP will have likely significant effects on the European Sites Identified above.

3.3 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 Clareville 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.

3.4 LDWMP APPROACH TO ASSESSMENT

3.4.1 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 3.4.2** below.

3.4.2 Environmental Assessment Methodology

The EAM has been developed based on a conceptual model of P transfer (see **Figure 3-1**), 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 3-2** 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.

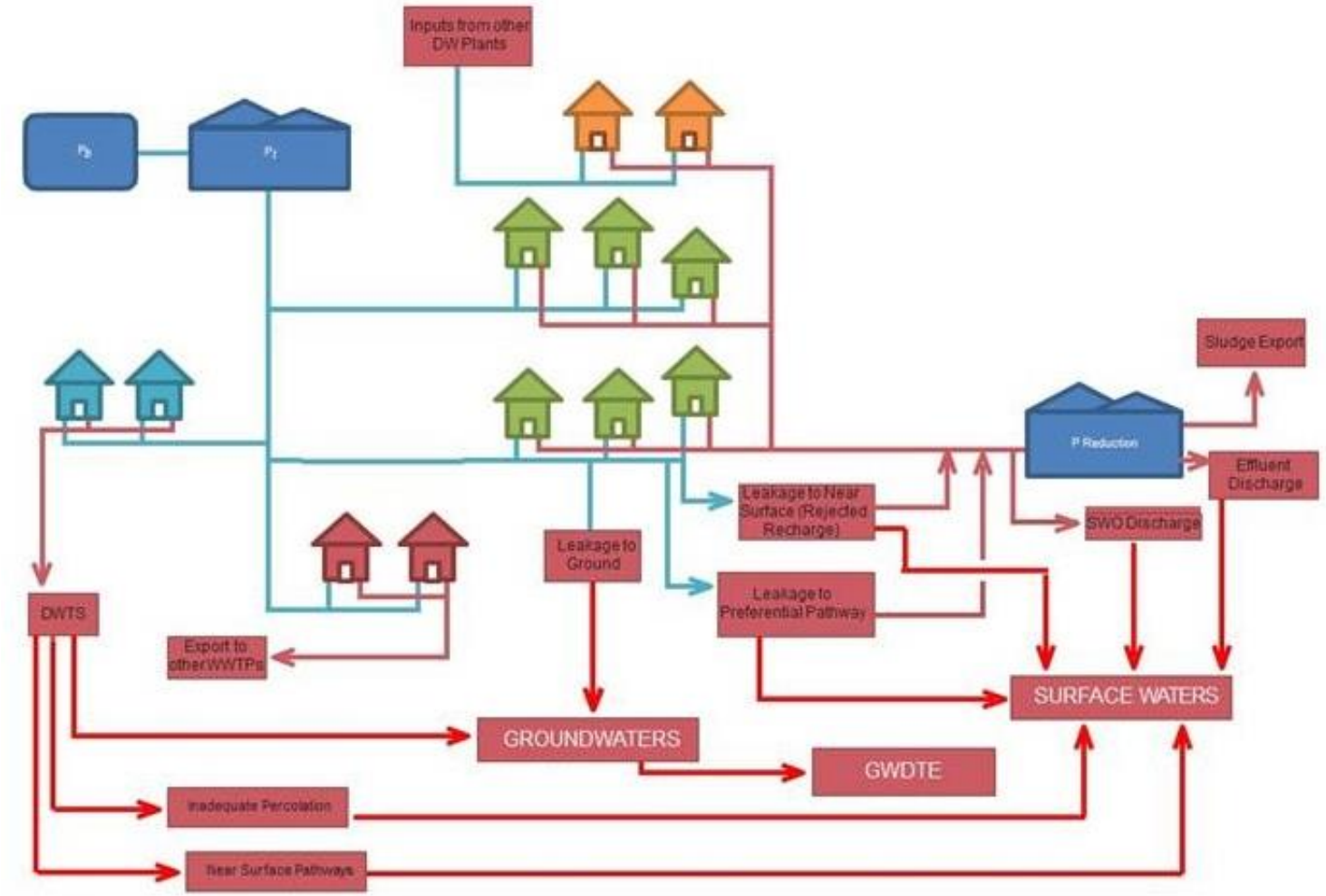


Figure 3-1: Conceptual Model of P Transfer

(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.)

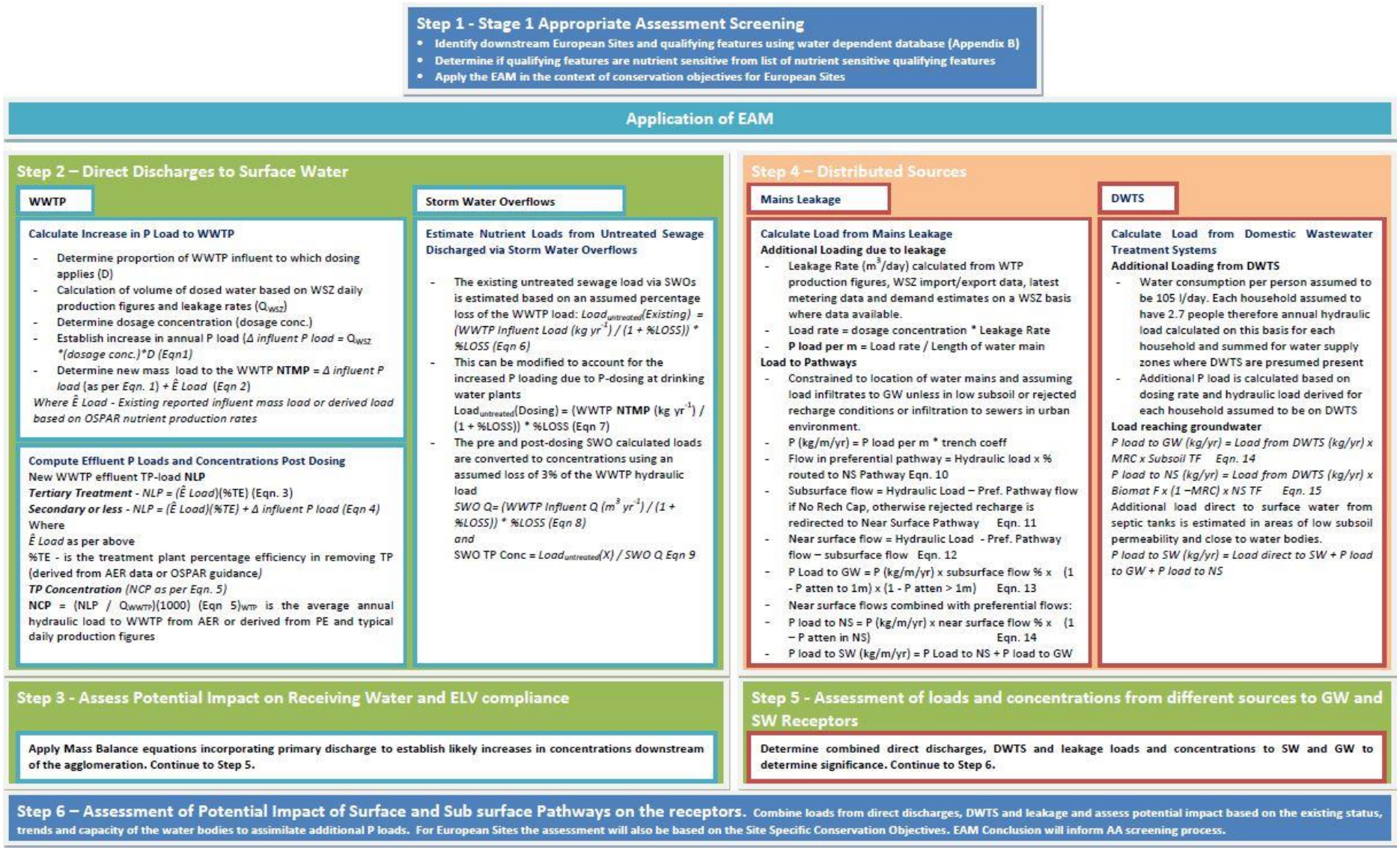


Figure 3-2: Stepwise Approach to the Environmental Assessment Methodology

4 PROJECT CONNECTIVITY TO EUROPEAN SITES

4.1 OVERVIEW OF THE PROJECT ZONE OF INFLUENCE

4.1.1 Construction Phase

As outlined in Section 3.2 there is no construction required as part of this proposal and therefore no potential for construction phase impacts.

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 Clareville 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.

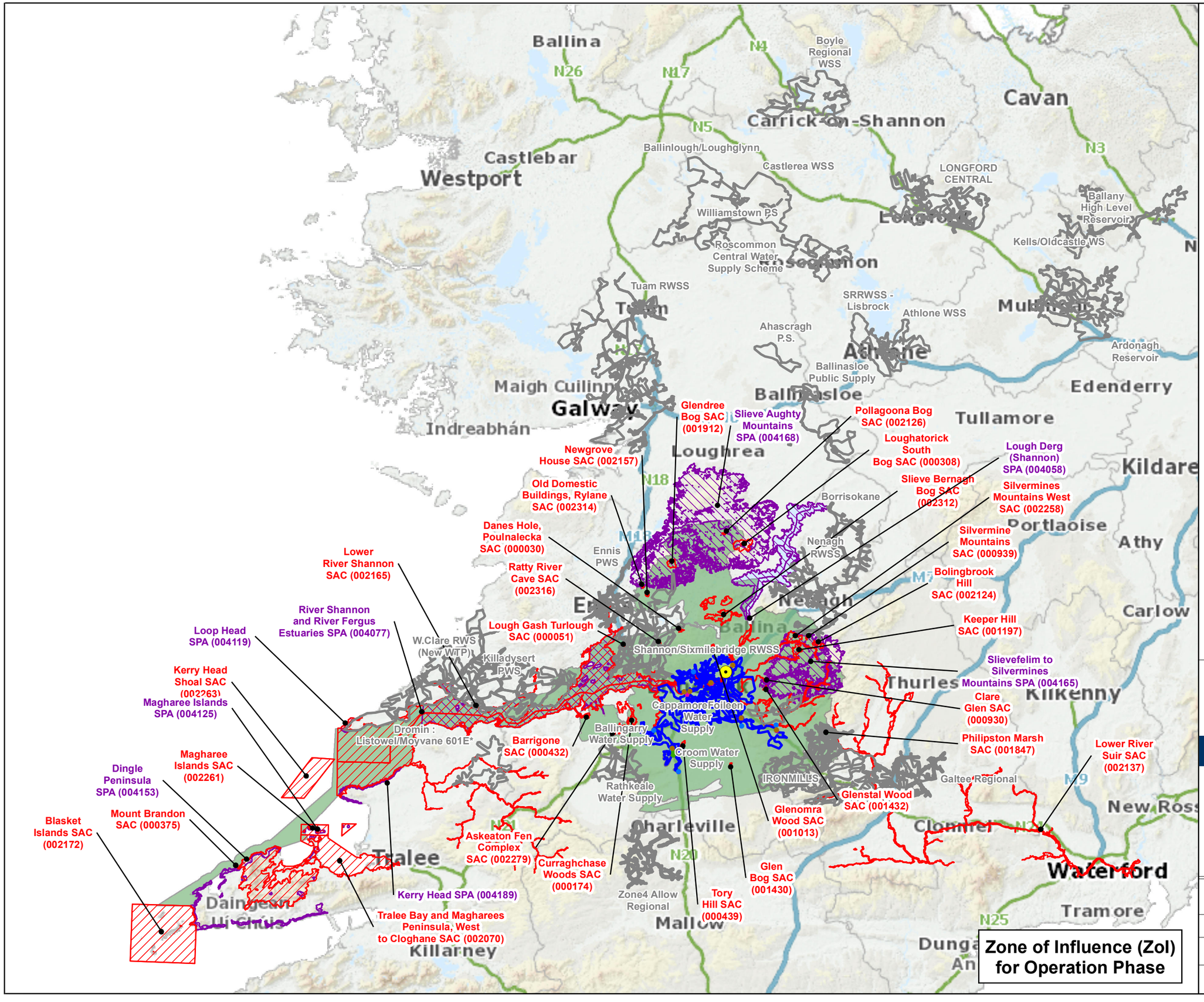
In the EAM, all water bodies linked to the WSZ have been identified. Downstream water bodies to the estuary and coastal water bodies have also been identified. Groundwater bodies intersecting the WSZs, are also included in the ZoI. Hydrogeological linkages in karst areas have also been taken into account. European Sites within the ZoI are listed in **Table 4.1**: and are displayed in **Figure 4-1**.

Table 4.1: 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	Yes	Yes
2	Curraghchase Woods	SAC 000174	Yes	Yes	Yes	Yes	Yes
3	Loughatorick South Bog	SAC 000308	Yes	Yes	No	No	No
4	Mount Brandon	SAC 000375	Yes	Yes	No	No	No
5	Barrigone SAC	SAC 000432	Yes	No	Yes	Yes	Yes
6	Tory Hill	SAC 000439	No	Yes	Yes	No	No
7	Clare Glen	SAC 000930	Yes	Yes	Yes	Yes	Yes
8	Silvermine Mountains	SAC 000939	Yes	Yes	Yes	No	Yes
9	Glenomra Wood	SAC 001013	No	Yes	Yes	No	Yes
10	Keeper Hill	SAC 001197	Yes	Yes	Yes	No	Yes
11	Glen Bog	SAC 001430	Yes	Yes	Yes	No	Yes

	Site Name	SAC / SPA Code	Water Dependent Species/ Habitats	Nutrient Sensitive Species/ Habitats	Surface Water Connectivity	Groundwater Connectivity	Potential Source Impact Pathway
12	Glenstal Wood	SAC 001432	Yes	Yes	Yes	Yes	Yes
13	Philipston Marsh	SAC 001847	Yes	Yes	No	Yes	Yes
14	Glendree Bog	SAC 001912	Yes	Yes	No	Yes	Yes
15	Tralee Bay and Magharees Peninsula, West to Cloghane	SAC 002070	Yes	Yes	Yes (South-western Atlantic Seaboard)	No	Yes
16	Bolingbrook Hill	SAC 002124	Yes	Yes	Yes	Yes	Yes
17	Pollagoona Bog	SAC 002126	Yes	Yes	No	No	No
18	Lower River Suir	SAC 002137	Yes	Yes	No	No	No
20	Newgrove House	SAC 002157	No	Yes	No	No	No
21	Lower River Shannon	SAC 002165	Yes	Yes	Yes (Shannon (Lower)	Yes	Yes
22	Blasket Islands	SAC 002172	Yes	Yes	Yes (South-western Atlantic Seaboard)	No	Yes
23	Silvermines Mountains West	SAC 002258	Yes	Yes	No	No	No
24	Magharee Islands	SAC 002261	Yes	Yes	Yes (South-western Atlantic Seaboard)	No	Yes
25	Kerry Head Shoal	SAC 002263	Yes	Yes	Yes (South-western Atlantic Seaboard)	No	Yes
26	Askeaton Fen Complex	SAC 002279	Yes	Yes	Yes	No	Yes
27	Slieve Bernagh Bog	SAC 002312	Yes	Yes	Yes	No	Yes
28	Old Domestic Buildings, Rylane	SAC 002314	No	Yes	No	No	No
29	Ratty River Cave	SAC 002316	Yes	Yes	Yes	No	Yes
30	River Shannon and River Fergus Estuaries	SPA 004077	Yes	Yes	Yes	No	Yes
31	Lough Derg (Shannon)	SPA 004058	Yes	Yes	No	Yes	Yes

	Site Name	SAC / SPA Code	Water Dependent Species/ Habitats	Nutrient Sensitive Species/ Habitats	Surface Water Connectivity	Groundwater Connectivity	Potential Source Impact Pathway
32	Loop Head	SPA 004119	Yes	Yes	Yes (Mouth of the Shannon)	No	Yes
33	Magharee Islands	SPA 004125	Yes	Yes	Yes (South-western Atlantic Seaboard)	No	Yes
34	Dingle Peninsula	SPA 004153	Yes	Yes	Yes (South-western Atlantic Seaboard)	No	Yes
35	Slievefelim to Silvermines Mountains	SPA 004165	Yes	Yes	Yes	No	Yes
36	Slieve Aughty Mountains	SPA 004168	Yes	Yes	No	No	No
37	Kerry Head	SPA 004189	Yes	Yes	Yes (South-western Atlantic Seaboard)	No	Yes



Legend

LEMA Emission Type

- Primary Discharge Point
- Secondary Discharge Point
- Storm Water Overflow
- Waste Water Treatment Plant
- Clareville 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 (February 2023)
EPA

N

0 5 10 20 Kilometres

Client: UISCE ÉIREANN : IRISH WATER

Project: Lead Mitigation Plan
Corrective Water Treatment Works

Title:

005 Clareville WTP (Limerick City) and Related Water Supply Zones

European Sites within the ZoI of the Proposed Project

RPS

Scale: 1:900,000 @ A3	Date: 28/04/2023
File Ref: MDW0766Arc0084aA01	Map Projection: Irish National Grid (TM65)

4.2 IDENTIFICATION OF RELEVANT EUROPEAN SITES

For the 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**.

For the operational phase, Clareville WTP and water supply zones are located adjacent to River Shannon and Estuary in the subcatchments: Ballynaclogh_SC_010, Shannon[Lower]_SC_100, Greanagh_SC_010, Shannon[Lower]_SC_090, Maigue_SC_040, Mulkear_SC_010, Mulkear_SC_020, Owenogarney_SC_020, Drumcomoge_SC_020, Shannon[Lower]_SC_080, Maigue_SC_050, Kileengarrif_SC_010, and the catchments: Lower Shannon (25); Shannon Estuary South (24) and Shannon Estuary North (27).

A number of European Sites also occur in these subcatchments and catchments which are hydrologically connected to the WSZ via river and lake water bodies. The Lower River Shannon SAC (2165) and the River Shannon and River Fergus Estuaries SPA have a strong hydrological link to the WSZ with surface water bodies within the WSZ directly within these European Sites or providing a surface water pathway from the WSZ to these European Sites. Due to this hydrological connectivity between these European Sites and the WSZ, they are included for further assessment in **Section 5** and **Section 6**.

The following sites are all located within the subcatchments intersected by the WSZ however they are all upstream of the WSZ and will not be affected by surface water pathways: Askeaton Fen Complex SAC (2279), Bolingbrook Hill SAC (2124), Clare Glen SAC (930), Curraghchase Woods SAC (174), Glen Bog SAC (1430), Glenomra Wood SAC (1013), Glenstal Wood SAC (1432), Keeper Hill SAC (1197), Ratty River Cave SAC (2316), Silvermine Mountains SAC (939), Silvermines Mountains West SAC (2258), Slieve Bernagh Bog SAC (2312), Tory Hill SAC (439), Slievefelim to Silvermines Mountains (4165).

The zone of influence for this surface water pathway has been terminated at Mouth of the Shannon coastal water body (IE_SH_060_0000) as the modelled post-dosing increase is not detectable (0.0000 mg/l) therefore there is no potential for likely significant effects on European Sites downstream of that water body. Therefore the following sites are excluded from further assessment: Blasket Islands SAC (2172), Kerry Head Shoal SAC (2263), Magharee Islands SAC (2261), Mount Brandon SAC (375), Tralee Bay and Magharees Peninsula, West to Cloghane SAC (2070), Dingle Peninsula SPA (4153), Kerry Head SPA (4189), Loop Head SPA (4119), Magharee Islands SPA (4125).

In addition to those sites hydrologically connected to the WSZ via surface water pathways, there are two European Sites that are located adjacent to river water bodies affected by dosing at Charleville WTP. These are Lower Shannon SAC and the River Shannon and River Fergus Estuaries SPA. 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 Mapping[4] there are a number of areas that flood along the Lower Shannon_050 and Lower Shannon_060 river water bodies

[4] https://www.floodinfo.ie/map/floodmaps/

that coincide with the Lower Shannon SAC and the River Shannon and River Fergus Estuaries SPA. These sites are already identified as having a surface water pathway to the water supply zone.

The Charleville (P1) WSZ intersects 27 GWBs as outlined in Table 3, **Appendix C**. 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[5], and was consulted in making the assessment.

Table 4.2: GWB within the ZoI of the Proposed Project that have a potential hydrogeological pathway to European Sites – Operational Phase

	GWB Name	European Site Name	SAC / SPA Code
1	IE_SH_G_009 Ardnacrusha	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
2	IE_SH_G_010 Askeaton	Lower River Shannon Curraghchase Woods Barrigone SAC Askeaton Fen Complex River Shannon and River Fergus Estuaries	SAC 002165 SAC 000174 SAC 000432 SAC 002279 SPA 004077
3	IE_SH_G_022 Ballingarry	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
4	IE_SH_G_036 Ballyneety	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
5	IE_SH_G_052 Castleconnell	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
6	IE_SH_G_070 Cratloe	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
7	IE_SH_G_084 Fedamore	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
8	IE_SH_G_106 Herbertstown	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
9	IE_SH_G_107 Hospital	Glen Bog Lower River Shannon River Shannon and River Fergus Estuaries	SAC 001430 SAC 002165 SPA 004077
10	IE_SH_G_119 Kildimo	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
11	IE_SH_G_129 Knockroe East	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
12	IE_SH_G_130 Knockroe Northwest	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
13	IE_SH_G_131 Knockroe Southwest	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077

[5] https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/activities/understanding-ireland-groundwater/Pages/Groundwater-bodies.aspx

	GWB Name	European Site Name	SAC / SPA Code
14	IE_SH_G_133 Knockseefin-Longstone East	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
15	IE_SH_G_134 Knockseefin -Longstone West	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
16	IE_SH_G_138 Limerick City East	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
17	IE_SH_G_139 Limerick City North	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
18	IE_SH_G_140 Limerick City Northwest	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
19	IE_SH_G_141 Limerick City Southwest	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
20	IE_SH_G_157 Lough Graney	Loughatorick South Bog Glenomra Wood Glendree Bog Pollagoona Bog Lower River Shannon Slieve Bernagh Bog Lough Derg (Shannon) River Shannon and River Fergus Estuaries Slieve Aughty Mountains	SAC 000308 SAC 001013 SAC 001912 SAC 002126 SAC 002165 SAC 002312 SPA 004058 SPA 004077 SPA 004168
21	IE_SH_G_176 GWDTE-Tory Hill Fen	Tory Hill	SAC 000439
22	IE_SH_G_196 Pallas Grean	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
23	IE_SH_G_197 Patrickswell	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
224	IE_SH_G_213 Slieve Phelim	Clare Glen Silvermine Mountains Keeper Hill Glenstal Wood Philipston Marsh Bolingbrook Hill Lower River Suir Lower River Shannon Silvermines Mountains West River Shannon and River Fergus Estuaries Slievefelim to Silvermines Mountains Slieve Aughty Mountains	SAC 000930 SAC 000939 SAC 001197 SAC 001432 SAC 001847 SAC 002124 SAC 002137 SAC 002165 SAC 002258 SPA 004077 SPA 004165 SPA 004168
25	IE_SH_G_229 Tulla-Newmarket on Fergus	Danes Hole, Poulnalecka Newgrove House Lower River Shannon Slieve Bernagh Bog Old Domestic Buildings, Rylane Ratty River Cave River Shannon and River Fergus Estuaries	SAC 000030 SAC 002157 SAC 002165 SAC 002312 SAC 002314 SAC 002316 SPA 004077
26	IE_SH_G_257 O'Briensbridge Gravels	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077
27	IE_SH_G_260 Industrial Facility (P0650-02)	Lower River Shannon River Shannon and River Fergus Estuaries	SAC 002165 SPA 004077

The groundwater bodies in Table 4.3 have a potential hydrogeological connectivity to European Sites. The majority of the groundwater bodies are hydrogeological connected to the Lower Shannon SAC and the River Shannon and River Fergus Estuaries SPA. Due to the hydrogeological connection (subsurface pathway) to these European sites, they are included for further assessment in Section 5 and Section 6. The GWBs range from poorly productive aquifers, where the groundwater flows will largely follow topography and therefore the flow will be towards the River Shannon and the Estuary. Productive fissured bedrock aquifers are also present and the general groundwater flow patterns are to the main rivers and streams overlying the groundwater body towards the River Shannon. Karstic bedrocks are also present, particularly around Limerick City an south of the Shannon Estuary where the main flowpaths are considered to be northwards and eastwards to Rivers such as the Maigue, Clonshire and Grenagh all of which discharge to the Shannon Estuary.

