



Natura Impact Statement

Proposed Dredging at Limerick City

December 2025

Contents

1.	Summary of Findings.....	1
1.1	Natura Impact Statement	1
2.	Introduction.....	2
2.1	Purpose of the Assessment and Legislative Context	2
2.2	Statement of Competency	3
2.3	Project Overview	3
3.	Methodology	4
3.1	Appropriate Assessment Guidance	4
3.2	Consultation	4
3.3	Desktop Study	4
3.3.1	Database Searches.....	4
3.4	Field Surveys.....	5
3.5	Assessment of Potentially Significant Effects.....	5
4.	Description of the Project.....	5
4.1	Site Location and Context.....	5
4.1.1	Purpose of the Project.....	6
4.1.2	Description of Existing Site	6
4.1.2.1	General Site Description.....	6
4.1.3	Field Surveys	8
4.1.3.1	Habitats.....	8
4.1.3.2	Flora	8
4.1.3.3	Otter.....	8
4.1.3.4	Birds	8
4.1.3.5	Fish	8
4.1.3.6	Sediments	9
4.2	Characteristics of the Project.....	10
5.	Identification of Other Plans, Projects and Activities.....	11
5.1.1	Plans	11
5.1.2	Projects	11
5.1.2.1	Mulkear European Innovation Partnership	11
5.1.2.2	Annacotty Fish Passage Project	12
5.1.3	Plans	12
5.1.4	Permitted and Proposed dredgings in the Locality	12
5.1.5	EPA Licenced/Registered Facilities.....	13
5.1.6	Existing Land-use and On-going Activities	13
5.1.7	Potential for Significant In-combination Effects.....	14
6.	Identification of Natura 2000 Sites.....	14
6.1.1	Description of Natura 2000 Sites	15
6.1.1.1	Lower River Shannon SAC (002165)	15
6.1.1.2	River Shannon and River Fergus Estuaries SPA (004077)	16
6.1.2	Impact prediction.....	19
6.1.2.1	Direct impacts.....	19
6.1.2.2	Indirect impacts	26
6.1.3	Selection of Qualifying Features for Impact Assessment.....	37
7.	Assessment of Potentially Significant Effects.....	52
7.1	Water quality.....	52
7.2	Habitat loss/alteration.....	53
7.3	Disturbance and/or displacement of species.....	53
7.4	Habitat or species fragmentation	54
7.5	Assessment of Potentially Significant Cumulative Effects	54
8.	Mitigation	55

8.1	Method statements.....	59
8.2	Juvenile lamprey salvage.....	59
8.3	Non-native species	59
8.4	Timing of the works.....	59
8.5	Ecological monitoring.....	60
8.6	Contaminated sediment	60
9.	Assessment of effect on conservation objectives.....	60
10.	Conclusion	66
11.	References	67

Tables

Table 1	List of granted and/or on-going planning applications within the vicinity of the proposed dredging site	13
Table 2	Natura 2000 sites included for Stage 2 Appropriate Assessment	14
Table 3	Ecological Characteristics, requirements and specialities of non-breeding waterbird SCI species for River Shannon and River Fergus Estuaries SPA.....	18
Table 4	Potential loss of lamprey and habitats within the proposed dredge areas	24
Table 5	Selection of qualifying features for impact assessment	39
Table 6	Qualifying Interests and Special Conservation Interests identified as being potentially significantly affected, and mitigation measures	56
Table 7	Assessment of residual impacts of the project on 'Estuaries'	62
Table 8	Assessment of residual impacts of the project on 'brook lamprey' and 'river lamprey'	63
Table 9	Assessment of residual impacts of the project on 'Sea lamprey'	64
Table 10	Assessment of residual impacts of the project on 'wetlands and waterbirds' of the River Shannon and River Fergus Estuaries SPA	65

Figures

Figure 1	Location of proposed dredging site.....	7
Figure 2	Habitat map	9
Figure 3	Clay net deposition at the end of the model run for the dredging campaign	29
Figure 4	Silt net deposition at the end of the model run for the dredging campaign.....	30
Figure 5	Sand net deposition at the end of the model run for the dredging campaign.....	31
Figure 6	I-WeBS count subsites and roost locations within the ZOI of the proposed dredging.....	38

Appendices

Appendix 1 – Screening for Appropriate Assessment Report
Appendix 2 – Method Statement
Appendix 3 – Lamprey Assessment of the River Shannon at Limerick
Appendix 4 – Marine Sediment Characterisation
Appendix 5 – Numerical Modelling Study
Appendix 6 – Environmental Commitments

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1. Summary of Findings

1.1 Natura Impact Statement

Project Title	Proposed Dredging at Limerick City
Project Proponent	Waterways Ireland
Project Location	Limerick City
Natura Impact Statement	In cases where an Appropriate Assessment is required, a Natura Impact Statement (NIS) is prepared and includes a report of a scientific examination of evidence and data, carried out by competent persons to identify and classify any implications of a project, individually, or in combination with other plans or projects, for Natura 2000 sites in view of the conservation objectives of the sites.
Conclusion	For the reasons set out in detail in this NIS, in the light of the best scientific knowledge in the field, all aspects of the project which, by itself, or in combination with other plans or projects, which may affect the relevant Natura 2000 sites have been considered. The NIS contains information which the competent authority may consider in making its own complete, precise and definitive findings and conclusions and upon which the competent authority is capable of determining that all reasonable scientific doubt has been removed as to the effects of the project on the integrity of the relevant Natura 2000 sites. Provided that the mitigation measures are implemented in full, it is considered that the proposed dredging, either individually, or in combination with other plans/projects, will not affect the integrity of any Natura 2000 Sites, namely: • Lower River Shannon SAC (0021650) • River Shannon and River Fergus Estuaries SPA (004077)

2. Introduction

2.1 Purpose of the Assessment and Legislative Context

Appropriate Assessment is the consideration of the impact of a project on the integrity of a Natura 2000 site, either alone or in combination with other plans or projects, with respect to the site's ecological structure and function, and in view of the site's conservation objectives. The conservation objectives of a Natura 2000 site are site specific and based on the ecological requirements of the species and habitats present. They define the desired conservation condition of certain species and habitat types for the site. Conservation objectives are defined using attributes and targets that are based on parameters as set out in the Habitats Directive for defining favourable status, namely area, range, structure and function. The conservation objectives may be either to maintain or restore the favourable conservation condition of a habitat/species.

Article 6(3) of Directive 92/43/EEC stipulates that certain projects and plans must be subjected to an "appropriate assessment" of their effects on the integrity of Natura 2000 site(s). Article 6(3) provides in full:

"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 for the site in view of the site's conservation objectives. In the 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."

A screening for Appropriate Assessment report was prepared for the proposed dredging to determine whether the project is likely to significantly affect Natura 2000 sites. The screening for Appropriate Assessment report determined that a full Appropriate Assessment of the proposed dredging is required, as it could not be excluded, on the basis of objective information, that the proposed dredging, individually or in combination with other plans or projects, will not have a significant impact on Natura 2000 sites, in view of the site's conservation objectives. It was concluded, in the absence of mitigation, that significant impacts on the following Natura 2000 sites, potentially occurring as a result of the proposed dredging that is the subject matter of this Natura Impact Statement (NIS), could not be ruled out:

- Lower River Shannon SAC (002165)
- River Shannon and River Fergus Estuaries SPA (004077)

Please refer to Appendix 1 for the screening for Appropriate Assessment report.

This NIS is a scientific examination of evidence and data, carried out by competent persons, to identify and classify any implications (ecological effects) for the Natura 2000 sites listed above in view of the conservation objectives of those sites. The aim of the NIS is to provide a sufficient level of information to the competent authority on which to base their Appropriate Assessment of the proposed dredging described in Section 4.5 below.

This NIS identifies the aspects of the proposed dredging that will interact with the ecological requirements or sensitivities of the habitats and species listed in Section 5.1.3 and determines whether these will result in adverse effects for the species and/or habitats for which the Natura 2000 sites listed above are designated. Mitigation measures to avoid or reduce ecological effects are provided in Section 7.

2.2 Statement of Competency

This report has been prepared by Gerard Hayes (BSc.) Ecologist at MWP. Gerard has 15 years' experience in ecological surveying, ecological impact assessment and the appropriate assessment process. He is an appropriately qualified, trained and competent professional. He has completed numerous ecological assessments for a wide variety of projects. He is an experienced field ecologist and has a diverse ecological survey profile, including habitats and flora, mammals (including bats), birds and terrestrial/aquatic invertebrates. He has held licences for surveying numerous protected species including salmon, lampreys and white-clawed crayfish.

2.3 Project Overview

Waterways Ireland is the North / South Implementation Body responsible for the inland navigable waterways systems in Ireland. The main functions of Waterways Ireland are the management, maintenance, development and restoration of the inland navigable waterway system throughout the island of Ireland, principally for recreational purposes. The Shannon Navigation in the Limerick City area, around Sarsfield Lock and the Abbey River, underwent a significant dredging operation in November and December 2011. Almost 12,000m³ of bed material deposits were removed to licensed landfill to restore navigation depths for boat traffic.

After the most recent flood event of 2015/2016 a Hydrographic survey was carried out at the request of locals and users on the navigation to determine if the Limerick navigation had silted up. Siltation is an annual event on the lower sections of the Limerick navigation. From the most recent Bathymetric survey (2021) cross sections were taken at 10 metre intervals on both upstream and downstream of the Lock and from that approx. 3361m³ of material was shown upstream of the Lock (with an estimated 10m³ of material containing solids) and 5374m³ of material below the Lock (with an estimated 70m³ of material containing solids) on the approach channel to the Dock and the Dock area. The total volume of material is estimated at 8735 m³. The method statement for the removal of silt upstream and downstream of Sarsfield Lock has been provided by Waterways Ireland (see Appendix 2).

It is proposed to place 10mm mesh over a pump to suck the silt only from the area and leave the solid material on the river bed. In advance of any dredging the floating jetties at Custom House Quay (area 1) and Arthur's Quay (area 2) will be removed. Dredged material will be pumped across the weir to the River Shannon. Refer to Figure 1 for locations of proposed dredge areas.

The pump will be attached to a crane on a pontoon raft operating at 14 set ups upstream of the weir and 14 set ups downstream of the weir. The crane has a full extension reach with the pump attachment of 13.5 metres and the locations shown are based on the crane working at 12 metres radius. The raft has 2 spud legs that hold the raft at a designated set up point. The silt will be pumped via a 200mm floating discharge pipe to the discharge area on an ebbing tide. The discharge pipes will be connected to the pump and floating on the surface. Concrete anchor blocks located at 10 metre intervals on the riverbed fastened to the discharge pipe via a light chain to hold it in position.

The percentage water to silt ratio is expected to be 80/20. The operating window to carry out works based on tide tables for the area is expected to be 5 hours. From the quantities above It is estimated that 108 hours of pumping will be required.

To remove the granular material a long reach excavator with a perforated bucket on the pontoon raft will excavate the material and fill a clay barge with a capacity of 10m³ that will travel to Limerick Port (with agreement from **Shannon Foynes Port Company**) where it will be removed by excavator and removed to a licensed landfill site. The total estimated of hard material is approximately 70m³. This material (mainly in the downstream approach channel) will be removed at full tide when the flows are low.

3. Methodology

3.1 Appropriate Assessment Guidance

This NIS has been prepared in accordance with the European Commission Methodological Guidance on the provision of Article 6(3) and 6(4) of the ‘Habitats’ Directive 92/43/EEC (EC, 2001) and the European Commission Guidance ‘Managing Natura 2000 sites’ (EC, 2018) and guidance prepared by the NPWS (DoEHLG, 2009).

3.2 Consultation

Consultation details are provided in the report for screening for AA (Appendix 1).

3.3 Desktop Study

In order to complete the NIS, certain information on the existing environment is required. A desk study was carried out to collate available information on the subject site’s natural environment. This comprised a review of the following publications, data and datasets:

- Ordnance Survey Ireland (OSI) Aerial photography and 1:50000 mapping
- National Parks and Wildlife Service (NPWS)
- National Biodiversity Data Centre (NBDC) (on-line map-viewer)
- BirdWatch Ireland
- Teagasc soil area maps (NBDC website)
- Geological Survey Ireland (GSI) area maps
- Environmental Protection Agency (EPA) water quality data
- Shannon International River Basin District (ShIRBD) datasets (Water Framework Directive)
- Review of requested records from NPWS Rare and Protected Species database
- Limerick Development Plan (2022 – 2028)
- Limerick City Docks Dredging Numerical Modelling Study (MaREI, 2021)
- Marine Sediment Characterisation - Limerick Docks Dredging and Disposal Operations (Aquafact, 2022).
- Other information sources and reports footnoted in the course of the report.

3.3.1 Database Searches

The study area lies within the Ordnance Survey National Grid hectad R55. Concise and site-specific information on species records available for the hectad R56 was retrieved from the NBDC on-line database and reviewed. Other species of conservation interest in the Lower River Shannon SAC was retrieved and can be found in the main body of this report.

3.4 Field Surveys

The desktop study was supplemented by both multi-disciplinary ecological walkover surveys and targeted ecological surveys of the proposed dredging site. These habitat and faunal surveys were undertaken by MWP staff ecologists. Survey methods can be found in the report for screening for Appropriate Assessment in Appendix 1.

Information on lampreys can be found in Appendix 3 under 'Lamprey assessment of the River Shannon at Limerick'. This assessment included an evaluation of lamprey spawning habitats and juvenile lamprey habitats both within and upstream of the proposed dredging site in the environs of Limerick City. Lamprey habitats were assessed with reference to habitat quality and juvenile lamprey density using electrical fishing in shallower areas and dredge sampling in deeper areas at all proposed dredge locations. Inland Fisheries Ireland were consulted and informed survey design.

3.5 Assessment of Potentially Significant Effects

Following the preparation of the screening for Appropriate Assessment report (see Appendix 1), it was concluded that the project could have significant effects, or significant effects could not be ruled out, for two Natura 2000 sites; namely the Lower River Shannon SAC (002165) and the River Shannon and River Fergus Estuaries SPA (004077).

An evaluation is undertaken hereunder to determine which of the qualifying interests (QIs) of the SAC and special conservation interests (SCIs) of the SPA potentially lie within the zone of influence of the project and require further assessment (see Section 6). This is done through a scientific examination of ecological evidence and data listed in Section 3.3 or referenced in the text as well as the results of the ecology surveys (Section 4.1.3).

The significance of the potential ecological effects that might arise from the proposed dredging is then identified through the use of key indicators (Section 6.1 to 6.4):

- Habitat loss/alteration
- Habitat or species fragmentation
- Disturbance and/or displacement of species
- Water quality and resource

The effects of the proposed dredging on the QIs of the SAC and SCIs of the SPA, potentially within the zone of influence of the proposed dredging, are assessed against the measures designed to achieve the conservation objectives of the designated sites. This is done to determine whether the project is likely to have adverse effects on the conservation objectives, which in turn could have an adverse effect on the integrity of the Natura 2000 sites in question (see Section 5).

4. Description of the Project

4.1 Site Location and Context

The proposed dredge sites are situated at various locations upstream and downstream of Sarsfield Lock, adjacent to the southern bank of the Abbey River and River Shannon in Limerick City (see Figure 1). The Abbey

River is a distributary of the River Shannon and isolates King's Island from the mainland. Flow in the Abbey River is affected by a weir and a lock (Sarsfield Lock) at the lower end of the channel. The Abbey River and River Shannon are both within the intertidal zone, this transitional waterbody known as Limerick Dock (EU Code IE_SH_060_0900).

After the most recent flood event of 2015/16, a Hydrographic survey was carried out at the request of locals and users on the navigation to determine if the Limerick Navigation had silted up. From the survey, approx. 3000m³ of material was shown upstream of Sarsfield Lock at three locations. A recent survey showed estimated quantities in excess of 3120m³ of material above the Lock and 3430m³ of material below the Lock (6300m³ of silt and 200m³ of material containing solids).

4.1.1 Purpose of the Project

The proposed works involve the excavation of sediment from the river bed, termed "maintenance dredging", at locations upstream and downstream of Sarsfield Lock. Maintenance dredging is required to deepen or maintain navigable channels, which are at risk of becoming silted over time due to the transport of suspended sediments into the sheltered waters of the harbour, that in turn deposit on the riverbed. This is required also to allow boats to moor in the marina and other parts of the channel. The project will increase the navigability of the quays and thereby reduce the associated safety concerns for pleasure and commercial boats. The works will focus on maintaining the navigability of the river channel and ensuring safe access for users.

4.1.2 Description of Existing Site

4.1.2.1 General Site Description

The proposed dredging is located in the Abbey River and River Shannon. The proposed dredging site is influenced by the tide, so flows and water levels vary considerably. Flow in the River Shannon is controlled by the ESB using structures installed for the Shannon hydroelectric scheme at Parteen Weir and Ardnacrusha generating station. When water levels fall to their minimum level at the end of the ebb of Spring tide, the wetted area of the river is reduced and much of the river substrate is above water level. This is a feature of the main channel of the River Shannon as far upstream as Thomond Weir and beyond, with the effect diminishing with distance upstream. The Abbey River also experiences this effect but to a lesser degree because of the weir at the lower end of the channel.

The Corine (2018) land cover categories for the development site comprise 'Continuous urban fabric' and 'watercourses'. The Abbey River and River Shannon are confined by vertical limestone walls at the study sites. There is a marina at the proposed uppermost dredge site. The WFD Status (2018 – 2020) of Limerick Dock is 'Unpolluted'.



Figure 1 Location of proposed dredging site

4.1.3 Field Surveys

4.1.3.1 Habitats

The habitat at the subject site comprises depositing/lowland rivers - FW2 associated with the lower reaches of the Shannon and Abbey Rivers. This part of the river is tidal but is considered fresh, but perhaps experiences some saline intrusion when river flows are low and tides are high, in which case the habitat may correspond to tidal river - CW2. At low tide, river substrates are exposed. These consist of mixed sediment with some areas (Sarsfield Lock) entirely of mud. These habitats are classified as Mud shores - LS4 and Mixed sediment shores - LS5 but do not feature the infaunal communities associated with such habitats that are regularly inundated by sea water. A habitat map for the proposed dredging site can be seen in Figure 2 where areas exposed during spring tides at the southern bank of the river have been mapped as Mud shores and Mixed sediment shores. The banks of the waterbodies in the study area are constructed of limestone blocks and classified as Stone walls - BL1. Terrestrial habitats adjacent to stone walls are classified as Buildings and artificial surfaces (BL3).

During one site visit, otter was observed foraging in the Abbey River next to the weir. No other evidence of otter was recorded during any of the ecological field surveys and no otter breeding or resting places were identified within the study area. The waterbodies in the study area are suitable foraging and commuting habitats, as they are large and support fish populations. Otter is a conservation interest of the Lower River Shannon SAC.

4.1.3.2 Flora

No rare or protected flora species were recorded during any of the ecological surveys. One European Communities Regulations 2011 (S.I. 477 of 2015) Third Schedule species was recorded, namely Canadian pondweed *Elodea canadensis*. This non-native species was recorded growing in the lower reach of the Abbey River within the proposed works area. Reproduction in *Elodea spp.* in the British Isles is through vegetative means. Water milfoil (*Myriophyllum sp.*) and *Cladophora sp.* were also recorded.

4.1.3.3 Otter

No evidence of otter was recorded during any of the ecological field surveys and no otter breeding or resting places were identified within the study area.

4.1.3.4 Birds

Common gull *Larus canus* and herring gull *Larus argentatus* were frequently recorded in the study area.

4.1.3.5 Fish

Fish encountered during surveys were sea lamprey (*Petromyzon marinus*), river/brook lamprey (*Lampetra sp.*), European eel (*Anguilla Anguilla*), roach (*Rutilus rutilus*), flounder (*Platichthys flesus*), goby (*Gobius sp.*), perch (*Perca fluviatilis*) and three-spined stickleback (*Gasterosteus aculeatus*). Table 7 lists the length statistics of other fish recorded during the surveys. Sea lamprey, brook lamprey (*Lampetra planeri*) and river lamprey (*Lampetra fluviatilis*) are conservation interests of the Lower River Shannon SAC.

European eel occurred less frequently than lampreys and showed preference to vegetated areas and larger substrate sizes. The European eel is subject to European Council Regulation 1100/2007 'Establishing measures for the recovery of the stock of European eel'. European eel is listed as 'Critically endangered' and is now 'Red Listed' according to 'Red List No. 5: Amphibians, Reptiles & Freshwater Fish' (King *et al.* 2011). Survey results are outlined in detail in Appendix 3.

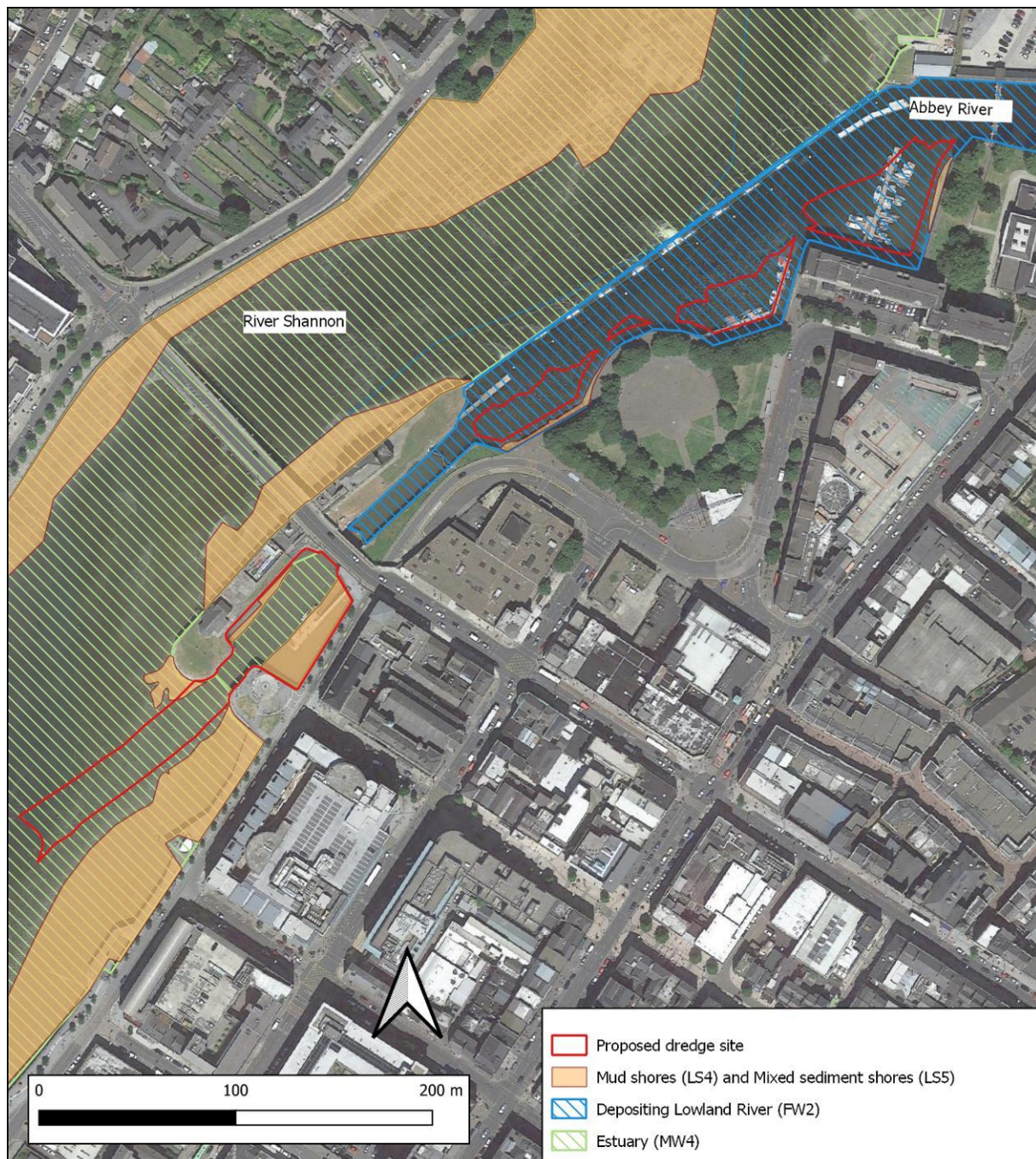


Figure 2 Habitat map

4.1.3.6 Sediments

A Marine Sediment Characterisation report (Aquafact, 2022) was prepared on behalf of Waterways Ireland. This report found that:

The sediments analysed for disposal were below the upper action limit for the majority of parameters at all stations. However, Lead was above the upper action level at station L1. A determination as to whether this material is suitable for disposal at sea will be made by the Marine Institute.

