A Study of Otter in Cork City and the Cork Harbour Area

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Executive Summary

This report sets out the findings of survey work conducted between May and December 2021 to gain an understanding of Eurasian otter (*Lutra lutra*) within the Cork City and Harbour area. It explores otter presence within these areas and offers recommendations on how these animals, and the habitats upon which they depend, should be treated within the urban setting. The expanding city is placed at the confluence of diverse terrestrial, freshwater and coastal zones, and evidently is a haven for otters. It is important that an understanding of otters and their needs is integrated into the inevitable development of the city.

Surveying for the distribution was conducted by visiting likely areas such as bridges, headlands, and other "landmark features" seeking spraints and holts; this provided information on the distribution of otters. Otter was found to be present throughout the study area. The watercourses are discussed under the following headings: Bride North River System, Blarney Area, Curraheen River System, Glashaboy River System, Douglas River System, and the Lee River.

The coastal areas are divided into Lough Mahon and the Outer Harbour Area. Coastal areas within Lough Mahon surveyed as part of this study included the Glanmire Area, Fota Island, Harpers Island, parts of Little Island, Rochestown and Passage West. Areas studied within the Outer Harbour Area included Monkstown, Ringaskiddy, Haulbowline Island, Rocky Island, Curraghbinny, Carrigaline, Crosshaven, Roches Point, White Gate, East Ferry, and Cobh. Whilst collecting spraint, general characteristics of the watercourses and coastal areas were noted and integrated into the report.

In order to provide recommendations, anthropogenic issues pertaining to otters and their habitats were identified during the fieldwork, and recommendations were made on how to address these issues. This was discussed under the following headings: Instream Habitats, Riparian Habitats, Woodland, Boulders Rock armour, Weirs, and Freshwater Bathing.

During the fieldwork, areas which were considered to offer good potential for the breeding area were identified using the descriptions offered in Liles 2003. A breeding area is a broad secluded area where the female rears young and may have several holts. Information on breeding sites is scarce in the literature, and breeding sites are generally difficult to find, particularly in non-urban areas. However, in an urban setting, secluded areas with good cover

are generally rare, and the identification and protection of such sites are important for otter conservation. Breeding area identification is not an exact science, but it provides particularly useful information. A non-exhaustive list of twelve potential breeding areas was identified and described within the study area and provides an excellent opportunity for further research.

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Recommended citation:

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References: The background mapping used was to create the maps used in this document is OpenTopoMap1

[1] OpenTopoMap is an open source topographic map generated from OpenStreetMap data and SRTM elevation data. OpenTopoMap is licensed under the Creative Commons (CC-BY-SA) license. For details and legend please see: https://opentopomap.org/about

1.0. Introduction

1.1. Introduction

The current report details the findings of survey work conducted between May and December 2021. The purpose of the survey work was to gain an understanding of Eurasian otter (*Lutra lutra*) presence within the Cork City and Harbour area, habitat requirements and other ecological influences. The work was commissioned by The Cork Nature Network CLG.

1.2. Geography of the Area

Cork Harbour is one of the largest natural harbours in the world. It hosts Ireland's second-largest city, a nationally and internationally important seaport, a large industrial area and a complex of varied habitats which are important for wildlife. The topography of the area is quite unique, interspersed with built-up urban areas, inter-tidal mudflats, and rocky shores, into which flows a web of V-shaped valleys. The bedrock of Cork City and Harbour area is composed of old red sandstone and siltstone, shale, and various limestones. The harbour is a drowned river valley which was once above glacial-era sea levels. It has many inlets and estuaries including the Tramore estuary, Lough Mahon, Owenboy Estuary, and the Lee Estuary. There are islands throughout the harbour, the largest being the Great Island, where Cobh is situated.

Although the aerial extent of the harbour is large, it is quite shallow, exposing ecosystems at low tide. The sheltered condition within the harbour creates an ideal environment for inter-tidal mudflats and salt marshes[2], an important feeding ground for birds and supports a diverse range of macro-invertebrates[3]. This site supports roosting habitats for over 20,000 wintering birds, making Cork Harbour an internationally important wetland site and a Special Protection Area (SPA).