There are a number of European Sites, other than the Lower River Shannon SAC and the River Shannon and River Fergus Estuaries SPA that are within the groundwater bodies identified in Table 4.2 but which are largely upgradient of the WSZ and therefore will not be significantly impacted by the orthophosphate dosing. Analysis of these water bodies is provided below:

Askeaton IE_SH_G_010

Other European sites within this groundwater body are: Curraghchase Woods SAC, Barrigone SAC and Askeaton Fen Complex. The WSZ intersects the south east corner of this GWB where the flows are known to occur in a south easterly direction[6] away from these three European sites. On this basis there is no potential for the orthophosphate dosing to impact on these European Sites from sub surface pathways.

Hospital IE_SH_G_107

Groundwater flow paths in this aquifer are short (30-300 m), with groundwater discharging locally to the streams, rivers and springs. Overall, the general groundwater flow directions are eastwards and westwards to the Rivers Maigue, Morningstar, Camoge and Mahore[7]. The WSZ intersects this groundwater body in the lower reaches of the Maigue River where groundwater flow are towards the River Maigue and onwards to the Shannon Estuary via the Maigue Estuary. The Glen Bog SAC is located in the upper reaches of the Maigue River and therefore is upgradient of the WSZ and any potential impact from orthophosphate dosing.

Lough Graney IE_SH_G_157

Other European Sites located in this GWB include: Slieve Bernagh Bog SAC, Loughatorick South Bog SAC, Glenomra Wood SAC, Glendree Bog SAC, Pollagoona Bog SAC, Lough Derg (Shannon) SPA, Slieve Aughty Mountains SPA. Groundwater flow paths are generally short, with groundwater discharging to springs, or to the streams and rivers that traverse the aquifer. Flow directions are expected to approximately follow the local surface water catchments and to be determined by local topographic variations[8]. The WSZ interacts this groundwater body in the southern extents of this GWB in the North Ballycannan_010 and Blackwater (Clare)_020 river water bodies which flow towards the Limerick Dock transitional Water body and onwards to the Upper Shannon Estuary. All of the European sites listed

[6] https://gsi.geodata.gov.ie/downloads/Groundwater/Reports/GWB/AskeatonGWB.pdf
[7] https://gsi.geodata.gov.ie/downloads/Groundwater/Reports/GWB/HospitalGWB.pdf
[8] https://gsi.geodata.gov.ie/downloads/Groundwater/Reports/GWB/LoughGraneyGWB.pdf

above are upstream of these river water bodies and therefore will not be impacted by the orthophosphate dosing as there is not hydrological or hydrogeological pathway.

GWDTE-Tory Hill Fen IE_SH_G_176

The WSZ only intersects the very southern tip of this GWB downgradient of the Tory Hill SAC and therefore there are no subsurface pathways where the very small loads from the orthophosphate dosing(0.7kg.yr) can impact on the SAC.

Slieve Phelim IE_SH_G_213

Groundwater flow paths in this GWB are short (30-300 m), with groundwater discharging to small springs, or to the streams and rivers that traverse the aquifer. Flow directions are expected to approximately follow the local surface water catchments[9].

European Sites underlain by this GWB include: Clare Glen SAC, Silvermine Mountains SAC, Keeper Hill SAC, Glenstal Wood SAC, Philipston Marsh SAC, Bolingbrook Hill SAC, Lower River Suir SAC, Lower River Shannon SAC, Silvermines Mountains West SAC, River Shannon and River Fergus Estuaries SPA, Slievefelim to Silvermines Mountains SPA. Given that groundwater flow directions follow local surface water catchments and all of the European Sites listed above, with the exception of the Lower River Shannon SAC and the River Shannon and River Fergus Estuaries SPA, are upstream of the WSZ and any potential sub surface or near surface pathways they can be excluded from any further assessment.

Tulla-Newmarket on Fergus IE_SH_G_229

The WSZ intersects the very south eastern corner of this large GWB. 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. Surface water drainage is mainly westwards, except in the south of the GWB, where rivers drain south to the Fergus Estuary or to the Crompaun River[10].

European Sites underlain by this GWB include: Danes Hole, Poulnalecka SAC, Newgrove House SAC, Lower River Shannon SAC, Slieve Bernagh Bog SAC, Old Domestic Buildings, Rylane SAC, Ratty River Cave SAC, River Shannon and River Fergus Estuaries and Slieve Aughty Mountains SPA. Given that groundwater flow directions follow local surface water catchments and all of the European Sites listed above, with the exception of the Lower River Shannon SAC and the River Shannon and River Fergus Estuaries SPA, are upstream of the WSZ and any potential sub surface or near surface pathways they can be excluded from any further assessment.

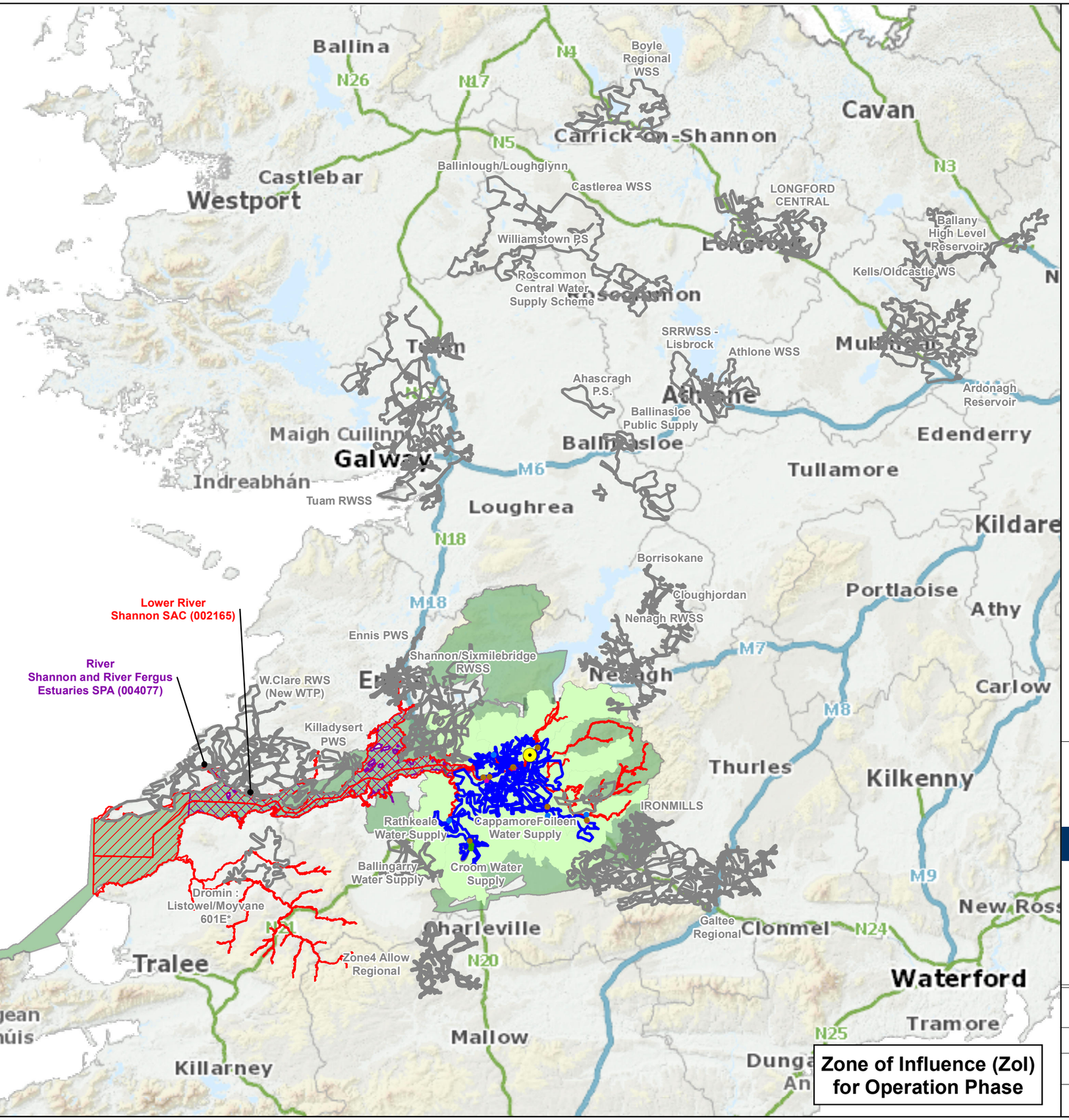
On this basis, two sites have been included for further assessment in order to evaluate the significance of potential effects arising during the operational phase in Sections 5 and 6 below i.e., Lower River Shannon SAC and the River Shannon and River Fergus Estuaries SPA.

[9] https://gsi.geodata.gov.ie/downloads/Groundwater/Reports/GWB/SlievePhelimGWB.pdf
[10] https://gsi.geodata.gov.ie/downloads/Groundwater/Reports/GWB/TullaNewmarketOnFergusGWB.pdf

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
Operational Phase								
Lower River Shannon SAC	SAC 002165	07 August 2012 Version 1	1029	Freshwater pearl mussel (*Margaritifera margaritifera*)	Yes	Yes	Yes	Yes
			1095	Sea lamprey (*Petromyzon marinus*)	Yes	Yes		
			1096	Brook lamprey (*Lampetra planeri*)	Yes	Yes		
			1099	River lamprey (*Lampetra fluviatilis*)	Yes	Yes		
			1106	Atlantic salmon (*Salmo salar*) (only in fresh water)	Yes	Yes		
			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	Yes	No		
			1150	*Coastal lagoons	Yes	Yes		
			1160	Large shallow inlets and bays	Yes	Yes		
			1170	Reefs	Yes	Yes		
			1220	Perennial vegetation of stony banks	Yes	Yes		
			1230	Vegetated sea cliffs of the Atlantic and Baltic	Yes	Yes		
			1310	*Salicornia* and other annuals colonizing mud and sand	Yes	Yes		
			1330	Atlantic salt meadows (*Glauco-Puccinellietalia*	Yes	Yes		
			1349	Bottlenose Dolphin (*Tursiops truncates)*	Yes	Yes		
			1355	Otter (*Lutra lutra)*	Yes	No		
			1410	Mediterranean salt meadows (*Juncetalia maritimi*)	Yes	Yes		
			3260	Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	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
			6410	*Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)	Yes	Yes		
			91E0	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)*	Yes	Yes		
River Shannon and River Fergus Estuaries SPA	SPA 004077	17 Sept 2012 Version 1	A017	Cormorant *Phalacrocorax carbo*	Yes	Yes	Yes	Yes
			A038	Whooper Swan *Cygnus*	Yes	Yes		
			A046	Light-bellied Brent Goose *Branta bernicla hrota*	Yes	Yes		
			A048	Shelduck *Tadorna tadorna*	Yes	Yes		
			A050	Wigeon *Anas penelope*	Yes	Yes		
			A052	Teal *Anas crecca*	Yes	Yes		
			A054	Pintail *Anas acuta*	Yes	Yes		
			A056	Shoveler *Anas clypeata*	Yes	Yes		
			A062	Scaup *Aythya marila*	Yes	Yes		
			A137	Ringed Plover *Charadrius hiaticula*	Yes	Yes		
			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		
			A149	Dunlin *Calidris alpina*	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		
			A179	Black-headed Gull *Chroicocephalus ridibundus*	Yes	Yes		
			A999	Wetlands	Yes	Yes		



Zone of Influence (ZoI) for Operation Phase

Legend

LEMA Emission Type

- Primary Discharge Point
- Secondary Discharge Point
- Storm Water Overflow
- Waste Water Treatment Plant
- Clareville 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

Data Source:
Irish Water
NPWS (February 2023)
EPA

N

0 5 10 20 Kilometres

Client: UISCE ÉIREANN : IRISH WATER

Project: Lead Mitigation Plan
Corrective Water Treatment Works

Title:
005 Clareville WTP (Limerick City) and Related Water Supply Zones
European Sites within the ZoI which are hydro(geo)logically connected

RPS

Scale: 1:900,000 @ A3	Date: 28/04/2023
File Ref: MDW0766Arc0084bA01	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

There is no construction works proposed as part of the proposed projects. The equipment and services required for dosing are already present in Charleville WTP.

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 Clareville 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 Clareville WTP.

5.3.1 Operational Phase

In the case of the additional orthophosphate load due to dosing at Charleville 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 5.1**. 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 an assessment of 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 for orthophosphate is calculated based on the surrogate ecological status as defined by the EPA for the purposes of classifying the status of the waterbody but the more conservative freshwater orthophosphate limits for the different indicative quality bands are applied.[11].

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

[11] 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.

statistically significant trends for a water body will not result in deterioration in status in the future 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 one future river basin cycles, i.e. within the next 6 years.

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 baseline 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.

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 the most up to date baseline data from the WFD monitoring programme. If tests fail and more investigation is required, more recent data can be used and the assessment rerun. For example, if project monitoring provides more recent baseline concentrations than that available from the WFD monitoring programme these can be used instead of the WFD baseline information, particularly if the most recent WFD monitoring is not available.

Table 5.1: 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[12]	Ortho P Indicative Quality[13] and Trends[14]	Baseline [15] Ortho P Conc.[16] (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.[17] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[18]	Evaluation
Lower River Shannon SAC (002165) and River Shannon and River Fergus Estuaries SPA	IE_SH_24B040800 BALLYNACLOGH_010	RWB	*Moderate*	*0.046*	*0.051*	*115.2*	*0.0050*	*0.051*	The increase in modelled concentration is >5% High/Good indicative quality boundary but the post dosing Ortho P concentration is modelled to be less than 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.

[12] Monitoring period is annual unless specified.
[13] Surrogate Indicative Quality in italic.
[14] Distance to threshold.
[15] Baseline year is 2021 for surface water bodies and 2016 for groundwater bodies.
[16] Surrogate concentration is given in italic mg/l
[17] 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.
[18] 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[12]	Ortho P Indicative Quality[13] and Trends[14]	Baseline [15] Ortho P Conc.[16] (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.[17] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[18]	Evaluation
Lower River Shannon SAC (002165) and River Shannon and River Fergus Estuaries SPA	IE_SH_24B050600 BARNAKYLE_020	RWB	Good Far	0.025	0.033	119.6	0.0054	0.031	The increase in modelled concentration is >5% High/Good indicative quality boundary but the post dosing Ortho P concentration is modelled to be less than 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_24M440880 Mondellihy_010	RWB	*Poor*	*0.077*	*0.087*	*24.0*	*0.0040*	*0.080*	
	IE_SH_24N150630 EAST CARRIG_010	RWB	*Poor*	*0.077*	*0.087*	*21.8*	*0.0017*	*0.078*	
	IE_SH_25B060250 BLACKWATER (CLARE)_020	RWB	Good Far	0.031	0.033	2.4	0.0001	0.031	The increase in modelled concentration is <5% High/Good indicative quality boundary. No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25B770990 BALLYARD_020	RWB	*Moderate*	*0.046*	*0.051*	*3.3*	*0.0001*	*0.046*	
	IE_SH_25G050200 GROODY_010	RWB	Poor Far	0.069	0.087	29.2	0.0013	0.071	The increase in modelled concentration is >5% High/Good indicative quality boundary but the post dosing Ortho P concentration is modelled to be less than 75% of the
			Poor Far	0.068	0.087			0.069	

Site Name (Code)	Contributing WB Code_Name	WB Type[12]	Ortho P Indicative Quality[13] and Trends[14]	Baseline [15] Ortho P Conc.[16] (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.[17] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[18]	Evaluation
									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_25K020150 KILLEENGARRIFF_010	RWB	*Good*	*0.030*	*0.033*	*31.0*	*0.0002*	*0.030*	The increase in modelled concentration is <5% High/Good indicative quality boundary. No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25M040200 MULKEAR (LIMERICK)_020	RWB	*Moderate*	*0.046*	*0.051*	*31.2*	*0.0001*	*0.046*	
	IE_SH_25M040590 MULKEAR (LIMERICK)_050	RWB	Good Far	0.028	0.033	42.4	0.0001	0.028	
	IE_SH_25N170970 North Ballycannan_010	RWB	Good Far	0.026	0.033	54.1	0.0040	0.030	The increase in modelled concentration is >5% High/Good indicative quality boundary but the post dosing Ortho P concentration is modelled to be less than 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.

Site Name (Code)	Contributing WB Code_Name	WB Type[12]	Ortho P Indicative Quality[13] and Trends[14]	Baseline [15] Ortho P Conc.[16] (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.[17] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[18]	Evaluation
Lower River Shannon SAC (002165) and River Shannon and River Fergus Estuaries SPA	IE_SH_25S012500 SHANNON (LOWER)_050	RWB	High Far	0.012	0.019	0.4	0.0000	0.012	The increase in modelled concentration is <5% High/Good indicative quality boundary. No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_25S012600 SHANNON (LOWER)_060	RWB	High Far	0.013	0.019	244.7	0.0000	0.013	
			Good Far	0.030	0.033			0.030	
			High Far	0.014	0.019			0.014	
			High Far	0.010	0.019			0.010	
			High Near	0.018	0.019			0.018	
	IE_SH_25W210770 WHITEHALL_010	RWB	*Poor*	*0.077*	*0.087*	*4.7*	*0.0008*	*0.077*	
	IE_SH_27C080300 CRATLOE_010	RWB	*Moderate*	*0.046*	*0.051*	*5.6*	*0.0010*	*0.047*	
	IE_SH_27C090600 CROMPAUN (EAST)_010	RWB	*Poor*	*0.077*	*0.087*	*21.0*	*0.0016*	*0.078*	The increase in modelled concentration is >5% High/Good indicative quality boundary but the post dosing Ortho P concentration is modelled to be less than 75% of the upper indicative quality threshold therefore there is no risk of deterioration in the Ortho P indicative

Site Name (Code)	Contributing WB Code_Name	WB Type[12]	Ortho P Indicative Quality[13] and Trends[14]	Baseline [15] Ortho P Conc.[16] (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.[17] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[18]	Evaluation
									quality or of preventing the achievement of WFD objectives.
	IE_SH_24B050300 BARNAKYLE_010	RWB	Moderate Far	0.043	0.051	0.0	0.0000	0.043	The increase in modelled concentration is <5% High/Good indicative quality boundary. No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
Lower River Shannon SAC (002165) and River Shannon and River Fergus Estuaries SPA	IE_SH_24B080900 BALLYNAMONA_010	RWB	*Poor*	*0.077*	*0.087*	*0.2*	*0.0000*	*0.077*	
	IE_SH_24C010600 CAMOGE_030	RWB	Poor Far	0.071	0.087	0.3	0.0000	0.071	
	IE_SH_24C030900 CLONSHIRE_040	RWB	*Poor*	*0.077*	*0.087*	*2.1*	*0.0001*	*0.077*	
	IE_SH_24G050600 GREANAGH_010	RWB	*Poor*	*0.077*	*0.087*	*7.0*	*0.0002*	*0.077*	
	IE_SH_24K620500 KILMOREEN_010	RWB	*Poor*	*0.077*	*0.087*	*0.1*	*0.0000*	*0.077*	
	IE_SH_24M010600 MAIGUE_060	RWB	Poor Near	0.068	0.087	0.0	0.0000	0.068	
	IE_SH_24M010700 MAIGUE_070	RWB	Poor Far	0.070	0.087	8.3	0.0000	0.070	
	IE_SH_24M010900 MAIGUE_080	RWB	Poor Far	0.059	0.087	20.7	0.0000	0.059	
	IE_SH_24M010980 MAIGUE_090	RWB	Poor Far	0.061	0.087	36.9	0.0001	0.061	

Site Name (Code)	Contributing WB Code_Name	WB Type[12]	Ortho P Indicative Quality[13] and Trends[14]	Baseline [15] Ortho P Conc.[16] (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.[17] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[18]	Evaluation
Lower River Shannon SAC (002165) and River Shannon and River Fergus Estuaries SPA	IE_SH_24T240890 TONLEGEE_010	RWB	*Poor*	*0.077*	*0.087*	*0.0*	*0.0000*	*0.077*	The increase in modelled concentration is <5% High/Good indicative quality boundary. No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_24W060910 West Liskennett_010	RWB	*Poor*	*0.077*	*0.087*	*4.2*	*0.0002*	*0.077*	
	IE_SH_25M040100 MULKEAR (LIMERICK)_010	RWB	Good Near	0.047	0.051	19.3	0.0001	0.047	
			Good Far	0.034	0.051			0.034	
	IE_SH_25M040400 MULKEAR (LIMERICK)_040	RWB	*Moderate*	*0.046*	0.051	1.4	0.0000	0.046	
	IE_SH_060_0700 Maigue Estuary	TWB	High (S) Far	0.017	0.019	211.5	0.0004	0.017	
			Poor (W) Far	0.069	0.102			0.069	
	IE_SH_060_0800 Upper Shannon Estuary	TWB	High (S) Near	0.020	0.019	6051.7	0.0007	0.021	
			High (W) Far	0.011	0.019			0.012	