- The sediment analysed for Waste Acceptance Criteria (WAC) was classified as inert at stations L3, L7, L9, and L10 and non-hazardous with regards to total organic carbon for stations L2, L4, L6, and L8. All other sediment analysed for WAC was classified as inert.
- The sediments analysed for disposal at sea were below the upper action limit for the majority of parameters at all stations. However, Lead was above the upper action level at station L1. The sediment analysed for Waste Acceptance Criteria was classified as inert at stations L3, L7, L9, and L10 and non-hazardous with regards to total organic carbon for stations L2, L4, L6, and L8. All other sediment analysed for WAC was classified as inert.
- Arsenic, Cadmium, Chromium, Copper, Zinc, Mercury, Aluminium and Lithium were all below the lower level guidance value as set out in Cronin *et al.* (2006). Lead (1160mg/kg) was above the upper action limit at one station, L1 (upper limit Pb 218mg/kg). Due to the high concentration of Lead recorded, SOCOTEC re-analysed the sample. The second analysis confirmed the initial finding.
- All stations were classified as non-hazardous with regards to pH.

4.2 Characteristics of the Project

The following table provides a summary of the characteristics of the project. It is important to note that the proposed maintenance works follow on from the most recent dredging carried out in 2011. During the dredging that took place at that time, the bed of the river was lowered to a specific design level. In the intervening years, silt has once again accumulated, so the proposed works aim to restore the bed levels to those achieved during past drainage maintenance.

Size, scale, area, land-take	The proposed dredge site comprises six areas of collective area of 0.96 ha. upstream and downstream of Sarsfield Lock. The proposed dredge material has depths of up to 1m (~0.3m on average). The total volume of material at 8735 m³ and it is estimated that ca. 70m³ of this will be hard material. The remainder will be pumped to the River Shannon upstream of Shannon Bridge.
Details of physical changes that will take place during the various stages of implementing the proposal	Hard substrates deposited in the dredge areas will be removed from the river and taken to an authorised waste facility. The finer sediments, including sand, silt and clay will be transported west, or downstream by the flow of the River Shannon. These activities will result in a reduction in the volume of fine sediment at the proposed dredge areas and an increase in the volume of fine sediment along the margins of the Shannon Estuary where they will eventually settle out.
Description of resource requirements for proposal (water resources, construction material, human presence etc)	Suction hopper dredger equipped with one or two rearward extending suction pipes, dredging pumps, an overflow to discharge the water Fuel and oils
Description of timescale for the various activities that will take place	The dredging works will take place between February and the end of May annually to avoid adversely affecting oysters in the bay and

as a result of implementation (including likely start and finish date)	summer leisure activities. The suction hopper dredger will be on site for a 4-6 week period in the initial year (250,000T) and annually thereafter over a 3-4 week period (between 75,000 and 150,000T p/a), subject to weather and tides.
Description of wastes arising and other residues (including quantities) and their disposal	The principal waste is the dredge material, which comprises of muddy sand dominated by silt-clay and very fine sand for the most part.
Identification of wastes arising and other residues (including quantities) that may be of particular concern in the context of the Natura 2000 network	Some of the substrates in the proposed dredge areas are considered marginally contaminated with arsenic, nickel and zinc. All other parameters are below the lower Irish action limit within the proposed dredge areas.
Description of any additional services required to implement the project or plan, their location and means of construction	N/A

5. Identification of Other Plans, Projects and Activities

5.1.1 Plans

With regards to the potential for in-combination effects, the Limerick City Development Plan was considered. The River Shannon or Abbey River are not zoned. Areas adjacent to these channels are zoned as 'City Centre Areas' described as 'retail commercial' or 'Public Open Space'. See Section 4.3 of Appendix 1 (report for screening for AA) has more detail on plans.

5.1.2 Projects

5.1.2.1 Mulkear European Innovation Partnership¹

The Mulkear European Innovation Partnership (EIP) is a five-year project focused on innovation, technology and knowledge transfer for farmer led enhancement of water quality, instream habitat and riparian management in the Mulkear Catchment covering Limerick and Tipperary counties.

The EIP initiative, co-funded by Ireland and the EU under the Rural Development Programme 2014-2020, is a new co-operation measure under Article 35(1) of the regulation. EIPs promote local solutions to specific issues and involve the establishment of Operational Groups to develop ideas, or take existing ideas/research and put them into practice by being hands on in terms of working towards the resolution of a practical problem.

The Mulkear EIP is bottom-up approach in its design and nature. The project is run by Mulkear Catchment Limited and wider support groups supported by the Department of Agriculture, Food and the Marine. The Mulkear EIP is an opportunity to help address water quality issues on a catchment basis. The project

¹ <https://www.mulkeareip.com/>

commenced in April 2019 and runs until at least December 2023 implementing a 5-year work programme with local farmers.

The project aims to deliver a partnership approach focused on enhancing water quality and sustainable water management on local farms by adopting a catchment approach and implementing a suite of catchment sensitive farming measures to support farm viability, water quality and biodiversity. The project is being implemented across the Mulkear Catchment (Counties Limerick & Tipperary) and has a total budget of €1,172,830.

5.1.2.2 Annacotty Fish Passage Project²

Inland Fisheries Ireland is leading this project as the state agency with responsibility for fish in rivers, such as the Mulkear. The project encourages pro-active engagement from stakeholders across the community including key state agencies, special interest groups, voluntary, public and private sectors.

Annacotty Weir is a high impact barrier to the migration of adult salmon and sea trout and a complete barrier to the migration of sea and river lamprey. To these anadromous species, human-made barriers are considered one of the most pressing threats to existing populations. Freshwater barriers to migration can block or delay migrating fish populations and may lead to increased mortality through diseases and predation. Delays in smolt migration may also affect their survival when they enter the sea. Annacotty Weir has been identified as a significant barrier to the free movement of fish and it is located within the Lower River Shannon 'Special Area of Conservation'. The ultimate goal of this project is to improve fish passage at Annacotty Weir on the River Mulkear for species such as Atlantic salmon, sea lamprey, river lamprey, eels and trout, helping them migrate both up and downstream.

Inland Fisheries Ireland recently secured €99,481 under the Salmon and Sea Trout Rehabilitation, Conservation and Protection Fund. This money will be used to support the assessment and planning phase of this project.

5.1.3 Plans

With regards to the potential for in-combination effects, the Limerick City Development Plan was considered. The River Shannon or Abbey River are not zoned. Areas adjacent to these channels are zoned as 'City Centre Areas' described as 'retail commercial' or 'Public Open Space'.

5.1.4 Permitted and Proposed dredgings in the Locality

A search of An Bord Pleanála online planning enquiry system for granted or on-going planning applications for the River Shannon, the Abbey River and the Shannon Estuary in Limerick was undertaken in March 2023. The relevant planning applications are listed in Table 1. There are numerous other planning applications that involve housing developments, commercial buildings, renovations and change of use of premises but these are of a scale that would not act in combination with the proposed dredge works to impact either the Lower River Shannon SAC or the River Shannon and River Fergus Estuaries SPA.

² <https://www.fisheriesireland.ie/what-we-do/conservation-and-development/annacotty>

Table 1 List of granted and/or on-going planning applications within the vicinity of the proposed dredging site

Application No.	Applicant	Location	Proposed dredging	Decision	Status	Decision Date
312559	Limerick City and County Council	Annacotty, Ballynanty, Castletroy, Corbally, Condell Road, Dock Road and Conigar embankments, Co. Limerick and Athlunkard, Knockballynameath and Quinspool South embankments, Co. Clare.	Ground investigation works to inform the option selection and design of the proposed Limerick City and Environs Flood Relief Scheme.	Conditional	Finalised	20/9/2022
306270	Limerick City and County Council	King's Island, Limerick.	Flood protection measures around King's Island.	Conditional	Finalised	21/5/2021
312146	Aughinish Alumina Ltd.	Townlands of Aughinish East, Aughinish West, Island Mac Teige, Glenbane West, and Fawnamore at or adjacent to Aughinish Island, Askeaton, Co. Limerick	Expansion of the Bauxite Disposal Area, extension to the existing Salt Cake Disposal Cell and extension of the permitted borrow pit at Aughinish Alumina Limited.	Conditional	*	8/12/2021

* Futureproof Clare (FPC), an environmental group has been successful in a High Court challenge to prevent the expansion Aughinish Alumina Ltd³.

5.1.5 EPA Licenced/Registered Facilities

A review of the EPA mapping tool determined that there are no IPPC, IPC or IEL⁴ facilities within the immediate vicinity of the subject site. Approximately 2 km upstream of the proposed dredging, a licenced landfill site (identified as Longpavement Landfill⁵) is situated on the west bank of the River Shannon at Monabraher, Longpavement, Limerick. Limerick Gasworks (IEL Registered Licence No. W00281-01) is located adjacent to the Dock Road, Limerick, approximately 1km south-west of the proposed dredging. Other EPA licenced facilities comprise Atlas Aluminium Limited (P0436-01) and James McMahon Limited (P0329-01) approximately 1.5 km southwest of the proposed dredging respectively. Limerick waste water treatment plant is located approximately 4 km southwest of the proposed dredging This treatment works an agglomeration >10,000 P.E. This facility discharges treated effluent to the River Shannon.

5.1.6 Existing Land-use and On-going Activities

On-going land-use within and extending away from the proposed dredging site comprises mainly agriculture, commercial forestry and commercial quarrying. Residential properties and farms occur throughout the surrounding area.

³ <https://www.radiokerry.ie/news/environmental-group-successful-in-aughinish-alumina-high-court-challenge-330187>

⁴ Integrated Pollution Control (IPC) Licence (formerly IPPC Licence), and Industrial Emissions Licence (IEL)

⁵ EPA Waste Licence No. W0076-01

5.1.7 Potential for Significant In-combination Effects

It is considered that agriculture, forestry, on-going and future potential quarrying operations and to a lesser extent one-off rural residential developments comprise the land-uses and activities which could potentially interact synergistically with the proposed dredging to result in significant cumulative or in-combination effects.

The potential in-combination effects are discussed further in Section 7.7 below.

6. Identification of Natura 2000 Sites

Appropriate Assessment is the consideration of the impact of the project on the integrity of the Natura 2000 site, either alone or in combination with other plans or projects, with respect to the site's ecological structure and function, and conservation objectives. Additionally, mitigation of these impacts can be considered.

In cases where an Appropriate Assessment is required a Natura Impact Statement (NIS) shall be prepared and shall include a report of a scientific examination of evidence and data, carried out by competent persons to identify and classify any implications for Natura 2000 sites in the view of the conservation objectives of the site. The aim of the assessment is to provide a sufficient level of information to the competent authority on which to base their Appropriate Assessment of the plan or project. The plan or project should be fully described particularly in relation to the aspects that could interact with the surrounding environment. The project has been fully described in Section 4 above.

The screening for Appropriate Assessment report concluded, in the absence of mitigation, that significant impacts as a result of the proposed dredging are likely, or significant impacts could not be ruled out at this stage, for the following Natura 2000 sites, listed in Table 2 below. Please see Appendix 1 for the screening for Appropriate Assessment report which has been prepared.

Table 2 Natura 2000 sites included for Stage 2 Appropriate Assessment

Designated Site	Site Code	Proximity of Designated Site to Nearest Point of Subject Site	Hydrological/Ecological Connection? (Yes/No)
Lower River Shannon SAC	002165	Within the designated site	Yes
River Shannon and River Fergus Estuaries SPA	004077	270 m to south-west	Yes

The focus of this assessment is to now determine whether the proposed dredging will have an adverse effect on the features of interest of the Natura 2000 sites i.e. habitats and species. This assessment identifies the environmental aspects of the project that will interact with the ecological requirements or sensitivities of the habitats and species, and in this case relate mainly to potential water quality and/or species disturbance/displacement impacts, as per Section 5. The test of the assessment is whether the plan or project will have 'an adverse effect on the integrity of the site'. Where potentially significant effects are identified proven mitigation measures will be recommended.

6.1.1 Description of Natura 2000 Sites

6.1.1.1 Lower River Shannon SAC (002165)

The Lower River Shannon SAC is designated for the protection of the following qualifying features of conservation interest.

Habitats

- Sandbanks which are slightly covered by sea water all the time [1110]
- Estuaries [1130]
- Mudflats and sandflats not covered by seawater at low tide [1140]
- Coastal lagoons [1150]
- Large shallow inlets and bays [1160]
- Reefs [1170]
- Perennial vegetation of stony banks [1220]
- Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]
- *Salicornia* and other annuals colonising mud and sand [1310]
- Atlantic salt meadows (*Glauco-Puccinellietalia maritima*) [1330]
- Mediterranean salt meadows (*Juncetalia maritimi*) [1410]
- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation [3260]
- *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) [6410]
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0]

Species

- *Margaritifera margaritifera* (Freshwater Pearl Mussel) [1029]
- *Petromyzon marinus* (Sea Lamprey) [1095]
- *Lampetra planeri* (Brook Lamprey) [1096]
- *Lampetra fluviatilis* (River Lamprey) [1099]
- *Salmo salar* (Salmon) [1106] (QI status pertains only to freshwater phases of life cycle)
- *Tursiops truncatus* (Common Bottlenose Dolphin) [1349]
- *Lutra lutra* (Otter) [1355]

The following text summarises the NPWS site synopsis for this designated site. The full site synopsis is available on the NPWS website.

This very large site stretches along the Shannon valley from Killaloe in Co. Clare to Loop Head/ Kerry Head, a distance of some 120km. The site thus encompasses the Shannon, Feale, Mulkear and Fergus estuaries, the freshwater lower reaches of the River Shannon (between Killaloe and Limerick), the freshwater stretches of much of the Feale and Mulkear catchments and the marine area between Loop Head and Kerry Head. Rivers within the sub-catchment of the Feale include the Galey, Smearlagh, Oolagh, Allaughaun, Owveg, Clydagh, Caher, Breanagh and Glenacorney. Rivers within the sub-catchment of the Mulkear include the Killeenagarraff, Annagh, Newport, the Dead River, the Bilboa, Glashacloonaraveela, Gortnageragh and Cahernahallia.

The Shannon and Fergus Estuaries form the largest estuarine complex in Ireland. They form a unit stretching from the upper tidal limits of the Shannon and Fergus Rivers to the mouth of the Shannon Estuary. This site is of great ecological interest as it contains a high number of habitats and species listed on Annexes I and II of the

E.U. Habitats Directive, including the priority habitats lagoon and alluvial woodland, the only known resident population of bottle-nosed dolphin in Ireland and all three Irish lamprey species. A good number of Red Data Book species are also present, perhaps most notably the thriving populations of triangular club-rush. A number of species listed on Annex I of the E.U. Birds Directive are also present, either wintering or breeding (NPWS 2013).

6.1.1.2 River Shannon and River Fergus Estuaries SPA (004077)

The estuaries of the River Shannon and River Fergus form the largest estuarine complex in Ireland. The site comprises the entire estuarine habitat from Limerick City westwards as far as Doonaha in Co. Clare and Dooneen Point in Co. Kerry. The site has vast expanses of intertidal flats which contain a diverse macroinvertebrate community, e.g. *Macoma-Scrobicularia-Nereis*, which provides a rich food resource for the wintering birds. Salt marsh vegetation frequently fringes the mudflats and this provides important high tide roost areas for the wintering birds. Elsewhere in the site the shoreline comprises stony or shingle beaches.

The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: cormorant, whooper swan, light-bellied brent goose, shelduck, wigeon, teal, pintail, shoveler, scaup, ringed plover, golden plover, grey plover, lapwing, knot, dunlin, black-tailed godwit, bar-tailed godwit, curlew, redshank, greenshank and black-headed gull. It is also of special conservation interest for holding an assemblage of over 20,000 wintering waterbirds. The E.U. Birds Directive pays particular attention to wetlands and, as these form part of this SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds.

The River Shannon and River Fergus Estuaries SPA is an internationally important site that supports an assemblage of over 20,000 wintering waterbirds. Apart from the wintering birds, large numbers of some species also pass through the site whilst on migration in spring and/or autumn. This site is a designated Special Protection Area (SPA) under the E.U. Birds Directive for the special conservation interest of the following features of interest:

- Cormorant (*Phalacrocorax carbo*) [A017]
- Whooper Swan (*Cygnus cygnus*) [A038]
- Light-bellied Brent Goose (*Branta bernicla hrota*) [A046]
- Shelduck (*Tadorna tadorna*) [A048]
- Wigeon (*Anas penelope*) [A050]
- Teal (*Anas crecca*) [A052]
- Pintail (*Anas acuta*) [A054]
- Shoveler (*Anas clypeata*) [A056]
- Scaup (*Aythya marila*) [A062]
- Ringed Plover (*Charadrius hiaticula*) [A137]
- Golden Plover (*Pluvialis apricaria*) [A140]
- Grey Plover (*Pluvialis squatarola*) [A141]
- Lapwing (*Vanellus vanellus*) [A142]
- Knot (*Calidris canutus*) [A143]
- Dunlin (*Calidris alpina*) [A149]
- Black-tailed Godwit (*Limosa limosa*) [A156]
- Bar-tailed Godwit (*Limosa lapponica*) [A157]
- Curlew (*Numenius arquata*) [A160]

- Redshank (*Tringa totanus*) [A162]
- Greenshank (*Tringa nebularia*) [A164]
- Black-headed Gull (*Chroicocephalus ridibundus*) [A179]
- Wetland and Waterbirds [A999]

Species vary considerably in different aspects of their ecology with regards to trophic (foraging) guild, food/prey requirements, principal supporting habitat within the site, ability to use alternative habitats within the site and site fidelity/faithfulness (NPWS, 2012b). Species will vary in this use of habitats within a site. This may vary between times of day, seasons and between different sites. The following table outlines the ecological characteristics, requirements and specialities for non-breeding waterbird SCIs within the River Shannon and River Fergus Estuaries SPA (table adapted from NPWS, 2012b).

Table 3 Ecological Characteristics, requirements and specialities of non-breeding waterbird SCI species for River Shannon and River Fergus Estuaries SPA⁶

Species	Distribution ^A	Trophic Guild ^B	Food Prey Requirements ^C	Principal Habitat within site ^D	Ability to use alternative habitats ^E
Bar-tailed godwit	Localised	4	Wide	Intertidal mud/sand flats	2
Black-headed gull	N/C	1,2,4,6,7	Wide	Intertidal flats and shallow and sheltered subtidal	2
Black-tailed godwit	Localised	4	Wide	Intertidal mud/sand flats	2
Cormorant	Widespread	3	Highly specialised	Sheltered and shallow subtidal	1
Curlew	Widespread	4	Wide	Intertidal mud/sand flats	2
Dunlin	Intermediate	4	Wide	Intertidal mud/sand flats	3
Golden plover	Intermediate	4	Wide	Intertidal mud/sand flats	2
Green shank	Intermediate	6	Wide	Intertidal mud/sand flats	3
Grey plover	Localised	4	Wide	Intertidal mud/sand flats	3
Knot	Localised	4	Narrower	Intertidal mud/sand flats	3
lapwing	Widespread	4	Wide	Intertidal mud/sand flats	2
Light-bellied Brent Goose	Localised	1,5,7	Highly specialised	Intertidal mud/sand flats	2
Red shank	Intermediate	4	Wide	Intertidal flats and sheltered shallow subtidal	2
Ringed Plover	Localised	4	Wide	Intertidal mud/sand flats	3
Pintail	Localised	1	Wide	Intertidal mud/sand flats, sheltered and shallow subtidal	2
Scaup	Highly Restricted	2	Wide	Subtidal	1
Shelduck	Localised	1,5	Wide	Intertidal mud/sand flats, shallow subtidal	3
Shoveler	Localised	1	Wide	Lagoon, brackish and freshwater lakes, plus intertidal sand and mud flats	3
Teal	Widespread	1	Wide	Intertidal mud/sand flats, shallow subtidal and lagoons	3
Whooper Swan	Widespread	1,7	Wide	Lagoon and associated habitats, intertidal mudflats and shallow subtidal	2
Wigeon	Widespread	1,5	Narrower	Intertidal mud/sand flats, sheltered and shallow subtidal lagoons	2

A: Distribution – Very Widespread (>300 sites), Widespread (200-300 sites), Intermediate (100-200 sites), Localised (50-100 sites), Highly Restricted (<50 sites) (based on Boland & Crowe, 2012).

B: Trophic Guild – 1= surface swimmer, 2= water column diver (Shallow), 3= water column diver (deeper), 4/5= Intertidal walker (out of water), 6= Intertidal walker (in water), 7= terrestrial walker

C: Food/Prey Requirements – species with a wide prey/food range, a narrow prey range (e.g. a species that forage upon a few species/taxa only), and species with highly specialised foraging requirements (e.g. piscivores).

D: Principal Supporting Habitat present within the SPA (Note that this is the main habitat used when foraging with the exception of Whooper Swan that utilise wetland habitats for roosting and forage within terrestrial grasslands outside of the SPA).

E: Ability to Use Alternative Habitat – refers to the species ability to utilise other habitats adjacent to the site: 1= wide-ranging species, 2= reliant on site but highly likely to use alternative habitat at certain times (e.g. high tide), 3= considered totally reliant on wetland habitats due to unsuitable surrounding habitats and/or species limited by habitat requirements.

F: Site fidelity on non-breeding grounds: Unknown; Weak; Moderate; or High.

⁶ https://www.npws.ie/sites/default/files/publications/pdf/004077RiverShannonandRiverFergusEstuariesSPASupportingDoc_V1.pdf

6.1.2 Impact prediction

The proposed dredging is to be undertaken by a cutter suction head on a barge. The barge will be moored in the dredge area while the suction pump will discharge the dredge material into the flow of the River Shannon below the weir. Works will take place however in an area where sediment has settled and these sediments occur within the SAC where the affected habitats have been identified as depositing lowland river, mud shores and estuary. These habitats have links with some of the habitats listed as qualifying interests of the Lower River Shannon SAC and support some of the species listed as qualifying interests of the Lower River Shannon SAC. Each QI is addressed with regard to direct and indirect impacts, and pathways, and potential effects as set out below.

The following has been taken from the 'Lower River Shannon SAC (site code: 2165) conservation objectives supporting document for marine habitats and species' (NPWS, 2012c) and is relevant to impact assessment for the proposed works:

"It is worth considering at the outset that in relation to Annex I habitat structure and function, the extent and quality of all habitats varies considerably in space and time and marine habitats are particularly prone to such variation. Habitats which vary naturally, i.e. biotic and/or abiotic variables are changing within an envelope of natural variation, must be considered to have favourable conservation condition. 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. The capacity of the habitat to recover from this change is obviously an important consideration (i.e. habitat resilience) thereafter".

Some activities may cause significant disturbance but may not necessarily represent a continuous or ongoing source of disturbance over time and space. This may arise for intermittent or episodic activities for which the receiving environment would have some resilience and may be expected to recover within a reasonable timeframe relative to the six-year reporting cycle (as required under Article 17 of the Directive). This Department is satisfied that such activities could 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.

6.1.2.1 Direct impacts

The proposed maintenance works are within the Abbey River navigation channel at Sarsfield's Lock at the confluence of the Abbey River with the River Shannon. There will therefore be no habitat loss within the semi-natural habitats of the SAC, where works will be limited to maintenance of the previously affected navigation channel.

The dredging of alluvial deposits and disposal to the River Shannon gives rise to the potential for direct water quality impacts arising via the mobilization of suspended solids within the river channel at elevations which may be harmful to habitats, fish and aquatic invertebrates in the River Shannon and Estuary within the Lower River Shannon SAC and the River Shannon and River Fergus Estuaries SPA.

The proposed works at the dredge sites are located approximately 270m upstream (east) of the River Shannon and River Fergus Estuaries SPA so there will be no direct impacts on habitats within this SPA.

The transport of hard material from the proposed dredge sites to Limerick Dock, approximately 1km to the west could result in displacement of birds from the river and/or the river margins. This activity however will involve the movement of only 70m³ of material and therefore be of short duration and intensity. While part of the River Shannon and River Fergus Estuaries would be used to facilitate this movement, this part of the river is frequented by boats, and within an urban context, and as such, there would be no significant disturbance

impact on birds. The conservation interests of the Lower River Shannon SAC are discussed hereunder with regard to direct impacts.

6.1.2.1.1 *Sandbanks which are slightly covered by sea water all the time [1110]*

The extent of mapped 'sandbanks which are slightly covered by seawater all the time' in the Lower River Shannon SAC is given in NPWS (2012b). This habitat is mapped as occurring south of Rinevella Point, Co. Clare and west of Ballybunion, Co. Kerry in the mouth of the Shannon Estuary. This habitat is in excess of 70km to the west of the proposed dredging so there will be no direct impacts on this habitat.

6.1.2.1.2 *Estuaries [1130]*

The Shannon and Fergus Estuaries form a unit stretching from the upper tidal limits of the Shannon and Fergus Rivers to the mouth of the Shannon Estuary (considered being a line across the narrow strait between Kilcredaun Point and Kilconly Point). Within this main unit, there are several tributaries with their own 'sub-estuaries' e.g. the Deel River, Mulkear River, and Maigue River (NPWS, 2012a). Mixing in estuaries is influenced by a number of factors including the size and shape of the inflowing river. This mixing is constantly changing as it also depends on the influence of wind, swell and the state of the tide.