Following generations of human activity, the harbour has many dredged channels to allow navigation in the harbour at low tides; for large shipping container vessels, oil tankers and cruise liners, and all manner of private vessels, making Cork City Harbour a hub of activity.

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[2] Much of which is designated as a Special Area of Conservation (SAC)

[3] such as *Scrobicularia plana, Peringia (Hydrobia) ulvae, Nepthys hombergi, Nereis diversicolor* and *Corophium volutator*

Given that the area is a nexus of diverse terrestrial, freshwater and coastal habitats, it is beyond doubt that it has been important to otters since before the earliest human settlements. The name 'Cork' is from the Irish term 'Corcach Mór Mumhan'. This term means the 'Great Marsh of Munster'. It refers to the fact that the city is built on a braided channel. Cork was originally a monastic settlement in the sixth century and became more urbanised at some point in the early 900s when Viking settlers founded a trading port as part of the global Scandinavian trade network. The centre of Cork City developed between the north and south channels of the river Lee, inside a fortified wall; this peculiar positioning and strong fortification was most likely an attempt to protect the settlers against local Chieftains. As Cork grew as a city, the channels between the islands were built over. Some of the main streets of present-day Cork, such as Grand Parade, South Mall, and Patrick's Street, were once river channels, and are still supported by stone arches which span the various stretches of the braided channel (Heritage Council, 2007). The city has been expanding since to an area of over 187km^2, and currently houses a population of 210,000 people[4]. This sprawl has come to include a number of river corridors and coastal areas.

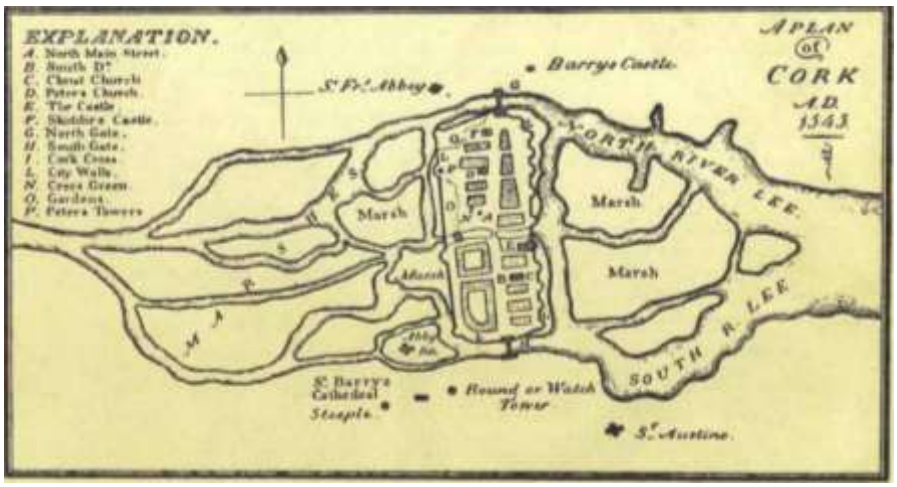

***Figure 1**: A map of Cork City (Heritage Council, 2007) from 1545 showing the original walled city surrounded by marshes*

4 https://www.cso.ie/en/media/csoie/releasespublications/documents/population/2017/Chapter_2_Geographical_distribution.pdf