Site Name (Code)	Contributing WB Code_Name	WB Type[12]	Ortho P Indicative Quality[13] and Trends[14]	Baseline [15] Ortho P Conc.[16] (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.[17] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[18]	Evaluation
Lower River Shannon SAC (002165) and River Shannon and River Fergus Estuaries SPA	IE_SH_060_0900 Limerick Dock	TWB	High (S) Far	0.008	0.019	5737.7	0.0008	0.009	The increase in modelled concentration is <5% High/Good indicative quality boundary. No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			High (W) Far	0.012	0.019			0.013	
	IE_SH_060_0350 Foynes Harbour		*Good (S)*	*0.045*	*0.053*	*0.0*	*0.0000*	*0.045*	
			Good (W)	*0.045*	*0.053*			*0.045*	
	IE_SH_060_1100 Fergus Estuary	TWB	*Good (S)*	*0.042*	0.049	0.0	0.0000	0.042	
			Good (W)	*0.033*	0.036			0.033	
	IE_SH_060_0300 Lower Shannon Estuary	TWB	High (S) Far	0.012	0.020	6051.7	0.0001	0.012	
			Good (W) Far	0.025	0.036			0.025	
	IE_SH_060_0600 Deel Estuary	TWB	Good (S) Upwards Far	0.037	0.053	0.0	0.0000	0.037	
			Moderate (W) Upwards Far	0.065	0.090			0.065	

Site Name (Code)	Contributing WB Code_Name	WB Type[12]	Ortho P Indicative Quality[13] and Trends[14]	Baseline [15] Ortho P Conc.[16] (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.[17] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[18]	Evaluation
	IE_SH_060_0000 Mouth of the Shannon (HAs 23;27)	CWB	High (S) Far	*0.008*	*0.019*	*6051.7*	*0.0000*	*0.008*	The increase in modelled concentration is <5% High/Good indicative quality boundary. No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good (W)	*0.033*	*0.036*			*0.033*	
Lower River Shannon SAC (002165) and River Shannon and River Fergus Estuaries SPA	IE_SH_010_0000 Southwestern Atlantic Seaboard (HA 23)	CWB	*High (S)*	*0.013*	*0.019*	*6051.7*	*0.0000*	*0.013*	
			High (W)	*0.013*	*0.019*			*0.013*	
	IE_SH_G_009 Ardnacrusha	GWB	*Good*	*0.018*	*0.026*	*7.7*	*0.0022*	*0.020*	The increase in modelled concentration is >5% High/Good indicative quality boundary but the post dosing Ortho P concentration is modelled to be less than 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_G_010 Askeaton	GWB	*Good*	*0.018*	*0.026*	*4.1*	*0.0001*	*0.018*	The increase in modelled concentration is <5% High/Good indicative quality boundary. No risk of
	IE_SH_G_022 Ballingarry	GWB	*Good*	*0.018*	*0.026*	*1.7*	*0.0001*	*0.018*	

Site Name (Code)	Contributing WB Code_Name	WB Type[12]	Ortho P Indicative Quality[13] and Trends[14]	Baseline [15] Ortho P Conc.[16] (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.[17] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[18]	Evaluation
	IE_SH_G_036 Ballyneety	GWB	Good Upwards Far	0.015	*0.026*	*13.6*	*0.0008*	*0.015*	deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
Lower River Shannon SAC (002165) and River Shannon and River Fergus Estuaries SPA	IE_SH_G_052 Castleconnell	GWB	*Good*	*0.018*	*0.026*	*34.6*	*0.0058*	*0.023*	The increase in modelled concentration is >5% High/Good indicative quality boundary but the post dosing Ortho P concentration is modelled to be less than 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_G_070 Cratloe	GWB	*Good*	*0.018*	*0.026*	*12.0*	*0.0075*	*0.025*	
	IE_SH_G_084 Fedamore	GWB	Good Upwards Far	0.006	0.026	41.9	0.0008	0.007	The increase in modelled concentration is <5% High/Good indicative quality boundary. No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
			Good Upwards Far	0.008	0.026			0.009	

Site Name (Code)	Contributing WB Code_Name	WB Type[12]	Ortho P Indicative Quality[13] and Trends[14]	Baseline [15] Ortho P Conc.[16] (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.[17] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[18]	Evaluation
	IE_SH_G_106 Herbertstown	GWB	Good None Near	0.034	0.026	0.1	0.0000	0.034	The increase in modelled concentration is <5% High/Good indicative quality boundary. No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_G_107 Hospital	GWB	Good Upwards Far	0.009	0.026	0.1	0.0000	0.009	
	IE_SH_G_119 Kildimo	GWB	*Good*	*0.018*	*0.026*	*8.0*	*0.0012*	*0.019*	
	IE_SH_G_129 Knockroe East	GWB	Good Upwards Far	0.013	0.026	1.0	0.0003	0.013	
	IE_SH_G_130 Knockroe Northwest	GWB	*Good*	*0.018*	*0.026*	*0.5*	*0.0003*	*0.018*	
	IE_SH_G_131 Knockroe Southwest	GWB	*Good*	*0.018*	*0.026*	*0.0*	*0.0000*	*0.018*	
	IE_SH_G_133 Knockseefin-Longstone East	GWB	*Good*	*0.018*	*0.026*	*0.3*	*0.0002*	*0.018*	
	IE_SH_G_134 Knockseefin -Longstone West	GWB	*Good*	*0.018*	*0.026*	*0.0*	*0.0000*	*0.018*	
	IE_SH_G_138 Limerick City East	GWB	*Good*	*0.018*	*0.026*	*64.2*	*0.0066*	*0.024*	The increase in modelled concentration is >5% High/Good indicative quality boundary but the post dosing Ortho P concentration is modelled to be less than 75% of the upper indicative quality
	IE_SH_G_139 Limerick City North	GWB	*Good*	*0.018*	*0.026*	*21.6*	*0.0057*	*0.023*	

Site Name (Code)	Contributing WB Code_Name	WB Type[12]	Ortho P Indicative Quality[13] and Trends[14]	Baseline [15] Ortho P Conc.[16] (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.[17] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[18]	Evaluation
									threshold therefore there is no risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_G_140 Limerick City Northwest	GWB	*Good*	*0.018*	*0.026*	*21.6*	*0.0102*	*0.028*	IE_SH_G_140 Limerick City Northwest and IE_SH_G_141 Limerick City Southwest: the modelled increase in these inner city groundwater bodies does cause the modelled baseline to rise just above 75% of the orthophosphate indicative quality upper threshold. The 2016-2021 ecological assessment confirms that both these GWB are at Good Status, with "Impact of Groundwater on Surface Water Ecological/Chemical Status Test" also Good. The modelled increases in concentrations do not cause

Site Name (Code)	Contributing WB Code_Name	WB Type[12]	Ortho P Indicative Quality[13] and Trends[14]	Baseline [15] Ortho P Conc.[16] (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.[17] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[18]	Evaluation
	IE_SH_G_141 Limerick City Southwest	GWB	*Good*	*0.018*	*0.026*	*176.4*	*0.0098*	*0.027*	any failures in overlying surface waterbodies (see Table 4.A). The potential loads from groundwater within each river were calculated and converted to concentration, these are all well below the limit of detection for waterbodies. In addition, the contribution of GWB pathways due to dosing is less than 10% relative of the Potential baseline for all the surface waterbodies. Therefore the potential impact on surface waters is not significant.
	IE_SH_G_157 Lough Graney	GWB	*Good*	*0.018*	*0.026*	*1.6*	*0.0000*	*0.018*	The increase in modelled concentration is <5% High/Good indicative quality boundary. No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_G_176 GWDTE-Tory Hill Fen (SAC000439)	GWB	*Good*	*0.018*	*0.026*	*0.7*	*0.0001*	*0.018*	
	IE_SH_G_196 Pallas Grean	GWB	Good Upwards Near	0.018	0.026	18.8	0.0054	0.023	The increase in modelled concentration is >5% High/Good indicative quality boundary but the

Site Name (Code)	Contributing WB Code_Name	WB Type[12]	Ortho P Indicative Quality[13] and Trends[14]	Baseline [15] Ortho P Conc.[16] (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.[17] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[18]	Evaluation
									post dosing Ortho P concentration is modelled to be less than 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_G_197 Patrickswell	GWB	*Good*	*0.018*	*0.026*	*4.0*	*0.0006*	*0.018*	The increase in modelled concentration is <5% High/Good indicative quality boundary. No risk of deterioration in the Ortho P indicative quality or of preventing the achievement of WFD objectives.
	IE_SH_G_213 Slieve Phelim	GWB	Good Upwards Far	0.005	0.026	17.0	0.0003	0.005	
			Good Upwards Far	0.005	0.026			0.005	
	IE_SH_G_229 Tulla-Newmarket on Fergus	GWB	*Good*	*0.018*	*0.026*	*0.1*	*0.0000*	*0.018*	
	IE_SH_G_257 O'Briensbridge Gravels	GWB	*Good*	*0.018*	*0.026*	*3.2*	*0.0012*	*0.019*	
	IE_SH_G_260 Industrial Facility (P0650-02)	GWB	*Good*	*0.018*	*0.026*	*4.6*	*0.0043*	*0.022*	The increase in modelled concentration is >5% High/Good indicative quality boundary but the post dosing Ortho P concentration is modelled

Site Name (Code)	Contributing WB Code_Name	WB Type[12]	Ortho P Indicative Quality[13] and Trends[14]	Baseline [15] Ortho P Conc.[16] (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.[17] (mg/l)	Post-dosing Ortho P Potential Baseline Conc. (mg/l)[18]	Evaluation
									to be less than 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.

^ Effective Rainfall used to calculate concentration
‡ Load from WWTP / SWO following treatment included

5.3.2 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 5.2**). 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 5.2 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 5.3**, 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 5.2: 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*
Adare Primary Discharge	**1**	**Existing**	117.3	0.574	0.459	0.780
		Post Dosing	117.3	0.574	0.459	0.780
Caherconlish Primary Discharge	**1.5**	**Existing**	18.4	0.057	0.046	0.078
		Post Dosing	18.4	0.057	0.046	0.078
Caherconlish SWOs (2 no)	**n/a**	**Existing**	13.4	1.43	1.15	1.95
		Post Dosing	17.7	1.89	1.51	2.57
Castletroy Primary Discharge	**1**	**Existing**	961.0	0.171	0.137	0.233
		Post Dosing	961.0	0.171	0.137	0.233

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*
Castletroy SWOs (5 no)	**n/a**	**Existing**	215.3	1.32	1.05	1.79
		Post Dosing	325.8	1.99	1.60	2.71
Croom Primary Discharge	**1.5**	**Existing**	88.3	0.410	0.328	0.557
		Post Dosing	88.3	0.410	0.328	0.557
Croom SWOs (2 no)	**n/a**	**Existing**	6.1	0.98	0.78	1.33
		Post Dosing	10.9	1.73	1.38	2.35
Limerick (Bunlicky) Primary Discharge	**6.5**	**Existing**	33,064.3	0.852	0.682	1.159
		Post Dosing	43,410.6	1.119	0.895	1.522
Limerick (Bunlicky) SWOs (26 no)	**n/a**	**Existing**	3,106.6	2.75	2.20	3.74
		Post Dosing	3,407.9	3.02	2.41	4.10
Pallasgreen Primary Discharge	**1**	**Existing**	33.5	0.127	0.102	0.173
		Post Dosing	33.5	0.127	0.102	0.173
Pallasgreen SWOs (1 no)	**n/a**	**Existing**	9.8	1.27	1.02	1.73
		Post Dosing	10.7	1.40	1.12	1.91

Note: The effluent concentrations are compliant with ELVs based on the latest AER reporting
As Adare (D0312), Caherconlish (D0308), Castletroy (D0019), Croom (D0307) WWTP's Name (code) receives tertiary treatment, i.e. chemical dosing for nutrient removal, the EAM assumes that the additional P loading to the plant can be dealt with and managed within the treatment process therefore there is no impact on the existing effluent quality.
For Limerick (Bunlicky (D0013) secondary treatment only is available and it is assumed that the additional load from orthophosphate dosing is not removed in the treatment process but rather is added to the existing effluent loads.

Table 5.3: 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
Adare (D0312)	IE_SH_060_0700	0.0840	0.0841	0.0841	0.0
Caherconlish (D0308)	IE_SH_25G050200	0.0693	0.0705	0.0711	0.8
Castletroy (D0019)	IE_SH_25S012600	0.0134	0.0242	0.0253	4.5
Croom (D0307)	IE_SH_24M010900	0.0702	0.0703	0.0703	0.0
Limerick (Bunlicky) (D0013)	IE_SH_060_0900	0.0295	0.0318	0.0325	2.2
Pallasgreen (D0503)	IE_SH_25M040100	0.0470	0.0471	0.0471	0.0

* No P status assigned, surrogate status given.

Adare Agglomeration

Adare agglomeration discharges into Maigue Estuary (IE_SH_060_0700) which is hydrologically connected to Lower River Shannon SAC and River Shannon and River Fergus Estuaries 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. Adare 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 undetectable (0.0 %) (**Table 5.3**). Therefore, there is no risk of failing to achieve WFD objectives for the Maigue Estuary (IE_SH_060_0700) , and its hydrologically connected European Sites as a result of dosing at Charleville WTP.

Caherconlish Agglomeration

Caherconlish agglomeration discharges into Groody_010 (IE_SH_25G050200) which is hydrologically connected to the Lower River Shannon SAC and River Shannon and River Fergus Estuaries 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. Caherconlish 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 (0.8%) (**Table 5.3**). Therefore, there is no risk of failing to achieve WFD objectives for the Groody_010 (IE_SH_25G050200) , and its hydrologically connected European Sites as a result of dosing at Charleville WTP.

Castletroy Agglomeration

Castletroy agglomeration discharges to Shannon (Lower)_060 (IE_SH_25S012600) which is hydrologically connected to the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA. The modelled effluent concentrations for both existing and post-dosing scenarios are compliant with the orthophosphate ELVs set in WWDL in the 2020 AER. Castletroy 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 (0.1 %) (**Table 5.3**). Therefore, there is no risk of failing to achieve WFD objectives for the Shannon (Lower)_060 (IE_SH_25S012600) and its hydrologically connected European Sites as a result of dosing at Charleville WTP.

Croom Agglomeration

Croom agglomeration discharges to Maigue_080 (IE_SH_24M010900) which is hydrologically connected to the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA. The modelled effluent concentrations for both existing and post-dosing scenarios are compliant with the orthophosphate ELVs set in WWDL in the 2021 AER. Croom 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 undetectable (0.0 %) (**Table 5.3**). Therefore, there is no risk of failing to achieve WFD objectives for the Shannon (Lower)_060 (IE_SH_25S012600) and its hydrologically connected European Sites as a result of dosing at Charleville WTP.

Limerick Agglomeration

Limerick agglomeration discharges to Limerick Dock (IE_SH_060_0900) which is hydrologically connected to the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA. The modelled effluent concentrations for both existing and post-dosing scenarios are compliant with the orthophosphate ELVs set in WWDL in the 2021 AER. For Limerick agglomeration secondary treatment only is available and it is assumed that the additional load from orthophosphate dosing is not removed in the treatment process but rather is added to the existing effluent loads. When mean flows are taken into account the increase in the receiving water is no significant (1.8%) (**Table 5.3**) and will not result in a risk to the WFD indicative quality. Therefore, there is no risk of failing to achieve WFD objectives for the Limerick Dock (IE_SH_060_0900) and its hydrologically connected European Sites as a result of dosing at Charleville WTP.

Pallasgreen Agglomeration

Pallasgreen agglomeration discharges to Mulkear (Limerick)_010 (IE_SH_25M040100) which is hydrologically connected to the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA. The modelled effluent concentrations for both existing and post-dosing scenarios are compliant with the orthophosphate ELVs set in WWDL in the 2021 AER. Pallasgreen 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 undetectable (0.0 %) (**Table 5.3**). Therefore, there is no risk of failing to achieve WFD objectives for the Shannon (Lower)_060 (IE_SH_25S012600) and its hydrologically connected European Sites as a result of dosing at Charleville WTP.

5.3.3 Assessment of Indirect Impact from subsurface flow

5.3.3.1 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 increases in concentrations in the subsurface pathways are insignificant (i.e. less than 0.00125 mg/l which is 5% of the Good/High boundary for Orthophosphate indicative quality in surface water bodies) for all river water bodies, except in IE_SH_24B040800 BALLYNACLOGH_010, IE_SH_24B050600 BARNAKYLE_020, IE_SH_24M440880 Mondellihy_010, IE_SH_24N150630 EAST CARRIG_010, IE_SH_25N170970 North Ballycannan_010, and IE_SH_27C090600 CROMPAUN (EAST)_010. However, for all of the waterbodies, the modelled increase in concentration does not cause the baseline to rise above 75% of the orthophosphate indicative quality upper threshold. The highest increase equal to 0.0050 mg/l, taking place in Ballynaclogh_010 (IE_SH_24B040800).

Increases in transitional waterbodies has been predicted to be either insignificant or undetectable.

5.3.3.2 Groundwater Assessment

Table 3 of **Appendix C** outlines the predicted loads and concentrations to GWBs connected to the WSZ. The predicted increases in concentration of orthophosphate in groundwater bodies are insignificant (i.e. <0.00175 mg/l which is 5% of the Good/Failing to achieve good boundary for Orthophosphate indicative quality in ground water bodies) except in the following cases:

IE_SH_G_009 Ardnacrusha, IE_SH_G_052 Castleconnell, IE_SH_G_070 Cratloe, IE_SH_G_138 Limerick City East, IE_SH_G_139 Limerick City North and IE_SH_G_260 Industrial Facility (P0650-02): the modelled increase does not cause the baseline concentration to rise above 75% of the orthophosphate indicative quality upper threshold.

IE_SH_G_140 Limerick City Northwest and IE_SH_G_141 Limerick City Southwest: the modelled increase in these inner city groundwater bodies does cause the modelled baseline to rise just above 75% of the orthophosphate indicative quality upper threshold. The 2016-2021 ecological assessment confirms that both these GWB are at Good Status, with "Impact of Groundwater on Surface Water Ecological/Chemical Status Test" also Good. The modelled increases in concentrations do not cause any failures in overlying surface waterbodies (see Table 4.A). The potential loads from groundwater within each river were calculated and converted to concentration, these are all well below the limit of detection for waterbodies. In addition, the contribution of GWB pathways due to dosing is less than 10% relative of the Potential baseline for all the surface waterbodies. Therefore the potential impact on surface waters is not significant.

The subsurface assessment takes into account the groundwater/surface water interaction and as the potential for impact on surface water is insignificant, there is no risk of impact on groundwater receptors due to orthophosphate dosing.

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.

5.3.3.3 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 Clareville WTP.

The increases in concentrations due to orthophosphate dosing are predicted to be insignificant (i.e. ≤0.00125, 5% of the Good / High boundary for Orthophosphate Indicative Quality), except in the following cases: Ballynaclogh_010 (IE_SH_24B040800), Barnakyle_020 (IE_SH_24B050600), Mondellihy_010 (IE_SH_24M440880), East Carrig_010 (IE_SH_24N150630), Groody_010 (IE_SH_25G050200), North Ballycannan_010 (IE_SH_25N170970), and Crompaun (East)_010 (IE_SH_27C090600). In all of these waterbodies the concentration will not exceed the 75% upper threshold, hence there is no risk of failing WFD objectives. Therefore dosing will not pose a risk of deterioration in indicative quality of the river water bodies identified in **Table 5.1**.

Table 4.A of Appendix C provides details of the combined orthophosphate inputs to river water bodies from direct discharges, DWWTSs and leakage loads.

5.3.4 Cumulative Impact Assessment

The cumulative impacts on the Shannon Catchments (HAs 24, 25, 26, and 27) associated with the corrective water treatment at the following additional WTPs have been assessed in combination with Clareville WTP.

- 012 Tuam WTP – Tuam RWSS
- 013 Portloman WTP – Ardonagh Reservoir
- 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
- 032 Dromin WTP - Listowel Regional Water Supply
- 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

The common water bodies that are impacted by the WSZs supplied by these WTPs have been summarised in Table 5 6 below.

Following dosing, the additional ortho P concentration in five surface waterbodies exceed the 5% Good/High indicative quality threshold (i.e. >0.00125mg/l). These are; BARNAKYLE_020 (IE_SH_24B050600), GROODY_010 (IE_SH_25G050200), North Ballycannan_010 (IE_SH_25N170970), CRATLOE_010 (IE_SH_27C080300) and CROMPAUN (EAST)_010 (IE_SH_27C090600). For these 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.