Estuarine habitat occurs in the River Shannon within the proposed dredge areas below Sarsfield Lock, and adjacent to the Abbey River, so there will be some direct impacts on this habitat. Estuarine, including tidal mudflats in the main channel of the River Shannon will be directly affected by the proposed works. The conservation objective document for the Lower River Shannon SAC notes that the estuarine habitat area was estimated as 24,273ha. The area proposed for dredging is less than 1 hectare (0.963 ha.) so the area directly affected is less than 0.004% of the entire area of estuarine habitat in the SAC. A significant negative effect is not predicted due to the very small proportion of this habitat directly affected and the temporary nature of the works.

The impacts relate to removal and disturbance of substrates, with consequent reduction in mass of sediment in the works area associated with dredging. There will be water quality impacts associated with dredging and the discharge of sediment to the estuary. Excessive siltation could have negative ecological effects on estuarine habitat and the ecosystems supported by same. It is important to note that no works will be undertaken outside of the original navigation channel works area, as works are limited to the maintenance of this navigation. There will therefore be no direct loss of semi-natural habitat within the study area.

6.1.2.1.3 *Mudflats and sandflats not covered by seawater at low tide [1140]*

'Mudflats and sandflats not covered by seawater at low tide' occur extensively throughout the Lower River Shannon SAC, in particular along the edges of the Shannon Estuary channel. They occur adjacent to the shores of Limerick Docks and the Inner Shannon Estuaries, beginning at Shannon Bridge and increasing in extent further downstream as the estuary channel widens.

During habitat surveys undertaken for the proposed works two small areas of previously unmapped 'Mud shore (LS4) corresponding to mudflats were identified within the enclosure of Sarsfield Lock. The proposal will result in works within these areas of mudflat so there will be direct impacts on this habitat. It is considered that this habitat will re-establish in the short-term post works given the naturally high levels of suspended solids in Limerick Docks and the sluggish waters within the confines of Sarsfield Lock.

The conservation objective document for the Lower River Shannon SAC notes that the estuarine habitat area was estimated as 8,808ha. The area proposed for dredging is less than 1 hectare (0.963 ha.) so the area directly affected is ca. 0.01% of the entire area of estuarine habitat in the SAC. A significant negative effect is not

predicted due to the very small proportion of this habitat directly affected and the temporary nature of the works.

6.1.2.1.4 *Coastal lagoons [1150]*

According to habitat mapping presented in NPWS (2012b), there are four coastal lagoons within the SAC, namely Quayfield and Poulaeala Loughs, Shannon Airport Lagoon, Scatterry Lagoon, and Cloonconneen Pool. The nearest of these is Shannon Airport Lagoon, located ca. 20km west of the proposed dredging. There will be no direct impacts on these habitats.

6.1.2.1.5 *Large shallow inlets and bays [1160]*

The habitat 'large shallow inlets and bays' is a large physiographic feature that may wholly or partly incorporate other Annex I habitats including reefs, sandbanks and mudflats and sandflats within its area. In contrast to estuaries, large shallow inlets and bays have limited freshwater influence. This habitat-type, with an estimated area of approximately 25,000ha, is mapped as occurring west of Shannon towards the mouth of the estuary. The habitat comprises the channel south of Kilrush, Co. Clare extending westwards to the outer extent of the estuary (NPWS, 2012a). This habitat is in excess of 40km to the west of the proposed dredging. There will be no direct impacts on this QI.

6.1.2.1.6 *Reefs [1170]*

'Reef' occurs throughout the estuary, mainly as scattered and isolated pockets within the inner estuary and covering more extensive areas towards the middle and outer reaches of the channel. A review of mapping available for this habitat-type determined that the closest areas of reef to the proposed dredging comprises areas located in the Inner and Maigue Estuaries of the greater Shannon Estuary, located approximately 10km from the proposed dredge site. There will be no direct impacts on this QI.

6.1.2.1.7 *Perennial vegetation of stony banks [1220]*

This habitat occurs along the coast where shingle (cobbles and pebbles) and gravel have accumulated to form elevated ridges or banks above the high tide mark. This habitat is recorded in 9 locations along the Shannon River and Estuary. At its closest, this habitat occurs at Ballymacrinan Bay (NPWS, 2012a), a distance in excess of 50km west of the project so there will be no direct impacts.

6.1.2.1.8 *Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]*

'Vegetated sea cliffs of the Atlantic and Baltic coasts' occur at the western extent of the Shannon Estuary. At its closest, this habitat is located at Baurrane on the southern coast of Co. Clare (NPWS, 2012a), in excess of 40km west of the proposed dredging so there will be no direct impacts.

6.1.2.1.9 *Salicornia and other annuals colonising mud and sand [1310]*

Salicornia and other annuals colonizing mud and sand are classified by Fossitt (2000) as lower salt marsh. A review of habitat mapping and the coastal habitats supporting document available for the SAC determined that of the ten sub-sites surveyed, mapped and assessed as part of the Saltmarsh Monitoring Project (McCorry & Ryle, 2009) the closest Salicornia habitat is mapped as occurring is the 'Inishdea, Owenshere' sub-site (SMP 0083)(NPWS, 2012a). Inishdea saltmarsh is located in southern Co. Clare, along the western side of the Fergus Estuary, in excess of 28km west of the proposed dredging so there will be no direct impacts.

6.1.2.1.10 *Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330]*

‘Atlantic salt meadows’ (ASM) generally occupy the widest part of the salt marsh gradient. A review of habitat mapping and the coastal habitats supporting document available for the SAC determined that of the ten sub-sites surveyed, mapped and assessed as part of the Saltmarsh Monitoring Project (McCorry & Ryle, 2009), the closest habitat to the proposal site is ca. 9km downstream, or ca. 7km west, where the habitat is classified as Potential Atlantic salt meadows. As noted in the conservation objectives for this site, further unsurveyed areas maybe present within the site. There will be no direct impacts on this habitat as it does not occur in the proposed works area. Mediterranean salt meadows (*Juncetalia maritimi*) [1410]

6.1.2.1.11 *Mediterranean salt meadows (Juncetalia maritimi)* [1410]

‘Mediterranean salt meadows’ (MSM) occupy the upper zone of salt marshes and usually occur adjacent to the boundary with terrestrial habitats. They are widespread on the Irish coastline; however, they are not as extensive as Atlantic salt meadows. A review of habitat mapping and the coastal habitats supporting document available for the SAC determined that of the ten sub-sites surveyed, mapped and assessed as part of the Saltmarsh Monitoring Project (McCorry & Ryle, 2009), the closest MSM site to the proposal site are associated with the estuaries of the Owenslieve, part of the River Fergus Estuary and the Ahacronane River, part of the Lower Shannon Estuary is the ‘Bunratty’ sub-site (SMP 0081)(NPWS, 2012a), so there will be no direct impacts.

6.1.2.1.12 *Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation* [3260]

This annexed habitat has a broad definition, covering from upland, flashy, oligotrophic, bryophyte- and algal-dominated rivers, to tidal reaches dominated by higher plants. The full distribution of this habitat and its sub-types within the SAC are currently unknown. The *Groenlandia densa* (L.) Fourr., Opposite-leaved Pondweed sub-type has been identified as a high conservation element in the SAC. In Ireland, this particular sub-type is associated with tidal reaches of rivers and other periodically disturbed watercourses (e.g. canals and drains) (NPWS, 2012a). *Groenlandia densa* was not identified during habitat surveys carried out at the proposed dredge works sites.

Canadian pondweed occurs in the Abbey River within parts of the proposed dredge sites but this is not conform to ‘Floating river vegetation’ as the habitat is commonly known, so there will be no direct impacts to this habitat.

6.1.2.1.13 *Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)* [6410]

‘Molinia meadows on calcareous, peaty or clayey-silt-laden soils’ is represented in Ireland by both fen and grassland communities on nutrient-poor soils. The habitat is either managed as traditional hay meadows or more usually by extensive pasture. *Molinia* meadows occur in lowland plains on neutral to calcareous gleys, sometimes with a marl layer beneath the surface, or on peaty soils both in lowland and upland situations (NPWS, 2019). The full extent of this habitat within the SAC is currently unknown. It has been recorded on the eastern bank of the Shannon, just north of Castleconnell, Co. Limerick NPWS (2012a).

Given the characteristics and location of the project, it is not considered that the proposal has any potential to impact on this habitat-type, which occurs only the terrestrial environments. Thus, the project will not affect the conservation objectives for ‘*Molinia* meadows’ and the habitat is not considered further in the NIS.

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

Alluvial woodland is a priority Annex I habitat. A number of variants of this habitat exist, of which riparian forests of *Fraxinus excelsior* and *Alnus glutinosa* of temperate and Boreal Europe lowland and hill watercourses are the

most common type found in Ireland. The Interpretation Manual of EU habitats (2013) states that all types occur on heavy soils which are periodically inundated by the annual rise of river levels, but which are otherwise well-drained and aerated during low water. In addition, there are gallery forests of tall willows alongside river channels and occasionally on river islands, where the tree roots are almost continuously submerged (NPWS, 2019a).

Alluvial woodlands occur along the Shannon, in the valley bottoms of the tributaries and on seepage zones on valley sides. Within the SAC, five sites have been surveyed as part of the National Survey of Native Woodlands. These are small stands, restricted to narrow bands where the ground is subject to flooding (NPWS, 2012a). The nearest mapped area of this habitat is at Clare Glen along the main channel of the Clare River, approximately 15km east of the proposed works. Given the characteristics and location of the project, it is not considered that the proposal has any potential to significantly impact on this habitat-type. Thus, the project will not affect the conservation objectives for 'Alluvial forests' and the habitat is not considered further in the NIS.

6.1.2.1.15 *Margaritifera margaritifera* (Freshwater Pearl Mussel) [1029]

The freshwater pearl mussel is a large, long-lived bivalve mollusc found in clean, fast-flowing, well-oxygenated rivers with unconsolidated substrates. Stable, clean gravel and sand with adequate availability of dissolved oxygen provides ideal habitat for juveniles. Water pH and hardness is also important with distribution mainly restricted to acidic, soft waters over-lying non-calcareous rock-types. Low nutrient status is also critical such that excess macrophyte and algal growth is prevented; therefore oligotrophic waterbodies are required. Conservation objectives for this species within the SAC apply to the freshwater pearl mussel population in the Cloon River, County Clare. This population is confined to the main channel and is distributed from Croany Bridge to upstream of Clonderalaw Bridge (NPWS (2012a)). The Cloon River enters the main Shannon Estuary in excess of 40km west of the proposal site.

Given the characteristics and location of the project, and the ecology of this species, it is not considered that the proposal has any potential to significantly impact on freshwater pearl mussel. Thus, the project will not affect the conservation objectives for 'Freshwater Pearl Mussel' and the species is not considered further in the NIS.

6.1.2.1.16 *Petromyzon marinus* (Sea Lamprey) [1095], *Lampetra planeri* (Brook Lamprey) [1096] and *L. fluviatilis* (River Lamprey) [1099]

The three lamprey species likely to occur at the proposed dredge locations: sea lamprey, river lamprey, and brook lamprey. The depositing areas at the proposed dredge locations provides some suitable habitat for larval lampreys which have probably drifted downstream from suitable spawning areas in the main channel in the River Shannon upstream. The proposed dredge locations are on a stretch of fresh water identified as the lower limit/range of suitable juvenile habitat in the Shannon and comprises marginal habitat with low densities of lamprey larvae. Lampreys were not detected in the proposed dredge sites downstream of Sarsfield Lock so the proposed works in these areas would not incur direct impact on lampreys or their habitats. The habitats affected by dredging will start to build up fine sediment when the River Shannon experiences floods and associated high suspended solids levels, so any reduction in suitable habitat for juvenile lampreys will be temporary, lasting only weeks.

The lamprey report (Appendix 3) maps the optimal juvenile lamprey habitats and provides estimated lamprey densities at survey locations within the proposed dredge sites. Three of the four proposed dredge locations within the Abbey River were found to support juvenile lampreys. All locations where lampreys were recorded coincided with areas identified as optimal habitats for same. The one proposed dredge location not identified as providing optimal juvenile lamprey habitat (Site 3) was an area that was not sheltered and subject to strong flows. Using results for sites where optimal habitats occurred within the proposed dredge areas, the average

juvenile lamprey density is considered to be in the order of 0.34/m². The area of optimal habitats that occurred within the proposed dredge areas was calculated as 2640 m², or 0.264 ha. Using these data, it is estimated that 880 juvenile lampreys occur in the optimal habitats directly affected by dredging. The greatest density of lampreys was found to be in the shallows near the margin of the river, outside the proposed dredge areas, with density generally decreasing with depth. Without mitigation, it is likely that hundreds of juvenile lampreys would be lost by the proposed dredging due to the mechanical action associated with the cutting head of the dredger, or if they are drawn into the dredger and discharged without being injured, they would be transferred to the main River Shannon where they would likely be washed downstream and expire in the brackish water of the estuary. It is possible that most lampreys can be removed from affected optimal habitats however before dredging and therefore such a loss can be avoided.

Table 4 Potential loss of lamprey and habitats within the proposed dredge areas

Designated Site	Area (m ²)	Estimated No. of lampreys
Optimal	2640	880
Suboptimal / unsuitable	4410	0
Total area within proposed dredge area (i.e. areas upstream of Sarsfield Lock)	7050	880

The works area does not provide suitable spawning habitat for lampreys within the Abbey River or the Lower Shannon at the lower end of the study area, so there will be no direct impacts on lamprey spawning areas. Migratory sea and river lampreys pass upstream through the River Shannon main channel during their spawning runs and it is considered that only a small proportion use the Abbey River to reach favourable spawning grounds upstream. There could be some disturbance impacts for lampreys migrating through the lower River Shannon should they be passing through at the time dredging is taking place by way of noise and elevated suspended solids in the water column. This could impede upstream or downstream movements, with the effect of energy wastage and increased risk of predation respectively. Elevated levels of suspended solids in the water column could also impact movement of this species through the impacted area and hydrocarbon pollution, if it occurred could affect dissolved oxygenation and therefore lamprey survival if oxygen concentrations were too low. The effects are not considered significant however taking account of the width of the River Shannon adjacent to the works (and related unimpacted area available to navigate the channel) and the episodic nature of the dredging (only taking place with the ebb tide).

There would be direct habitat loss for juvenile lampreys in the short-term arising from the proposed works, with the removal of silt deposits within the existing navigation channel. However, the relatively low numbers of lamprey juveniles and proposed mitigation measures for these species are considered to negate the potential for any significant effects on these species with regard to the integrity of the Lower River Shannon SAC.

The proposed maintenance works would not affect the distribution of lamprey species within the SAC, and with the exception of short term sub-optimal habitat loss, there would be no net impact on the abundance of lamprey species, provided the mitigation measures proposed are implemented.

6.1.2.1.17 *Salmo salar* (Salmon) [1106] QI status pertains only to freshwater phases of life cycle)

Adult salmon occur in the Shannon Estuary prior to returning to natal streams to spawn, and smolts occur in the estuary on their journey from influent rivers to the sea. It is noted that conservation objectives for the Lower

River Shannon SAC are only for salmon in fresh waters, and that the proposed works are within the WFD transitional waterbody 'Limerick Dock' so the proposed works area does not pertain to a freshwater environment. However, it is considered that the proposed dredge areas upstream of Sarsfield Lock, in the Abby River, are within freshwater.

The Abbey River is considered likely to support low numbers of juvenile salmon, and the proposed dredge areas would not be used by spawning salmon with reference to Hendry and Cragg-Hine (2003), which describes the ecology of the Atlantic salmon. It is likely that occasional salmon smolts move through the Abbey River during their downstream migration and some adult salmon may also use the Abbey River as they re-enter fresh water to spawn in upstream areas. Most migrating salmon will use the River Shannon as opposed to the Abby River given its relatively large size however.

The proposed works may therefore give rise to disturbance impacts affecting this species due to noise and elevated suspended solids, but the effect is not considered significant taking account of the width of the River Shannon adjacent to the works (and related unimpacted area available to navigate the channel) and the episodic nature of the dredging (only taking place with the ebb tide). Elevated levels of suspended solids in the water column could also impact movement of this species through the impacted area and hydrocarbon pollution, if it occurred could affect dissolved oxygenation and therefore salmon survival if oxygen concentrations were too low. High suspended solids concentrations can affect the feeding and health of individual species either indirectly through increased turbidity of the water, or directly through clogging of gills (Naden *et al*, 2003). Taking account of the large flow rates at the proposed works locations, the mobility of salmon, and the extent of river available, pollution via suspended solids or hydrocarbons will highly unlikely to be of a magnitude that results in damage to fish.

There will be no impacts affecting salmon with appropriate mitigation measures for the protection of water quality, and timing to avoid times when smolts are moving downstream.

6.1.2.1.18 *Tursiops truncatus* (Common Bottlenose Dolphin) [1349]

There is a resident population of bottle-nosed dolphin in the Shannon Estuary. This is the only known resident population of this Annex II species in Ireland. The majority of the Shannon Estuary is considered to comprise suitable habitat for this species, apart from the inter-tidal areas of the Fergus Estuary and the inner estuary channel in the vicinity of Shannon town stretching east towards Limerick; however, a review of on-line species records shows that sightings are concentrated in the outer channel. Within the SAC two 'critical areas', representing habitat used preferentially by bottlenose dolphin, have been identified. These are located in the vicinity of Tarbert/Killimer and further west towards the mouth of the estuary in the vicinity of Ballybunion and Kilcreaun Point (NPWS, 2012). A review of studies (unpublished reports) available on the NPWS website on the Shannon Estuary bottlenose dolphin population determined that previous surveys have focussed on the outer estuary channel, including these 'critical areas', rather than in the inner estuary in the vicinity of Shannon and the proposed works.

Given the characteristics and location of the project including the localised nature, extent and scale of the proposed works, the dilution potential of the River Shannon and estuary and the distribution of bottlenose dolphin habitat and records within the outer estuary beyond the zone of influence of the proposed dredging, there is no potential to significantly impact on this species. Thus, the project will not affect the conservation objectives for 'Common Bottlenose Dolphin' and the species is not considered further in the NIS.

6.1.2.1.19 *Lutra lutra* (Otter) [1355]

Otter are widespread in Ireland throughout freshwater and coastal habitats. Otter has two basic requirements: aquatic prey and safe refuges in which to rest. In Ireland, otters are found along rivers, lakes and coasts, where

fish and other prey are abundant, and where the bank-side habitat offers sufficient cover. The presence of freshwater, a sufficient prey-base and suitable sites for holts/couches are key factors in determining otter distribution.

The proposed works would be located within Limerick City centre and subject to background lighting, noise, traffic and human disturbance along the existing river walls and bridges. The Abbey River at the proposed dredge sites is bounded by artificial surfaces that include footpaths and pontoons which are used by pedestrians while the Abbey River is used by boat and kayak users. The proposed works are considered likely to give rise to limited disturbance impacts on otter foraging and commuting within the study area due to the presence of machinery and elevated levels of suspended solids via substrate removal. Taking account of the size of the River Shannon at Limerick, otter would likely continue to utilise the watercourse within the works; however, they may not use the lower Abbey River during the works period. Overall, nocturnal movement of otter within the works area is not likely to be affected by the proposed works any more than the existing background influence of city activity, in the context of boat traffic, urban traffic, hard infrastructure and low cover at the proposed dredge locations and immediate environs.

In respect of potential for some very localized and temporary disturbance and/or displacement to otter potentially foraging in the area, Chanin (2003) indicates that otters will rest under roads, in industrial buildings, close to quarries, and at other sites close to high levels of human activity, clearly indicating that otters are very flexible in their use of resting sites and do not necessarily avoid 'disturbance' in terms of noise or proximity to human activity. Increased human presence could reduce the occurrence of otter in the study area for the duration of the works but no couch sites or holts occur in the environs of the dredge sites and bearing in mind the wide availability of suitable habitat in the vicinity of the works, this impact is not considered significant.

The range, distribution and abundance of this species within the Lower River Shannon will not be affected by direct impacts proposed works as works are temporary, will not significantly reduce the amount of animals preyed upon by otter, and a relatively small area of any otters hunting territory will be impacted and only for a short duration.

6.1.2.1.20 *Other considerations*

Integrity of the Lower River Shannon SAC is also dependent on other ecological features in addition to the species and habitats listed as conservation interests. One species identified as being an important component of the Lower River Shannon ecosystem is smelt *Osmerus operlanus*. This fish species is mentioned in the SAC site synopsis. Adult smelt migrate upstream into the upper tidal freshwater reaches of the River Shannon annually to spawn. It is thought that smelt may spawn in the Abbey River so any water quality impacts could affect this species. Smelt shoals during the spawning season which occurs in spring, primarily March, with eggs adhering to stones and instream vegetation (King *et al.* 2011). Smelt could potentially be affected by the works proposed due to increased suspended solids but a significant effect is not predicted because works will take place at the lower end of the freshwater reach of the Abbey River and most smelt in the Shannon system can be expected to spawn upstream of this area i.e. in the Abbey River and River Shannon.

6.1.2.2 Indirect impacts

The proposed disposal of sediments from dredge sites to the main channel of the River Shannon introduces the potential for changes to estuarine habitats downstream through deposition of sediment in areas where the dredged material settles out of suspension. A numerical modelling study was undertaken to examine such impacts of the proposed dredging (MaREI, 2021), which is provided in Appendix 5. The modelling approach was to simulate the largest maintenance dredging event to take place in one works period, as a greatest effect scenario, to assess the impact of the dredging on the downstream benthic environment. The model included both river flow and tidal forcings to simulate the hydrodynamics responsible for sediment transport in the River

Shannon. It should be noted that the model was set up to simulate the transport of finer sediment particles of clay and silt, which represent the greatest threat to smothering of benthic habitat. The model domain covered the entire Shannon Estuary from the western coastline of Kilbaha in Co. Clare, eastwards as far as the Parteen weir in Limerick, in effect, the entire Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA in the zone of influence of the proposed works. The model was configured to yield greatest accuracy in close proximity to the dredge sites. The model utilised a river flow of 176.6m³/s as an input condition, this representing the 25th percentile winter flows of the River Shannon between 2009 and 2019.

The bed level at the end of the model run for the dredging campaign for clay, silt and sand is presented in Figures 3 – 5. From analyses of Figure 3 - 5 below and Figures 12 and 18 of the numerical modelling study (Appendix 5), most of the sediments disposed to the River Shannon at Limerick will be deposited at the following locations along the River Shannon Estuary downstream (to the west) of the proposed works:

1. the southern shore from the works location to ca. 3km west. This referred to Limerick Docks⁷ (EU code IE_SH_060_0900) henceforth; and
2. northern and southern shore ca. 12km west, associated with the Owenogarney and Mague River estuaries, respectively and small bays associated with the northern shore from ca. 14km to 18km west. This part of the estuary is referred to as the Upper Shannon Estuary (EU code IE_SH_060_0800) and the Mague Estuary (EU code IE_SH_060_0700).

Clay, being the smallest fraction of the sediment will be dispersed to the greatest extent. In general, the thickness of disposed sediment deposited decreases with distance downstream.

Where it is predicted to be deposited, clay net bed level thickness is estimated to vary from below 0.05mm to 0.75mm. The deposited depth of clay in the middle estuary will be 0.5mm – 0.15mm. The greatest accumulations will be along the southern shore of the Limerick Docks section of the Estuary, to ca. 3km west of the dredge location at Sarsfield Lock.

Silt net bed level thickness along reach of the middle estuary is predicted to vary from below 0.05mm to 0.6mm. The greatest accumulations will be along the southern shore of the Limerick Dock component of the Estuary in areas ca. 300m, 900m and 1800m west of the works site at Sarsfield Lock.

The prediction for sand deposition indicates that all sand will fall out of the water column in the Limerick Dock part of the Estuary. The greatest concentration of sand deposition will be within 600m of the proposed dredge site at Sarsfield Lock, where some accumulations of above 190mm are predicted in the environs of the R527 (Shannon Bridge), less than 300m downstream of the works, on the southern side of the river. Accumulations of sand beyond 1km are sparse and predicted to be less than 30mm.

The gradient in salinity along the River Shannon Estuary, from the mouth of the estuary to the limit of the tidal influence, likely dictates the diversity of species present along the length of the estuary. Sediment deposition on the estuary bed and suspended solids within the water column also greatly influence species distribution and abundance within the habitat (NPWS, 2019). The proposed dredging will have no influence of salinity levels but will affect sediments to some degree within Limerick Docks, the Upper Shannon Estuary and the northern extent of the Mague Estuary.

It is important to note that, based on WFD monitoring, some 73,417 kg of suspended solids enter the Shannon Estuary on a daily basis from the main rivers entering the transitional waterbody. According to an Application for a Dumping at Sea Permit from Shannon Foynes Port Company⁸, suspended solids levels of 80 mg/l are

⁷ The Shannon Estuary is the largest estuarine complex in Ireland, covering an area of 501 km² of transitional water. The estuary is divided into a number of transitional waterbodies for the purposes of the Water Framework Directive (WFD).