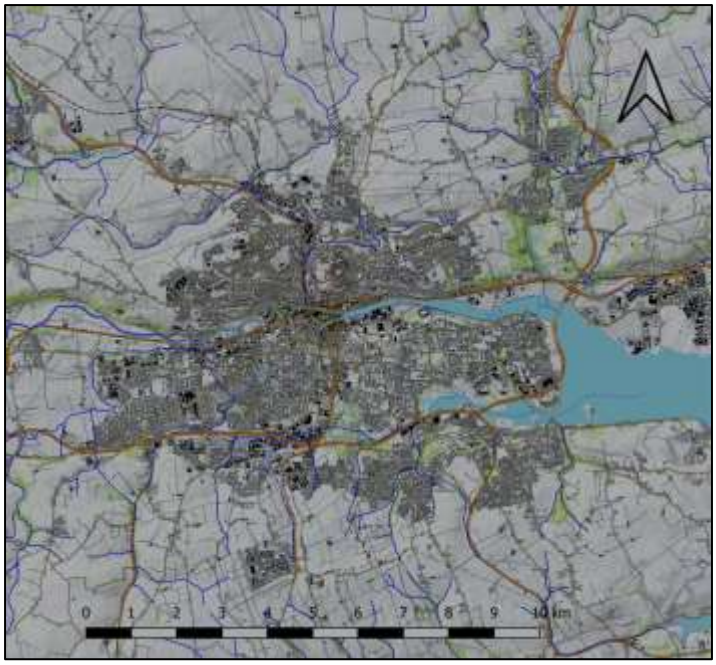

***Figure 2**: A map of the urban sprawl of modern Cork City*

1.3. Otter

Otter populations declined throughout Europe after the 1960s and the species is now rare or absent from many parts of its former range. Ireland continues to remain a stronghold for the European otter (Bailey and Rochford, 2006). Four national surveys have been conducted to date. The first in 1980/81 found signs of otters throughout the country, at 88% of sites surveyed. There was suggestion of declines in the survey results of 1990/91 and 2004/05 (Bailey and Rochford, 2006) but the most recent survey (2010) indicated recovery to 1980 levels (Reid et al., 2013). Otters have two basic requirements: aquatic prey and safe refuges where they can rest. In Ireland, otter populations are found along rivers, lakes, and coasts, where fish and other prey are abundant, and where the bank-side vegetation offers cover (Chanin, 2003). The otter is an opportunistic predator with a broad and varied diet. In coastal areas fish, crabs and molluscs are eaten. In freshwater areas a variety of fish from sticklebacks to salmon and eels will be taken, while crayfish and frogs can be important locally or seasonally (Chanin, 2003).

Information regarding distribution, habitat use, and diet comes from spotting otter tracks and signs. Individual otters are highly territorial, using droppings (spraints) to mark their home ranges. Favoured locations for leaving spraints are in-stream boulders, bridge footings and grassy tussocks (seats). Within its territory, an otter may have several resting sites (couches) and underground denning sites (holts) (Liles, 2003; Chanin, 2003).

Distribution

In Ireland, the otter population is geographically widely spread (e.g., NPWS, 2009; NPWS, 2019) and its presence will depend on the provision of suitable aquatic habitats, sufficient food, and cover for resting and breeding.

The territories of otters can stretch for several kilometres. The smallest territories are thought to occur at coastal sites, where territories may be as small as 2km. The longest territories occur in upland streams where an individual may have to range more than 20km to find sufficient food (NPWS, 2009). The territories of males tend to be larger than females and indeed may overlap with several female otters. Within their territories, an individual otter may utilise several holts. Holts tend to be more numerous in coastal territories. Freshwater territories are likely to contain fewer holt sites but may have other resting sites, such as couches, which are utilised more frequently (Chanin, 2003b). Holts can include natural crevices, associated with the roots of trees growing along river and lake banks. These natural recesses provide the otter with a holt that has multiple entrances from which the otter can escape if disturbed. Whilst individual otters rarely dig their own holts, they will use burrows made by other animals such as rabbits and foxes.

Reproduction

Otters can breed at any time of year (Liles, 2003). Scent markings by the females signal to male otters that the females are ready to mate. The pregnancy lasts for approximately two months after which a litter of cubs is born. A litter usually consists of two or three young, but litters with as many as five have been documented. The cubs remain in the natal holt for up to two months before venturing out on their own, although the mother may move the cubs between holts within her territory periodically. The juvenile otters sometimes remain as a family group for around six months or longer before the young otters disperse to establish their own territories (Chanin, 2003).

Foraging

Otters that live in rivers and lakes tend to be completely nocturnal, with a tendency toward being crepuscular. Foraging at night or in turbid water is aided by their sensitive whiskers. Otters are principally piscivorous, relying predominantly on salmonids[5], eel (*Anguilla anguilla)*

[5] salmon (*Salmo salar)* and trout (*Salmo trutta)*

and small fish species such as stickleback, Gasterosteidae *spp.* and minnow (*Phoxinus phoxinus)*. However, otters are not limited to feeding on fish and are opportunistic predators of a range of prey when available: frogs (*Rana temporaria)* are frequently eaten by otters, and the remains of invertebrates, birds and small mammals have also been found in spraints. Crayfish (*Austropotamobius pallipes)* can be important if the water chemistry allows for their presence. Otters that forage at the coast may have flexible foraging times linked to the tides (Chanin, 2003b). At low tide, otters hunt in the exposed rock pools and seaweed-covered rocks.