Table 5.4: 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_24B050600 BARNAKYLE_020	RWB	Good Far	0.025	0.033	154.4	0.0070	0.032‡
IE_SH_25B060250 BLACKWATER (CLARE)_020	RWB	Good Far	0.031	0.033	3.8	0.0001	0.031‡
IE_SH_25G050200 GROODY_010	RWB	Poor Far	0.069	0.087	30.8	0.0014	0.071‡
		Poor Far	0.068	0.087			0.069‡
IE_SH_25K020150 KILLEENGARRIFF_010	RWB	*Good*	*0.030*	*0.033*	*31.7*	*0.0002*	*0.030*
IE_SH_25M040200 MULKEAR (LIMERICK)_020	RWB	*Moderate*	*0.046*	*0.051*	*100.2*	*0.0003*	*0.046‡*
IE_SH_25M040590 MULKEAR (LIMERICK)_050	RWB	Good Far	0.028	0.033	143.2	0.0003	0.028
IE_SH_25N170970 North Ballycannan_010	RWB	Good Far	0.026	0.033	62.7	0.0047	0.031‡
IE_SH_25S012500 SHANNON (LOWER)_050	RWB	High Far	0.012	0.019	1249.2	0.0002	0.012
IE_SH_25S012600 SHANNON (LOWER)_060	RWB	High Far	0.013	0.019	1641.7	0.0002	0.014‡
		Good Far	0.030	0.033			0.030
		High Far	0.014	0.019			0.014‡
		High Far	0.010	0.019			0.010
		High Near	0.018	0.019			0.018
IE_SH_27C080300 CRATLOE_010	RWB	*Moderate*	*0.046*	*0.051*	*7.5*	*0.0013*	*0.047*

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_27C090600 CROMPAUN (EAST)_010	RWB	*Poor*	*0.077*	*0.087*	*21.2*	*0.0016*	*0.078*
IE_SH_24B080900 BALLYNAMONA_010	RWB	*Poor*	*0.077*	*0.087*	*1.0*	*0.0000*	*0.077*
IE_SH_24C010600 CAMOGE_030	RWB	Poor Far	0.071	0.087	27.9	0.0002	0.071
IE_SH_24C030900 CLONSHIRE_040	RWB	*Poor*	*0.077*	*0.087*	*37.0*	*0.0012*	*0.078*
IE_SH_24G050600 GREANAGH_010	RWB	*Poor*	*0.077*	*0.087*	*42.0*	*0.0011*	*0.078*
IE_SH_24M010600 MAIGUE_060	RWB	Poor Near	0.068	0.087	12.8	0.0000	0.068
IE_SH_24M010700 MAIGUE_070	RWB	Poor Far	0.070	0.087	53.4	0.0001	0.070
IE_SH_24M010900 MAIGUE_080	RWB	Poor Far	0.059	0.087	74.8	0.0001	0.060‡
IE_SH_24M010980 MAIGUE_090	RWB	Poor Far	0.061	0.087	91.2	0.0002	0.061‡
IE_SH_24W060910 West Liskennett_010	RWB	*Poor*	*0.077*	*0.087*	*10.1*	*0.0004*	*0.077‡*
IE_SH_25M040100 MULKEAR (LIMERICK)_010	RWB	Good Near	0.047	0.051	83.3	0.0003	0.047‡
		Good Far	0.034	0.051			0.034
IE_SH_25M040400 MULKEAR (LIMERICK)_040	RWB	*Moderate*	*0.046*	*0.051*	*101.6*	*0.0003*	*0.046*
IE_SH_060_0700 Maigue Estuary	TWB	High (S) Far	0.017	0.019	337.1	0.0010	0.018‡
		Poor (W) Far	0.069	0.102			0.070
IE_SH_060_0800 Upper Shannon Estuary	TWB	High (S) Near	0.020	0.019	8287.5	0.0010	0.021‡
		High (W) Far	0.011	0.036			0.012

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_060_0900 Limerick Dock	TWB	High (S) Far	0.008	0.019	7089.5	0.0009	0.009‡
		High (W) Far	0.012	0.019			0.013
IE_SH_060_0350 Foynes Harbour	TWB	*Good (S)*	0.042	0.049	1333.5	0.0001	0.042
		Good (W)	0.033	0.036			0.033
IE_SH_060_1100 Fergus Estuary	TWB	*Good (S)*	0.012	0.020	9883.5	0.0001	0.012‡
		Good (W)	0.025	0.036			0.025
IE_SH_060_0300 Lower Shannon Estuary	TWB	High (S) Far	0.037	0.053	119.4	0.0002	0.037
		Good (W) Far	0.065	0.090			0.065
IE_SH_060_0600 Deel Estuary	TWB	Good (S) Upwards Far	0.008	0.019	10774.6	0.0001	0.008‡
		Moderate (W) Upwards Far	*0.033*	*0.036*			*0.033*
IE_SH_060_0000 Mouth of the Shannon (HAs 23;27)	CWB	High (S) Far	*0.013*	*0.019*	*11018.9*	*0.0000*	*0.013*‡
		Good (W)	*0.013*	*0.019*			*0.013*

‡ Load from WWTP / SWO following treatment included

The baseline concentration for the following river water bodies; SHANNON (LOWER)_060 (IE_SH_25S012600), MAIGUE_060 (IE_SH_24M010600), MULKEAR (LIMERICK)_010 (IE_SH_25M040100) and the baseline concentrations for the following transitional water body; Upper Shannon Estuary IE_SH_060_0800 (summer) 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. Therefore, dosing will not cause a

deterioration in the orthophosphate indicative quality or prevent the achievement of the WFD objectives of the water bodies.

5.3.5 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. As outlined in Section5.3.3.2 5.3.3.2 the subsurface assessment takes into account the groundwater/surface water interaction and as the potential for impact on surface water is insignificant, there is no risk of impact on groundwater receptors due to orthophosphate dosing.

In the case of combined orthophosphate inputs to surface water bodies from direct discharges, DWWTSs and leakage loads, the predicted increase in concentration for all waterbodies will not exceed the 75% upper threshold, hence there is no risk of failing WFD objectives.

The cumulative assessment of dosing at Charleville 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

There is no construction works proposed as part of the proposed projects. The equipment and services required for dosing are already present in Charleville 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 Lower River Shannon SAC 002165

6.2.1.1 (1029) Freshwater Pearl Mussel (*Margaritifera margaritifera*)

The population of the Freshwater pearl mussel in this SAC lies within the Cloon River, Co. Clare only. The Cloon population is confined to the main channel and is distributed from Croany Bridge to approx. 1.5km upstream of Clonderalaw Bridge. The Environmental Quality Ratios for the water quality parameters monitored within Freshwater pearl mussel catchments correspond to high ecological status. Orthophosphate specific targets are not defined in the SSCOs (NPWS, 2012). Nevertheless, the Freshwater pearl mussel requires High Status conditions. The Surface Water Regulations (2009) set a limit of ≤0.025 (mean) or ≤0.045 (95%ile) for Molybdate Reactive Phosphorus (MRP) (mg P/l) for High Status waters. The habitat in the Cloon failed both standards during 2009 sampling undertaken to inform the preparation of the sub-basin management plan for this site.

The location of Freshwater pearl mussel populations in the SAC are not connected to the water bodies identified in **Table 5.1.** In the absence of pathways for impacts, there will be no likely significant effects on the conservation status of this Annex II species due to dosing at Charleville WTP.

In terms of the potential for impact to Atlantic salmon, which are host to the larval stage of the Freshwater pearl mussel (glochidia), please see **Section 6.2.1.2** below.

6.2.1.2 (1095) Sea Lamprey (*Petromyzon marinus*), (1096) Brook Lamprey (*Lampetra planeri*), (1099) River Lamprey (*Lampetra fluviatilis*) and (1106) Salmon (*Salmo salar*) (in fresh water)

Artificial barriers can block or cause difficulties to the upstream migration of lamprey species and Atlantic salmon; thereby limiting the species to lower stretches and restricting access to spawning areas. Specific barriers serve to constrain the up-river migration of lamprey species in the Lower River Shannon SAC. The upper extent of the SAC boundary in the River Fergus is delineated by a barrier to migration. For salmon, the large hydro-electric station at Ardnacrusha and the Parteen regulating weir present considerable obstructions to upstream passage of salmon on the Shannon main channel. While both have fish passes installed, upstream migration of salmon is still problematical[21]. No

obstacles causing significant fish passage issues for salmon are present on the Feale and Mulkear rivers; however, barriers for lamprey migration are present.

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[19]) highlights the deterioration in water quality and ongoing point and diffuse sources of pollution as a key threat to these species and includes the potential effects from municipal discharges. The SSCO (NPWS, 2012[20]) states that lampreys and salmon spawn in clean gravels. 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. The SSCO for salmon also requires a Q-value of at least 4, which equates to good ecological status.

Error! Reference source not found. and Error! Reference source not found. identifies the surface and gr oundwater bodies which are hydrologically or hydrogeologically connected to the Lower River Shannon SAC and will receive inputs from the proposed orthophosphate dosing at Charleville WTP:

- The river water bodies hydrologically connected to the site include: BALLYNACLOGH_010 (IE_SH_24B040800), BARNAKYLE_020 (IE_SH_24B050600), Mondellihy_010 (IE_SH_24M440880), EAST CARRIG_010 (IE_SH_24N150630), BLACKWATER (CLARE)_020 (IE_SH_25B060250), BALLYARD_020 (IE_SH_25B770990), GROODY_010 (IE_SH_25G050200), KILLEENGARRIFF_010 (IE_SH_25K020150), MULKEAR (LIMERICK)_020 (IE_SH_25M040200), MULKEAR (LIMERICK)_050 (IE_SH_25M040590), North Ballycannan_010 (IE_SH_25N170970), SHANNON (LOWER)_050 (IE_SH_25S012500), SHANNON (LOWER)_060 (IE_SH_25S012600), WHITEHALL_010 (IE_SH_25W210770), CRATLOE_010 (IE_SH_27C080300), CROMPAUN (EAST)_010 (IE_SH_27C090600), BARNAKYLE_010 (IE_SH_24B050300), BALLYNAMONA_010 (IE_SH_24B080900), CAMOGE_030, (IE_SH_24C010600), CLONSHIRE_040 (IE_SH_24C030900), GREANAGH_010 (IE_SH_24G050600), KILMOREEN_010 (IE_SH_24K620500) MAIGUE_060 (IE_SH_24M010600), MAIGUE_070 (IE_SH_24M010700) MAIGUE_080 (IE_SH_24M010900), MAIGUE_090 (IE_SH_24M010980), TONLEGEE_010 (IE_SH_24T240890), West Liskennett_010 (IE_SH_24W060910), MULKEAR (LIMERICK)_010 (IE_SH_25M040100), MULKEAR (LIMERICK)_040 (IE_SH_25M040400);
- The groundwater bodies hydrogeologically connected to the site include: Ardnacrusha (IE_SH_G_009) Askeaton (IE_SH_G_010), Ballingarry (IE_SH_G_022) Ballyneety (IE_SH_G_036) Castleconnell (IE_SH_G_052), Cratloe (IE_SH_G_070), Fedamore (IE_SH_G_084), Herbertstown (IE_SH_G_106), Hospital (IE_SH_G_107), Kildimo (IE_SH_G_119), Knockroe East (IE_SH_G_129), Knockroe Northwest (IE_SH_G_130), Knockroe Southwest (IE_SH_G_131), Knockseefin-Longstone East (IE_SH_G_133), Knockseefin - Longstone West (IE_SH_G_134), Limerick City East (IE_SH_G_138), Limerick City North (IE_SH_G_139), Limerick City Northwest (IE_SH_G_140), Limerick City Southwest (IE_SH_G_141), Lough Graney (IE_SH_G_157), Pallas Grean (IE_SH_G_196), Patrickswell (IE_SH_G_197), Slieve Phelim (IE_SH_G_213), Tulla-Newmarket on Fergus (IE_SH_G_229), O'Briensbridge Gravels (IE_SH_G_257) and Industrial Facility (P0650-02) IE_SH_G_260;

[19] 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.

[20] NPWS 2012 Lower River Shannon SAC 002165 Conservation Objectives

- The transitional water bodies hydrologically connected to the SAC include: Maigue Estuary (IE_SH_060_0700), Upper Shannon Estuary (IE_SH_060_0800), Limerick Dock (IE_SH_060_0900), Foynes Harbour (IE_SH_060_0350), the Fergus Estuary (IE_SH_060_1100), Lower Shannon Estuary (IE_SH_060_0300), Deel Estuary (IE_SH_060_0600), Mouth of the Shannon (HAs 23;27) (IE_SH_060_0000) and Southwestern Atlantic Seaboard (HA 23) (IE_SH_010_0000).

The potential impacts of orthophosphate dosing at Clareville WTP are assessed in the context of brook lamprey; river lamprey; and Atlantic salmon occurring in all river water bodies, and for sea lamprey to occur in all river; transitional and coastal water bodies identified in **Table 5.1**.

The EAM has assessed the potential for impact on orthophosphate indicative quality and has based this assessment on a conservative basis using all available flow data. Full details of the assessment results are provided in **Appendix C** and discussed above in **Section 5**.

The modelled additional orthophosphate concentrations for the majority of the river water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) therefore there is no risk of deterioration of the current orthophosphate indicative quality of these river water bodies, or of preventing the achievement of WFD objectives.

The increases in concentrations due to orthophosphate dosing are predicted to be insignificant (i.e. ≤0.00125), except in the following cases: Ballynaclogh_010 (IE_SH_24B040800), Barnakyle_020 (IE_SH_24B050600), Mondellihy_010 (IE_SH_24M440880), East Carrig_010 (IE_SH_24N150630), Groody_010 (IE_SH_25G050200), North Ballycannan_010 (IE_SH_25N170970), and Crompaun (East)_010 (IE_SH_27C090600). In all of these waterbodies the concentration will not exceed the 75% upper threshold, hence there is no risk of failing WFD objectives.

The modelled additional orthophosphate concentrations for the transitional and coastal water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) with some water bodies having an undetectable (0.0000 mg/l) modelled additional increases in concentration, therefore, dosing does not pose a risk of deterioration in the Good and High indicative quality of these water bodies.

The predicted increases in concentration of orthophosphate in groundwater bodies are insignificant (i.e. <0.00175 mg/l which is 5% of the Good/Failing to achieve good boundary for Orthophosphate indicative quality in ground water bodies) except in the following cases:

IE_SH_G_009 Ardnacrusha, IE_SH_G_052 Castleconnell, IE_SH_G_070 Cratloe, IE_SH_G_138 Limerick City East, IE_SH_G_139 Limerick City North and IE_SH_G_260 Industrial Facility (P0650-02): the modelled increase does not cause the baseline concentration to rise above 75% of the orthophosphate indicative quality upper threshold.

IE_SH_G_140 Limerick City Northwest and IE_SH_G_141 Limerick City Southwest: the modelled increase in these inner city groundwater bodies does cause the modelled baseline to rise just above 75% of the orthophosphate indicative quality upper threshold. The 2016-2021 ecological assessment confirms that both these GWB are at Good Status, with “Impact of Groundwater on Surface Water Ecological/Chemical Status Test” also Good. The modelled increases in concentrations do not cause any failures in overlying surface waterbodies (see Table 4.A). The potential loads from groundwater within each river were calculated and converted to concentration, these are all well below the limit of detection for waterbodies. In addition, the contribution of GWB pathways due to dosing is less than

10% relative of the Potential baseline for all the surface waterbodies. Therefore the potential impact on surface waters is not significant.

The subsurface assessment takes into account the groundwater/surface water interaction and as the potential for impact on surface water is insignificant, there is no risk of impact on groundwater receptors due to orthophosphate dosing. 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.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Clareville 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.

6.2.1.3 (1110) Sandbanks which are slightly covered by sea water all the times, (1130) Estuaries, (1140) Mudflats and sandflats not covered by seawater at low tide

The habitat area of sandbanks in this SAC is estimated at 1.353 ha and are located within the coastal water body Mouth of the Shannon (HAs 23;27) (IE_SH_060_0000) in the area from Kerry Head to Beal Head.

The extent of habitat area for estuaries in this SAC is estimated as 24,273 ha, as defined by Water Framework Transitional water body delineation. The habitat extends from Limerick Dock on the eastern side of the site, to almost Kilrush on the western side of the site. The habitat also encompasses the Annex I habitat 'Mudflats and sandflats not covered by seawater at low tide'.

The habitat area within this site for mudflats and sandflats not covered by seawater at low tide is 8,808 ha. Both the Fergus and inner Shannon estuaries feature vast expanses of intertidal mudflats, often fringed with saltmarsh vegetation. The smaller estuaries also feature mudflats.

Annex I habitat structure and function, and the extent and quality of all habitats varies considerably in space and time; marine habitats are particularly prone to such variation. Anthropogenic disturbance may be considered significant when it causes a change in biotic and/or abiotic variables in excess of what could reasonably be envisaged under natural processes. A target for these habitats states that proposed activities or operations that cause significant disturbance to the community but may not necessarily represent a continuous or ongoing source of disturbance over time and space may be assessed in a context-specific manner, giving due consideration to the proposed nature and scale of activities during the reporting cycle and the particular resilience of the receiving habitat in combination with other activities within the designated site (NPWS, 2012[20]).

Table 5.1 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to the Lower River Shannon SAC and will receive inputs from the proposed orthophosphate dosing at Clareville WTP, these have also been listed in **Section 6.2.1.2**.

The EAM has assessed the potential for impact on orthophosphate indicative quality and has based this assessment on a conservative basis using all available flow data. Full details of the assessment results are provided in **Appendix C** and discussed above in **Section 5**.

The modelled additional orthophosphate concentrations for the majority of the river water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) therefore there is no risk of deterioration of the current orthophosphate indicative quality of these river water bodies, or of preventing the achievement of WFD objectives.

The increases in concentrations due to orthophosphate dosing are predicted to be insignificant (i.e. ≤0.00125), except in the following cases: Ballynaclogh_010 (IE_SH_24B040800), Barnakyle_020 (IE_SH_24B050600), Mondellihy_010 (IE_SH_24M440880), East Carrig_010 (IE_SH_24N150630), Groody_010 (IE_SH_25G050200), North Ballycannan_010 (IE_SH_25N170970), and Crompaun (East)_010 (IE_SH_27C090600). In all of these waterbodies the concentration will not exceed the 75% upper threshold, hence there is no risk of failing WFD objectives.

The modelled additional orthophosphate concentrations for the transitional and coastal water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) with some water bodies having an undetectable (0.0000 mg/l) modelled additional increases in concentration, therefore, dosing does not pose a risk of deterioration in the Good and High indicative quality of these water bodies.

The predicted increases in concentration of orthophosphate in groundwater bodies are insignificant (i.e. <0.00175 mg/l which is 5% of the Good/Failing to achieve good boundary for Orthophosphate indicative quality in ground water bodies) except in the following cases:

IE_SH_G_009 Ardnacrusha, IE_SH_G_052 Castleconnell, IE_SH_G_070 Cratloe, IE_SH_G_138 Limerick City East, IE_SH_G_139 Limerick City North and IE_SH_G_260 Industrial Facility (P0650-02): the modelled increase does not cause the baseline concentration to rise above 75% of the orthophosphate indicative quality upper threshold.

IE_SH_G_140 Limerick City Northwest and IE_SH_G_141 Limerick City Southwest: the modelled increase in these inner city groundwater bodies does cause the modelled baseline to rise just above 75% of the orthophosphate indicative quality upper threshold. The 2016-2021 ecological assessment confirms that both these GWB are at Good Status, with “Impact of Groundwater on Surface Water Ecological/Chemical Status Test” also Good. The modelled increases in concentrations do not cause any failures in overlying surface waterbodies (see Table 4.A). The potential loads from groundwater within each river were calculated and converted to concentration, these are all well below the limit of detection for waterbodies. In addition, the contribution of GWB pathways due to dosing is less than 10% relative of the Potential baseline for all the surface waterbodies. Therefore the potential impact on surface waters is not significant.

The subsurface assessment takes into account the groundwater/surface water interaction and as the potential for impact on surface water is insignificant, there is no risk of impact on groundwater receptors due to orthophosphate dosing. 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.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Clareville 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.

6.2.1.4 (1150) Coastal Lagoons

"Coastal lagoons" is a priority habitat in Annex I of the Habitats Directive. A coastal lagoon is a lake or pond that is fully or partially separated from the sea by a permeable barrier that can be entirely natural such as shingle or can be an artificial embankment. Salinity varies depending on such factors such as freshwater inputs and barrier permeability. There are four coastal lagoons – Quayfield and Poulaweala Loughs, Shannon Airport lagoon, Scattery Lagoon and Cloonconeen Pool, located within this site. Quayfield and Poulaweala Loughs lie in Co. Limerick (NPWS 2012[20]).

Shannon Airport lagoon lies south east to the WSZ boundary, between the Fergus and Upper Shannon Estuary. The lagoon constitutes a small (2ha) artificial lagoon with a sluiced inlet, formed behind a coastal embankment (artificial). There has been considerable debate and controversy in relation to this lagoon, and the possible safety threat of waterbirds colliding with aircraft. When visited briefly in 1996, salinity measured 13psu and water depth was approximately 1m, but when sampled in 2002, a large part of the lagoon was dry and salinity measured 0psu[21].

Scattery Island lagoon is situated on Scattery Island in the Mouth of the Shannon coastal water body, 2.5km southwest of Kilrush, Co. Clare. The lagoon is a small (10ha), shallow, "estuarine" natural sedimentary lagoon with a cobble/shingle barrier. A relatively large natural inlet allows most tides to enter through the barrier, and salinity is generally high, ranging from 29-32psu at the time of sampling (18-21/9/03).

Cloonconeen Pool lies in the Shannon Estuary, just west of Kilcredaun Point, 2km southwest of Carrigaholt. It is a small (7ha) natural sedimentary lagoon with a cobble barrier in an area of partially cut peat bog which has become flooded by seawater. Salinity was high at the time of sampling (9-10/8/96[21]) and ranged from 32-34psu in the main pool but is probably less for much of the time. There is a drowned forest of pine, some 4,000 years old on the beach. Further offshore is another barrier of rock, which possibly represents the position of a former complete barrier, enclosing a larger lagoon. The lagoon and cobble barrier, together with the drowned forest, is of great geomorphological interest.

Structure and functions relate to the physical components of a habitat ("structure") and the ecological processes that drive it ("functions"). For lagoons these include attributes such as salinity, hydrology and various water quality attributes. Lagoons can vary considerably in salinity both within and between sites depending on the volume and timing of inflowing and outflowing fresh and seawater. Salinity is probably the most important variable in the classification of lagoon types (Roden and Oliver, 2010[21]). All the lagoons identified within the Lower River Shannon SAC can be classified as shallow, thus even small changes in water depth can cause significant losses in habitat area.

In the COs supporting document for coastal lagoons for the site[21], the target for the attribute water quality- Molybdate Reactive Phosphorus (MRP) is: annual median MRP within natural ranges and less than 0.1mg/L. The target is based on Roden and Oliver (2010[22]). This limit is required to ensure that excessive shading from phytoplankton does not reduce submergent colonisation of the littoral zone.

[21] NPWS 2012 Lower River Shannon SAC (site code 2165) Conservation objectives supporting document - Lagoons

[22] Roden, C.M. and Oliver, G. 2010. Monitoring and assessment of Irish Lagoons for the purpose of the EU Water Framework Directive.

Table 5.1 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to the Lower River Shannon SAC and will receive inputs from the proposed orthophosphate dosing at Clareville WTP these have also been listed in **Section 6.2.1.2**.

The EAM has assessed the potential for impact on orthophosphate indicative quality and has based this assessment on a conservative basis using all available flow data. Full details of the assessment results are provided in **Appendix C** and discussed above in **Section 5**.

The modelled additional orthophosphate concentrations for the majority of the river water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) therefore there is no risk of deterioration of the current orthophosphate indicative quality of these river water bodies, or of preventing the achievement of WFD objectives.

The increases in concentrations due to orthophosphate dosing are predicted to be insignificant (i.e. ≤0.00125), except in the following cases: Ballynaclogh_010 (IE_SH_24B040800), Barnakyle_020 (IE_SH_24B050600), Mondellihy_010 (IE_SH_24M440880), East Carrig_010 (IE_SH_24N150630), Groody_010 (IE_SH_25G050200), North Ballycannan_010 (IE_SH_25N170970), and Crompaun (East)_010 (IE_SH_27C090600). In all of these waterbodies the concentration will not exceed the 75% upper threshold, hence there is no risk of failing WFD objectives.

The modelled additional orthophosphate concentrations for the transitional and coastal water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) with some water bodies having an undetectable (0.0000 mg/l) modelled increases in concentration, therefore, dosing does not pose a risk of deterioration in the Good and High indicative quality of these water bodies.