⁸ https://epawebapp.epa.ie/licences/lic_eDMS/090151b280476a10.pdf

common from Limerick City to 40 km down estuary (westwards) and particularly in the upper estuary due to large riverine inputs of suspended material, with the turbidity maximum generally occurring at the freshwater/seawater interface.

Temporally short periods of increased turbidity will have no measurable impact on photosynthesis or the phytoplankton status of Limerick Dock or Inner Shannon Estuary water bodies. Impacts on phytoplankton will be localised and decrease significantly with distance downstream of the operation and will only be present during the physical acts of dredging and dumping. The level of impact on phytoplankton will not be at a level that affects the functioning of the estuarine ecosystem, or the dependent flora within the ecosystem, or indeed the conservation interests of the Lower River Shannon SAC or the River Shannon and River Fergus Estuaries SPA.

Given the naturally high background levels of suspended solids in the estuary (approximately 80 mg/l in the vicinity of Limerick City), the short-lived increase in suspended solids is considered unlikely to have any significant negative impact on the Annex I habitats or infauna in the part of the estuary affected by disposed material. This is because of the nature of the material being dredged, with total organic carbon values ranging from 1.52% to 2.89%, based on the Marine Sediment Characterisation report (Appendix 4). Following concerns over how differences in dredged material properties affects recovery following dredged material deposition on mudflats, Bolam *et al.* (2004) conducted a field manipulation experiment to investigate the effects of increased sediment organic content (from 0.9% to 2.8%) and sand content (from 12.0% to 47.0%) on macrofaunal recolonization and sediment properties on an intertidal mudflat in the UK. The results suggested that while increased sand content had no discernible effect on sediment property changes, increased organic content resulted in marked reductions in redox potential at 1-, 2- and 4-cm sediment depths. These sediments exhibited a distinct 'cracking' appearance on their surfaces. Similarly, while macrofaunal recovery was only affected by increased sand content in the short-term (1 month), total numbers of individuals, number of species and diversity took longer to recover in sediments with increased organic contents. Given the dispersion of dredged sediment over a massive area in the estuary, the increased organic load will be insignificant, with the spoil from dredging of a small area dispersed over many kilometers squared, so the benthic communities and dependent organisms will not be adversely affected.

The sediment dredged from the navigation channel will settle out largely on mudflat where the community is mapped as '*intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex*'. This community is dominated by polychaetes and the bivalve *Macoma balthica*, invertebrates adapted to life in muddy environments. Based on the depths of deposited sediment predicted in the modelling report, the dumping operation will be unlikely to adversely affect benthic infauna, even where deposition depths are greatest. Birds listed as conservation interests using the mudflats will not be affected in terms of foraging opportunities. Overall, the proposed dredging and associated deposition will not result in change significantly different to those envisaged under natural processes. For example, in a situation of long average flow rate of 208.1 m³/s at Limerick⁹ and where suspended solids levels of 80 mg/l regularly occur, the daily quantity of river load transported in suspension is 1438 tonnes (80/1000,000 x 208.1 x 3600 X 24). During the proposed dredging, the total volume of material to be removed is estimated at 8735 m³. Based on silt having a density of 1.3 tonnes/m³, and assuming all suspended material is silt, the daily volume of suspended silt passing downstream through Limerick is approx. 1106 m³. This means that under normal river flow, a quantity of sediment equivalent to that proposed to be dredged could be naturally transferred to the estuary in ca. 8 days.

As mentioned above in Section 6.1.2, some activities may cause significant disturbance but may not necessarily represent a continuous or ongoing source of disturbance over time and space. This is the case for intermittent / episodic proposed dredging for which the receiving environment would have some resilience and will be expected to recover within a reasonable timeframe relative to the six-year reporting cycle.

⁹ <http://www.serbd.com/MultiDownloads/Creport/Chapters/Physical%20Description%20Ch3.pdf>

The potential for direct impacts arising with regard to hydrological effects were considered as part of the current assessment. If the works are limited to the removal of accumulated silt to the design level of the original scheme however, hydrological impacts affecting flow velocities, channel depths, storage and draw-down from the Abbey River would be as per the original scheme, so significant hydro-morphological impacts would not occur, nor would significant ecological effects. Dredging is required where silt has settled because of the low energy associated with sheltered parts of the river, dictated by walls and strong flows away from walls. Most water flowing through the River Shannon and Abbey River in the environs of the proposed dredge sites is via the deeper areas with little accumulations of fine sediment, so the proposed dredging will have no significant impacts on adjacent areas due to alterations of flow. Downstream of Sarsfield Lock, there will be dredging adjacent to mudflat, so this introduces the risk of alteration of mudflat beyond the footprint of works. This could happen if water flow rates increased, especially where an artificial edge has been created by dredging and where shear stress could result in erosion. Large tidal alongshore flows, which could lead to high shear stresses, do not feature along the margins of the River Shannon Estuary below Sarsfield Lock. This is because flows are largely confined to the center of the channel at low tide, which corresponds to times when the mudflat is not in contact with moving water, and because flows are negligible at times when the mud is covered with water, due to shelter provided by Sarsfield Lock.

There will be ex-situ indirect impacts on the SPA with regard to alterations of estuarine habitats as described above for the Lower River Shannon SAC. These physical impacts could have a negative effect on the infauna of mudflats and therefore potentially affect some feeding grounds of birds within Limerick Docks, the Inner Estuary and the Mague Estuary i.e. due to deposition of sediments from the dredge sites on these areas during high tide and reduced feeding opportunities for birds that use these areas at low tide. The level of impact is considered insignificant however, taking account of the depth of deposition on bird foraging habitats, the temporary nature of the works and the resilience of estuarine habitats with respect to fallout of suspended materials in the water column.

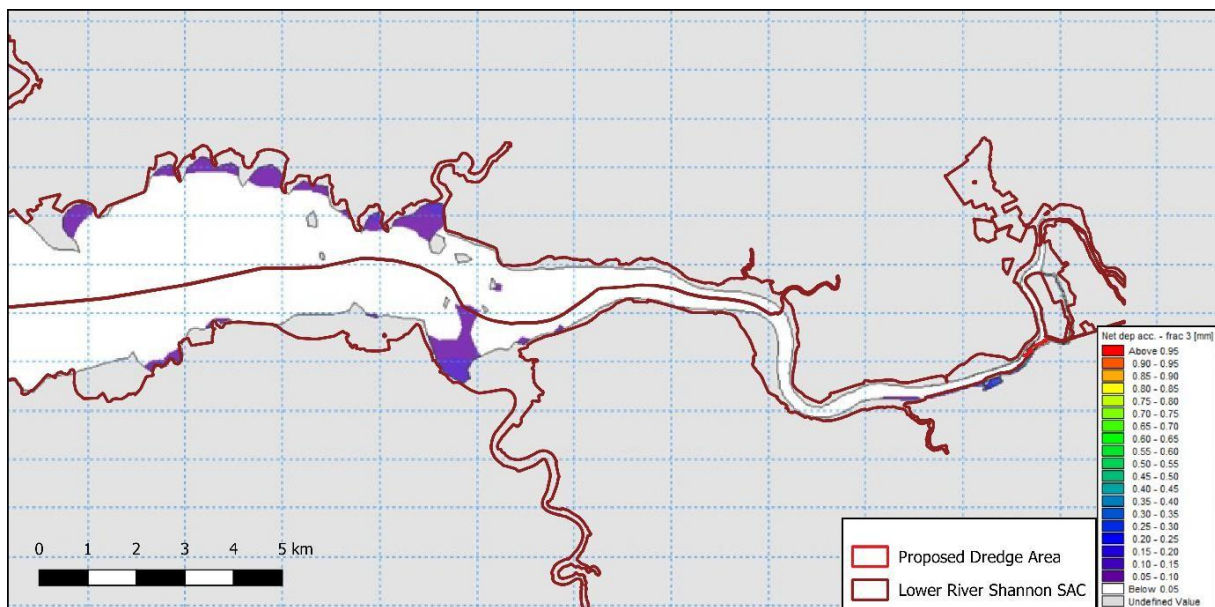


Figure 3 Clay net deposition at the end of the model run for the dredging campaign

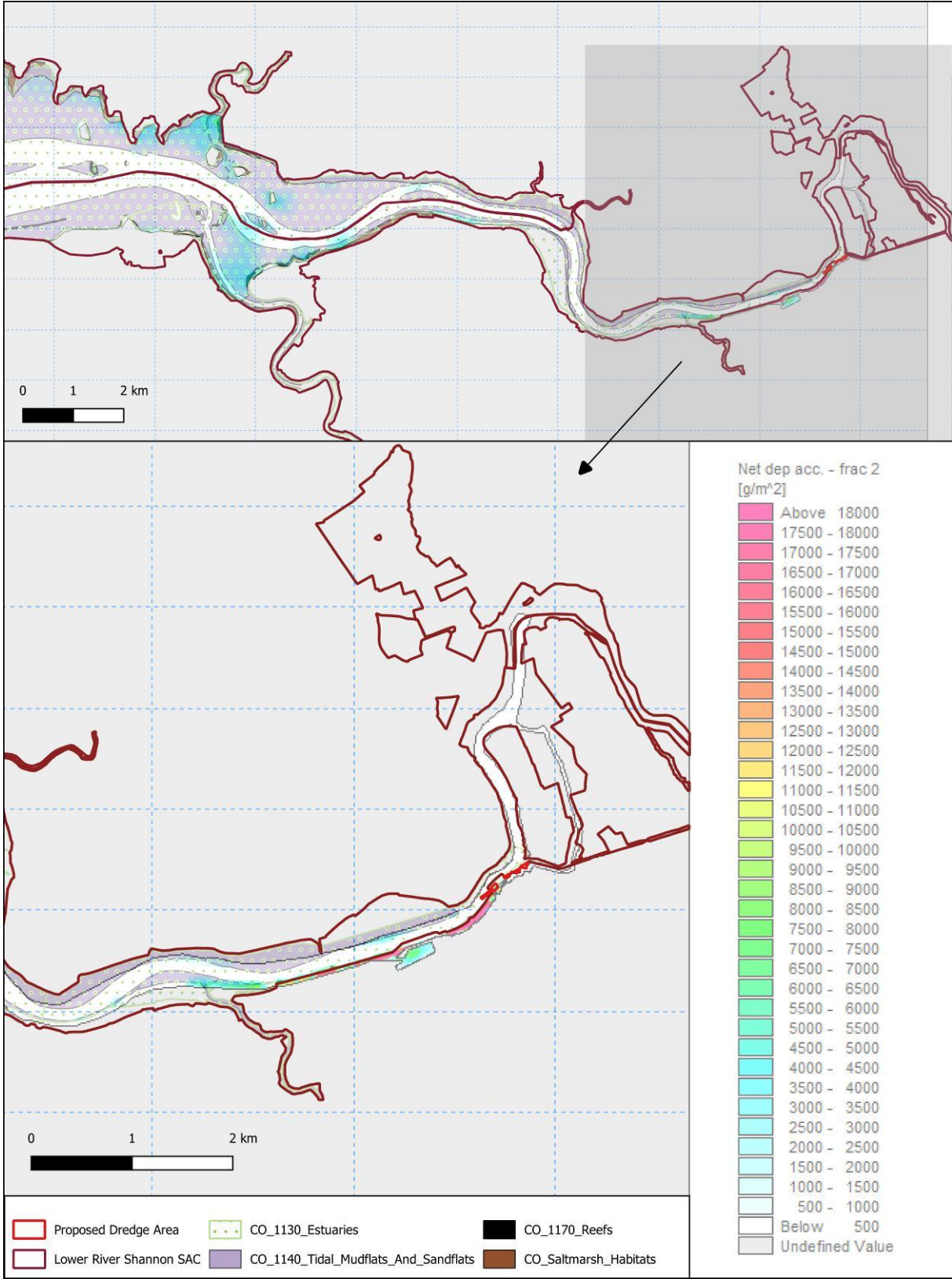


Figure 4 Silt net deposition at the end of the model run for the dredging campaign

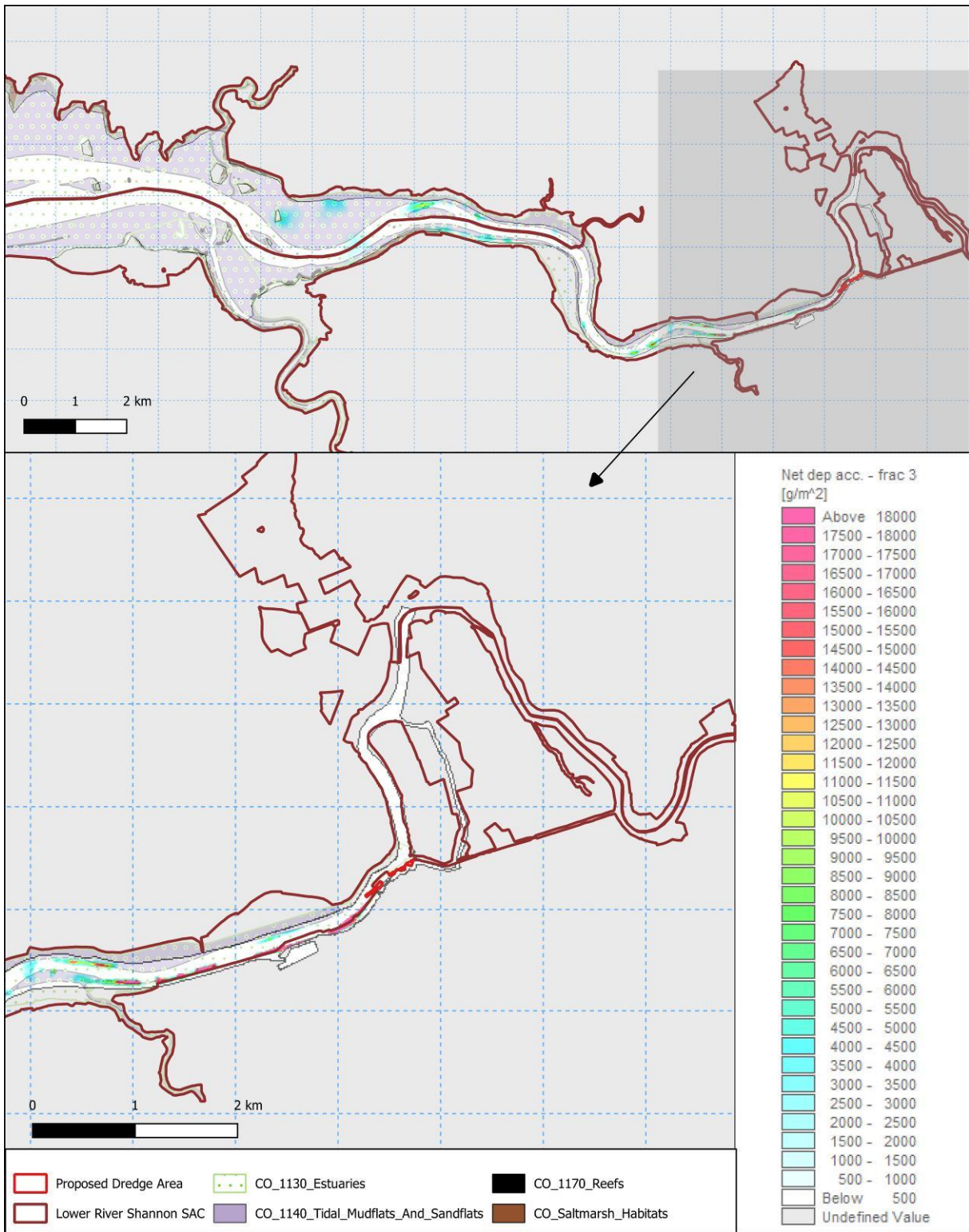


Figure 5 Sand net deposition at the end of the model run for the dredging campaign

Based on the sediment sampling information provided in Appendix 4 there is some potential that the heavy metal Lead could be transported from the upper site on the Abbey River at Custom House Quay to downstream areas. Additional indirect impacts due to mobilization could include the re-suspension and remobilization of Lead which may be transported downstream of the works area to the River Shannon Estuary within the SAC and

SPA, potentially affecting infauna of estuarine sediment and birds that depend on the benthic community for feeding. Taking account of the fact that the concentration of this heavy metal at level above WAC was detected only at one location, works at only 1 set up location out of 28 will entail disturbance of this sediment over a short duration of less than 4 hours (based on 108 hours in total at 28 stations), and dispersion/dilution ensuing from disposal to the River Shannon, the impact on biota is not expected to be significant. Nonetheless, given the uncertainty, mitigation will be required to ensure Lead is not released to the River Shannon at a concentration above that deemed environmentally acceptable.

6.1.2.2.1 *Sandbanks which are slightly covered by sea water all the time [1110]*

The extent of mapped 'sandbanks which are slightly covered by seawater all the time' in the Lower River Shannon SAC is given in NPWS (2012b). This habitat is mapped as occurring south of Rinevella Point, Co. Clare and west of Ballybunion, Co. Kerry in the mouth of the Shannon Estuary. This habitat is in excess of 70km to the west of the proposed dredging. Given the intervening distance between the proposal and this habitat, it is considered that the project does not have potential for significant effects on sandbanks. The hydrodynamic modelling study indicates that substrates from dredge works will not be transported to the outer estuary, all deposited in either Limerick Docks or the upper Shannon Estuary. Thus, the project will not affect the conservation objectives for 'sandbanks which are slightly covered by sea water all the time' and the habitat is not considered further in the NIS.

6.1.2.2.2 *Estuaries [1130]*

Resuspension and release of sediment will take place during dredging, increasing the suspended solids concentration in the estuary. It is considered that any potential water quality impacts will be localised in view of the localised nature, extent and scale of the proposed works and due to the dilution potential of the River Shannon and estuary. Sediment mobilised during the works will be carried out towards the sea, or west due to the flow of the River Shannon and because works will take place during the ebb tide. The hydrodynamic modelling study indicates that some substrates from dredge works will be transported to the Upper Shannon Estuary, around the estuaries of the Fergus and Maigue, but most sediment will be deposited to Limerick Docks within 3km of the proposed works. Excessive siltation can have negative ecological effects on estuarine habitat and the ecosystems supported by same but the magnitude of increased deposition as a result of the proposed dredging is so low that it is considered physically imperceptible and ecologically insignificant.

An impact of the proposed dredging that is not possible to quantify is that related to the remobilisation of Lead. As outlined above, this toxic metal is of concern at only one location and its release to the water column of the River Shannon could have effects on animal life in the estuary downstream. Due to this water quality uncertainty, this CI will be considered further in the NIS. While some other CIs of the SAC are a subset of the CI 'Estuaries', the subject of Lead will not be discussed hereto forth with respect to impacts, given the low probability of significant effects. Mitigation will be required in relation to Lead, and this is discussed in Section 8.

6.1.2.2.3 *Mudflats and sandflats not covered by seawater at low tide [1140]*

With alteration of bed levels, there is also some potential for erosion of mudflats due to localised changes in flow adjacent to the dredge areas. This impact will not be of high magnitude however because the overall aim of the dredging is to level the bed at the works areas, so no abrupt changes and therefore no significant erosion is predicted.

Beyond the zone of the proposed dredging, the works will not cause a change in biotic and/or abiotic variables in excess of what could reasonably be envisaged under natural processes within the estuary, taking account of background environmental conditions (large river giving rise to massive dilution of discharged sediment, naturally high levels of sediment) and the extent and resilience of mudflats.

The impact is considered imperceptible, given the localised and temporary nature of the works and the fact that the sediment will be dispersed over a very large area, based on modelling. The most extensive impact will be on the mudflats associated with the Inner estuary and the Maigue Estuary, where deposits of clay will be no more than 0.15mm. Furthermore, the greatest accumulation of disposed sediment pertains to sand, and this will generally not be deposited on mudflat, as per the predictive model, due to speed of currents and shape of the channel. The model that was used to predict deposition depths used a flow of 176.6m³/s as an input condition. When flow is greater than this (the River Shannon has a long-term average flow rate of 208.1 m³/s at Limerick), the dispersion rates can be expected to be even greater so the depths of accumulated sediment in the Shannon Estuary downstream would be generally less than that predicted by the model.

Target 1 of the conservation objectives for ‘mudflats and sandflats not covered by seawater at low tide’ refers to the stability of the permanent habitat area, subject to natural processes (NPWS, 2012a). ‘Mudflats and sandflats not covered by seawater at low tide’ area was estimated using OSI data as 8,808ha. The ex-situ effects will be limited to a small fraction of this area, with the most intense effects on the narrow strip of this habitat in the Limerick Dock component of the estuary. Overall, the impact is not considered significant as the proposed dredging will not undermine biodiversity conservation objectives for the Lower River Shannon SAC i.e. the habitat area will not decrease and intertidal communities will be conserved.

6.1.2.2.4 *Coastal lagoons [1150]*

According to habitat mapping presented in NPWS (2012b), there are four coastal lagoons within the SAC, namely Quayfield and Poulaeala Loughs, Shannon Airport Lagoon, Scatterry Lagoon, and Cloonconneen Pool. The nearest of these is Shannon Airport Lagoon, located ca. 20km west of the proposed dredging and this lagoon is disconnected from the greater estuary via sluice gates. The other lagoons are beyond the zone of influence of the sediments mobilised during the dredging. Therefore, the project does not have the potential to affect the lagoons conservation objectives and thus ‘Coastal lagoon’ habitat will not be considered further in the NIS.

6.1.2.2.5 *Large shallow inlets and bays [1160]*

This QI is mapped as occurring west of Shannon towards the mouth of the estuary, in excess of 40km to the west of the proposed dredging. Given the intervening distance between the proposal and this habitat it is considered that the project does not have potential for significant effects on this habitat. Thus, the project will not affect the conservation objectives for ‘large shallow inlets and bays’ and the habitat is not considered further in the NIS.

6.1.2.2.6 *Reefs [1170]*

The closest areas of reef to the proposed dredging are located approximately 10km to the west. Modelling indicates deposition of some clay and silt to this part of the estuary but deposited depths are very shallow. The model predicts that, where clay will potentially be deposited on reef habitat, depths will range from 0.02 mm to 0.05 mm. Any potential water quality impacts will be minimal in view of the dilution potential of the River Shannon and estuary and also with reference to naturally high suspended solids concentrations that periodically exist in the waterbody (spring tides in combination with westerly winds result in conditions that increase mobilisation of clay in the water column). The proposed dredging will involve disposal of 8665m³ of sediment to the River Shannon over the course of 108 hours (5 hour working windows). Based on an average river flow of 208.1m³/s, the projected increase in Suspended Solids due to dredging would be 5.8mg/l following homogenous mixing. In the context of frequent background levels of 80mg/l, the predicted increase in Suspended Solids is not considered significant, increasing only by 7.25%.

Bearing in mind the frequently naturally high background levels of suspended solids, any minor changes to the reef habitats and ecosystems supported are not deemed significant. It is considered that the community types

that comprise this habitat will not be adversely affected: Furoid-dominated intertidal reef community complex; Mixed subtidal reef community complex; Faunal turf-dominated subtidal reef community; Anemone-dominated subtidal reef community; and Laminaria- dominated community complex, and as such, 'Reefs' will not be considered further in the NIS.

6.1.2.2.7 *Perennial vegetation of stony banks [1220]*

At its closest, this habitat occurs at a distance in excess of 50km west of the project. Given the distance intervening, the proposal has no potential to significantly impact on this habitat-type. Thus, the project will not affect the conservation objectives for 'perennial vegetation of stony banks' and the habitat is not considered further in the NIS.

6.1.2.2.8 *Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]*

At its closest, this habitat is in excess of 40km west of the proposed dredging. Given the characteristics of the project, and the distance intervening, it is not considered that the proposal has any potential to significantly impact on this habitat-type. Thus, the project will not affect the conservation objectives for 'Vegetated sea cliffs of the Atlantic and Baltic coasts' and the habitat is not considered further in the NIS.

6.1.2.2.9 *Salicornia and other annuals colonising mud and sand [1310]*

The nearest area of this habitat is along the western side of the Fergus Estuary, in excess of 28km west of the proposed dredging and to the west of any influence of the disposed sediment.

Given the characteristics of the project including the localised nature, extent and scale of the proposed works, and the distance intervening, it is not considered that the proposal has any potential to significantly impact on this habitat-type. Thus, the project will not affect the conservation objectives for 'Salicornia and other annuals colonising mud and sand' and the habitat is not considered further in the NIS.