The predicted increases in concentration of orthophosphate in groundwater bodies are insignificant (i.e. <0.00175 mg/l which is 5% of the Good/Failing to achieve good boundary for Orthophosphate indicative quality in ground water bodies) except in the following cases:

IE_SH_G_009 Ardnacrusha, IE_SH_G_052 Castleconnell, IE_SH_G_070 Cratloe, IE_SH_G_138 Limerick City East, IE_SH_G_139 Limerick City North and IE_SH_G_260 Industrial Facility (P0650-02): the modelled increase does not cause the baseline concentration to rise above 75% of the orthophosphate indicative quality upper threshold.

IE_SH_G_140 Limerick City Northwest and IE_SH_G_141 Limerick City Southwest: the modelled increase in these inner city groundwater bodies does cause the modelled baseline to rise just above 75% of the orthophosphate indicative quality upper threshold. The 2016-2021 ecological assessment confirms that both these GWB are at Good Status, with “Impact of Groundwater on Surface Water Ecological/Chemical Status Test” also Good. The modelled increases in concentrations do not cause any failures in overlying surface waterbodies (see Table 4.A). The potential loads from groundwater within each river were calculated and converted to concentration, these are all well below the limit of detection for waterbodies. In addition, the contribution of GWB pathways due to dosing is less than 10% relative of the Potential baseline for all the surface waterbodies. Therefore the potential impact on surface waters is not significant.

The subsurface assessment takes into account the groundwater/surface water interaction and as the potential for impact on surface water is insignificant, there is no risk of impact on groundwater receptors due to orthophosphate dosing. 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.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Clareville 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.

6.2.1.5 (1160) Large shallow inlets and bays

The habitat area of large shallow inlets and bays is estimated as 35,282ha in this SAC (NPWS 2012[20]). The site supports an excellent example of the habitat, which is contained within the coastal water body Mouth of the Shannon (HAs 23;27) (IE_SH_060_0000). Littoral sediment communities in the mouth of the Shannon Estuary occur in areas that are exposed to wave action and also in areas extremely sheltered from wave action. Characteristically, exposed sediment communities are composed of coarse sand and have a sparse fauna. Species richness increases as conditions become more sheltered. All shores in the site have a zone of sand hoppers at the top, and below this each of the shores has different characteristic species giving a range of different shore types.

This habitat also encompasses the Annex I habitats mudflats and sandflats not covered by water at low tide, sandbanks which are slightly covered by sea water all the time and reefs. As for estuaries, sandbanks, and mudflats above, a target for this habitat (under conservation of the community type) states that proposed activities or operations that cause significant disturbance to the community, but may not necessarily represent a continuous or ongoing source of disturbance over time and space, may be assessed in a context-specific manner giving due consideration to the proposed nature and scale of activities during the reporting cycle and the particular resilience of the receiving habitat in combination with other activities within the designated site[23].

Table 5.1 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to the Lower River Shannon SAC and will receive inputs from the proposed orthophosphate dosing at Clareville WTP, these have also been listed in **Section 6.2.1.2**.

The mapped QI habitat occurs within the Mouth of the River Shannon coastal waterbody. The project ZoI was terminated at this coastal water body where the modelled additional increase is undetectable (0.0000mg/l). Therefore, dosing does not pose a risk of deterioration in the indicative quality of the Mouth of the Shannon and potential likely significant effects upon this habitat have been excluded.

The EAM has assessed the potential for impact on orthophosphate indicative quality and has based this assessment on a conservative basis using all available flow data. Full details of the assessment results are provided in **Appendix C** and discussed above in **Section 5**.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Clareville 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.

[23] NPWS 2012 Lower River Shannon SAC (site code 2165) Conservation objectives supporting document - Marine habitats and species

6.2.1.6 (1170) Reefs

This habitat area within the Lower River Shannon SAC is estimated as 21,421ha, and is found within the Fergus Estuary; Upper and Lower Shannon Estuary and Mouth of the Shannon water bodies. There are no nutrient specific targets in the SSCO (NPWS, 2012[20]) for this habitat. The attributes and targets that will maintain the favourable conservation condition of this habitat do not make specific reference to water quality or nutrient conditions. The COs supporting document for Marine habitats (NPWS, 2012[23]) does require that activities or operations that cause significant disturbance to communities, but may not necessarily represent a continuous or ongoing source of disturbance over time and space, may be assessed in a context-specific manner, giving due consideration to the proposed nature and scale of activities during the reporting cycle and the particular resilience of the receiving habitat in combination with other activities within the designated site.

Table 5.1 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to the Lower River Shannon SAC and will receive inputs from the proposed orthophosphate dosing at Clareville WTP, these have also been listed in **Section 6.2.1.2**.

The mapped QI habitat is located within the transitional and coastal water bodies associated with the SAC.

The EAM has assessed the potential for impact on orthophosphate indicative quality and has based this assessment on a conservative basis using all available flow data. Full details of the assessment results are provided in **Appendix C** and discussed above in **Section 5**.

The modelled additional orthophosphate concentrations for the transitional and coastal water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) with some water bodies having an undetectable (0.0000 mg/l) modelled increases in concentration, therefore, dosing does not pose a risk of deterioration in the Good and High indicative quality of these water bodies.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Clareville 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.

6.2.1.7 (1230) Vegetated Sea Cliffs of Atlantic and Baltic Coasts

Most of the Lower River Shannon SAC west of Kilcredaun Point/Kilconly Point is bounded by high rocky sea cliffs. There are some areas where the hard rock is overlain by soft rock and some other small areas dominated by soft rock. The cliffs support a typical maritime flora and habitat for a diversity of cliff nesting birds including peregrine falcon (*Falco peregrinus*) and chough (*Pyrrhocorax pyrrhocorax*) (NPWS, 2012[24]). The cliffs in the outer part of the site are sparsely vegetated with lichens, Red Fescue, Sea Beet (*Beta vulgaris* subsp. *maritima*), Sea Campion (*Silene vulgaris* subsp. *maritima*), Thrift and plantains (*Plantago* spp.). A rare endemic type of sea-lavender, *Limonium recurvum* subsp. *pseudotranswallianum,* occurs on cliffs near Loop Head. Cliff-top vegetation usually consists of either grassland or maritime heath. The boulder clay cliffs further up the estuary tend to be more densely

[24] NPWS 2012 Lower River Shannon SAC (site code 2165) Conservation objectives supporting document - coastal habitats

vegetated, with swards of Red Fescue and species such as Kidney Vetch (*Anthyllis vulneraria*) and Common Bird's-foot-trefoil (*Lotus corniculatus*) (NPWS, 2013[25]).

The overall objective for vegetated sea cliffs in Lower River Shannon SAC is to 'maintain favourable conservation condition'. The objective is based on an assessment of the current condition of the habitat under a range of attributes and targets. There are no nutrient specific targets for this habitat. There is however, a target for the attribute negative indicator species which states that negative indicator species should make up less than 5% of the vegetation cover. Negative indicator species can include species indicative of changes in nutrient status (e.g. *Urtica dioica*).

Table 5.1 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to the Lower River Shannon SAC and will receive inputs from the proposed orthophosphate dosing at Clareville WTP, these have also been listed in **Section 6.2.1.2**.

The mapped QI habitat occurs mainly within the Mouth of the River Shannon coastal waterbody. The project ZoI was terminated at the Mouth of the River Shannon coastal waterbody where the modelled additional increase is undetectable (0.0000mg/l). Undocumented QI habitat is also mapped within the Lower River Shannon Estuary where the predicted increase in concentration is negligible (i.e. 0.0001 mg/l) and potential likely significant effects upon this habitat have been excluded.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Clareville 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.

6.2.1.8 (1310) Salicornia and other annuals colonising mud and sand, (1330) Atlantic salt meadows (Glauco-Puccinellietalia maritimae) and (1410) Mediterranean salt meadows (Juncetalia maritime)

There are three saltmarsh habitats within this site, and the Saltmarsh Monitoring Project[26] has documented an estimated area of 0.223ha for *Salicornia* habitat. Further unsurveyed areas maybe present within the site. For Atlantic salt meadows, the SMP mapped 119.36ha and additional areas of potential saltmarsh (376.07ha) were identified from an examination of aerial photographs, giving a total estimated area of 495.43ha. Further unsurveyed areas maybe present within the site.

For Mediterranean salt meadows, eight sub-sites that support the habitat were mapped (22.379ha) as part of the SMP and additional areas of potential saltmarsh (25.646ha) were identified from an examination of aerial photographs, giving a total estimated area of 48.025ha. Saltmarsh habitat also occurs at 11 other sub-sites within the SAC. Further unsurveyed areas maybe present within the site.

Within Lower River Shannon SAC, the areas of *Salicornia* habitat are limited, although the habitat was recorded from six of the ten sub-sites surveyed by the SMP.

The distribution of the three habitats extends from east of the Maigue estuary to Kilcredaun Point.

[25] NPWS 2013 Lower River Shannon SAC 002165 Site Synopsis
[26] https://www.npws.ie/sites/default/files/publications/pdf/McCorry_2007_Saltmarsh_survey.pdf

While there are no nutrient specific targets set for these habitats, the location, character and dynamic behaviour of saltmarshes are governed by sediment supply, tidal regime, wind-wave climate and sea level change. A target has been set (under structure and function) to maintain the physical structure: flooding regime of the habitats. The regular ebb and flow of the tide brings salinity, but also nutrients, organic matter and sediment, which are central to the development, growth and survival of saltmarshes.

Table 5.1 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to the Lower River Shannon SAC and will receive inputs from the proposed orthophosphate dosing at Clareville WTP, these have also been listed in **Section 6.2.1.2**.

These QI habitats are distributed along the Fergus Estuary (IE_SH_060_1100), Upper Shannon Estuary (IE_SH_060_0800) and Lower Shannon Estuary (IE_ SH_060_0300) as well as the Mouth of the River Shannon coastal water body (IE_SH_060_000). The project ZoI was terminated at the Mouth of the River Shannon coastal water body (IE_SH_060_000) where the modelled additional increase is undetectable (0.0000mg/l).

The modelled additional orthophosphate concentrations for the transitional and coastal water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) with some water bodies having an undetectable (0.0000 mg/l) modelled increases in concentration (i.e. Mouth of the Shannon and the Fergus Estuary), therefore, dosing does not pose a risk of deterioration in the Good and High indicative quality of these water bodies.

The EAM has assessed the potential for impact on orthophosphate indicative quality and has based this assessment on a conservative basis using all available flow data. Full details of the assessment results are provided in **Appendix C** and discussed above in **Section 5**.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Clareville 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 habitats.

6.2.1.9 (1349) Common Bottlenose Dolphin (Tursiops truncatus)

The bottlenose dolphin habitat extends throughout the coastal and transitional water bodies within the Lower River Shannon SAC and the dolphins are known to range widely throughout the site. Critical habitat areas[27] are between Tarbert Island and Scattery Island. The population is described as resident within the site with dolphin groups present in the estuary throughout the year, repeated occurrence of known individuals within the between years, and a fine scale genetic distinction evident between members of the Shannon population and populations or communities occurring outside the estuary (NPWS, 2012[23]). A target has been established for this species which states that human activities should occur at levels that do not adversely affect the bottlenose dolphin population at the site. While the target predominantly relates to preventing impacts from man-made energy e.g. aerial or underwater noise, light or thermal energy, it also includes for proposed activities or operations that

[27] Critical areas are described within NPWS (2012) as representing high value habitats used preferentially by the species within its overall range at the site and they broadly coincide with areas of steep benthic (i.e. seafloor) slope, greater depth and stronger currents. See NPWS 2012 Lower River Shannon SAC (site code 2165) Conservation objectives supporting document - marine habitats and species

may result in the deterioration of key resources e.g. water quality, feeding etc., upon which the bottlenose dolphin depends. It is not fully known what the ecological requirements of the species are; therefore, assessment needs to be on a case by case basis where appropriate.

Table 5.1 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to the Lower River Shannon SAC and will receive inputs from the proposed orthophosphate dosing at Clareville WTP, these have also been listed in **Section 6.2.1.2**.

The bottlenose dolphin habitat is distributed along the Fergus Estuary (IE_SH_060_1100), Upper Shannon Estuary (IE_SH_060_0800) and Lower Shannon Estuary (IE_ SH_060_0300) as well as the Mouth of the River Shannon coastal water body (IE_SH_060_000). The project ZoI was terminated at the Mouth of the River Shannon coastal water body where the modelled additional increase is undetectable (0.0000mg/l) and is located upstream of this coastal water body.

The EAM has assessed the potential for impact on orthophosphate indicative quality and has based this assessment on a conservative basis using all available flow data. Full details of the assessment results are provided in Appendix C and discussed above in **Section 5.**

are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) with some water bodies having an undetectable (0.0000 mg/l) modelled increases in concentration (i.e. Mouth of the Shannon and the Fergus Estuary), therefore, dosing does not pose a risk of deterioration in the Good and High indicative quality of these water bodies.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Drumcliffe 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.

6.2.1.10 (1355) Otter (*Lutra lutra*)

A review of the SSCOs (NPWS, 2012[20]) found no specific attributes or targets relating to water quality for the species however the NPWS Threat Response Plan for the Otter (NPWS, 2009[28]) review of and response to the pressures and threats to otters in Ireland, categorized three principal risks to otters: i) habitat destruction and degradation; ii) water pollution; and, iii) accidental death and/or persecution.

The extent of terrestrial, marine and freshwater (river) otter habitat within the site includes all areas within a 10m terrestrial buffer along the shoreline (above the high water mark and along river banks) identified as critical for otters; areas within 80m of the shoreline (high water mark) and river length calculated on the basis that otters will utilise freshwater habitats from estuary to headwaters (NPWS, 2012[20]). The diet of the species varies locally and seasonally; however, it is dominated by fish, in particular salmonids, eels and sticklebacks in freshwater.

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

Table 5.1 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to the Lower River Shannon SAC and will receive inputs from the proposed orthophosphate dosing at Clareville WTP these have also been listed in **Section 6.2.1.2**.

The EAM has assessed the potential for impact on orthophosphate indicative quality and has based this assessment on a conservative basis using all available flow data. Full details of the assessment results are provided in **Appendix C** and discussed above in **Section 5**.

The modelled additional orthophosphate concentrations for the majority of the river water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) therefore there is no risk of deterioration of the current orthophosphate indicative quality of these river water bodies, or of preventing the achievement of WFD objectives.

The increases in concentrations due to orthophosphate dosing are predicted to be insignificant (i.e. ≤0.00125), except in the following cases: Ballynaclogh_010 (IE_SH_24B040800), Barnakyle_020 (IE_SH_24B050600), Mondellihy_010 (IE_SH_24M440880), East Carrig_010 (IE_SH_24N150630), Groody_010 (IE_SH_25G050200), North Ballycannan_010 (IE_SH_25N170970), and Crompaun (East)_010 (IE_SH_27C090600). In all of these waterbodies the concentration will not exceed the 75% upper threshold, hence there is no risk of failing WFD objectives.

The modelled additional orthophosphate concentrations for the transitional and coastal water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) with some water bodies having an undetectable (0.0000 mg/l) modelled increases in concentration, therefore, dosing does not pose a risk of deterioration in the Good and High indicative quality of these water bodies.

The predicted increases in concentration of orthophosphate in groundwater bodies are insignificant (i.e. <0.00175 mg/l which is 5% of the Good/Failing to achieve good boundary for Orthophosphate indicative quality in ground water bodies) except in the following cases:

IE_SH_G_009 Ardnacrusha, IE_SH_G_052 Castleconnell, IE_SH_G_070 Cratloe, IE_SH_G_138 Limerick City East, IE_SH_G_139 Limerick City North and IE_SH_G_260 Industrial Facility (P0650-02): the modelled increase does not cause the baseline concentration to rise above 75% of the orthophosphate indicative quality upper threshold.

IE_SH_G_140 Limerick City Northwest and IE_SH_G_141 Limerick City Southwest: the modelled increase in these inner city groundwater bodies does cause the modelled baseline to rise just above 75% of the orthophosphate indicative quality upper threshold. The 2016-2021 ecological assessment confirms that both these GWB are at Good Status, with “Impact of Groundwater on Surface Water Ecological/Chemical Status Test” also Good. The modelled increases in concentrations do not cause any failures in overlying surface waterbodies (see Table 4.A). The potential loads from groundwater within each river were calculated and converted to concentration, these are all well below the limit of detection for waterbodies. In addition, the contribution of GWB pathways due to dosing is less than 10% relative of the Potential baseline for all the surface waterbodies. Therefore the potential impact on surface waters is not significant.

The subsurface assessment takes into account the groundwater/surface water interaction and as the potential for impact on surface water is insignificant, there is no risk of impact on groundwater receptors due to orthophosphate dosing. 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.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Clareville 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.

6.2.1.11 (3260) Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation

The Interpretation Manual of European Union Habitats (EC Commission 2013[29]) characterises this habitat by the following species; *Ranunculus saniculifolius, R. trichophyllus, R. fluitans, R. peltatus, R. penicillatus ssp. penicillatus, R. penicillatus ssp. pseudofluitantis, R. aquatilis, Myriophyllum spp., Callitriche spp., Sium erectum, Zannichellia palustris, Potamogeton spp., Fontinalis antipyretica*. This habitat is sometimes associated with the flowering rush *Butomus umbellatus* as part of bank side communities.

The conservation objectives supporting document notes the following "*The description of the habitat is broad, covering rivers from upland bryophyte and macroalgal dominated stretches, to lowland depositing rivers with pondweeds and starworts (European Commission, 2007, Hatton-Ellis and Grieve, 2003). Selection of Special Areas of Conservation for the habitat in Ireland has used this broad interpretation. Thus, it must be recognised that a number of sub-types of this habitat exist in Ireland. As in the UK, it is considered that the habitat as defined is too broad for a single set of conservation guidelines to cover it (Hatton-Ellis and Grieve, 2003). Site-specific conservation objectives for the habitat identify and concentrate upon the high-conservation value sub-types" and "The full distributions of this habitat and its sub-types in this site are currently unknown. The basis for the selection of the SAC for the habitat was the presence of plant species that are listed as characteristic of the habitat, such as Batrachian species of Ranunculus, Potamogeton spp. and Fontinalis antipyretica Hedw., (European Commission, 2007). These taxa were recorded during the NHA survey. The presence of rare and protected macrophyte species was also noted*" (NPWS 2012)[30].

In Ireland the riverine areas of highest conservation interest in term of this Annex I habitat are associated with lowland depositing and tidal rivers and unmodified fast flowing low nutrient rivers. A number of rare submerged and marginal species are found in the former including opposite-leaved pondweed (*Groenlandia densa*), water-starworts (e.g. *Callitriche truncata*), triangular club-rush (*Schoenoplectus triqueter*), needle spike-rush (*Eleocharis acicularis*) and mud-dwelling mosses (e.g. *Ephemerum* spp.). The low-nutrient, high-velocity river types are associated with high bryophyte diversity, cascades, riffles and riparian woodland. Important communities also occur in groundwater-fed, base-rich oligotrophic rivers. (NPWS 2019)[31].

Many Irish rivers have been heavily modified, particularly through arterial drainage and channelisation. These activities have changed channel hydrology and morphology, resulting in the accumulation of larger amounts of fine sediment. Such fines provide a rooting medium for plants and, as a result, stream watercrowfoot (*Ranunculus penicillatus*) has increased in abundance. Consequently, the habitat erroneously became synonymous with water-crowfoot in Ireland. Crowfoot

[29] https://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf

[30] NPWS 2012 Lower River Shannon SAC (site code 2165) Conservation objectives supporting document - Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitrich-Batrachion vegetation (habitat code 3260)

dominated reaches frequently have low diversity and are of low conservation value, and an abundance of the species generally indicates poor condition and damage (NPWS 2019)[32].

There are three sub-types of this habitat which are of high conservation value known to occur in this SAC i.e. *Groenlandia densa, Schoenoplectus triqueter* and bryophyte-rich streams and rivers. The full distribution of the Annex I habitat and its sub-types in this site are currently unknown (NPWS, 2012[33]).

There are stretches of six main rivers in the Lower River Shannon SAC: the Shannon, the Cloon, the Fergus, the Mulkear, the Maigue and the Feale. The high conservation value areas influenced by the tide are found, most notably, in the Shannon, the Fergus and the Maigue. The catchments of these three rivers are dominated by limestone geology. Significant non-tidal stretches of the Cloon, the Mulkear and the Feale are also included in the site. These three systems vary in character, with the Mulkear catchment heavily influenced by base-rich geology (Carboniferous limestone), while the Cloon and Feale catchments are dominated by Namurian sandstones and shales. The Cloon is a fast, short, coastal river with a small (c. 59 km^2), lowland catchment. In contrast, the Feale and Mulkear catchments are larger, having both upland streams and rivers and significant lowland stretches; the Feale rising in the Mullaghareirk Mountains, the Mulkear in the Silvermines.

Groenlandia densa is a pondweed found in calcareous waters in rivers, streams, canals, ditches and ponds (Preston and Croft, 2001, Preston, 2003). In Ireland, it is typically associated with tidal stretches of rivers and other periodically disturbed watercourses (e.g. canals and drains), where it presumably benefits from the reduction in competition through disturbance. *Groenlandia densa* is known from the northern bank of the River Shannon at the Shannon (New) Bridge and also the Limerick (Park) Canal, Limerick City, "from near the River Shannon at its north-east end to the lock gates at its south-west end" (Reynolds et al., 2006). The mapped distribution of the sub-type extends for c. 1.6 km. The species is likely to be more widespread in the tidal stretches of the Shannon and other rivers, as well as in marginal ditches.

Schoenoplectus triqueter, Triangular Club-rush, is a rare and highly threatened vascular plant species in Britain and Ireland, where it is restricted to tidal stretches of rivers (Preston and Croft, 2001, Preston et al., 2002, Rich and FitzGerald, 2002). Within the site, *Schoenoplectus triqueter* is known from both banks of the Shannon between King's Island in Limerick City and Cratloe Creek (c. 9.5 km extent), and from the following rivers and creeks: Ballinacurra Creek (1.8 km), Crompaun River (or Meelick Creek) (1.6 km), Cratloe Creek (1.2 km), the River Maigue (10.5 km) and the Owenagarney (or Ratty) River (0.6 km) (Deegan and Harrington, 2004; Rich and FitzGerald, 2002).

A rich bryophyte flora has been recorded from the Bilboa River, Mulkear catchment, including the 'Vulnerable' *Schistidium platyphyllum* (Mitt.) H. Perss. and the 'Near Threatened' *Philonotis caespitosa Jur.* (Lockhart 1992, Lockhart et al., 2012). *Cinclidotus riparius* (Host ex Brid.) *Arn*. was recorded in the River Fergus near Ennis in 1884 by S.A. Stewart, but on all recent field visits, the water level has been too high to allow comprehensive searches (Lockhart et al., 2012). This species, in particular, requires further investigation in the Fergus and in other nearby rivers, lakes and turloughs. In addition to these

[32] https://www.npws.ie/sites/default/files/publications/pdf/NPWS_2019_Vol1_Summary_Article17.pdf

[33] NPWS 2012 Lower River Shannon SAC (site code 2165) Conservation objectives supporting document - Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitrich-Batrachion vegetation (habitat code 3260)

known important bryophyte-rich streams and rivers in the site, there are likely to be other stretches with bryophyte-rich sub-types.