6.1.2.2.10 *Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330]*

With reference to conservation objectives, estuary type saltmarsh over a mud substrate is what typically characterises the substrate associated with this habitat. The clay component of the dredge material discharged to the River Shannon may be some deposition of mud on ASM, but the quantity will be negligible. It is noteworthy, as per NPWS (2019a), that the accumulation of muddy sediments is what leads to the development of saltmarsh, so a very small addition of clay, the same material that is deposited naturally onto saltmarsh and which allows for the development of saltmarsh will not affect any of the attributes or contravene and targets set out in the conservation objectives for this habitat with respect to the conservation objectives for the Lower River Shannon SAC. With the minimal increase to clay deposition, as projected by modelling, structural variation within sward, transitional zones and sub-communities with typical species will be maintained as is Atlantic salt meadows contain several distinctive zones that are related to elevation and submergence frequency, and the lowest part along the tidal zone is generally dominated by common saltmarsh-grass (NPWS, 2019a). It is this lower zone of the ASM that will be subject to the greatest exposure to clay deposition and this fraction of the ASM will only be inundated at high tide.

Particle modelling does not predict deposition of sand or any substantial amounts of silt on ASM, so these particles will not affect ASM habitat as they will not be deposited to any significant degree. The natural circulation of sediments and organic matter will not be affected, so the physical structure of the ASM, including the pan structure will be maintained, with reference to the proposed dredging and deposition.

For reasons outlined above, it is considered that there is no potential for significant effects to occur, and as such, 'Atlantic salt meadows' will not be considered further in the NIS.

6.1.2.2.11 *Mediterranean salt meadows (Juncetalia maritimi) [1410]*

The closest MSM sites to the proposal site are associated with the estuaries of the Owenslieve, part of the River Fergus Estuary and the Ahacronane River, part of the Lower Shannon Estuary), 32 km and 36km from the proposed dredge site respectively and both beyond the zone of influence.

Given the characteristics of the project including the localised nature, extent and scale of the proposed works, and the distance intervening, it is not considered that the proposal has any potential to significantly impact on this habitat-type. Thus, the project will not affect the conservation objectives for 'Mediterranean salt meadows' and the habitat is not considered further in the NIS.

6.1.2.2.12 *Water courses of plain to montane levels with the Ranunculion fluitantis and Callitriche-Batrachion vegetation [3260]*

Canadian pondweed occurs in the study area so must be considered in terms of it outcompeting other plants by shading. This plant is aquatic, so is at its lower limit in the Abbey River upstream of Sarsfield Lock. 'Floating river vegetation' is not considered to be within the zone of influence of the project and thus, there is no potential for significant indirect impacts to this habitat.

It is likely that fragments of this plant are frequently washed downstream during high flows but perish when exposed to brackish waters. The proposed works will cause an influx of Canadian pondweed to the River Shannon but the plant will not survive in the marine environment and therefore will not recolonise other freshwater habitats within the SAC.

6.1.2.2.13 *Petromyzon marinus (Sea Lamprey) [1095], Lampetra planeri (Brook Lamprey) [1096] and L. fluviatilis (River Lamprey) [1099]*

There may be indirect impacts on lamprey nursery areas adjacent to proposed dredge areas, if soft substrates destabilise, and get washed away by river flow. This could result in juvenile lampreys being carried downstream and into brackish water where they would perish.

6.1.2.2.14 *Salmo salar (Salmon) [1106] QI status pertains only to freshwater phases of life cycle)*

The component of proposed works within the Abbey River are at the lower extent of the freshwater reach of the River Shannon, the Abbey River being a tributary and reconnecting with the main channel of the Shannon at Sarsfield Lock. All indirect impacts of the proposed works are in the downstream direction and it is noted that the River Shannon downstream of Sarsfield Lock is brackish, so there will be no indirect impacts on salmon, as the QI status of the species only pertains to freshwater phases.

6.1.2.2.15 *Lutra lutra (Otter) [1355]*

Any water quality impacts associated with dredging via machinery (hydrocarbon source) and sediment disturbance could affect the feeding efficiency of otter in downstream areas via increased suspended solids levels (reducing visibility) and reduction in prey biomass if pollution was significant. This impact is predicted to be insignificant given the temporary nature of the works, the naturally high suspended solids levels that feature in the River Shannon Estuary, large river flow and that machinery used will be operating according to best practice.

6.1.2.2.16 *Other considerations*

There is potential for the re-suspension and transportation of a variety of polluting substances, including PCB's, Hydrocarbons, PAH's, metals and other potentially polluting materials. On the 20th of July 2022, 10 sediment stations were sampled for physical and chemical analysis to assess the nature of the material to be dredged (see

Appendix 4). The sediment analysed for Waste Acceptance Criteria¹⁰ was classified as inert at four stations and non-hazardous with regards to total organic carbon at four stations. Based on the results, and with the possible exception of Lead, there are no significant issues predicted with release of these substances to the water column as concentrations are not deemed hazardous with respect to Landfill Waste Acceptance Criteria Limit Values. Lead occurred at a concentration above the upper action level in the sediment at one of the three sampled locations at the uppermost dredge location on the Abbey River. Lead is a toxic cumulative poison (EPA, 2001). Environmental quality standards for priority substances and certain other pollutants are stipulated in Directive 2008/105/EC of the European Parliament and of the council. Lead is on the list of priority substances in the field of water policy.

According to Eggleton and Thomas (2004):

- sediment disturbance can lead to changes in the chemical properties of sediment that stimulate the mobilisation of contaminants
- remobilisation of sediment-associated contaminants can occur during natural events, such as tidal movement and storms, or during human activities such as dredging and dredge disposal and
- the fate of contaminants in undisturbed sediments and in sediments that subjected to major disturbances is not well understood.

Significant negative effects on fauna in the Shannon Estuary with regard to Lead are unlikely however for the following reasons:

- the receiving waterbody, the River Shannon provides massive dilution, having a long-term average flow rate of 208.1 m³/s at Limerick¹¹. Following mixing with ambient waters, Lead would be only available to biota in concentrations below those deemed damaging to the ecosystem of the Shannon Estuary, where it would settle following discharge from the source site.
- Leads toxicity to aquatic life is strongly correlated with the concentration of dissolved labile lead (Demayo, 1982).
- Any Lead mobilised will be dispersed throughout over a large area and settle out in finer sediment as depicted by the modelling (See Appendix 5). As noted in Eggleton and Thomas (2004), fine-grained bottom sediments tend to accumulate contaminants due to their sorptive nature, and thus act as an important reservoir by reducing the toxicity potential to aquatic organisms.
- The Lead concentration threshold for WAC was exceeded at only one location.

The dissolved lead water quality standard for the protection of fish propagation in saltwater is 8 µg/L¹². Where Lead exceeded the WAC standard of 218 mg/kg at the uppermost survey station, it was found at 1160mg/kg, so there is some potential for impacts to the receiving ecosystems.

Smelt are a component of the Lower River Shannon SAC feed on plankton and shrimps when young before turning piscivorous. Increased suspended solids of the magnitude and duration likely to arise from the proposed works are not expected to affect smelt.

¹⁰ Waste Acceptance Criteria (WAC) analysis involves testing the solid sample for contamination and pollutants before disposal in landfills. Water is passed through the material to form a leachate. The leachate is then analysed for the various harmful elements. A certificate of analysis is produced detailing all of the results. The results are compared to established limits and the material is classed as inert, stable non-reactive or hazardous.

¹¹ <http://www.serbd.com/MultiDownloads/Creport/Chapters/Physical%20Description%20Ch3.pdf>

¹² https://19january2021snapshot.epa.gov/sites/static/files/2015-06/ny_al_394_03121998.pdf

6.1.3 Selection of Qualifying Features for Impact Assessment

When Natura 2000 sites are selected for stage 2 assessments, then all the qualifying features of conservation interest must be included in that stage of the assessment. However, when assessing impact, qualifying features are only considered relevant where a credible or tangible source-pathway-receptor link exists between the proposed dredging and a protected species or habitat type. In order for an impact to occur there must be a risk initiated by having a 'source' (e.g. nearby watercourse), a 'receptor' (e.g. a protected species associated aquatic or riparian habitats), and an impact pathway between the source and the receptor (e.g. a watercourse which connects the proposed dredging site to the site designated for the protection of habitats or species).

Identifying a risk that could, in theory, cause an impact does not automatically mean that the risk event will occur, or that it will cause or create an adverse impact. However, identification of the risk does mean that there is a latent possibility of ecological or environmental damage occurring, with the level and significance of the impact depending upon the nature of the risk, the extent of the exposure to the risk and the characteristics of the receptor. Therefore, bearing in mind the scope, scale, nature and size of the proposed maintenance works, its location relative to the distribution of the species and habitats listed and the degree of connectedness that exists between the proposed works and the potential receptors, it is considered that not all of them are within the zone of potential impact.

An evaluation based on these factors to determine which species and habitats are the plausible ecological receptors for potential impacts of the unmitigated proposal has been conducted. Table 5 lists the qualifying features of the Lower River Shannon SAC (002165) and the River Shannon and River Fergus Estuaries SPA (004077) and evaluates through a scientific examination of evidence and data whether or not these features are plausible ecological receptors and thus should or should not be selected for further assessment in the NIS. The qualifying features that are selected for further assessment are discussed further in Table 5 followed by an assessment of potentially significant adverse effects arising from the proposed maintenance dredging works.

I-WeBS count subsites and roost locations within the ZOI of proposed dredging locations are illustrated in Figure 6. There is a terrestrial black-headed gull roost site at Sarsfield Lock (roost ID PT3) and another ca. 270m south of Sarsfield Lock (PT6) in the Cathedral subsite (Code OI448). There is a mute swan terrestrial / subtidal roost site (PT7) on the north shore of the Shannon in the Cathedral subsite. There is a herring gull and terrestrial black-headed gull roost site (PT1) in the Cathedral subsite ca. 900m north of the nearest proposed dredge location. These roosts are east / upstream of the SPA.

Within the SPA, the nearest roost location to the proposed dredge works is ca. 3.4km west / downstream at a terrestrial black-headed gull and redshank roost (PT8) within Coonagh Point subsite. There is a subtidal black-headed gull roost (PT9) within Coonagh Point subsite (OI457) ca. 4.3 km west / downstream of the proposed dredge site. There is a subtidal common gull roost (PT10) within Coonagh Point subsite ca. 5.6 km downstream of the proposed dredge site.

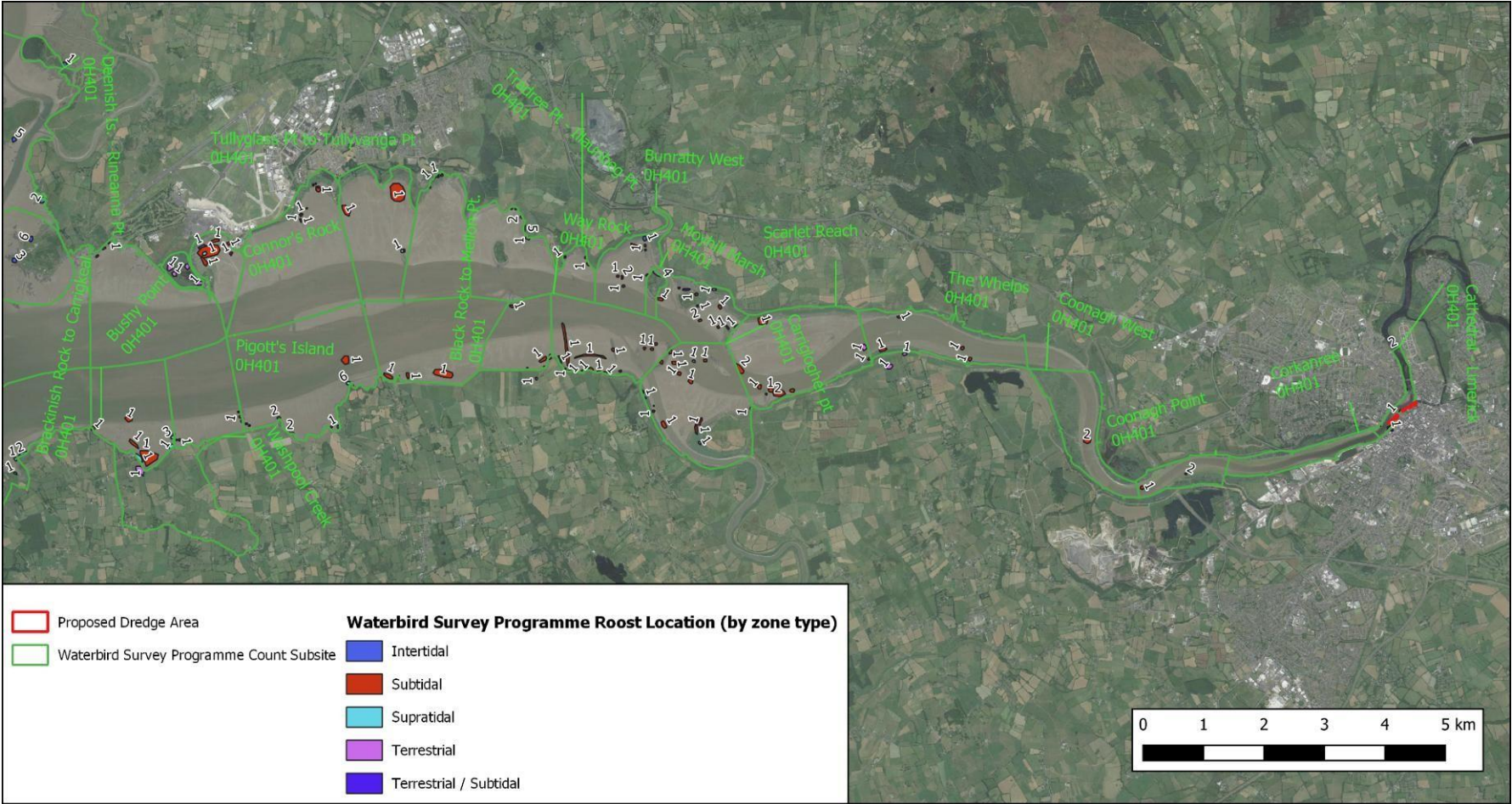


Figure 6 I-WeBS count subsites and roost locations within the ZOI of the proposed dredging

Table 5 Selection of qualifying features for impact assessment¹³

Qualifying Features	Potential for Significant Impacts	Rationale
Lower River Shannon SAC (002165)		
Sandbanks which are slightly covered by sea water all the time [1110]	No	The extent of mapped 'sandbanks which are slightly covered by seawater all the time' in the Lower River Shannon SAC is given in NPWS (2012b). This habitat is mapped as occurring south of Rinevella Point, Co. Clare and west of Ballybunion, Co. Kerry in the mouth of the Shannon Estuary. This habitat is in excess of 50km to the west of the proposed dredging. Given the intervening distance between the proposal and this habitat it is considered that the project does not have potential for significant effects on sandbanks. The hydrodynamic modelling study indicates that substrates from dredge works will not be transported to the outer estuary, all deposited in either Limerick Docks or the upper Shannon Estuary. Thus, the project will not affect the conservation objectives for 'sandbanks which are slightly covered by sea water all the time' and the habitat is not considered further in the NIS.
Estuaries [1130]	Yes	The Shannon and Fergus Estuaries form a unit stretching from the upper tidal limits of the Shannon and Fergus Rivers to the mouth of the Shannon Estuary (considered being a line across the narrow strait between Kilcredaun Point and Kilconly Point). Within this main unit, there are several tributaries with their own 'sub-estuaries' e.g. the Deel River, Mulkear River, and Maigue River (NPWS, 2012a). Mixing in estuaries is influenced by a number of factors including the size and shape of the inflowing river. This mixing is constantly changing as it also depends on the influence of wind, swell and the state of the tide. Estuarine habitat occurs in the River Shannon within the proposed dredge areas below Sarsfield Lock, and adjacent to the Abbey River. It is considered that any potential water quality impacts will be localised in view of the localised nature, extent and scale of the proposed works and due to the dilution potential of the River Shannon and estuary. The hydrodynamic modelling study indicates that some substrates from dredge works will be transported to the Upper Shannon Estuary, around the estuaries of the Fergus and Maigue, but most sediment will be deposited to Limerick Docks within 3km of the proposed works. There is some potential for water quality impacts due to elevated levels of the metal Lead and subsequent ecological effects. Therefore, 'Estuaries' will be considered further in the NIS.
Mudflats and sandflats not covered by seawater at low	No	'Mudflats and sandflats not covered by seawater at low tide' occur extensively throughout the site, in particular along the edges of /the Shannon Estuary channel. They occur adjacent to the shores of Limerick Docks and the Inner Shannon Estuaries, beginning at Shannon

¹³ Information on distribution of birds listed as SCIs of the River Shannon and River Fergus Estuaries SPA is from a review of waterbird distribution for SCI species within the SPA carried out as part of the sub-site assessments for the 2010/11 Waterbird Survey Programme, as outlined in NPWS (2012d). This data is applicable with respect to various bird species usage of the specific parts of the SPA, in cognisance that birds tend display fidelity/preference to areas that provide suitable roosting and foraging habitats and that there has been no significant change to the estuarine habitats supporting wading birds since the 2010/11 Waterbird Survey.

Qualifying Features	Potential for Significant Impacts	Rationale
tide [1140]		Bridge and increasing in extent further downstream as the estuary channel widens. During habitat surveys undertaken for the proposed works two small areas of previously unmapped 'Mud shore (LS4)' corresponding to mudflats were identified within the enclosure of Sarsfield Lock. The proposal will result in works within these areas of mudflat so there will be direct impacts on this habitat. It is considered that this habitat will re-establish in the short-term post works given the naturally high levels of suspended solids in Limerick Docks and the sluggish waters within the confines of Sarsfield Lock. The works proposed will directly be impacting a habitat listed as a CI of the SAC, but the proportion of habitat directly impacted is negligible, at < 0.004% of the total within the SAC. Based on modelling the impact of deposition on mudflats due to the discharge of dredged material is not considered significant so there is no potential for significant effects to occur, and as such, this habitat is not considered further in the NIS.
Coastal lagoons [1150]	No	According to habitat mapping presented in NPWS (2012b), there are four coastal lagoons within the SAC, namely Quayfield and Poulaeala Loughs, Shannon Airport Lagoon, Scatterry Lagoon, and Cloonconneen Pool. The nearest of these is Shannon Airport Lagoon, located ca. 20km west of the proposed dredging and this lagoon is disconnected from the greater estuary via sluice gates. The other lagoons are beyond the zone of influence of the disposed sediments Therefore, the project does not have the potential to affect the lagoons conservation objectives and thus 'Coastal lagoon' habitat will not be considered further in the NIS.
Large shallow inlets and bays [1160]	No	The habitat 'large shallow inlets and bays' is a large physiographic feature that may wholly or partly incorporate other Annex I habitats including reefs, sandbanks and mudflats and sandflats within its area. In contrast to estuaries, large shallow inlets and bays have limited freshwater influence. This habitat-type, with an estimated area of approximately 25,000ha, is mapped as occurring west of Shannon towards the mouth of the estuary. The habitat comprises the channel south of Kilrush, Co. Clare extending westwards to the outer extent of the estuary (NPWS, 2012a). This habitat is in excess of 40km to the west of the proposed dredging. Given the intervening distance between the proposal and this habitat it is considered that the project does not have potential for significant effects on this habitat. Thus, the project will not affect the conservation objectives for 'large shallow inlets and bays' and the habitat is not considered further in the NIS.
Reefs [1170]	No	'Reef' occurs throughout the estuary, mainly as scattered and isolated pockets within the inner estuary and covering more extensive areas towards the middle and outer reaches of the channel. A review of mapping available for this habitat-type determined that the closest areas of reef to the proposed dredging comprises areas located in the Inner and Maigue Estuaries of the greater Shannon Estuary, located approximately 10km from the proposed dredge site. Modelling indicates deposition of some clay and silt to this part of the estuary but deposition depths are predicted to be less than 0.1mm. Any potential water quality impacts will be minimal in view of the dilution potential of the River Shannon and estuary and also with reference to naturally high suspended solids concentrations that periodically exist in the waterbody (spring tides in combination with westerly winds result in conditions that increase mobilisation of

Qualifying Features	Potential for Significant Impacts	Rationale
Perennial vegetation of stony banks [1220]	No	clay in the water column). Suspended solids levels of 80 mg/l are common from Limerick City to 40 km down estuary (westwards). The proposed dredging will involve disposal of 8665m³ of sediment to the River Shannon over the course of 108 hours (5 hour working windows). Based on an average river flow of 208.1m³/s, the projected increase in Suspended Solids due to dredging would be 5.8mg/l following homogenous mixing. In the context of frequent background levels of 80mg/l, the predicted increase in Suspended Solids is not considered significant, increasing only by 7.25%. Bearing in mind the frequently naturally high background levels of suspended solids, any minor changes to the reef habitats and ecosystems supported are not deemed significant. It is considered that the community types that comprise this habitat will not be adversely affected: Furoid-dominated intertidal reef community complex; Mixed subtidal reef community complex; Faunal turf-dominated subtidal reef community; Anemone-dominated subtidal reef community; and Laminaria- dominated community complex, and as such, 'Reefs' will not be considered further in the NIS. This habitat occurs along the coast where shingle (cobbles and pebbles) and gravel have accumulated to form elevated ridges or banks above the high tide mark. This habitat is recorded in 9 locations along the Shannon River and Estuary. At its closest, this habitat occurs at Ballymacrinan Bay (NPWS, 2012a), a distance in excess of 50km west of the project. Given the distance intervening, it is not considered that the proposal has any potential to significantly impact on this habitat-type. Thus, the project will not affect the conservation objectives for 'perennial vegetation of stony banks' and the habitat is not considered further in the NIS.
Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]	No	'Vegetated sea cliffs of the Atlantic and Baltic coasts' occur at the western extent of the Shannon Estuary. At its closest, this habitat is located at Baurrane on the southern coast of Co. Clare (NPWS, 2012a), in excess of 40km west of the proposed dredging. Given the characteristics of the project, and the distance intervening, it is not considered that the proposal has any potential to significantly impact on this habitat-type. Thus, the project will not affect the conservation objectives for 'Vegetated sea cliffs of the Atlantic and Baltic coasts' and the habitat is not considered further in the NIS.
<i>Salicornia</i> and other annuals colonising mud and sand [1310]	No	Salicornia and other annuals colonizing mud and sand are classified by Fossitt (2000) as lower salt marsh. A review of habitat mapping and the coastal habitats supporting document available for the SAC determined that of the ten sub-sites surveyed, mapped and assessed as part of the Saltmarsh Monitoring Project (McCorry & Ryle, 2009) the closest Salicornia habitat is mapped as occurring is the 'Inishdea, Owenshere' sub-site (SMP 0083)(NPWS, 2012a). Inishdea saltmarsh is located in southern Co. Clare, along the western side of the Fergus Estuary, in excess of 28km west of the proposed dredging and to the west of any influence of the disposed sediment. Within the sub-site, Salicornia habitat is not well-developed occupying a single patch of ground of 0.003ha (NPWS, 2012a). Given the characteristics of the project including the localised nature, extent and scale of the proposed works, and the distance intervening, it is not considered that the proposal has any potential to significantly impact on this habitat-type. Thus, the project will not affect the conservation objectives for 'Salicornia and other annuals colonizing mud and sand' and the habitat is not considered further in the NIS.
Atlantic salt meadows	No	'Atlantic salt meadows' (ASM) generally occupy the widest part of the salt marsh gradient. A review of habitat mapping and the coastal