The SSCOs for this habitat indicate that the concentration of nutrients in the water column should be sufficiently low to prevent changes in species composition or habitat condition. Phosphorus (MRP) is typically the limiting nutrient in rivers; however increased nitrogen (NO3-) may negatively impacts upon some aquatic plant communities. Nutrient enrichment leads to increased filamentous-green-algal biomass, and consequent changes in other algae, bryophyte and macrophyte species composition and abundance. Standards for total ammonia and molybdate reactive phosphorus in rivers were established by Schedule Five of the European Communities Environmental Objectives (Surface Water) Regulations (S.I. 272 of 2009). Mean annual total ammonia must be ≤ 0.040 mg/l N for high status and ≤ 0.065 mg/l N for good status, and the annual 95th percentile must be ≤ 0.090 mg/l N (high) and ≤ 0.140 mg/l N (good). Mean molybdate reactive phosphorus must be ≤ 25 µg/l P (high) or ≤ 35 µg/l P (good) and the annual 95th percentile must be ≤ 45 µg/l P (high) and ≤ 75 µg/l P (good).

Table 5.1 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to the Lower River Shannon SAC and will receive inputs from the proposed orthophosphate dosing at Clareville WTP these have also been listed in **Section 6.2.1.2**.

While the known extent of the three sub-types has been broadly mapped within the SAC (See Appendix 1 Distribution map in NPWS 2012), the exact area of each has not been quantified. The area of the *Schoeoplectus triqueter* sub-type is likely to be smaller than the mapped range, however, as both the *Groenlandia densa* and the bryophyte-rich sub-types are presumed to be more widespread than mapped, it is not possible to comment on their areas at this time. For this reason, and on a precautionary basis, the assessment included all river water bodies with hydrological connectivity to this site as identified in **Table 5.1**. Groundwaters are also included given that the hydrological regime required for the habitat includes groundwater discharge which is important for certain sub-types of the habitat.

The EAM has assessed the potential for impact on orthophosphate indicative quality and has based this assessment on a conservative basis using all available flow data. Full details of the assessment results are provided in Appendix C and discussed above in **Section 5.**

The modelled additional orthophosphate concentrations for the majority of the river water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) therefore there is no risk of deterioration of the current orthophosphate indicative quality of these river water bodies, or of preventing the achievement of WFD objectives.

The increases in concentrations due to orthophosphate dosing are predicted to be insignificant (i.e. ≤0.00125), except in the following cases: Ballynaclogh_010 (IE_SH_24B040800), Barnakyle_020 (IE_SH_24B050600), Mondellihy_010 (IE_SH_24M440880), East Carrig_010 (IE_SH_24N150630), Groody_010 (IE_SH_25G050200), North Ballycannan_010 (IE_SH_25N170970), and Crompaun (East)_010 (IE_SH_27C090600). In all of these waterbodies the concentration will not exceed the 75% upper threshold, hence there is no risk of failing WFD objectives.

The modelled additional orthophosphate concentrations for the transitional and coastal water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) with some water bodies having an undetectable (0.0000 mg/l) modelled increases in concentration, therefore, dosing does not pose a risk of deterioration in the Good and High indicative quality of these water bodies.

The predicted increases in concentration of orthophosphate in groundwater bodies are insignificant (i.e. <0.00175 mg/l which is 5% of the Good/Failing to achieve good boundary for Orthophosphate indicative quality in ground water bodies) except in the following cases:

IE_SH_G_009 Ardnacrusha, IE_SH_G_052 Castleconnell, IE_SH_G_070 Cratloe, IE_SH_G_138 Limerick City East, IE_SH_G_139 Limerick City North and IE_SH_G_260 Industrial Facility (P0650-02): the modelled increase does not cause the baseline concentration to rise above 75% of the orthophosphate indicative quality upper threshold.

IE_SH_G_140 Limerick City Northwest and IE_SH_G_141 Limerick City Southwest: the modelled increase in these inner city groundwater bodies does cause the modelled baseline to rise just above 75% of the orthophosphate indicative quality upper threshold. The 2016-2021 ecological assessment confirms that both these GWB are at Good Status, with "Impact of Groundwater on Surface Water Ecological/Chemical Status Test" also Good. The modelled increases in concentrations do not cause any failures in overlying surface waterbodies (see Table 4.A). The potential loads from groundwater within each river were calculated and converted to concentration, these are all well below the limit of detection for waterbodies. In addition, the contribution of GWB pathways due to dosing is less than 10% relative of the Potential baseline for all the surface waterbodies. Therefore the potential impact on surface waters is not significant.

The subsurface assessment takes into account the groundwater/surface water interaction and as the potential for impact on surface water is insignificant, there is no risk of impact on groundwater receptors due to orthophosphate dosing. 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.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Clareville 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.

6.2.1.12 (6410) Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)

Molinia meadows on calcareous, peaty or clayey-silt-laden soils is a semi-natural grassland listed on Annex I of the Habitats Directive. Areas of *Molinia-Succisa* grassland are often seasonally flooded and can be managed as rough grazing or through a traditional regime of mowing during the drier summer months. They occur primarily in the midlands and the north-west, and less often in the south and east. The main negative impacts recorded for Annex I grassland habitats are species composition change (succession) and problematic native species (e.g. bracken). *Molinia* meadows are a groundwater dependent terrestrial ecosystem (GWDTE) and have low to moderate sensitivity to changes in groundwater quantity and quality[34]. The Lower River Shannon SAC has a number of GWBs within the WSZ which are hydrogeologically connected to the habitat *Molinia* meadows.

[34] Working Group on Groundwater (2005) WFD Pressures and Impacts Assessment Methodology, Guidance document no. GW11.

The Irish Semi-Natural Grasslands Survey (ISGS) 2007 – 2012 included surveys undertaken in Co. Clare and Co. Limerick[35]. Ten sites in Co. Clare and 3 sites in Co. Limerick were recorded[36]. The habitat has been recorded on the eastern bank of the Shannon, just north of Castleconnell, Co. Limerick (Figure 20, 21, O'Neill et. al., 2013[35]). There is hydrological connectivity between the Clareville WSZ and this location. The remaining two sites in Co. Limerick are located adjacent to White river (near Ballyhahil) which is a tributary of the Lower Shannon estuary, and the third site is located close to the Camoge River (tributary of the Maigue) and Lough Gur near Holycross / Meanus in the townland of Cahirguillamore. The White River has no history of flood events as confirmed through the OPW flood maps website[37] and is unlikely to be affected by flooding from the River Shannon on this basis. There is a history of flooding near the Cahirguillamore site at Ballymullane / Grange; and this this site is located within the Camoge_020 river water body where there is a hydrological link to the WSZ.

Table 5.1 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to the Lower River Shannon SAC and will receive inputs from the proposed orthophosphate dosing at Clareville WTP these have also been listed in **Section 6.2.1.2**.

The EAM has assessed the potential for impact on orthophosphate indicative quality and has based this assessment on a conservative basis using all available flow data. Full details of the assessment results are provided in Appendix C and discussed above in **Section 5.**

The modelled additional orthophosphate concentrations for the majority of the river water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) therefore there is no risk of deterioration of the current orthophosphate indicative quality of these river water bodies, or of preventing the achievement of WFD objectives.

The increases in concentrations due to orthophosphate dosing are predicted to be insignificant (i.e. ≤0.00125), except in the following cases: Ballynaclogh_010 (IE_SH_24B040800), Barnakyle_020 (IE_SH_24B050600), Mondellihy_010 (IE_SH_24M440880), East Carrig_010 (IE_SH_24N150630), Groody_010 (IE_SH_25G050200), North Ballycannan_010 (IE_SH_25N170970), and Crompaun (East)_010 (IE_SH_27C090600). In all of these waterbodies the concentration will not exceed the 75% upper threshold, hence there is no risk of failing WFD objectives.

The modelled additional orthophosphate concentrations for the transitional and coastal water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) with some water bodies having an undetectable (0.0000 mg/l) modelled increases in concentration, therefore, dosing does not pose a risk of deterioration in the Good and High indicative quality of these water bodies.

The predicted increases in concentration of orthophosphate in groundwater bodies are insignificant (i.e. <0.00175 mg/l which is 5% of the Good/Failing to achieve good boundary for Orthophosphate indicative quality in ground water bodies) except in the following cases:

IE_SH_G_009 Ardnacrusha, IE_SH_G_052 Castleconnell, IE_SH_G_070 Cratloe, IE_SH_G_138 Limerick City East, IE_SH_G_139 Limerick City North and IE_SH_G_260 Industrial Facility (P0650-02): the

[35] https://www.npws.ie/sites/default/files/publications/pdf/IWM-78-Irish-semi-natural-grassland-survey.pdf
[36] BEC consultants (2013) Irish Semi-natural Grasslands Survey, Annual Report No. 4: Western Seaboard Counties & County Tipperary
[37] http://www.floodmaps.ie/View/Default.aspx

modelled increase does not cause the baseline concentration to rise above 75% of the orthophosphate indicative quality upper threshold.

IE_SH_G_140 Limerick City Northwest and IE_SH_G_141 Limerick City Southwest: the modelled increase in these inner city groundwater bodies does cause the modelled baseline to rise just above 75% of the orthophosphate indicative quality upper threshold. The 2016-2021 ecological assessment confirms that both these GWB are at Good Status, with "Impact of Groundwater on Surface Water Ecological/Chemical Status Test" also Good. The modelled increases in concentrations do not cause any failures in overlying surface waterbodies (see Table 4.A). The potential loads from groundwater within each river were calculated and converted to concentration, these are all well below the limit of detection for waterbodies. In addition, the contribution of GWB pathways due to dosing is less than 10% relative of the Potential baseline for all the surface waterbodies. Therefore the potential impact on surface waters is not significant.

The subsurface assessment takes into account the groundwater/surface water interaction and as the potential for impact on surface water is insignificant, there is no risk of impact on groundwater receptors due to orthophosphate dosing. 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.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Clareville 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.

6.2.1.13 (91E0) Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)

Alluvial woodlands occur along the Shannon, in the valley bottoms of the tributaries and on seepage zones on valley sides. The uplands consist largely of shales and slates which typically produce poorly-drained soils. Steep, relatively dry slopes favour sessile oak woodlands. However, these frequently contain seepages and springs (locally petrifying) while colluviation and flushing enriches the soils on the lower slopes. A review of the SSCOs for this habitat found no nutrient specific targets (NPWS 2012[20]). The SCCOs target indicates that an appropriate hydrological regime is necessary for maintenance of alluvial vegetation, with periodic flooding essential to maintaining the alluvial woodlands along the river floodplains. The main pressures on this habitat are invasive alien species, grazing, forest management, agriculture, urban development and sewage and slurry discharges.

Mapped location of Alluvial forest with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) designated in the Lower River Shannon SAC are located along the River Shannon in Co. Limerick. It is noted within the SSCO that other unmapped areas may occur within the SAC.

located within the Camoge_020 river water body where there is a hydrological link to the WSZ.

Table 5.1 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to the Lower River Shannon SAC and will receive inputs from the proposed orthophosphate dosing at Clareville WTP these have also been listed in **Section 6.2.1.2**.

The EAM has assessed the potential for impact on orthophosphate indicative quality and has based this assessment on a conservative basis using all available flow data. Full details of the assessment results are provided in Appendix C and discussed above in **Section 5.**

The modelled additional orthophosphate concentrations for the majority of the river water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) therefore there is no risk of deterioration of the current orthophosphate indicative quality of these river water bodies, or of preventing the achievement of WFD objectives.

The increases in concentrations due to orthophosphate dosing are predicted to be insignificant (i.e. ≤0.00125), except in the following cases: Ballynaclogh_010 (IE_SH_24B040800), Barnakyle_020 (IE_SH_24B050600), Mondellihy_010 (IE_SH_24M440880), East Carrig_010 (IE_SH_24N150630), Groody_010 (IE_SH_25G050200), North Ballycannan_010 (IE_SH_25N170970), and Crompaun (East)_010 (IE_SH_27C090600). In all of these waterbodies the concentration will not exceed the 75% upper threshold, hence there is no risk of failing WFD objectives.

The modelled additional orthophosphate concentrations for the transitional and coastal water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) with some water bodies having an undetectable (0.0000 mg/l) modelled increases in concentration, therefore, dosing does not pose a risk of deterioration in the Good and High indicative quality of these water bodies.

The predicted increases in concentration of orthophosphate in groundwater bodies are insignificant (i.e. <0.00175 mg/l which is 5% of the Good/Failing to achieve good boundary for Orthophosphate indicative quality in ground water bodies) except in the following cases:

IE_SH_G_009 Ardnacrusha, IE_SH_G_052 Castleconnell, IE_SH_G_070 Cratloe, IE_SH_G_138 Limerick City East, IE_SH_G_139 Limerick City North and IE_SH_G_260 Industrial Facility (P0650-02): the modelled increase does not cause the baseline concentration to rise above 75% of the orthophosphate indicative quality upper threshold.

IE_SH_G_140 Limerick City Northwest and IE_SH_G_141 Limerick City Southwest: the modelled increase in these inner city groundwater bodies does cause the modelled baseline to rise just above 75% of the orthophosphate indicative quality upper threshold. The 2016-2021 ecological assessment confirms that both these GWB are at Good Status, with “Impact of Groundwater on Surface Water Ecological/Chemical Status Test” also Good. The modelled increases in concentrations do not cause any failures in overlying surface waterbodies (see Table 4.A). The potential loads from groundwater within each river were calculated and converted to concentration, these are all well below the limit of detection for waterbodies. In addition, the contribution of GWB pathways due to dosing is less than 10% relative of the Potential baseline for all the surface waterbodies. Therefore the potential impact on surface waters is not significant.

The subsurface assessment takes into account the groundwater/surface water interaction and as the potential for impact on surface water is insignificant, there is no risk of impact on groundwater receptors due to orthophosphate dosing. 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.

In light of the EAM assessment results, which evaluate the additional orthophosphate loading from dosing at Clareville 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.

6.2.2 River Shannon and River Fergus Estuaries SPA 004077

The estuaries of the River Shannon and River Fergus form the largest estuarine complex in Ireland (NPWS, 2015)[38]. The site comprises the entire estuarine habitat from Limerick City westwards as far as Doonaha in Co. Clare and Dooneen Point in Co. Kerry.

River Shannon and River Fergus Estuaries SPA has 21 SCIs all of which are considered nutrient sensitive (see **Appendix B**). The SSCOs for the SPA (NPWS, 2012[39]) outline the attributes and targets of population trend and distribution for each SCI as follows:

- Population trend: long term population trends should be stable or increasing; and
- Distribution: there should be no significant decrease in the range, timing or intensity of use of areas by the listed species, other than that occurring from natural patterns of variation.

There is also a target for the wetland habitat that supports the SPA in which the permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 32,261 hectares, other than that occurring from natural patterns of variation.

There are no nutrient specific targets for the SCIs. 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 conditions that support Favourable Conservation Status. In preparing the 2nd Cycle RBMP (2018-2021) (DHPLG, 2018[40]) 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.

Table 5.1 identifies the surface and groundwater bodies which are hydrologically or hydrogeologically connected to the Lower River Shannon SAC and will receive inputs from the proposed orthophosphate dosing at Clareville WTP these have also been listed in **Section 6.2.1.2**.

The EAM has assessed the potential for impact on orthophosphate indicative quality and has based this assessment on a conservative basis using all available flow data. Full details of the assessment results are provided in Appendix C and discussed above in **Section 5.**

The modelled additional orthophosphate concentrations for the majority of the river water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) therefore there is no risk of deterioration of the current orthophosphate indicative quality of these river water bodies, or of preventing the achievement of WFD objectives.

[38] NPWS 2015 River Shannon and River Fergus Estuaries SPA 004077 Site Synopsis
[39] NPWS 2012 River Shannon and River Fergus Estuaries SPA 004077 Conservation Objectives
[40] DHPLG 2018 River Basin Management Plan 2018-2021

The increases in concentrations due to orthophosphate dosing are predicted to be insignificant (i.e. ≤0.00125), except in the following cases: Ballynaclogh_010 (IE_SH_24B040800), Barnakyle_020 (IE_SH_24B050600), Mondellihy_010 (IE_SH_24M440880), East Carrig_010 (IE_SH_24N150630), Groody_010 (IE_SH_25G050200), North Ballycannan_010 (IE_SH_25N170970), and Crompaun (East)_010 (IE_SH_27C090600). In all of these waterbodies the concentration will not exceed the 75% upper threshold, hence there is no risk of failing WFD objectives.

The modelled additional orthophosphate concentrations for the transitional and coastal water bodies are within 5% of the High/Good indicative quality boundary (i.e. <0.00125 mg/l) with some water bodies having an undetectable (0.0000 mg/l) modelled increases in concentration, therefore, dosing does not pose a risk of deterioration in the Good and High indicative quality of these water bodies.

The predicted increases in concentration of orthophosphate in groundwater bodies are insignificant (i.e. <0.00175 mg/l which is 5% of the Good/Failing to achieve good boundary for Orthophosphate indicative quality in ground water bodies) except in the following cases:

IE_SH_G_009 Ardnacrusha, IE_SH_G_052 Castleconnell, IE_SH_G_070 Cratloe, IE_SH_G_138 Limerick City East, IE_SH_G_139 Limerick City North and IE_SH_G_260 Industrial Facility (P0650-02): the modelled increase does not cause the baseline concentration to rise above 75% of the orthophosphate indicative quality upper threshold.

IE_SH_G_140 Limerick City Northwest and IE_SH_G_141 Limerick City Southwest: the modelled increase in these inner city groundwater bodies does cause the modelled baseline to rise just above 75% of the orthophosphate indicative quality upper threshold. The 2016-2021 ecological assessment confirms that both these GWB are at Good Status, with “Impact of Groundwater on Surface Water Ecological/Chemical Status Test” also Good. The modelled increases in concentrations do not cause any failures in overlying surface waterbodies (see Table 4.A). The potential loads from groundwater within each river were calculated and converted to concentration, these are all well below the limit of detection for waterbodies. In addition, the contribution of GWB pathways due to dosing is less than 10% relative of the Potential baseline for all the surface waterbodies. Therefore the potential impact on surface waters is not significant.

The subsurface assessment takes into account the groundwater/surface water interaction and as the potential for impact on surface water is insignificant, there is no risk of impact on groundwater receptors due to orthophosphate dosing. 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.

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

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
Limerick Development Plan 2022-2028 **<u>Objectives</u>** ***Objective EH O1 - Designated Sites and Habitats Directive*** It is an objective of the Council to ensure that projects/plans likely to have significant effects on European Sites (either individually or in combination with other plans or projects) are subject to an appropriate assessment and will not be permitted under the Plan unless they comply with Article 6 of the Habitats Directive. The Council, will through the planning enforcement process where applicable, seek to restore the ecological functions of designated sites, where they have been damaged through inappropriate development. ***Objective EH O15 Ground Water, Surface Water Protection and River Basin Management Plans*** It is an objective of the Council to: a) Protect ground and surface water resources and to take into account the requirement of the Water Framework Directive when dealing with planning and land use issues. b) Implement the provisions of the River Basin Management Plan 2022 – 2028 and any succeeding plan. The filling of wetlands, surface water features and modifications and drainage of peatlands shall generally be prohibited. c) Implement the measures put forward in the Limerick Groundwater Protection Plan, in assessing planning applications and their consequences for ground water. d) The Blue Dot Catchments programme is a key action under the River Basin Management Plan for Ireland 2022-2028. The aim of the programme is to protect and restore high ecological status to a network of rivers and water bodies in Limerick. In Limerick, the following rivers and water bodies are Blue Dot Catchments, Bleach Lough, the Ogeen River and the Behanagh River. The Council will take a precautionary approach to development which might affect water quality in these areas in line with requirements of the Water Framework Directive. ***Objective EH O17 - Water Quality***	▪ 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 and the Habitats Directive. There is no potential for cumulative impacts with this plan.

Plan / Programme/Policy	Key Types of Impacts	Potential for In-combination Effects and Mitigation
It is an objective of the Council to support commitments to achieve and maintain 'At Least Good' status, except where more stringent obligations are required. There shall be no deterioration of status for all water bodies under the Marine Strategy Framework Directive and its programme of measures, the Water Framework Directive and the River Basin Management Plan. Key challenges include, inter alia, the need to address significant deficits in urban waste-water treatment and water supply, addressing flooding and increased flood risks from extreme weather events and increased intense rainfall because of climate change. ***Objective IN O6 - Water Services*** It is an objective of the Council to: a) Support Irish Water in the provision of water and wastewater infrastructure and services in accordance with the Service Level Agreement, until such time as the Agreement is terminated. b) Collaborate with Irish Water in the protection of water supply sources to avoid water quality deterioration and reduce the level of treatment required in the production of drinking water, in accordance with Article 7(2) of the WFD. Protection and restoration of drinking water at the source can have co-benefits for biodiversity and climate change. c) Liaise with Irish Water during the lifetime of the Plan to secure investment in the pro-vision, extension and upgrading of the piped water distribution network and wastewater pipe network across Limerick City and County, to serve existing population and future population growth and sustain economic growth, in accordance with the requirements of the Core and Settlement Strategies.		
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 Directive (WFD) (2000/60/EC).	▪ 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
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 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.

Plan / Programme/Policy	Key Types of Impacts	Potential for In-combination Effects and Mitigation
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[41]. 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 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	• Overgrazing; • Land use change or intensification; • Water pollution; • Nitrogen deposition; • Disturbance to habitats / species;	The RDP for 2014 – 2020 has been subject to SEA[42], and AA[43]. 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 measures in place, it was concluded that there would be no significant in-combination impacts on Natura 2000 sites.

[41] http://www.agriculture.gov.ie/media/migration/foodindustrydevelopmenttrademarkets/agri-foodandtheeconomy/foodwise2025/environmentalanalysis/AgriFoodStrategy2025NISDRAFT300615.pdf
[42] https://www.agriculture.gov.ie/media/migration/ruralenvironment/ruraldevelopment/ruraldevelopmentprogramme2014-2020/StrategEnvironmAssessSumState090615.pdf
[43] 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
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.		
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 the NAP include: ▪ Better Policy Alignment; ▪ Compliance and Enforcement; ▪ Climate Action Measures. ▪ Biodiversity Measures; and	▪ 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. 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.