Qualifying Features	Potential for Significant Impacts	Rationale
(<i>Glauco-Puccinellietalia maritimae</i>) [1330]		habitats supporting document available for the SAC determined that of the ten sub-sites surveyed, mapped and assessed as part of the Saltmarsh Monitoring Project (McCorry & Ryle, 2009) the closest habitat to the proposal site is ca. 9km downstream, or ca. 7km west, where the habitat is classified as Potential Atlantic salt meadows. As noted in the conservation objectives for this site, further unsurveyed areas maybe present within the site. There will be no direct impacts on this habitat. With reference to conservation objectives, estuary type saltmarsh over a mud substrate is what typically characterises the substrate associated with this habitat, and while there may be some deposition of mud on ASM, the quantity will be negligible. It is noteworthy, as per NPWS (2019a), that the accumulation of muddy sediments is what leads to the development of saltmarsh, so a very small addition of clay substrate will not affect any of the attributes of contravene and targets set out in the conservation objectives for this habitat with respect to the conservation objectives for the Lower River Shannon SAC. It is noted that the increased turbidity from dredging works are associated with the naturally occurring substrates that comprise the deposition for saltmarsh habitat, so there will be no material change to the habitat. Particle modelling does not predict deposition of sand on ASM. Atlantic salt meadows contain several distinctive zones that are related to elevation and submergence frequency, and the lowest part along the tidal zone is generally dominated by common saltmarsh-grass (NPWS, 2019a). The natural circulation of sediments and organic matter will not be affected, so the physical structure of the ASM, including the pan structure will be maintained, with refence to the proposed dredging and disposition. With the minimal quantities of clay deposition on ASM, estimated to be less than 0.2mm, as projected by modelling, structural variation within sward, transitional zones and sub-communities with typical species associated with ASM will be maintained as is. For reasons outlined above, it is considered that there is no potential for significant effects to occur, and as such, 'Atlantic salt meadows' will not be considered further in the NIS.
Mediterranean salt meadows (<i>Juncetalia maritimi</i>) [1410]	No	'Mediterranean salt meadows' (MSM) occupy the upper zone of salt marshes and usually occur adjacent to the boundary with terrestrial habitats. They are widespread on the Irish coastline; however, they are not as extensive as Atlantic salt meadows. A review of habitat mapping and the coastal habitats supporting document available for the SAC determined that of the ten sub-sites surveyed, mapped and assessed as part of the Saltmarsh Monitoring Project (McCorry & Ryle, 2009), the closest MSM site to the proposal site are associated with the estuaries of the Owenslieve, part of the River Ferus Estuary and the Ahacronane River, part of the Lower Shannon Estuary is the 'Bunratty' sub-site (SMP 0081)(NPWS, 2012a), both beyond the zone of influence. Given the characteristics of the project including the localised nature, extent and scale of the proposed works, and the distance intervening, it is not considered that the proposal has any potential to significantly impact on this habitat-type. Thus, the project will not affect the conservation objectives for 'Mediterranean salt meadows' and the habitat is not considered further in the NIS.
Water courses of plain to montane levels with the <i>Ranunculion fluitantis</i> and	No	This annexed habitat has a broad definition, covering from upland, flashy, oligotrophic, bryophyte- and algal-dominated rivers, to tidal reaches dominated by higher plants. The full distribution of this habitat and its sub-types within the SAC are currently unknown. The <i>Groenlandia densa</i> (L.) Fourr., Opposite-leaved Pondweed sub-type has been identified as a high conservation element in the SAC. In

Qualifying Features	Potential for Significant Impacts	Rationale
<i>Callitriche-Batrachion</i> vegetation [3260]		Ireland, this particular sub-type is associated with tidal reaches of rivers and other periodically disturbed watercourses (e.g. canals and drains) (NPWS, 2012a). <i>Groenlandia densa</i> was not identified during habitat surveys carried out at the proposed dredge works sites. Canadian pondweed occurs in the study area so must be considered in terms of it outcompeting other plants by shading. This plant is aquatic, so is at its lower limit in the Abbey River upstream of Sarsfield Lock. It is likely that fragments of this plant are frequently washed downstream but perish when exposed to brackish waters. The proposed works will cause an influx of Canadian pondweed to the River Shannon but will not survive in the marine environment and therefore will not recolonise other freshwater habitats within the SAC. ‘Floating river vegetation’ as the habitat is commonly known is not considered to be within the zone of influence of the project and thus, there is no potential for significant effects to this habitat.
<i>Molinia</i> meadows on calcareous, peaty or clayey-silt-laden soils (<i>Molinion caeruleae</i>) [6410]	No	‘<i>Molinia</i> meadows on calcareous, peaty or clayey-silt-laden soils’ is represented in Ireland by both fen and grassland communities on nutrient-poor soils. The habitat is either managed as traditional hay meadows or more usually by extensive pasture. <i>Molinia</i> meadows occur in lowland plains on neutral to calcareous gleys, sometimes with a marl layer beneath the surface, or on peaty soils both in lowland and upland situations (NPWS, 2019). The full extent of this habitat within the SAC is currently unknown. It has been recorded on the eastern bank of the Shannon, just north of Castleconnell, Co. Limerick NPWS (2012b). Given the characteristics and location of the project, it is not considered that the proposal has any potential to significantly impact on this habitat-type. Thus, the project will not affect the conservation objectives for ‘<i>Molinia</i> meadows’ and the habitat is not considered further in the NIS.
Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i>) [91E0]	No	Alluvial woodland is a priority Annex I habitat. A number of variants of this habitat exist, of which riparian forests of <i>Fraxinus excelsior</i> and <i>Alnus glutinosa</i> of temperate and Boreal Europe lowland and hill watercourses are the most common type found in Ireland. The Interpretation Manual of EU habitats (2013) states that all types occur on heavy soils which are periodically inundated by the annual rise of river levels, but which are otherwise well-drained and aerated during low water. In addition, there are gallery forests of tall willows alongside river channels and occasionally on river islands, where the tree roots are almost continuously submerged (NPWS, 2019a). Alluvial woodlands occur along the Shannon, in the valley bottoms of the tributaries and on seepage zones on valley sides. Within the SAC, five sites have been surveyed as part of the National Survey of Native Woodlands. These are small stands, restricted to narrow bands where the ground is subject to flooding (NPWS, 2012a). The nearest mapped area of this habitat is at Clare Glen along the main channel of the Clare River, approximately 15km east of the proposal area. Given the characteristics and location of the project, it is not considered that the proposal has any potential to significantly impact on this habitat-type. Thus, the project will not affect the

Qualifying Features	Potential for Significant Impacts	Rationale
		conservation objectives for 'Alluvial forests' and the habitat is not considered further in the NIS.
Freshwater Pearl Mussel (<i>Margaritifera margaritifera</i>) [1029]	No	The freshwater pearl mussel is a large, long-lived bivalve mollusc found in clean, fast-flowing, well-oxygenated rivers with unconsolidated substrates. Stable, clean gravel and sand with adequate availability of dissolved oxygen provides ideal habitat for juveniles. Water pH and hardness is also important with distribution mainly restricted to acidic, soft waters over-lying non-calcareous rock-types. Low nutrient status is also critical such that excess macrophyte and algal growth is prevented; therefore oligotrophic waterbodies are required. Conservation objectives for this species within the SAC apply to the freshwater pearl mussel population in the Cloon River, County Clare. This population is confined to the main channel and is distributed from Croany Bridge to upstream of Clonderlaw Bridge (NPWS (2012b). The Cloon River enters the main Shannon Estuary in excess of 40km west of the proposal site. Given the characteristics and location of the project, and the ecology of this species, it is not considered that the proposal has any potential to significantly impact on freshwater pearl mussel. Thus, the project will not affect the conservation objectives for 'Freshwater Pearl Mussel' and the species is not considered further in the NIS.
Sea Lamprey (<i>Petromyzon marinus</i>) [1095]	Yes	The life cycle of the sea lamprey (<i>Petromyzon marinus</i>) contains both a marine phase and a freshwater phase. Sea lampreys spend their adult life in marine and estuarine waters, living as external parasites on other fish species. They migrate up rivers in spring to spawn in areas of clean gravel, after which they die. Sea lamprey is known to spawn within the Lower Shannon and its tributaries (Kelly and King, 2001). The two 10km grid squares, R35 and R36, which encompass the proposal site, are included within the current known range for sea lamprey (NPWS, 2019b). This distribution is based on records in freshwater habitats, but adult sea lamprey, and transformers (intermediate stage between larvae and adult) occur in the Shannon Estuary. The early life stages of this species require clean substrates in fast flowing freshwater habitats during spawning and ova development. The proposed dredging will not adversely affect these habitats as there are no suitable spawning habitat occurs. This species must pass through the River Shannon at Limerick to reach freshwater spawning grounds in the River Shannon and Mulkear Rivers and also on their seaward outmigration. Sea lamprey ammocoetes were recorded in very low densities within the proposed dredge areas upstream of Sarsfield Lock (0.07/m²) but not downstream of same. The density of juvenile sea lampreys recorded from the study area confirms that the proposed works area is not particularly important for this species in terms of the COs of the SAC as a whole. The conservation status of sea lamprey in Ireland is classified as near threatened, and issues that may have an impact on their long-term future include pollution and instream works in river channels¹⁴. The proposed dredge sites in the Abbey River are of importance for juvenile lampreys in the context of local biodiversity, and every effort needs to be made to preserve this species. The proposed dredging could result in mortality of sea lampreys from the proposed dredge areas within the freshwater reach of the

¹⁴ <https://www.fisheriesireland.ie/species/sea-lamprey-petromyzon-marinus#:~:text=They%20spend%20up%20to%20three,channels%20and%20barriers%20to%20migration.>

Qualifying Features	Potential for Significant Impacts	Rationale
		Abbey River by the action of suction dredging. Juvenile lampreys could be washed into the brackish waters of the Shannon Estuary and as such 'Sea lamprey' will be considered further in the NIS. Mitigation will be required to avoid mortality and prevent juvenile lampreys being carried into the main flow of the River Shannon.
Brook Lamprey (<i>Lampetra planeri</i>) [1096]	Yes	Unlike sea and river lamprey, brook lamprey is not parasitic and is non-migratory, spending its entire life in freshwater. Species distribution within river catchments is dependent on the availability of suitable habitat; adults require fine sand/gravel areas in which to spawn while the juvenile form needs clean, fine sediment into which to burrow (King, et al., 2011). It is considered that any potential water quality impacts will be localised in view of the localised nature, extent and scale of the proposed works and the dilution potential of the River Shannon Estuary. The early life stages of this species require clean substrates in fast flowing freshwater habitats during spawning and ova development. The proposed dredging will not adversely affect these habitats. River/brook lampreys were recorded in low densities (0.53/m²) within the proposed dredge areas upstream of Sarsfield Lock but not downstream of same. It is likely that a portion of the juvenile lampreys recorded (See Appendix 3) were brook lamprey. The proposed dredging will likely result in the loss of brook lampreys from the freshwater reach of the Abbey River to the brackish waters of the Shannon Estuary, and as such 'brook lamprey' will be considered further in the NIS. To mitigate this, juvenile lampreys can be removed from works areas prior to dredging by electrical fishing.
River Lamprey (<i>Lampetra fluviatilis</i>) [1099]	Yes	River lamprey has a similar life history to sea lamprey. River lampreys spend their adult life in marine and estuarine waters, living as external parasites on other fish species. River lamprey is known to spawn within the lower Shannon and its tributaries (Kelly and King, 2001). The two 10km grid squares, which encompass the proposal site, are included within the current known range for river lamprey (NPWS, 2019b). This distribution is based on records in freshwater habitats, but adult river lamprey, and transformers (intermediate stage between larvae and adult) occur in the Shannon Estuary. It is considered that any potential water quality impacts will be localised in view of the localised nature, extent and scale of the proposed works and the dilution potential of the River Shannon Estuary. The early life stages of this species require clean substrates in fast flowing freshwater habitats during spawning and ova development. The proposed dredging will not adversely affect these habitats. River lampreys were recorded in low densities within the proposed dredge areas upstream of Sarsfield Lock (0.13/m²) but not downstream of same. It is likely that a portion of the juvenile lampreys recorded (See Appendix 3) were river lamprey. The proposed dredging will likely result in the loss of river lampreys from the freshwater reach of the Abbey River to the brackish waters of the Shannon Estuary, and as such 'river lamprey' will be considered further in the NIS. To mitigate this, juvenile lampreys can be removed from works areas prior to dredging by electrical fishing.
Salmon (<i>Salmo salar</i>) [1106]	No	Salmon is an anadromous species, living in freshwater for at least the first two or three years of life before migrating to sea. Most Irish

Qualifying Features	Potential for Significant Impacts	Rationale
		fish spend one winter at sea before returning to their natal rivers. Salmon has been observed spawning in the lower Shannon and its tributaries. The 10km grid square which encompasses the proposal site is included within the current known range and distribution for Atlantic salmon (NPWS, 2019b). This distribution is based on records in freshwater habitats. Adult salmon occur in the Shannon Estuary prior to returning to natal streams to spawn, and smolts occur in the estuary on their journey from influent rivers to the sea. It is noted that conservation objectives for the Lower River Shannon SAC are only for salmon in fresh waters, and that the proposed works are within the WFD transitional waterbody 'Limerick Dock' so the proposed works area does not pertain to a freshwater environment. However, it is considered that the proposed dredge areas upstream of Sarsfield Lock are within freshwater. Any water quality impacts that could potentially affect freshwater will be localised and limited to the lower 350m of the Abbey River, which is identified as an unsuitable / suboptimal habitat for juvenile salmon, with reference to Hendry and Cragg-Hine (2003), which describes the ecology of the when adults are returning from the sea. Taking account of the large flow rate of the Abbey River at the proposed works locations, the mobility of salmon, and the extent of river available, pollution via suspended solids or hydrocarbons will highly unlikely to be of a magnitude that results in damage to fish. In addition, due to the fact that smolts outmigrate at times of high flow, 'Atlantic salmon' is not likely to be affected. On the basis of precaution, potential for significant impacts when smolts are outmigrating will be required and this species will therefore be considered further.
Common Bottlenose Dolphin (<i>Tursiops truncatus</i>) [1349]	No	There is a resident population of bottle-nosed dolphin in the Shannon Estuary. This is the only known resident population of this Annex II species in Ireland. The majority of the Shannon Estuary is considered to comprise suitable habitat for this species, apart from the inter-tidal areas of the Fergus Estuary and the inner estuary channel in the vicinity of Shannon town stretching east towards Limerick; however, a review of on-line species records shows that sightings are concentrated in the outer channel. Within the SAC two 'critical areas', representing habitat used preferentially by bottlenose dolphin, have been identified. These are located in the vicinity of Tarbert/Killimer and further west towards the mouth of the estuary in the vicinity of Ballybunion and Kilcredaun Point (NPWS, 2012). A review of studies (unpublished reports) available on the NPWS website on the Shannon Estuary bottlenose dolphin population determined that previous surveys have focussed on the outer estuary channel, including these 'critical areas', rather than in the inner estuary in the vicinity of Shannon and the proposed works. Given the characteristics and location of the project including the localised nature, extent and scale of the proposed works, the dilution potential of the River Shannon and estuary and the distribution of bottlenose dolphin habitat and records within the estuary, it is not considered that the proposal has any potential to significantly impact on this species. Thus, the project will not affect the conservation objectives for 'Common Bottlenose Dolphin' and the species is not considered further in the NIS.
Otter (<i>Lutra lutra</i>) [1355]	No	Otter are widespread in Ireland throughout freshwater and coastal habitats. Otter has two basic requirements: aquatic prey and safe refuges in which to rest. In Ireland, otters are found along rivers, lakes and coasts, where fish and other prey are abundant, and where

Qualifying Features	Potential for Significant Impacts	Rationale
		the bank-side habitat offers sufficient cover. The presence of freshwater, a sufficient prey-base and suitable sites for holts/couches are key factors in determining otter distribution. The 10km grid square which encompasses the proposal site, is included within the current known range and distribution for otter (NPWS, 2019b). Based on the ubiquitous nature of this species and the abundance of suitable foraging and commuting habitat in the area, it is considered that otter are likely to occur in the general vicinity of the proposed works, and as such may be subject to some disturbance impacts. Such impacts will be low however in the context of the already highly disturbed nature of the study area. There is, therefore, no potential for significant impacts to otter, and as such 'Otter' will not be considered further in the NIS.
River Shannon and River Fergus Estuaries SPA (004077)		
Cormorant (<i>Phalacrocorax carbo</i>)	No	Cormorant are a common sight on the River Shannon in Limerick, a species that uses a wide range of foraging habitats and with a wide prey/food range. They are a highly versatile species that forage in marine, estuarine and freshwater habitats depending on environmental conditions. Based on its adaptability, this species will be considered further in the NIS.
Whooper swan (<i>Cygnus cygnus</i>)	No	Whooper swan have been known to utilise Shannon Airport Lagoon as a roost location. Shannon Airport Lagoon has been noted previously as a regularly-used site during autumn (Robinson <i>et al.</i> 2004a). There are no records of Whooper swan foraging near the proposed dredging site and this species does not utilise the areas of the Shannon Estuary within the ZOI for foraging. Based on this, this species is not considered to be within the zone of potential influence of the proposal and will not be considered further in the NIS.
Light-bellied brent goose (<i>Branta bernicla hrota</i>)	No	This species is amber-listed as the majority winter at less than ten sites and the Irish population is also internationally significant. It winters on coastal estuaries during the autumn and early winter as well as on grasslands from mid-winter before departing to breeding grounds in Canada in late April. Brent Geese are grazers and are known for their preference for foraging in intertidal areas with the Eelgrass <i>Zostera</i> sp. (Robinson <i>et al.</i> 2004b). Where this food source is absent the birds feed upon algae and saltmarsh plants and the species also grazes terrestrially. A review of waterbird distribution for SCI species within the SPA determined that Brent geese exhibited a relatively restricted distribution occurring in only seven sub-sites, and were associated mostly with the outer section of the site. Based on this, this species is not considered to be within the zone of potential influence of the proposal and will not be considered further in the NIS.
Shelduck (<i>Tadorna tadorna</i>)	No	A review of waterbird distribution for SCI species within the SPA determined that shelduck was recorded within the vicinity of the River Fergus Estuary (OH510, OH511, OH512), which is beyond the ZOI of the proposed dredging. Based on this, this species is not considered further in the NIS.

Qualifying Features	Potential for Significant Impacts	Rationale
Wigeon (<i>Anas penelope</i>)	No	A review of waterbird distribution for SCI species within the SPA determined that wigeon was recorded within the vicinity of the River Fergus Estuary (OH510, OH511, OH512), which is beyond the ZOI of the proposed dredging. Based on this, this species is not considered further in the NIS.
Teal (<i>Anas crecca</i>)	No	A review of waterbird distribution for SCI species within the SPA determined that teal was recorded within the vicinity of the River Fergus Estuary (OH510, OH511, OH512), which is beyond the ZOI of the proposed dredging. Based on this, this species is not considered further in the NIS.
Pintail (<i>Anas acuta</i>)	No	Pintail is red-listed due to a decline in its non-breeding (wintering) population. It is an extremely rare breeding species with records from the Midlands and north (Dempsey and O' Cleary, 2002). Wintering takes places primarily within estuaries or coastal brackish lagoons. Pintail feed on a variety of plant and animal material obtained from shallow water although they can be observed foraging on land. A review of waterbird distribution for SCI species within the SPA determined that pintail was recorded in only two sub-sites: OH519 (Poulnasherry outer bay) and OK509 (Carrig Island), both in the outer section of the SPA. Pintail populations were not recorded in the Inner Shannon River Estuary during winter Low Tide Counts in 2010. Based on this, this species is not considered to be within the zone of potential influence of the proposal and will not be considered further in the NIS.
Shoveler (<i>Anas clypeata</i>)	No	A review of waterbird distribution for SCI species within the SPA determined that shoveler was recorded in six sub-sites overall including in the River Fergus Estuary, where peak numbers were recorded during low tide surveys. Shoveler was also recorded here during high tide surveys. Based on this, this species is not considered to be within the zone of potential influence of the proposal and will not be considered further in the NIS.
Scaup (<i>Aythya marila</i>)	No	Scaup are a winter visitor to Ireland, arriving from breeding sites to the north between November and April to coastal areas, estuaries, brackish lagoons and freshwater lakes close to the coast. They forage in sub-tidal areas, diving to hunt for molluscs and crustaceans as well as feeding on marine plants in areas typically with a depth of less than 10m. Scaup is amber-listed for its small breeding population and its localised wintering range. A review of waterbird distribution for SCI species within the SPA determined that scaup was recorded in only three sub-sites: OH519 (Poulnasherry outer bay), OH521 (Clonderlaw Bay outer) and OH522 (Clonderlaw Bay inner). Based on this, this species is not considered to be within the zone of potential influence of the proposal and will not be considered further in the NIS.
Ringed plover (<i>Charadrius</i>)	No	Ringed plovers are 'visual foragers' searching the sediment surface for the visible signs of prey such as worms, crustaceans and insects.

Qualifying Features	Potential for Significant Impacts	Rationale
<i>hiaticula</i>)		A substantial proportion of ringed plovers occur on non-estuarine coasts, the species exhibiting a degree of plasticity in habitat choice and being found in habitats such as shingle shores, saltmarsh and short grassland as well as artificial habitats. They breed on shingle and sandy beaches (Dempsey and O'Cleary, 2002) and rough ground around the coast. They are found in the outer estuary on intertidal mudflats.
Golden plover (<i>Pluvialis apricaria</i>)	No	A review of waterbird distribution for SCI species within the SPA determined that ringed plover was not recorded anywhere in the vicinity of the proposal site. Based on this, this species is not considered to be within the zone of potential influence of the proposal and will not be considered further in the NIS. A review of waterbird distribution for SCI species within the SPA determined that golden plover was recorded regularly (three low tide surveys or more) within 12 sub-sites including OH512 (Connor's Rock), where significant numbers (>1500 individuals) were recorded. Based on this, golden plover is considered to be foraging within the zone of potential influence of the proposal, as the principal foraging habitat for this species within the SPA corresponds to 'Intertidal mud/sand flats', which though has been identified as being potentially significantly impacted, will not be impacted to a degree that affects foraging for this species i.e. less than 0.2mm of clay deposited on some of its foraging habitat following the dredge regime of 15 days. This species will not be considered further in the NIS.
Grey plover (<i>Pluvialis squatarola</i>)	No	A review of waterbird distribution for SCI species within the SPA determined that grey plover was recorded regularly (three low tide surveys or more) within OH510. The February 2011 roost survey recorded birds in OH511 (Rinnanna South) in the inner estuary. Supratidal roosting was recorded in OH512 (Connor's Rock). Based on this, this species is considered to be within the zone of potential influence of the proposal, but will not be impacted to a degree that affects foraging for this species i.e. less than 0.2mm of clay deposited on some of its foraging habitat following the dredge regime of 15 days. This species will not be considered further in the NIS.
Lapwing (<i>Vanellus vanellus</i>)	No	A review of waterbird distribution for SCI species within the SPA carried out as part of the sub-site assessments for the 2010/11 Waterbird Survey Programme, as outlined in NPWS (2012d) determined that lapwing was regularly recorded foraging inter-tidally in OH512 (Connor's Rock). This sub-site also supported roosting birds. Lapwings were also recorded in OH510 and OH511. Based on this, this species is considered to be within the zone of potential influence of the proposal but will not be impacted to a degree that affects foraging for this species i.e. less than 0.2mm of clay deposited on some of its foraging habitat following the dredge regime of 15 days. This species will not be considered further in the NIS.
Knot (<i>Calidris canutus</i>)	No	A review of waterbird distribution for SCI species within the SPA determined that knot was recorded in the sub-sites OH510, OH511 and OH512. Based on this, this species is considered to be within the zone of potential influence of the proposal but will not be impacted to a degree that affects foraging for this species i.e. less than 0.2mm of clay deposited on some of its foraging habitat following the dredge regime of 15 days. This species will not be considered further in the NIS.

Qualifying Features	Potential for Significant Impacts	Rationale
Dunlin (<i>Calidris alpina</i>)	No	A review of waterbird distribution for SCI species within the SPA suggest that dunlin have a widespread foraging distribution across the site and as a versatile species, they are likely to exploit a variety of intertidal food resources. Dunlin was found to occur regularly during low tide surveys within sub-sites OH510 and OH512. Dunlin was also recorded in OH511. Based on this, this species is considered to be within the zone of potential influence of the proposal but will not be impacted to a degree that affects foraging for this species i.e. less than 0.2mm of clay deposited on some of its foraging habitat following the dredge regime of 15 days. This species will not be considered further in the NIS..
Black-tailed godwit (<i>Limosa limosa</i>)	No	A review of waterbird distribution for SCI species within the SPA found that black-tailed godwits were relatively widespread in their distribution within the site. The species was found to occur in all four sub-sites in the vicinity of the River Fergus Estuary. They were found to occur regularly within OH510 (Brackinish Rock to Carrigkeal) with peak numbers recorded during low tide surveys. OH512 (Connor's Rock) held peak numbers during low tide surveys in October. Records of black-tailed godwits in roosting/other behaviour during low tide surveys were irregular (of note was the count of 2,400 roosting within OH512 (Connor's Rock) on 21/10/10. Although relatively versatile in terms of habitat choice, black-tailed godwits are generally found in muddier sediments within inner estuaries, favouring biotopes that support favoured prey such as bivalves <i>Macoma balthica</i>, <i>Scrobicularia plana</i> or polychaete <i>Hediste diversicolor</i>. This is in agreement with the pattern of distribution noted above i.e. the preference for inner estuary sub-sites. Based on this, this species is considered to be within the zone of potential influence of the proposal but will not be impacted to a degree that affects foraging for this species i.e. less than 0.2mm of clay deposited on some of its foraging habitat following the dredge regime of 15 days. This species will not be considered further in the NIS..
Bar-tailed godwit (<i>Limosa lapponica</i>)	No	Bar-tailed godwits forage by probing within intertidal sediment for invertebrate species, predominantly large polychaete worms such as <i>Arenicola marina</i> and <i>Nephtys</i> sp. They often feed at the tide edge with their heads in water. The species is characteristic of sites with sandy substrates (e.g. Hill et al. 1993) or sections of a site that have sandy (as opposed to muddy) sediment. The dominant intertidal benthic community type across the site is 'intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans' (NPWS, 2012b). This broad community type has a wide variability in sediment type from gravel to fine sand to muds. Of note are high abundances of <i>Nephtys hombergii</i> that occur from the lower Fergus Estuary westwards, this polychaete a known prey species of bar-tailed godwits. A review of waterbird distribution for SCI species within the SPA found bar-tailed godwits to have a relatively restricted foraging distribution within the site. They were not recorded in any of the sub-sites in the vicinity of the proposal site. The habitats used by this species but will not be impacted to a degree that affects foraging i.e. less than 0.2mm of clay deposited on some of its foraging habitat following the dredge regime of 15 days. This species will not be considered further in the NIS.