Plan / Programme/Policy	Key Types of Impacts	Potential for In-combination Effects and Mitigation
Nitrates Derogation.		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, 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	• Habitat loss or destruction; • Habitat fragmentation or degradation; • Water quality changes; • Disturbance to species.	Ireland's Forestry Programme 2014 – 2020 has undergone AA[44]. 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.

[44] 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
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 – Framework Plan This Framework will deliver a sustainable water supply on a catchment and water resource zone basis, meeting growth and demand requirements through drought and critical periods. The resources plan takes account of WFD	• Increased abstractions leading to changes / pressure on existing	The plan will seek to develop sustainable water supplies but must consider particularly critical drought periods when assimilation capacity for diffuse runoff may be reduced.

Plan / Programme/Policy	Key Types of Impacts	Potential for In-combination Effects and Mitigation
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.	hydrology / hydrogeological regimes.	The SEA Environmental Report for the Framework Plan has made mitigation recommendations for the implementation of the Framework Plan which are included in the Environmental Action Plan (EAP), and the EAP will provide a basis for tracking recommendations from the SEA and NIS during the Framework Plan implementation and Regional Plan development. A Monitoring Plan has also been developed which covers the integration of environmental and sustainability considerations throughout implementation of the Framework Plan and the options development methodology and provides a framework for future long-term monitoring. Therefore, no likely significant in-combination effects are envisaged.
Planning Applications There are a number of planning applications pending or recently approved within the ZoI. The Limerick City and County Council planning systems were searched for applications predominately in Limerick City. The applications are primarily for the construction of new infrastructure or renovations to existing infrastructure.	• 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 Limerick City and County Development Plan 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 (IED) 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 nine active IED facilities and 7 IPC facilities in the Clareville P1 WSZ.	▪ Changes to water quality or quantity; ▪ Nutrient enrichment /eutrophication.	The EPA is responsible for monitoring emissions and dealing with any infringements on IED/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 operational orthophosphate dosing at the Clareville WTP, 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 operational phase, the potential for direct, indirect and cumulative impacts Lower River Shannon SAC (002165) and the River Shannon and River Fergus Estuaries (004077), have been assessed. Due to the low orthophosphate inputs following dosing at Clareville 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 at Clareville 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

Code	Qualifying Interest	Water dependant	GWDTE	Nutrient sensitive
3260	Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	Yes		Yes
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

Code	Qualifying Interest	Water dependant	GWDTE	Nutrient sensitive
8330	Submerged or partially submerged sea caves	Yes		Yes
91A0	Old sessile oak woods with Ilex and Blechnum in the British Isles	No		Yes
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

RPS

Irish Water - Lead in Drinking Water Mitigation Plan

Environmental Assessment Methodology (EAM) Summary Report

005 Clareville WTP (Limerick City) (1900PUB1032)

National Lead in Water Mitigation Strategy

Environmental Assessment Methodology Report – 005 Clareville WTP (Limerick City)

Document Control Sheet

Client:	Irish Water
Project Title:	National Lead in Water Mitigation Strategy
Document Title:	Environmental Assessment Methodology Report: 005 Clareville WTP (Limerick City) (1900PUB1032)
Document No:	MDW0766RP_5.1_EAM_005_Clareville (P1)_F01

Text Pages:	15	Appendices:	-

Rev.	Status	Date	Author(s)		Reviewed By		Approved By	
A01	Draft	28th March 2023	YE		IP		MM	
F01	Final	2nd May 2023	YE		IP		MM	

005 Clareville WTP (Limerick City) (1900PUB1032)

Supporting spreadsheet: 005_Clareville WTP - Limerick City Water Supply-P1_V07.xlsx

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

Clareville WTP supplies Limerick City. This EAM also includes the WSZs related to a number of WTPs that are due to be rationalised to Clareville, namely: Adare PWS, Croom PWS and Pallasgreen Water Supply. The distribution input for Limerick City Water Supply is 45,948 m^3/day (65% of which is accounted for, with the remainder assumed to be lost through leakage) serving a population of approximately 130,500 in 2023.

The area is served by Adare (D0312), Caherconlish (D0308), Castletroy (D0019), Croom (D0307), Limerick (Bunlicky) (D0013) and Pallasgreen (D0503) WWTPs which are 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 are two WWTP with a population equivalent of less than 500, namely Ballycannon (A0081) and Banogue (A0215). The estimated additional load from this agglomeration due to the orthophosphate dosing is considered at the water body level via the surface water pathways. It is estimated that there are 5,942 properties across the WSZ that are serviced by a DWWTS.

This assessment has been undertaken for the WSZ in isolation however should corrective water treatment be proposed for WTPs in the same catchment area, then the cumulative impact from the combined loads to downstream water bodies are assessed (see Summary and Mitigation Section, Tables 5.A and 5.B).

Water Treatment Plant	**Clareville WTP (Limerick City)**	
Water Supply Zone	**Limerick City Water Supply (1900PUB1032)** **Adare PWS (1900PUB1002)** **Croom PWS (1900PUB1023)** **Pallasgreen Water Supply (1900PUB1044)** **See Figure 4.1 / 4.2 of the AA Screening for a map of the WSZ(s) and ZoI.**	
Step 1 Appropriate Assessment Screening	**European Sites within Zone of Influence**	
	SACs	
	Danes Hole, Poulnalecka SAC 000030 Curraghchase Woods SAC 000174 Loughatorick South Bog SAC 000308 Mount Brandon SAC 000375 Barrigone SAC 000432 Tory Hill SAC 000439 Clare Glen SAC 000930 Silvermine Mountains SAC 000939	Tralee Bay and Magharees Peninsula, West to Cloghane SAC 002070 Bolingbrook Hill SAC 002124 Pollagoona Bog SAC 002126 Lower River Suir SAC 002137 Newgrove House SAC 002157 Lower River Shannon SAC 002165 Blasket Islands SAC 002172 Silvermines Mountains West SAC 002258

	Glenomra Wood SAC 001013 Keeper Hill SAC 001197 Glen Bog SAC 001430 Glenstal Wood SAC 001432 Philipston Marsh SAC 001847 Glendree Bog SAC 001912	Magharee Islands SAC 002261 Kerry Head Shoal SAC 002263 Askeaton Fen Complex SAC 002279 Slieve Bernagh Bog SAC 002312 Old Domestic Buildings, Rylane SAC 002314 Ratty River Cave SAC 002316
	SPAs	
	River Shannon and River Fergus Estuaries SPA 004077 Lough Derg (Shannon) SPA 004058 Loop Head SPA 004119 Magharee Islands SPA 004125	Dingle Peninsula SPA 004153 Slievefelim to Silvermines Mountains SPA 004165 Slieve Aughty Mountains SPA 004168 Kerry Head SPA 004189
	Appropriate Assessment Screening 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 = 1.5 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*
Adare Primary Discharge	1	Existing	117.3	0.574	0.459	0.780
		Post Dosing	117.3	0.574	0.459	0.780
Caherconlish Primary Discharge	0.15	Existing	18.4	0.057	0.046	0.078
		Post Dosing	18.4	0.057	0.046	0.078
Caherconlish SWOs (2 no)	n/a	Existing	13.4	1.43	1.15	1.95
		Post Dosing	17.7	1.89	1.51	2.57
Castletroy Primary Discharge	1	Existing	961.0	0.171	0.137	0.233
		Post Dosing	961.0	0.171	0.137	0.233
Castletroy SWOs (5 no)	n/a	Existing	215.3	1.32	1.05	1.79
		Post Dosing	325.8	1.99	1.60	2.71
Croom Primary Discharge	1.5	Existing	88.3	0.410	0.328	0.557
		Post Dosing	88.3	0.410	0.328	0.557
Croom SWOs (2 no)	n/a	Existing	6.1	0.98	0.78	1.33
		Post Dosing	10.9	1.73	1.38	2.35
Limerick (Bunlicky) Primary Discharge	6.5	Existing	33,064.3	0.852	0.682	1.159
		Post Dosing	43,410.6	1.119	0.895	1.522
Limerick (Bunlicky) SWOs (26 no)	n/a	Existing	3,106.6	2.75	2.20	3.74
		Post Dosing	3,407.9	3.02	2.41	4.10
Pallasgreen Primary Discharge	1	Existing	33.5	0.127	0.102	0.173
		Post Dosing	33.5	0.127	0.102	0.173
Pallasgreen	n/a	Existing	9.8	1.27	1.02	1.73

SWOs (1 no)		**Post Dosing**	10.7	1.40	1.12	1.91

Note: The effluent concentrations are compliant with ELVs based on the latest AER reporting

As Adare (D0312), Caherconlish (D0308), Castletroy (D0019), Croom (D0307) WWTP's receives tertiary treatment, i.e. chemical dosing for nutrient removal, the EAM assumes that the additional P loading to the plant can be dealt with and managed within the treatment process therefore there is no impact on the existing effluent quality.

For Limerick (Bunlicky (D0013) secondary treatment only is available and it is assumed that the additional load from orthophosphate dosing is not removed in the treatment process but rather is added to the existing effluent loads.

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

Table 2: Mass balance assessment based on 1.5 mg/l dosing using available background concentrations and mean flow information

Agglom. (WWDL code)	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.
Adare (D0312)	IE_SH_060_0700	0.0840	0.0841	0.0841	0.0
Caherconlish (D0308)	IE_SH_25G050200	0.0693	0.0705	0.0711	0.8
Castletroy (D0019)	IE_SH_25S012600	0.0134	0.0135	0.0135	0.1
Croom (D0307)	IE_SH_24M010900	0.0702	0.0703	0.0703	0.0
Limerick (Bunlicky) (D0013)	IE_SH_060_0900	0.0295	0.0314	0.0319	1.8
Pallasgreen (D0503)	IE_SH_25M040100	0.0470	0.0471	0.0471	0.0

Surface Assessment

Maigue Estuary (*IE_SH_060_0700*) – The effluent concentrations from Adare are modelled to be compliant with ELVs (Table 1) and this is confirmed in the 2021 AER for orthophosphate. Tertiary treatment is assumed to remove any additional orthophosphate from the effluent. The mass balance assessment in Table 2 demonstrates that the impact on the receiving water body is undetectable.

GROODY_010 (*IE_SH_25G050200*) – The effluent concentrations from Caherconlish are modelled to be compliant with ELVs (Table 1) and this is confirmed in the 2021 AER for orthophosphate. Tertiary treatment is assumed to remove any additional orthophosphate from the effluent. The mass balance assessment in Table 2 demonstrates that the impact on the receiving water body is negligible.

SHANNON (LOWER)_060 (*IE_SH_25S012600*) – The effluent concentrations from Castletroy are modelled to be compliant with ELVs (Table 1) and this is confirmed in the 2020 AER for orthophosphate. Tertiary treatment is assumed to remove any additional orthophosphate from the effluent. The mass balance assessment in Table 2 demonstrates that the impact on the receiving water body is insignificant.

MAIGUE_080 (*IE_SH_24M010900*) – The effluent concentrations from Croom are modelled to be compliant with ELVs (Table 1). The 2020 AER does report failure in

	compliance for orthophosphate due to a shock load to the WWTP, however this incident was reported as closed. Tertiary treatment is assumed to remove any additional orthophosphate from the effluent. The mass balance assessment in Table 2 demonstrates that the impact on the receiving water body is undetectable. ***Limerick Dock (IE_SH_060_0900)*** – The effluent concentrations from Limerick (Bunlicky) are modelled to be compliant with ELVs (Table 1) and this is confirmed in the 2020 AER for orthophosphate. The mass balance assessment in Table 2 demonstrates that the impact on the receiving water body is insignificant. ***MULKEAR (LIMERICK)_010 (*IE_SH_25M040100*)*** – The effluent concentrations from Pallasgreen are modelled to be compliant with ELVs (Table 1) and this is confirmed in the 2021 AER for orthophosphate. Tertiary treatment is assumed to remove any additional orthophosphate from the effluent. The mass balance assessment in Table 2 demonstrates that the impact on the receiving water body is undetectable. The dosing will therefore have an insignificant impact on the direct discharges to surface water from agglomerations within the WSZ.
Step 4 Distributed Inputs to surface water bodies from sub surface pathways	**<u>Subsurface Assessment</u>** The modelled increases in concentrations in the subsurface pathways are insignificant (i.e. less than 0.00125 mg/l which is 5% of the Good/High boundary for Orthophosphate indicative quality in surface water bodies) for all river water bodies, except in IE_SH_24B040800 BALLYNACLOGH_010, IE_SH_24B050600 BARNAKYLE_020, IE_SH_24M440880 Mondellihy_010, IE_SH_24N150630 EAST CARRIG_010, IE_SH_25N170970 North Ballycannan_010, and IE_SH_27C090600 CROMPAUN (EAST)_010. However, for all of the waterbodies, the modelled increase in concentration does not cause the baseline to rise above 75% of the orthophosphate indicative quality upper threshold. The highest increase equal to 0.0050 mg/l, taking place in Ballynaclogh_010 (IE_SH_24B040800). Transitional and coastal water bodies directly affected by this WSZ are: Maigue Estuary (IE_SH_060_0700), Upper Shannon Estuary (IE_SH_060_0800), Limerick Dock (IE_SH_060_0900), Foynes Harbour (IE_SH_060_0350), Poulaweala Lough / Quayfield Lough (IE_SH_060_0400), Fergus Estuary (IE_SH_060_1100), Lower Shannon Estuary (IE_SH_060_0300), Deel Estuary (IE_SH_060_0600), Mouth of the Shannon (HAs 23;27) (IE_SH_060_0000), and Southwestern Atlantic Seaboard (HA 23) (IE_SH_010_0000). Increase for all these waterbodies has been predicted to be either insignificant or undetectable.
Step 5 and 6: Combined Inputs to Groundwater Bodies	**<u>Groundwater Bodies as receptors connected to WSZ</u>** Table 3 gives the loads and modelled concentrations for the assessment of groundwater bodies. The predicted increases in concentration of orthophosphate in groundwater bodies are insignificant (i.e. <0.00175 mg/l which is 5% of the Good/Failing to achieve good boundary for Orthophosphate indicative quality in ground water bodies) except in the following cases: IE_SH_G_009 Ardnacrusha, IE_SH_G_052 Castleconnell, IE_SH_G_070 Cratloe, IE_SH_G_138 Limerick City East, IE_SH_G_139 Limerick City North and IE_SH_G_260 Industrial Facility (P0650-02): the modelled increase does not cause the baseline concentration to rise above 75% of the orthophosphate indicative quality upper

threshold.

IE_SH_G_140 Limerick City Northwest and IE_SH_G_141 Limerick City Southwest: the modelled increase in these inner city groundwater bodies does cause the modelled baseline to rise just above 75% of the orthophosphate indicative quality upper threshold. The 2016-2021 ecological assessment confirms that both these GWB are at Good Status, with "Impact of Groundwater on Surface Water Ecological/Chemical Status Test" also Good. The modelled increases in concentrations do not cause any failures in overlying surface waterbodies (see Table 4.A). The potential loads from groundwater within each river were calculated and converted to concentration, these are all well below the limit of detection for waterbodies. In addition, the contribution of GWB pathways due to dosing is less than 10% relative of the Potential baseline for all the surface waterbodies. Therefore the potential impact on surface waters is not significant.

The subsurface assessment takes into account the groundwater/surface water interaction and as the potential for impact on surface water is insignificant, and none of the overlying surface waterbodies are at bad ecological status, there is no risk of impact on groundwater receptors due to orthophosphate dosing.

It is therefore concluded that the appropriate RAG status for IE_SH_G_140 Limerick City Northwest and IE_SH_G_141 Limerick City Southwest is GREEN.

Table 3: Increased loading and concentrations to groundwater bodies connected to the WSZs ***(note: where existing monitoring data is not available, a surrogate indicative quality is derived from the initial characterisation or chemical status of the WB, and the mid-range of that indicative quality is used as Baseline Concentration)***

EU_CD/Name	Ortho P Indicative Quality, Trends and distance to threshold *[Surrogate Indicative Quality given in italic]*	Baseline Year 2012 Ortho P Conc. *[Surrogate Conc. given in italic] mg/l*	75% of Ortho P indicative quality upper threshold mg/l	Total Ortho P load to GW kg/yr	Potential Increase in Ortho P Conc. due to Dosing mg/l	Potential Baseline for Ortho P Conc. following dosing mg/l	Notes
IE_SH_G_009 Ardnacrusha	*Good*	*0.018*	*0.026*	*7.7*	*0.0022*	*0.020*	
IE_SH_G_010 Askeaton	*Good*	*0.018*	*0.026*	*4.1*	*0.0001*	*0.018*	
IE_SH_G_022 Ballingarry	*Good*	*0.018*	*0.026*	*1.7*	*0.0001*	*0.018*	
IE_SH_G_036 Ballyneety	Good Upwards Far	0.015	*0.026*	*13.6*	*0.0008*	*0.015*	
IE_SH_G_052 Castleconnell	*Good*	*0.018*	*0.026*	*34.6*	*0.0058*	*0.023*	
IE_SH_G_070 Cratloe	*Good*	*0.018*	*0.026*	*12.0*	*0.0075*	*0.025*	
IE_SH_G_084 Fedamore	Good Upwards Far	0.006	0.026	41.9	0.0008	0.007	MP1
	Good Upwards Far	0.008	0.026	41.9	0.0008	0.009	MP2

IE_SH_G_106 Herbertstown	Good None Near	0.034	0.026	0.1	0.0000	0.034	
IE_SH_G_107 Hospital	Good Upwards Far	0.009	0.026	0.1	0.0000	0.009	
IE_SH_G_119 Kildimo	*Good*	*0.018*	*0.026*	*8.0*	*0.0012*	*0.019*	
IE_SH_G_129 Knockroe East	Good Upwards Far	0.013	0.026	1.0	0.0003	0.013	
IE_SH_G_130 Knockroe Northwest	*Good*	*0.018*	*0.026*	*0.5*	*0.0003*	*0.018*	
IE_SH_G_131 Knockroe Southwest	*Good*	*0.018*	*0.026*	*0.0*	*0.0000*	*0.018*	
IE_SH_G_133 Knockseefin-Longstone East	*Good*	*0.018*	*0.026*	*0.3*	*0.0002*	*0.018*	
IE_SH_G_134 Knockseefin - Longstone West	*Good*	*0.018*	*0.026*	*0.0*	*0.0000*	*0.018*	
IE_SH_G_138 Limerick City East	*Good*	*0.018*	*0.026*	*64.2*	*0.0066*	*0.024*	
IE_SH_G_139 Limerick City North	*Good*	*0.018*	*0.026*	*21.6*	*0.0057*	*0.023*	
IE_SH_G_140 Limerick City Northwest	*Good*	*0.018*	*0.026*	*21.6*	*0.0102*	*0.028*	
IE_SH_G_141 Limerick City Southwest	*Good*	*0.018*	*0.026*	*176.4*	*0.0098*	*0.027*	
IE_SH_G_157 Lough Graney	*Good*	*0.018*	*0.026*	*1.6*	*0.0000*	*0.018*	
IE_SH_G_176 GWDTE-Tory Hill Fen (SAC000439)	*Good*	*0.018*	*0.026*	*0.7*	*0.0001*	*0.018*	
IE_SH_G_196 Pallas Grean	Good Upwards Near	0.018	0.026	18.8	0.0054	0.023	
IE_SH_G_197 Patrickswell	*Good*	*0.018*	*0.026*	*4.0*	*0.0006*	*0.018*	
IE_SH_G_213 Slieve Phelim	Good Upwards Far	0.005	0.026	17.0	0.0003	0.005	MP1
	Good Upwards Far	0.005	0.026	17.0	0.0003	0.005	MP2
IE_SH_G_229 Tulla-Newmarket on Fergus	*Good*	*0.018*	*0.026*	*0.1*	*0.0000*	*0.018*	
IE_SH_G_257 O'Briensbridge Gravels	*Good*	*0.018*	*0.026*	*3.2*	*0.0012*	*0.019*	
IE_SH_G_260 Industrial Facility (P0650-02)	*Good*	*0.018*	*0.026*	*4.6*	*0.0043*	*0.022*	

* Trend is Statistically Significant.

MP: multiple Monitoring Points given for waterbody

Step 5 and 6: Combined Inputs to Surface Water Bodies

Combined Assessment

Table 4.A and Table 4.B give the loads and modelled concentrations for the combined assessment to rivers and receiving waterbodies respectively. The increases in concentrations due to orthophosphate dosing are predicted to be insignificant (i.e. ≤0.00125, 5% of the Good / High boundary for Orthophosphate Indicative Quality), except in the following cases: IE_SH_24B040800 BALLYNACLOGH_010, IE_SH_24B050600 BARNAKYLE_020, IE_SH_24M440880 Mondellihy_010, IE_SH_24N150630 EAST CARRIG_010, IE_SH_25G050200 GROODY_010, IE_SH_25N170970 North Ballycannan_010, and IE_SH_27C090600 CROMPAUN (EAST)_010. For none of these waterbodies the concentration would not exceed the 75% upper threshold, hence there is no risk of failing WFD objectives.