Qualifying Features	Potential for Significant Impacts	Rationale
Curlew (<i>Numenius arquata</i>)	No	A review of waterbird distribution for SCI species within the SPA found that curlew exhibited a widespread foraging distribution across the site. Curlews were recorded in the sub-sites OH510, OH511 and OH512. Based on this, this species is considered to be within the zone of potential influence of the proposal but will not be impacted to a degree that affects foraging i.e. less than 0.2mm of clay deposited on some of its foraging habitat following the dredge regime of 15 days. This species will not be considered further in the NIS.
Redshank (<i>Tringa totanus</i>)	No	A review of waterbird distribution for SCI species within the SPA found that redshank to be widespread within the site. Redshanks were recorded roosting in the sub-site OH511 (Rinnanna South) where a single intertidal roost of 90 individuals was recorded. Redshanks were recorded regularly (three or more low tide surveys) in OH512. Redshank was also recorded in OH510. Based on this, this species is considered to be within the zone of potential influence of the proposal but will not be impacted to a degree that affects foraging i.e. less than 0.2mm of clay deposited on some of its foraging habitat following the dredge regime of 15 days. This species will not be considered further in the NIS.
Greenshank (<i>Tringa nebularia</i>)	No	A review of waterbird distribution for SCI species within the SPA determined that greenshank were recorded in the sub-site OH512. Based on this, this species is considered to be within the zone of potential influence of the proposal but will not be impacted to a degree that affects foraging i.e. less than 0.2mm of clay deposited on some of its foraging habitat following the dredge regime of 15 days. This species will not be considered further in the NIS.
Black-headed gull (<i>Chroicocephalus ridibundus</i>)	No	A review of waterbird distribution for SCI species within the SPA determined that black-headed gull was recorded in all four sub-sites in the vicinity of ZOI of the works. Based on this, this species is considered to be within the zone of potential influence of the proposal but this. One roost site of this species occurs at Sarsfield Lock and another ca. another ca. 270m south of Sarsfield Lock. This species where has become accustomed to human disturbance within the city and while there may be some increased noise the increase compared to background levels will be of a magnitude that disturbs this species. The dredge operation is expected to last only 15 days and there are alternative roost sites in the vicinity of Limerick city, therefore this species will not be considered further in the NIS.
Wetlands & waterbirds	Yes	The River Shannon and River Fergus Estuaries SPA is designated for the protection of 'Wetlands'. It is expected that the proposed works will result in ex-situ effects via an increase in deposition of sediment in Limerick Docks, Inner Shannon Estuary and Maigue Estuary. This impact is negligible however and significant effects are not predicted with regard to the physical structure of estuarine habitats that support waterbirds. There is potential for contamination of the wetland with Lead should dredging take place where elevated levels of this heavy metal were detected within the Abbey River. Therefore, there is potential for direct/indirect impacts to wetland habitat within the River Shannon and River Fergus Estuaries SPA, and as such 'Wetlands and Waterbirds' will be considered further in the NIS.

7. Assessment of Potentially Significant Effects

There follows an evaluation of potentially significant effects which may arise as a result of the proposed dredging on the qualifying features that have been selected for impact assessment in Section 6 above. Following this, a determination is made as to whether the proposal is likely to have adverse effects on the integrity of the Natura 2000 sites selected for assessment. The likelihood of adverse effects to a Natura 2000 site from the proposed dredging has been determined based on a number of indicators including:

- Water quality
- Habitat loss or alteration
- Disturbance and/or displacement of species
- Habitat or species fragmentation

The likelihood of significant cumulative/in-combination effects is assessed in Section 7.5 below.

7.1 Water quality

The main risk to water quality in the Lower River Shannon SAC and the River Shannon and River Fergus Estuary SPA is disposal of dredged material to the River Shannon. Another risk to water quality arises as a result of the potential for discharge of polluting substances required to carry out the proposed dredge works, namely fuels/oils. There is potential for uncontrolled discharge of polluting substances from the following activities:

- The potential risk of organic pollution through accidental spillage of hydrocarbons from construction-related vehicles, machinery, and equipment
- Increased nutrients/sedimentation
- Mobilisation of Lead

It is considered that the potential impacts to the habitat types of the Lower River Shannon cSAC and the River Shannon and River Fergus Estuaries SPA relate to water quality impacts. The habitat and species types that may incur potentially significant impacts are:

- Estuaries
- The three species of lampreys
- Wetlands & waterbirds

Estuaries support a diverse range of plant and animal species dependent on good water quality for optimum ecological functioning. There is potential for significant water quality impacts to occur to the estuarine habitat type and associated dependent species.

Maitland (2003) points out that significant pollution can eliminate whole populations of river lamprey from rivers, and in such cases, it is usually severe pollution in the lower reaches that prevents upstream migration and kills downstream migrants. In addition to direct toxic effects, pollution can have a major impact on lamprey by smothering both spawning gravels and nursery silts. Taking account of the fact that the proposed works area is at the lower end of distribution of the freshwater stages of migratory lampreys (river and sea) and is at the lower end of distribution of the brook lamprey, the potential impacts on juvenile lampreys are limited to those in the study area, which represents a very small proportion of the populations of these species in the Shannon/Mulkear system.

In the event a relatively large accidental spillage of fuels/oils occurred from machinery and equipment being used to facilitate the proposed works, this may have a significant impact on water quality. Given that best practice measures will be implemented at a minimum, the frequency and duration of the works, and the fact that works will be taking place on the ebb tide all reduce to insignificant the risk to significant ecological effects due to water quality deterioration from hydrocarbon pollution.

High levels of suspended solids in the River Shannon Estuary could interfere with the migratory movements of lampreys and other fish. To this end, the proposed dredging could have water quality impacts that alter fish movements. It is important to note however that fish moving upstream will generally do so on the flooding tide, so not coinciding with the time of dredging (dredging carried out at ebb tide).

NPWS (2019) note that Atlantic salt marsh is an important habitat for wildlife including wintering waders and wildfowl. The mudflats within the estuary, to the upper zones subject to the least submergence frequency, along with the avifauna they support, are considered to represent 'wetlands and waterbirds' an SCI for the River Shannon and River Fergus Estuaries SPA. With the exception of Lead, it is considered that there will be no impacts of ecological significance on habitats utilised by birds listed as SCIs within the SPA. The favourable conservation condition of the wetland habitat resource for the regularly-occurring migratory waterbirds that in the SPA that utilise it would not be affected by the increased amount of fine sediment discharged during dredging.

In the event of a reduction in water quality as a result of the discharge of Lead to the River Shannon, waterbirds could be indirectly impacted should their food source be significantly affected.

7.2 Habitat loss/alteration

The proposed dredging occurs along the lower reach of the Abbey River upstream of Sarsfield Lock and the main channel of the River Shannon below Sarsfield Lock. As the dredge sites occur within/adjacent to the Lower River Shannon SAC this site will be subject to direct habitat alteration to the intertidal mudflats that occur below Sarsfield Lock.

There will be a reduction in the quantity of silt and other fine substrates at the proposed dredge sites. Though silt can be expected to replenish these areas post works, the removal of silt represents a temporary loss of optimal juvenile lamprey habitat. Not all the soft sediment at the proposed dredge sites will be removed however, so juvenile lampreys entering the works area from upstream, after the works are completed, will have ample opportunity to settle in soft substrates in the areas impacted by the dredging.

Differences between the existing environment and those expected following dredging are not considered to be at a level that will significantly change the ecology of the estuarine environment of the Lower River Shannon SAC.

7.3 Disturbance and/or displacement of species

There is a risk that lampreys in silt will be injured, perhaps fatally, and also disturbed during dredging. Based on the scale of the SAC and extent of suitable juvenile lamprey habitat outside of the proposed works area, the removal of ca. 0.4ha of juvenile lamprey habitat (area upstream of Sarsfield Lock) is not likely to be significant, but as a precaution, and for conservation purposes, and taking account of the conservation status of river and sea lamprey, this effect must be deemed significant. The density of lampreys in the dredge sites within the Abbey River would be reduced and there will be less juvenile habitat available to lampreys, so the CO attributes 'Juvenile density in fine sediment' and 'Availability of juvenile habitat' would be affected.

7.4 Habitat or species fragmentation

Habitat fragmentation has been defined as 'reduction and isolation of patches of natural environment' (Hall, *et al.*, 1997) cited in (Franklin *et al.*, 2002) which results in spatial separation of habitat areas which had previously been in a state of greater continuity. Adverse effects of habitat fragmentation on species include the increased isolation of populations which can detrimentally impact on the resilience or robustness of the populations.

The River Shannon is a large freshwater body at Limerick, the proposed works only affect a portion of one side of the channel and the works site is near the downstream end of the freshwater environment, so as such, habitat fragmentation is not envisaged. It is considered that the proposed works areas are at the lower end of the distribution of lampreys in the Shannon system, so species fragmentation is not anticipated with respect to this group. The low frequency and short duration of the proposed works (8 days at 5 hrs per day) means that species disturbance will be episodic and given that the works will take place in an environment with high background noise levels, species utilising the site and environs will not be subject to significant fragmentation.

7.5 Assessment of Potentially Significant Cumulative Effects

As well as singular effects, the potential for in-combination or cumulative effects also need to be considered. A cumulative effect arises from incremental changes caused by another past, present or reasonably foreseeable future actions together with the proposed dredging. The EC (2001) guidelines on the provision of Article 6 of the Habitats' Directive state that the phrase 'in combination with other plans or projects' in Article 3(3) of the Habitats Directive refers to the cumulative effects due to plans or projects 'that are currently under consideration together with the effects of any existing or proposed projects or plans.' Relevant plans and projects have been identified in Section 4.3 above.

The Aughinish Alumina refinery is considered a major operation on the Shannon Estuary. This facility is located almost 30km west of the proposed works but impacts from ongoing operations were considered in combination with the dredging proposed within Limerick. An NIS prepared for Aughinish Alumina Ltd. in 2016 for maintenance dredging and dumping at sea at Aughinish Alumina Jetty considered in detail the potential for adverse impacts upon the Lower River Shannon SAC and the River Shannon and River Fergus Estuaries SPA, including the potential for indirect habitat loss or degradation and the potential for disturbance or displacement of qualifying/special conservation interests of these designated sites.

The dredging at Aughinish has taken place, but given that this was maintenance dredging, it will be required again, so there is the possibility of this occurring at the same time as the proposed dredging in Limerick. Any dredging at Aughinish will occur within a highly regulated area with licensed environmental protection systems already in place. In any case, given the distance between Limerick and Aughinish, the ZOI of these separate operations does not overlap, or if there is any overlap the effects of deposition would be negligible even if the operations took place synchronously. It is therefore considered that the proposed dredging at Limerick will not impact the Lower River Shannon SAC or the River Shannon and River Fergus Estuaries SPA in combination with any operations that may occur at Aughinish, or indeed with any other activities. This conclusion has been arrived at based on the relatively small amount of dredged material at Limerick, relative to the Shannon Estuary, the short duration and low frequency of the works.

8. Mitigation

Table 6 lists the Qualifying Interests and Special Conservation Interests identified as being potentially significantly effected by the proposed dredge works, as identified in Section 6.1.3. Mitigation to avoid, or reduce to insignificant, the possible negative effects on QIs and SCIs are included in Table 6 and described in more detail below.

Additional mitigation has been included to limit the environmental impact on the local environment, and to avoid impacting migratory fish. It is noted that these mitigations are not necessary for upholding the conservation objectives of the subject Natura 2000 sites, but purely for ecological/conservation reasons.

Table 6 Qualifying Interests and Special Conservation Interests identified as being potentially significantly affected, and mitigation measures

Natura 2000 Site	Conservation interest	Impact due to proposed dredging	Impact mechanism	Possible effect (pre mitigation)	Mitigation
Lower River Shannon SAC (002165)	Estuaries [1130]	Estuarine habitat occurs in the River Shannon within the proposed dredge areas below Sarsfield Lock, and adjacent to the Abbey River. There is some potential for water quality impacts due to elevated levels of the metal Lead and subsequent ecological effects.	Disturbance of sediment contaminated with Lead at the northern end of the uppermost dredge site on the Abbey River and dispersion of Lead to the Shannon Estuary	Lead has a toxic effect on biota and could therefore affect the infauna of intertidal community types that form part of the estuary. The target 'conservation of community types in a natural condition' will likely not be affected due to dilution, short time frame of works and limited quantity of Lead in the sediment, but there is still however a risk.	Avoid dredging in the area where Lead was recorded in the sediment at a concentration of 1160 mg/kg i.e. station L1 of the Marine Sediment Characterisation report as per Appendix 4. Additional sampling is required to define the extent of the proposed dredge area in exceedance of Waste Acceptance Criteria, of 218 mg/kg. No sediment will be dredged at this location unless found to be below the WAC level.
	Sea Lamprey (<i>Petromyzon marinus</i>) [1095]	Sea lamprey ammocoetes were recorded in very low densities within the proposed dredge areas upstream of Sarsfield Lock (0.07/m ²) but not downstream of same. The density of juvenile sea lampreys recorded from the study area confirms that the proposed works area is not particularly important for this species in terms of the COs of the SAC as a whole. The conservation status of sea lamprey in Ireland is classified as near threatened, and issues that may have an impact on their long-term future include pollution and instream works in river	The mechanical action of the suction dredger in soft sediments occupied by lampreys means that lampreys will be at least displaced and quantity/quality of habitat reduced – juvenile lampreys occur in the top layers of the sediment and dredging will take place down to	The density of lampreys in the dredge sites within the Abbey River would be reduced and there will be less juvenile habitat available to lampreys, so the CO attributes 'Juvenile density in fine sediment' and 'Availability of juvenile habitat' would be affected so this effect is considered significant.	Lampreys will be removed by electric fishing at the proposed dredge sites (corresponding to those areas upstream of Sarsfield Lock) in advance of the works and relocate them to suitable areas upstream. This will involve depletion fishing, using methodology outlined in Harvey & Cowx (2003). Lamprey removal will focus on an area of 1m² at a time. Each of these areas would be fished a minimum of

Natura 2000 Site	Conservation interest	Impact due to proposed dredging	Impact mechanism	Possible effect (pre mitigation)	Mitigation
		channels ¹⁵ . The proposed dredge sites in the Abbey River are of importance for juvenile lampreys in the context of local biodiversity, and every effort needs to be made to preserve this species.	design level. The proposed dredging could result in mortality of lampreys from the proposed dredge areas within the freshwater reach of the Abbey River by the action of suction dredging. Juvenile lampreys could be washed into the brackish waters of the Shannon Estuary.		three times: three passes. Lampreys will be released upstream to habitats suitable to the requirements of juvenile lampreys with reference to Maitland (2003), in consultation with IFI. All electric fishing will be carried out prior to dredging following receipt of a Section 14 authorisation from IFI. All electric fishing and lamprey identification will be carried out by a suitably qualified ecologist with experience in juvenile lamprey identification.
	Brook Lamprey (<i>Lampetra planeri</i>) [1096]	River/brook lampreys were recorded in low densities (0.53/m ²) within the proposed dredge areas upstream of Sarsfield Lock but not downstream of same. It is likely that a large portion of the juvenile lampreys that occur in the sediment that will be excavated are brook lamprey. The proposed dredging will likely result in the loss of brook lampreys from the freshwater reach of the Abbey River to the brackish waters of the Shannon Estuary.	As for sea lamprey	As for sea lamprey	As for sea lamprey
	River Lamprey (<i>Lampetra</i>)	River lampreys were recorded in low densities	As for sea lamprey	As for sea lamprey	As for sea lamprey

¹⁵ <https://www.fisheriesireland.ie/species/sea-lamprey-petromyzon-marinus#:~:text=They%20spend%20up%20to%20three,channels%20and%20barriers%20to%20migration.>

Natura 2000 Site	Conservation interest	Impact due to proposed dredging	Impact mechanism	Possible effect (pre mitigation)	Mitigation
River Shannon and River Fergus Estuaries SPA (004077)	<i>fluvialis</i>) [1099]	within the proposed dredge areas upstream of Sarsfield Lock (0.13/m²) but not downstream of same. It is likely that a portion of the juvenile lampreys that occur in the sediment that will be excavated are river lamprey. The proposed dredging will likely result in the loss of river lampreys from the freshwater reach of the Abbey River.			
	Wetlands & waterbirds	There is potential for contamination of the estuarine waters with Lead should dredging take place where elevated levels of this heavy metal were detected within the Abbey River. Therefore, there is potential for indirect impacts to waterbirds within the River Shannon and River Fergus Estuaries SPA, and as such 'Wetlands and Waterbirds' will be considered further in the NIS.	Disturbance of sediment contaminated with Lead at the northern end of the uppermost dredge site on the Abbey River and dispersion of Lead to the Shannon Estuary	Lead has a toxic effect on biota and could therefore affect the infauna of intertidal and subtidal community types that form part of the estuary. Various waterbirds that utilise mudflats for foraging could be affected by Lead due to its toxicity but this will likely not be the case due to dilution, short time frame of works and limited quantity of Lead in the sediment. There is still a risk however.	As for 'Estuaries'

8.1 Method statements

A concise list of the primary construction mitigation measures are outlined in Appendix 6 (Environmental Commitments). These are measures aimed at providing environmental awareness for a prospective contractor. Implementation of the full mitigation will be required by the appointed contractor. A works method statement will be prepared by the appointed dredging contractor which will include the specifications and commitments set out below and incorporating these details with regard to the machinery and methodology to be employed to undertake the required dredging. This will include details on how water quality will be protected with the avoidance of spills and the use of bio-degradable oils, using best practice approaches.

The method statement will also include for the protection of the site with regard to the cleaning of machinery and the avoidance of the dispersal of non-native species (see Section 8.2).

A method statement will also be required for the electrical fishing required to remove juvenile lampreys from the proposed dredge areas (see Section 8.3).

8.2 Juvenile lamprey salvage

juvenile lampreys will be relocated to alternative suitable locations prior to dredging. Lampreys will be removed by electric fishing at the proposed dredge sites (corresponding to those areas upstream of Sarsfield Lock) in advance of the works. A 1-meter buffer around the shallow margins of the proposed dredge areas will also be fished to remove lampreys that may be indirectly affected by removal of adjacent sediments. A significant proportion of older age groups present can be expected to be removed, but small larvae will not. The removal method will involve depletion fishing, using methodology outlined in Harvey & Cowx (2003). Lamprey removal will focus on an area of 1m² at a time. Each of these areas would be fished a minimum of three times: three passes. The August – September work period will facilitate efficient capture of juvenile lampreys as it coincides with a period when water levels are likely to be low.

Lampreys will be released upstream to habitats suitable to the requirements of juvenile lampreys with reference to Maitland (2003), in consultation with IFI. All electric fishing will be carried out prior to dredging following receipt of a Section 14 authorisation from IFI. All electric fishing, lamprey identification and lamprey relocation will be carried out by a suitably qualified ecologist with experience in juvenile lamprey identification.

8.3 Non-native species

It is imperative that all measures are taken to ensure that the non-native and invasive zebra mussel is not spread by the proposed works. To prevent the transfer of aquatic organisms, particularly (zebra mussel) to other catchments, all equipment which is in contact with the water of River Shannon and Abbey River must be cleaned and disinfected upon completion of works, before being moved to other areas. Likewise, any equipment being brought to the site from other areas must be effectively cleaned in advance to ensure that non-native species are not introduced to the site. These procedures will be detailed in the Contractor's Works Method Statement.

8.4 Timing of the works

The proposed works will take place between October to February inclusive. This work period would avoid the downstream migratory period for salmon smolts and juvenile lampreys; along with upstream migrations of eels and smelt. Juvenile salmon and smolts move downstream through the Abbey River (April/May); smelt spawn

within the Abbey River and Lower Shannon during March/April; lamprey transformers (sea and river species) migrate downstream in the spring; adult sea and river lamprey move upstream in the spring; adult salmon run the River Shannon from February onwards. In particular, the times when juvenile fish are present (and smelt spawning) will be avoided.

The proposed dredging upstream of Sarsfield Lock will commence at the downstream end and proceed in the upstream direction. This will lessen the potential for any water quality impacts on juvenile lampreys in sediments.

8.5 Ecological monitoring

To ensure that mitigation measures committed to, including those that will be set out in the Contractor's Works Method Statement, the proposed works are monitored by an independent ecologist with experience in the aquatic ecological interests of the Lower River Shannon SAC. The appointed site ecologist will be appointed by and work for the client rather than the contractor.

8.6 Contaminated sediment

Dredging in the area where Lead was recorded in the sediment at a concentration of 1160 mg/kg will be avoided. There was only one incidence of exceedance of Waste Acceptance Criteria of 218 mg/kg, station L1 (Latitude 52.66681, longitude -8.62514). Additional sampling is required to define the extent of the proposed dredge area where Lead is present in the sediment above the WAC. No dredging will take place in areas where Lead is found to be greater than the WAC threshold of 218 mg/kg.

It is considered that concentrations of this substance in the water column and any deposited Lead would be at non-hazardous levels, due to the dilution provided by the River Shannon in the form of fresh water from upstream and from brackish water from the estuary to the west.

If a determination is made by the Marine Institute that Lead at the level recorded at L1 is suitable for disposal to the River Shannon, then it is considered that dredging at Custom House Quay can take place without further testing of substrates.

If not, it may be possible to remove sediment that is greater than the Lead WAC threshold from the river using another mechanism such as excavation and dispose of the sediment to an appropriate facility. This would require a separate method statement.

9. Assessment of effect on conservation objectives

Detailed conservation objectives (COs) have been developed for the Lower River Shannon SAC and for the River Shannon and River Fergus Estuaries SPA. In Section 6.1.3 above, an evaluation was undertaken to determine which of the QIs potentially lie within the zone of influence of the project and required further assessment in the NIS. This was done through a scientific examination of ecological evidence and data. The effects of the project on the QIs which have been identified as being potentially within the zone of influence have been assessed against the measures designed to achieve the conservation objectives. An assessment of the effect of the project on COs selected for further assessment has been presented below under the Lower River Shannon cSAC and the River Shannon and River Fergus Estuaries SPA.

The following tables give the assessment of effect of the project on the Conservation Objectives for QIs and SCIs identified as being potentially significantly affected by the proposed dredging i.e. 'Estuaries' and the three

species of lampreys. Within the River Shannon and River Fergus Estuaries SPA, which largely overlaps with the Lower River Shannon SAC, these habitats can be interpreted as, or correspond to the wetlands component of the SCI 'wetlands and waterbirds' of the River Shannon and River Fergus Estuaries SPA. The target for this CO is that the 'permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 32,261ha, other than that occurring from natural patterns of variation' (NPWS, 2012d). It can be seen from Table 7 and Table 9 that there will be no significant change to the extent or ecosystem quality of the important wetland habitats within the Shannon Estuary, so no significant effects are predicted for the River Shannon and River Fergus Estuaries SPA.

Table 7 Assessment of residual impacts of the project on 'Estuaries'

Attribute/ Measure	Target	Assessment of Potentially Significant Effects	Significance affecting the integrity of the SAC
Habitat area/ hectares	Area stable or increasing, subject to natural processes	Estuarine habitat occurs in the River Shannon within the proposed dredge areas below Sarsfield Lock, and adjacent to the Abbey River. The project will not result in a significant reduction in area of this habitat type. The qualifying features 'Mudflats and sandflats not covered by seawater at low tide' and 'Reefs' are a subset of 'Estuaries' and there is some potential for significant impacts for these QIs, as outlined below.	Not significant, not affecting the integrity of the SAC
Community distribution/ hectares	To conserve the community types for which this habitat is designated in a natural condition	The hydrodynamic modelling study indicates that some substrates from dredge works will be transported to the Upper Shannon Estuary, around the estuaries of the Fergus and Maigue, but most sediment will be deposited to Limerick Docks within 3km of the proposed works. There is some potential for water quality impacts due to elevated levels of the heavy metal Lead and subsequent ecological effects due to the release of this substance during dredging.	Not significant, not affecting the integrity of the SAC, as areas where Lead is above WAC will be avoided.

Table 8 Assessment of residual impacts of the project on 'brook lamprey' and 'river lamprey'.