Table 4.A: Increased loading and concentrations to River 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 orthophosphate indicative quality / Ecological status of upstream/downstream WBs, and the mid-range of that indicative quality is used as Baseline Concentration)***

EU_CD/Name	Ortho P Indicative Quality, Trends and distance to threshold *[Surrogate Indicative Quality given in italic]*	Baseline Year 2014 Orth P Conc. *[Surrogate Conc. given in italic]* mg/l	75% of Ortho P indicative quality upper threshold mg/l	Total Ortho P load in receiving waters kg/ yr	Potential Increase in Ortho P Conc. using flows (30%ile or gauged) mg/l	Potential Baseline for Ortho P Conc. following dosing mg/l	Notes
IE_SH_24B040800 BALLYNACLOGH_010	*Moderate*	*0.046*	*0.051*	*115.2*	*0.0050*	*0.051*	
IE_SH_24B050600 BARNAKYLE_020	Good Far	0.025	0.033	119.6	0.0054	0.031	‡
IE_SH_24M440880 Mondellihy_010	*Poor*	*0.077*	*0.087*	*24.0*	*0.0040*	*0.080*	
IE_SH_24N150630 EAST CARRIG_010	*Poor*	*0.077*	*0.087*	*21.8*	*0.0017*	*0.078*	
IE_SH_25B060250 BLACKWATER (CLARE)_020	Good Far	0.031	0.033	2.4	0.0001	0.031	†
IE_SH_25B770990 BALLYARD_020	*Moderate*	*0.046*	*0.051*	*3.3*	*0.0001*	*0.046*	
IE_SH_25G050200 GROODY_010	Poor Far	0.069	0.087	29.2	0.0013	0.071	‡ MP1
	Poor Far	0.068	0.087			0.069	* MP2
IE_SH_25K020150 KILLEENGARRIFF_010	*Good*	*0.030*	*0.033*	*31.0*	*0.0002*	*0.030*	
IE_SH_25M040200 MULKEAR (LIMERICK)_020	*Moderate*	*0.046*	*0.051*	*31.2*	*0.0001*	*0.046*	‡
IE_SH_25M040590 MULKEAR (LIMERICK)_050	Good Far	0.028	0.033	42.4	0.0001	0.028	

IE_SH_25N170970 North Ballycannan_010	Good Far	0.026	0.033	54.1	0.0040	0.030	‡
IE_SH_25S012500 SHANNON (LOWER)_050	High Far	0.012	0.019	0.4	0.0000	0.012	
IE_SH_25S012600 SHANNON (LOWER)_060	High Far	0.013	0.019	244.7	0.0000	0.013	‡ MP1
	Good Far	0.030	0.033			0.030	MP2
	High Far	0.014	0.019			0.014	† MP3
	High Far	0.010	0.019			0.010	MP4
	High Near	0.018	0.019			0.018	MP5
IE_SH_25W210770 WHITEHALL_010	*Poor*	*0.077*	*0.087*	*4.7*	*0.0008*	*0.077*	
IE_SH_27C080300 CRATLOE_010	*Moderate*	*0.046*	*0.051*	*5.6*	*0.0010*	*0.047*	
IE_SH_27C090600 CROMPAUN (EAST)_010	*Poor*	*0.077*	*0.087*	*21.0*	*0.0016*	*0.078*	
IE_SH_24B050300 BARNAKYLE_010	Moderate Far	0.043	0.051	0.0	0.0000	0.043	
IE_SH_24B080900 BALLYNAMONA_010	*Poor*	*0.077*	*0.087*	*0.2*	*0.0000*	*0.077*	
IE_SH_24C010600 CAMOGE_030	Poor Far	0.071	0.087	0.3	0.0000	0.071	*
IE_SH_24C030900 CLONSHIRE_040	*Poor*	*0.077*	*0.087*	*2.1*	*0.0001*	*0.077*	
IE_SH_24G050600 GREANAGH_010	*Poor*	*0.077*	*0.087*	*7.0*	*0.0002*	*0.077*	
IE_SH_24K620500 KILMOREEN_010	*Poor*	*0.077*	*0.087*	*0.1*	*0.0000*	*0.077*	
IE_SH_24M010600 MAIGUE_060	Poor Near	0.068	0.087	0.0	0.0000	0.068	*
IE_SH_24M010700 MAIGUE_070	Poorf Far	0.070	0.087	8.3	0.0000	0.070	
IE_SH_24M010900 MAIGUE_080	Poor Far	0.059	0.087	20.7	0.0000	0.059	‡ *
IE_SH_24M010980 MAIGUE_090	Poor Far	0.061	0.087	36.9	0.0001	0.061	‡
IE_SH_24T240890 TONLEGEE_010	*Poor*	*0.077*	*0.087*	*0.0*	*0.0000*	*0.077*	
IE_SH_24W060910 West Liskennett_010	*Poor*	*0.077*	*0.087*	*4.2*	*0.0002*	*0.077*	ǂ
IE_SH_25M040100 MULKEAR (LIMERICK)_010	Good Near	0.047	0.051	19.3	0.0001	0.047	‡ MP1
	Good Far	0.034	0.051			0.034	MP2
IE_SH_25M040400 MULKEAR (LIMERICK)_040	*Moderate*	*0.046*	0.051	1.4	0.0000	0.046	

‡ Load from WWTP / SWO following treatment added.

* Trend is Statistically Significant.

MP: multiple Monitoring Points given for waterbody

Table 4.B: Increased loading and concentrations to Transitional and Coastal 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 orthophosphate indicative quality / Ecological status of upstream/downstream WBs, and the mid-range of that indicative quality is used as Baseline Concentration).***

EU_CD/Name	Ortho P Indicative Quality, Trends and distance to threshold *[Surrogate Indicative Quality indicated in italic]*	Baseline Year 2014 Ortho P Conc. *[Surrogate Conc. given in italic]* mg/l	75% of Ortho P indicative quality upper threshold mg/l	Total Ortho P load in receiving waters kg/ yr	Potential Increase in Ortho P Conc. using flows (30%ile, gauged or tidal) mg/l	Potential Baseline for Ortho P Conc. following dosing mg/l	Notes
IE_SH_060_0700 Maigue Estuary	High (S) Far	0.017	0.019	211.5	0.0004	0.017	‡
	Poor (W) Far	0.069	0.102			0.069	
IE_SH_060_0800 Upper Shannon Estuary	High (S) Near	0.020	0.019	6051.7	0.0007	0.021	‡
	High (W) Far	0.011	0.019			0.012	
IE_SH_060_0900 Limerick Dock	High (S) Far	0.008	0.019	5737.7	0.0008	0.009	‡
	High (W) Far	0.012	0.019			0.013	
IE_SH_060_0350 Foynes Harbour	*Good (S)*	*0.045*	*0.053*	*0.0*	*0.0000*	*0.045*	
	Good (W)	*0.045*	*0.053*			*0.045*	
IE_SH_060_1100 Fergus Estuary	*Good (S)*	*0.042*	0.049	0.0	0.0000	0.042	
	Good (W)	*0.033*	0.036			0.033	
IE_SH_060_0300 Lower Shannon Estuary	High (S) Far	0.012	0.020	6051.7	0.0001	0.012	‡
	Good (W) Far	0.025	0.036			0.025	
IE_SH_060_0600 Deel Estuary	Good (S) Upwards Far	0.037	0.053	0.0	0.0000	0.037	
	Moderate (W) Upwards Far	0.065	0.090			0.065	

	IE_SH_060_0000 Mouth of the Shannon (HAs 23;27)	High (S) Far	*0.008*	*0.019*	*6051.7*	*0.0000*	*0.008*	‡
		Good (W)	*0.033*	*0.036*			*0.033*	
	IE_SH_010_0000 Southwestern Atlantic Seaboard (HA 23)	*High (S)*	*0.013*	*0.019*	*6051.7*	*0.0000*	*0.013*	‡
		High (W)	*0.013*	*0.019*			*0.013*	

‡ Load from WWTP / SWO following treatment added.

* Trend is Statistically Significant.

S = Summer monitoring period, W = Winter monitoring period

Summary and Mitigation Proposed

Considering Clareville WTP in isolation, orthophosphate dosing is predicted to have insignificant impact on all waterbodies. The modelled increases in load and concentrations to both groundwater and surface water receptors do not cause a risk to WFD objectives.

The modelled increases in concentration IE_SH_G_140 Limerick City Northwest and IE_SH_G_141 Limerick City Southwest is significant and does raise the baseline concentration above 75% of the orthophosphate indicative quality upper threshold. However, further assessment has shown insignificant impact of these groundwater bodies on their overlying surface waterbodies. It is therefore concluded that the appropriate RAG status for IE_SH_G_140 Limerick City Northwest and IE_SH_G_141 Limerick City Southwest is GREEN.

The breakdown from source to pathway is depicted in Figure 1 and the fate of P loads from Clareville WTP is shown in Figure 2.

The cumulative impacts on the Shannon Catchments (HAs 24, 25, 26, and 27) associated with the corrective water treatment at the following additional WTPs have been assessed in combination with Clareville WTP.

- 012 Tuam WTP – Tuam RWSS
- 013 Portloman WTP – Ardonagh Reservoir
- 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
- 032 Dromin WTP - Listowel Regional Water Supply
- 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

The cumulative loads to water bodies that are impacted by the WSZs supplied by these WTPs have been summarised in Tables 5.A and 5.B below.

Table 5.A: Cumulative assessment of the increased loading and concentrations to River water bodies impacted by 005 Clareville WTP (Limerick City) and other WSZs proposed for corrective water treatment in the upstream catchments ***(note: where existing monitoring data is not available, a surrogate indicative quality is derived from ecological status of the WB or orthophosphate indicative quality / Ecological status of upstream/downstream WBs, and the mid-range of that indicative quality is used as Baseline Concentration).***

EU_CD/Name	Ortho P Indicative Quality, Trends and distance to threshold *[Surrogate Indicative Quality given in italic]*	Baseline Year 2014 Orth P Conc. *[Surrogate Conc. given in italic]* mg/l	75% of Ortho P indicative quality upper threshold mg/l	Total Ortho P load in receiving waters kg/ yr	Potential Increase in Ortho P Conc. using flows (30%ile or gauged) mg/l	Potential Baseline for Ortho P Conc. following dosing mg/l	Notes
IE_SH_24B050600 BARNAKYLE_020	Good Far	0.025	0.033	154.4	0.0070	0.032	‡
IE_SH_25B060250 BLACKWATER (CLARE)_020	Good Far	0.031	0.033	3.8	0.0001	0.031	†
IE_SH_25G050200 GROODY_010	Poor Far	0.069	0.087	30.8	0.0014	0.071	‡
	Poor Far	0.068	0.087			0.069	*
IE_SH_25K020150 KILLEENGARRIFF_010	*Good*	*0.030*	*0.033*	*31.7*	*0.0002*	*0.030*	
IE_SH_25M040200 MULKEAR (LIMERICK)_020	*Moderate*	*0.046*	*0.051*	*100.2*	*0.0003*	*0.046*	‡
IE_SH_25M040590 MULKEAR (LIMERICK)_050	Good Far	0.028	0.033	143.2	0.0003	0.028	
IE_SH_25N170970 North Ballycannan_010	Good Far	0.026	0.033	62.7	0.0047	0.031	‡
IE_SH_25S012500 SHANNON (LOWER)_050	High Far	0.012	0.019	1249.2	0.0002	0.012	

IE_SH_25S012600 SHANNON (LOWER)_060	High Far	0.013	0.019	1641.7	0.0002	0.014	‡ MP1
	Good Far	0.030	0.033			0.030	MP2
	High Far	0.014	0.019			0.014	† MP3
	High Far	0.010	0.019			0.010	MP4
	High Near	0.018	0.019			0.018	MP5
IE_SH_27C080300 CRATLOE_010	*Moderate*	*0.046*	*0.051*	*7.5*	*0.0013*	*0.047*	
IE_SH_27C090600 CROMPAUN (EAST)_010	*Poor*	*0.077*	*0.087*	*21.2*	*0.0016*	*0.078*	
IE_SH_24B080900 BALLYNAMONA_010	*Poor*	*0.077*	*0.087*	*1.0*	*0.0000*	*0.077*	
IE_SH_24C010600 CAMOGE_030	Poor Far	0.071	0.087	27.9	0.0002	0.071	*
IE_SH_24C030900 CLONSHIRE_040	*Poor*	*0.077*	*0.087*	*37.0*	*0.0012*	*0.078*	
IE_SH_24G050600 GREANAGH_010	*Poor*	*0.077*	*0.087*	*42.0*	*0.0011*	*0.078*	
IE_SH_24M010600 MAIGUE_060	Poor Near	0.068	0.087	12.8	0.0000	0.068	*
IE_SH_24M010700 MAIGUE_070	Poor Far	0.070	0.087	53.4	0.0001	0.070	
IE_SH_24M010900 MAIGUE_080	Poor Far	0.059	0.087	74.8	0.0001	0.060	‡ *
IE_SH_24M010980 MAIGUE_090	Poor Far	0.061	0.087	91.2	0.0002	0.061	‡
IE_SH_24W060910 West Liskennett_010	*Poor*	*0.077*	*0.087*	*10.1*	*0.0004*	*0.077*	ǂ
IE_SH_25M040100 MULKEAR (LIMERICK)_010	Good Near	0.047	0.051	83.3	0.0003	0.047	‡ MP1
	Good Far	0.034	0.051			0.034	MP2
IE_SH_25M040400 MULKEAR (LIMERICK)_040	*Moderate*	*0.046*	*0.051*	*101.6*	*0.0003*	*0.046*	

‡ Load from WWTP / SWO following treatment added.

* Trend is Statistically Significant.

MP: multiple Monitoring Points given for waterbody

Table 5.B: Cumulative assessment of the increased loading and concentrations to Transitional/Coastal water bodies impacted by 005 Clareville WTP (Limerick City) and other WSZs proposed for corrective water treatment in the upstream catchments ***(note: where existing monitoring data is not available, a surrogate indicative quality is derived from ecological status of the WB or orthophosphate indicative quality / Ecological status of upstream/downstream WBs, and the mid-range of that indicative quality is used as Baseline Concentration).***

EU_CD/Name	Ortho P Indicative Quality, Trends and distance to threshold *[Surrogate Indicative Quality indicated in italic]*	Baseline Year 2014 Ortho P Conc. *[Surrogate Conc. given in italic]* mg/l	75% of Ortho P indicative quality upper threshold mg/l	Total Ortho P load in receiving waters kg/ yr	Potential Increase in Ortho P Conc. using flows (30%ile, gauged or tidal) mg/l	Potential Baseline for Ortho P Conc. following dosing mg/l	Notes
IE_SH_060_0700 Maigue Estuary	High (S) Far	0.017	0.019	337.1	0.0010	0.018	‡
	Poor (W) Far	0.069	0.102			0.070	
IE_SH_060_0800 Upper Shannon Estuary	High (S) Near	0.020	0.019	8287.5	0.0010	0.021	‡
	High (W) Far	0.011	0.036			0.012	
IE_SH_060_0900 Limerick Dock	High (S) Far	0.008	0.019	7089.5	0.0009	0.009	‡
	High (W) Far	0.012	0.019			0.013	
IE_SH_060_0350 Foynes Harbour	*Good (S)*	0.042	0.049	1333.5	0.0001	0.042	
	Good (W)	0.033	0.036			0.033	
IE_SH_060_1100 Fergus Estuary	*Good (S)*	0.012	0.020	9883.5	0.0001	0.012	‡
	Good (W)	0.025	0.036			0.025	
IE_SH_060_0300 Lower Shannon Estuary	High (S) Far	0.037	0.053	119.4	0.0002	0.037	
	Good (W) Far	0.065	0.090			0.065	
IE_SH_060_0600 Deel Estuary	Good (S) Upwards Far	0.008	0.019	10774.6	0.0001	0.008	‡
	Moderate (W) Upwards Far	*0.033*	*0.036*			*0.033*	

IE_SH_060_0000 Mouth of the Shannon (HAs 23;27)	High (S) Far	*0.013*	*0.019*	*11018.9*	*0.0000*	*0.013*	‡
	Good (W)	*0.013*	*0.019*			*0.013*	

‡ Load from WWTP / SWO following treatment added.

* Trend is Statistically Significant.

S = Summer monitoring period, W = Winter monitoring period

The modelled increase in concentration due to cumulative impacts is above significant levels for some waterbodies, as highlighted in Tables 5.A and 5.B, however the increase does not raise the baseline concentration above 75% of the orthophosphate indicative quality upper threshold.

The cumulative assessment has demonstrated that there will not be 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

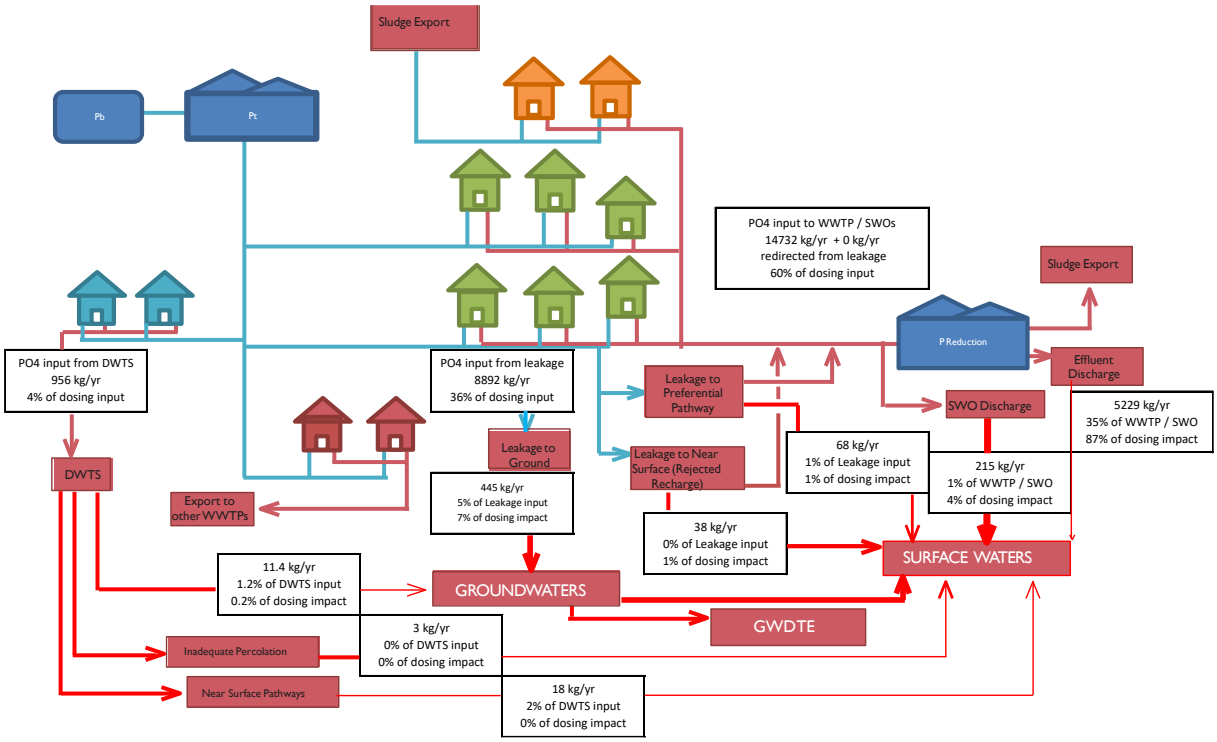
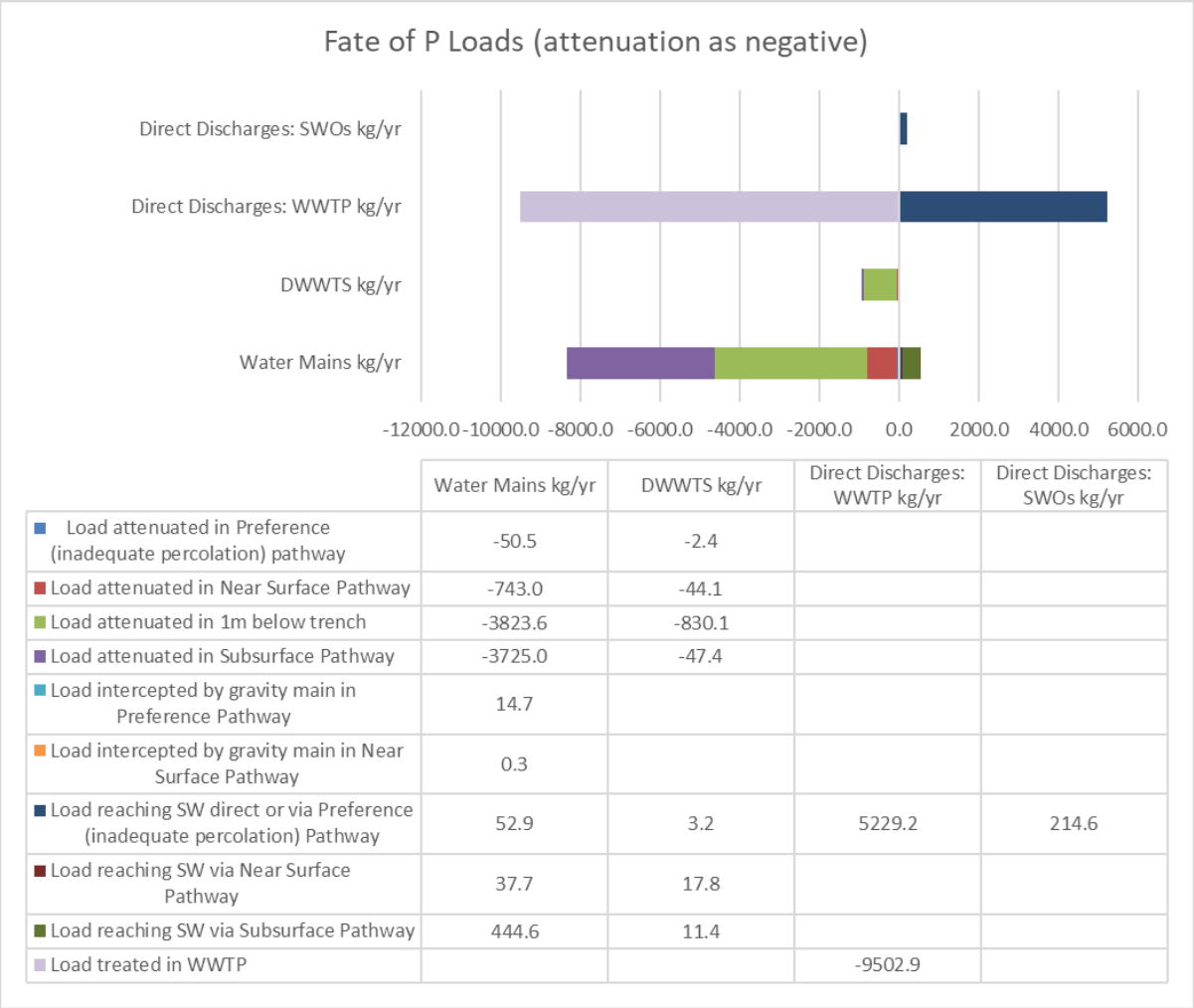


Figure 1 – Source Pathway Receptor model for Clareville WTP Regional WSZ illustrating key sources and pathways to the associated WSZs



	Water Mains kg/yr	DWWTS kg/yr	Direct Discharges: WWTP kg/yr	Direct Discharges: SWOs kg/yr
Load attenuated in Preference (inadequate percolation) pathway	-50.5	-2.4		
Load attenuated in Near Surface Pathway	-743.0	-44.1		
Load attenuated in 1m below trench	-3823.6	-830.1		
Load attenuated in Subsurface Pathway	-3725.0	-47.4		
Load intercepted by gravity main in Preference Pathway	14.7			
Load intercepted by gravity main in Near Surface Pathway	0.3			
Load reaching SW direct or via Preference (inadequate percolation) Pathway	52.9	3.2	5229.2	214.6
Load reaching SW via Near Surface Pathway	37.7	17.8		
Load reaching SW via Subsurface Pathway	444.6	11.4		
Load treated in WWTP			-9502.9	

Figure 2 – Fate of orthophosphate loads modelled for Clareville WTP impacting on the Mouth of the Shannon (HAs 23;27) due to dosing by source type, indicating levels of attenuation (negative values) in pathways and relative impact on the surface water receptor.