Attribute/ Measure	Target	Assessment of potentially significant effects, with mitigation considered	Significance affecting the integrity of the SAC
Distribution/ % of river accessible	Access to all watercourses down to first order streams	The project will not result in the physical impediment to the migration of fish. No significant effects to conservation objective anticipated.	Not significant, not affecting the integrity of the SAC
Population structure of juveniles/ Number of age/size groups	At least 3 age/size groups present	Lamprey are present as juveniles in sediments at the proposed dredge sites, with the greatest numbers in the soft substrates near the river margins. Mitigation involves removal of lampreys from proposed dredge sites by electric fishing in advance of the works, and within 1m of the dredge sites where water is shallow, and timing to avoid temporal overlap with migratory fish movements. While it is accepted that all lampreys may not be salvaged, most of the larger / older cohorts can be translocated to optimal habitats upstream.	A large proportion of the lampreys at the proposed dredge sites can be removed, with most larger/older lampreys removed, therefore, the number of lampreys lost will not be significant. The impact on this attribute is therefore not significant and does not affect the integrity of the SAC.
Juvenile density in fine sediment/ Juveniles per m ²	Juvenile density at least 2 per m ²	Juveniles live buried in silt beds. With mitigation to remove lampreys before dredging, lamprey numbers can be conserved.	A large proportion of the lampreys at the proposed dredge sites can be removed, therefore, the number of lampreys lost will not be significant within the Abbey River as lampreys taken from the proposed dredge area can be relocated to optimal areas upstream. The impact on this attribute is therefore not significant and does not affect the integrity of the SAC.
Extent and distribution of spawning habitat/ m ² and occurrence	No decline in extent & distribution of spawning beds	The proposed dredge site or downstream areas are not suitable spawning areas for lampreys so there is no potential for this conservation objective to be negatively affected.	Not significant, not affecting the integrity of the SAC.

Table 9 Assessment of residual impacts of the project on ‘Sea lamprey’

Attribute/ Measure	Target	Assessment of potentially significant effects, with mitigation considered	Significance affecting the integrity of the SAC
Distribution/ % of river accessible	Greater than 75% of main stem length of rivers accessible from estuary	The project will not result in the physical impediment to the migration of fish. No significant effects to conservation objective anticipated.	Not significant, not affecting the integrity of the SAC
Population structure of juveniles/ Number of age/size groups	At least 3 age/size groups present	Lamprey are present as juveniles in sediments at the proposed dredge sites, with the greatest numbers in the soft substrates near the river margins. Mitigation involves removal of lampreys from proposed dredge sites by electric fishing in advance of the works, and within 1m of the dredge sites where water is shallow, and timing to avoid temporal overlap with migratory fish movements. While it is accepted that all lampreys will not be salvaged, most of the larger / older cohorts can be translocated to optimal habitats upstream.	A large proportion of the lampreys at the proposed dredge sites can be removed, with most larger/older lampreys removed, therefore, the number of lampreys lost will not be significant. The impact on this attribute is therefore not significant and does not affect the integrity of the SAC.
Juvenile density in fine sediment/ Juveniles per m ²	Juvenile density at least 1 per m ²	Juveniles live buried in silt beds. With mitigation to remove lampreys before dredging, lamprey numbers can be conserved.	A large proportion of the lampreys at the proposed dredge sites can be removed, therefore, the number of lampreys lost will not be significant within the Abbey River as lampreys taken from the proposed dredge area can be relocated to optimal areas upstream. The impact on this attribute is therefore not significant and does not affect the integrity of the SAC.
Extent and distribution of spawning habitat/ m ² and occurrence	No decline in extent & distribution of spawning beds	The proposed dredge site or downstream areas are not suitable spawning areas for lampreys so there is no potential for this conservation objective to be negatively affected.	Not significant, not affecting the integrity of the SAC

Table 10 Assessment of residual impacts of the project on ‘wetlands and waterbirds’ of the River Shannon and River Fergus Estuaries SPA

Attribute/ Measure	Target	Assessment of potentially significant effects, with mitigation considered	Significance affecting the integrity of the SAC
Wetland habitat area/hectares	The permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 32,261ha, other than that occurring from natural patterns of variation	There is potential for contamination of the estuarine waters with Lead should dredging take place where elevated levels of this heavy metal were detected within the Abbey River. Therefore, there is potential for indirect impacts to waterbirds. Mitigation involves water quality protection by avoiding dredging of areas where Lead is found at levels greater than WAC.	In relation of Lead, the release of this metal to the main flow of the River Shannon at Limerick will not bring about any significant water quality impacts for these reasons: • levels below the WAC are deemed environmentally safe, • significant dispersal throughout a large area of the River Shannon Estuary • the average flow of the receiving water at the time of proposed dredging is 208m³/s so there is massive dilution. Significant impacts on water quality, or secondary impacts on fauna consumed by birds will not take place, and therefore there will be no significant impacts on birds utilising estuarine habitats. The mitigated impact of the proposed dredging is not significant, and therefore will not affect the integrity of the SPA.

10. Conclusion

The proposed works include the removal of silt and substrate accumulations which have developed within the navigable channel of the Abbey River and River Shannon below Sarsfield Lock since the most recent dredging scheme. The methodology for the proposed works, including the equipment and machinery to be employed, will be set out in the Contractor's Works Method Statement, based inter alia on environmental protection measures outlined in Section 8, mitigation.

The timing of the works has been identified as a mitigation measure where the current assessment conclusion is based on the recommendation that works will only be carried out during the period October to February in order to reduce impacts affecting migratory Annex II species.

Provided that the proposed dredging is carried out in accordance with the recommended mitigation measures set out above, there will be no adverse impact on the integrity of the Lower River Shannon SAC or the River Shannon and River Fergus Estuaries SPA.

It is concluded that the proposed dredging, subject to the proposed mitigation measures, will not result in direct, indirect or cumulative impacts which would have the potential to adversely affect the conservation objectives of the Lower River Shannon SAC or the River Shannon and River Fergus Estuaries SPA in relation to the relevant Annex II species and Annex I habitats; with regard to their range, population densities or conservation status within these designated areas.

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Appendix 1

Screening for Appropriate Assessment report

Appendix 2

Method Statement for the removal of silt upstream and downstream of Sarsfield Lock

BACKGROUND:

After the most recent flood event of 2015/2016 a Hydrographic survey was carried out at the request of locals and users on the navigation to determine if the Limerick navigation had silted up. Siltation is an annual event on the lower sections of the Limerick navigation. From the most recent Bathymetric survey (2021) cross sections were taken at 10 metre intervals on both upstream and downstream of the Lock and from that approx. 3361m³ of material was shown upstream of the Lock (with an estimated 10m³ of material containing solids) and 5374m³ of material below the Lock (with an estimated 70m³ of material containing solids) on the approach channel to the Dock and the Dock area.

The total Volume of material is estimated at 8735 m³.

Method:

It is proposed to place 10mm mesh over the DOP pump to suck the silt only from the area and leave the solid material on the River bed. In advance of any dredging the floating jetties at Custom House Quay (area1) and Arthur Quay (area 2) will be removed.

The DOP pump will be attached to a crane on a pontoon raft (See figure 3) operating at 14 set ups upstream of the weir and 14 set ups downstream of the weir. The crane has a full extension reach with the Dop pump attachment of 13.5 metres and the locations shown are based on the crane working at 12 metres radius. The raft has 2 spud legs that hold the raft at a designated set up point. The silt will be pumped via a 200mm floating discharge pipe to the discharge area shown below on an ebbing tide. The discharge pipes will be connected to the pump and floating on the surface. Concrete anchor blocks located at 10 metre intervals on the River bed fastened to the discharge pipe via a light chain to hold it in position.

In Appendix 2 Areas 1, 2 and 3 (Plant set up Locations 1 to 14) will Pump to the discharge area 1 upstream of Sarsfield Bridge. In Appendix 1 Area 4 and 5 (set up locations 15 to 28) will pump to discharge area 2 Upstream of Shannon Bridge.

The percentage water to silt ratio is expected to be 80/20. The operating window to carry out works based on tide tables for the area is expected to be 5 hours. From the quantities above It is estimated that 108 hours of pumping will be required.

To remove the granular material a long reach excavator with a perforated bucket on the pontoon raft as in Figure 3 will excavate the material and fill a clay barge (Figure 4) with a capacity of 10m³ that will travel to Limerick Port where it will be removed by excavator, **immediately** loaded into trucks and roll on/off sealed steel skips, and removed to a licensed landfill site. The total estimated of hard material is approximately 70m³. This material (mainly in the downstream approach channel) will be removed at full tide when the flows are low.

Operating at a daily discharge of 80m³ /hour this equates to 15 days of excavation.



Figure 3 – Typical crane on a 4 unit pontoon raft



Figure 4 - Clay Barge

DOP® PUMP

GENERAL INFORMATION

		DOP1515	DOP1815	DOP2320
PERFORMANCE	Mixture capacity (m³/hr)	200 - 500	300 - 600	500 - 1000
	Pump speed approx. (rpm)	1200	1000	850
	Max. power at shaft (kW)	65	95	150
HYDRAULIC REQUIREMENTS	Oil flow (l/min)	190	260	430
	Oil pressure (bar)	225	225	225
CUTTER / AUGER DRIVE	Max. power at shaft (kW)	12	16	26
	Oil flow (l/min)	35	45	75
	Oil pressure (bar)	225	225	225
JETWATER	Connection (diameter in mm)	75	75	100
	Advised capacity (m³/hr)	50 - 125	75 - 150	125 - 250
	Pressure (bar)	5	5	5
DIMENSIONS	Suction bore (mm)	150	180	230
	Discharge connection (mm)	180	200	250
	Spherical passage (mm)	75	110	125

DOP Pump details

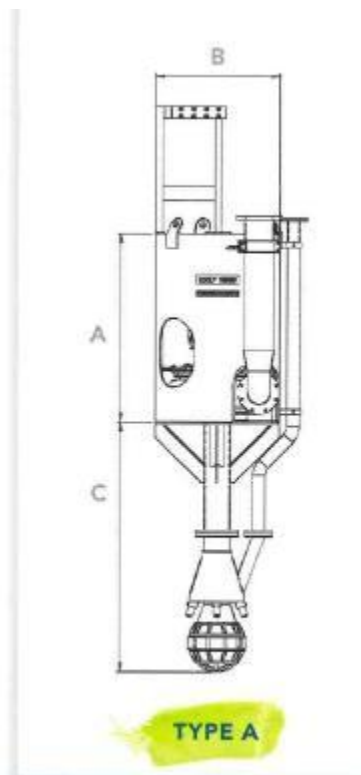


Figure 4 - Cutting- head

		DOP1515	DOP1815	DO
WEIGHT BASIC PUMP UNIT	Hydraulic driven (kgs)	900	1400	
	Electric driven (kgs)	1400	2100	
DIMENSIONS	A (height in mm)	1010	1360	
	B (diameter in mm)	830	910	
	C (height in mm)	1600	1805	
	D (height in mm)	930	1075	
	E (height in mm)	990	1140	
	F (height in mm)	1290	1450	
	G (height in mm)	1100	1240	

Figure 5 - Pump dimensions

Vessel 'Kismet' Specifications

- Department of Transport approved Class VIIIa.
- Load-lined
- Passenger licence
- D.O.T approved crane operation, cargo carriage 42 tonnes to sea and carriage of passenger simultaneously.
- D.O.T. approved stability booklet

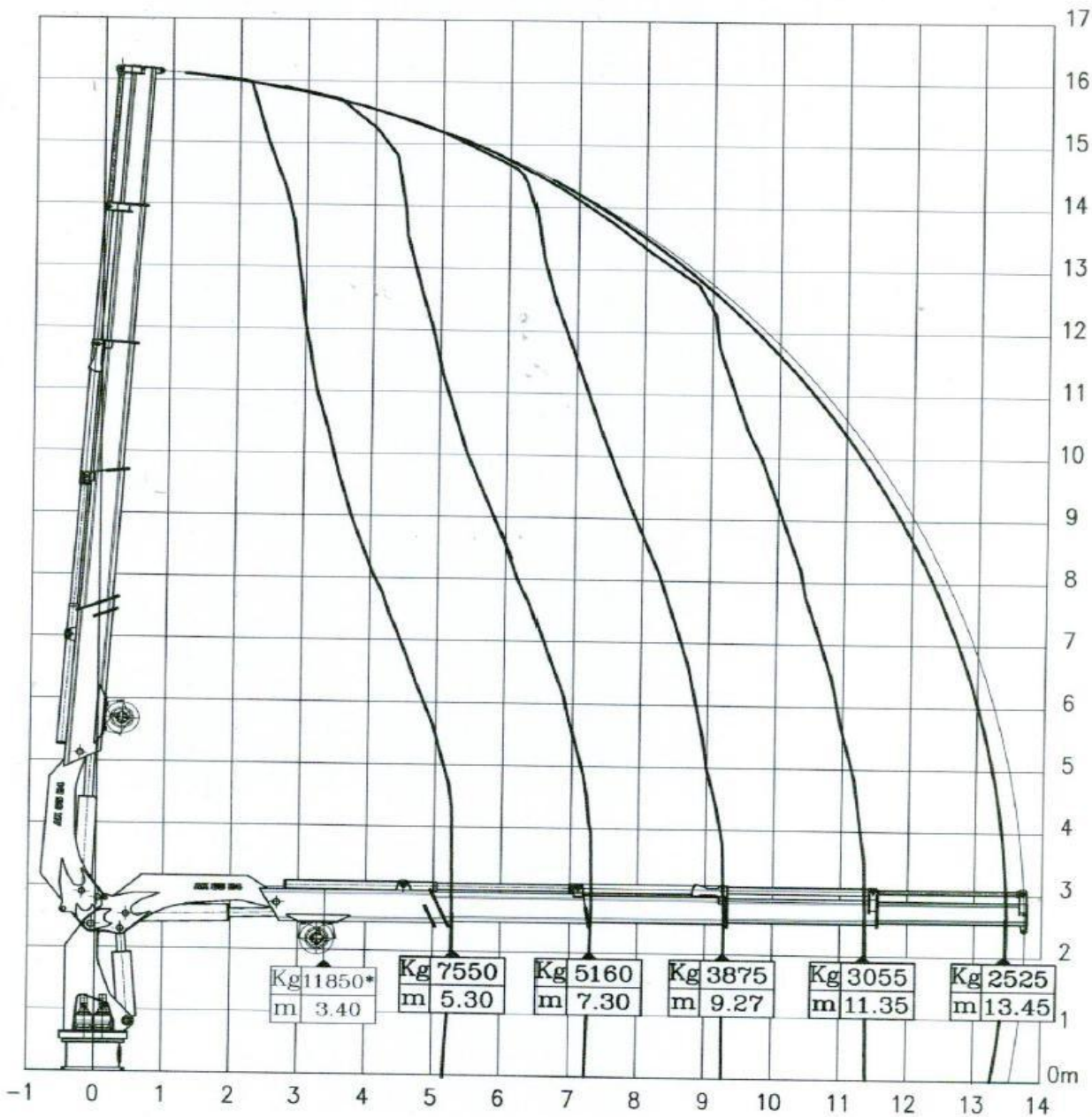
Length	14.5 metres
Draft	1 metre
Beam	8.5 metres
Propulsion	2 no. Caterpillar 3208 NA 210HP Twin disc transmission MG5061SC 3:1
Equipment	13 tonnes winch 47 tonnes/metre H.S. Marine Crane Loading Ramp
Clear Deck Area	115 Sq Metres
Cargo capacity	42 tonnes to sea



Figure 6 - Raft spec and details

WORKING DIAGRAM with HOOK
(Max.permitted heel/trim 5°/2')

HS.Marine

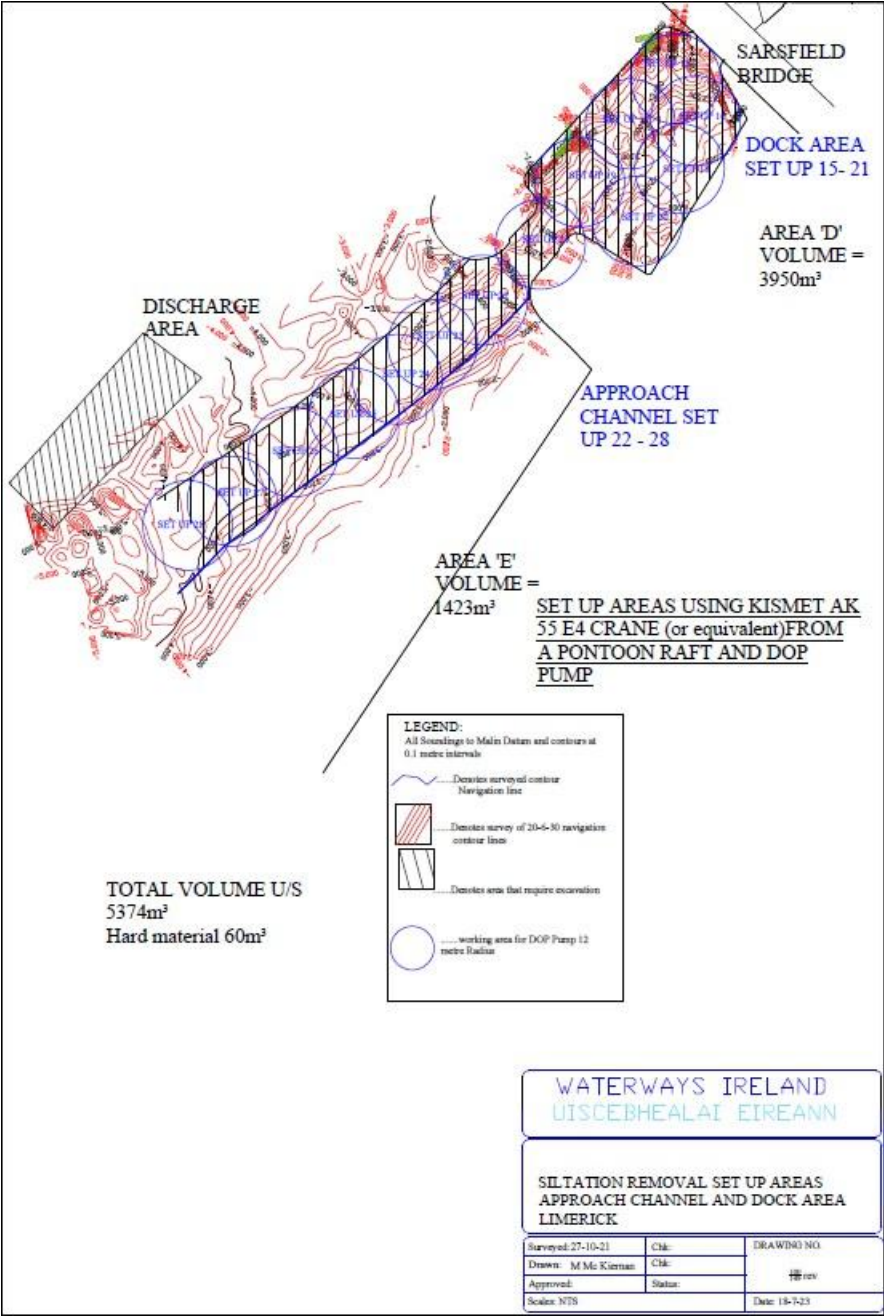


Marine Crane type AK 55 E4

HS.Marine Srl - Via G.Marconi, 33 Sabbioneta (MN) - ITALY, Phone +39-0375/254819, Fax +39-0375/255049, e mail hs.marine@libero.it
We reserve the right to change design and specification without prior notice. DWG N°176.00.00.00

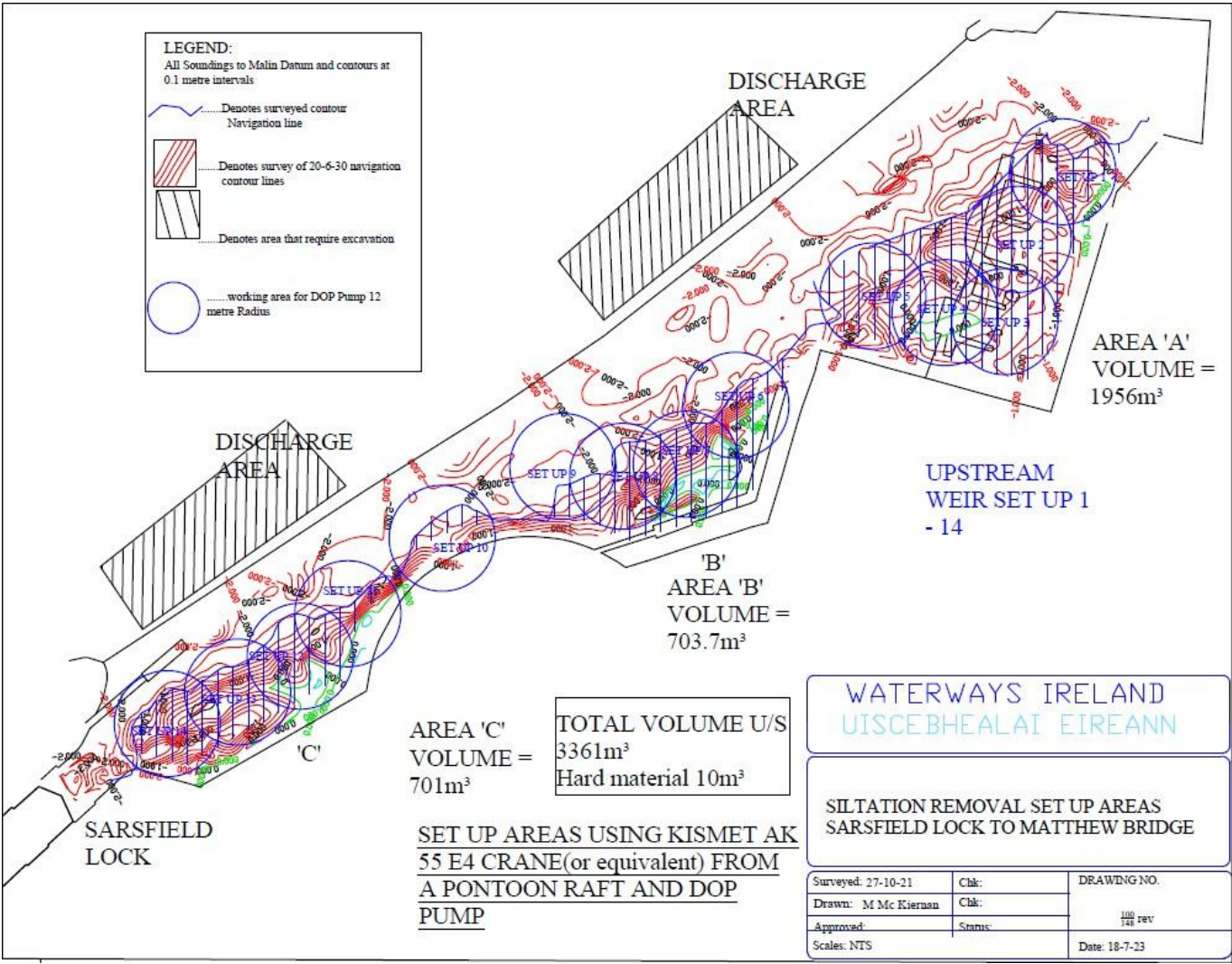
Figure 7 - Crane Reach details

APPENDIX 1



Set ups areas downstream of Sarsfield Lock

APPENDIX 2



Set up areas Upstream of Sarsfield Lock

Appendix 3

Lamprey assessment of the River Shannon at Limerick

Appendix 4

Marine Sediment Characterisation Report

Appendix 5

Numerical Modelling Study

Appendix 6

Environmental Commitments

1. Method Statements will be prepared by the appointed contractor. These will be submitted to Limerick County Council, Inland Fisheries Ireland and National Parks and Wildlife Service (NPWS) for approval in advance of works commencing. Method Statements will be used to translate the project requirements into planned systems of work instructions to the site staff and operatives involved. They will define the proposed method of working for an element or section of work taking into account the particular requirements of the project including site conditions, safety hazards, the contract drawings, specification or code of practice and ecological requirements (as outlined in mitigation Section 8 and highlighted by site ecologist). They define the proposed use of plant, labour and materials, any hold points or permits and may be supplemented by drawings, sketches and produce data as necessary.
2. The contractor will employ technology to ensure there will be no dredging outside of dredge location boundaries.
3. The contractor will adhere to the following environmental commitments: working between October - February inclusive, hydrocarbon control emergency response plan, site training and environmental awareness, non-native and invasive species control and minimising noise.
4. Substances that can cause water quality problems will need to be controlled adequately at all times during the works. Refuelling of machinery will be in designated refuelling areas. Spill kits and personnel practised in their use will be required in case of an oil spillage.
5. The timing of construction in the intertidal area will be influenced by the tide as disposal can take place only during the ebb tide. There are tide timetables available online e.g. <http://www.ukho.gov.uk/easytide/EasyTide/index.aspx>.
6. A project ecologist (environmental clerk of works) will be appointed to monitor the works on a weekly basis for the full duration of the project. The contractor will work with the ecologist to deliver environmental compliance on site, as set out in the mitigation in the NIS. The ecologist will audit the construction works from an environmental viewpoint.