Legal status

The otter is classified as "near threatened" by the IUCN Red List with a decreasing population trend and, as such, is listed in Appendix I of CITES, Appendix II of the Bern Convention (Council of Europe, 1979) and Annexes II and IV of the EC Habitats Directive (92/43/EEC). Otters, along with their breeding and resting places, are also protected under provisions of the Irish Wildlife Acts 1976 to 2012.

Figure 3A *(top left): A typical otter spraint taken in the Glashaboy catchment.*
Figure 3B *(top right): An illustration and photograph of an otter footprint*[6]*.*
Figure3C *(bottom): An otter enjoying a sunny evening at Fota Island.*

[6] Source : https://www.otterspotter.de/en/footprint

2.0. Method

The survey followed where possible the best practice survey methodology for otters as recommended in Chanin (2003b), "*Monitoring the otter (Lutra lutra). Conserving Natura 2000 Rivers Monitoring. Series No. 10*," and Bailey & Rochford (2006), "*Otter Survey of Ireland 2004/2005. Irish Wildlife Manuals, No. 23*." Surveying was carried out by visiting bridges and areas where access permitted; the watercourses and coastal areas were not generally walked in their entirety due to the scale of the study area, and so spot checks were carried out targeting likely areas such as bridges, headlands, and other such "landmark features" which are often used by otter to mark territory. The presence of otters was ascertained during targeted surveys by seeking spraints; other field signs were also sought such as footprints and slides as well as holts and couches. Surveying was conducted within urban, peri-urban, and coastal areas; non-coastal rural areas were generally not visited except for areas of the Bride and Glashaboy catchments, and areas around Blarney. Initially, the aim of the survey was to collect spraint samples and carry out DNA analysis to quantify the population of otters, however, it was later decided not to analyse the samples due to doubts over the efficacy of extracting DNA from spraint. As a result, much of the fieldwork effort was devoted to gathering spraint, with a view to creating a map of the territories of individuals across the city and harbour area, and although this map could not be produced without the DNA analysis, the spraint-based fieldwork still provided very useful data as confirmation of otter presence and as a general indicator of how an area was used by an otter.

As a result of this broadscale approach, areas were not studied in high resolution, opting instead to select the most likely areas where spraints would be found. A dedicated high-resolution survey of the same area where more survey hours be applied to the study would certainly yield more signs of activity. However, this approach produced a useful overview of otter activity in the city and harbour area.

During the river survey, as well as looking for signs of otters, a general appraisal was made of the aquatic habitats, the riparian habitats, and the physical and hydro morphological characteristics. It was also intended to identify issues pertaining to the aquatic environment and determine their causes and effects where possible. Notes were taken and linked to a field map. Aquatic habitat assessment was conducted in line with the methodology given in the Environment Agency's, 'River Habitat Survey in Britain and Ireland Field Survey Guidance

Manual 2003' (EA, 2003). Habitats of use to the various life stages of salmonids were assessed based on the information provided in the book “Trout and Salmon. Ecology, Conservation and Rehabilitation” (Crisp, 2000). Lamprey ammocoete habitat as well as the suitability of adult spawning habitat was assessed based on the information provided in Maitland (2003) and Gardiner (2003).

A desktop study was conducted by the authors of this report, and a range of online resources was utilised in accessing a variety of information; these included the EPA website, the NPWS website, the OPW, the IFI and Catchments.ie websites, ViewrangerGPS, and a number of papers, documents, and articles relevant to the project. Online resources were visited prior to the site’s first visit in order to obtain an overview of the site and to inform how best to conduct the survey in terms of on-site methods, health & safety issues, potential limitations & pitfalls. These resources were re checked by the authors of this report in order to clarify the range of parameters and compile them, along with the findings of the on-site survey work, in order to attain an accurate appraisal of the study area.

Information provided below on the geography of the areas surveyed is gleaned from OSI mapping as well as the EPA Mapviewer, much of it was also gathered during the fieldwork. Information on water quality throughout this document is generally sourced from the EPA Mapviewer or from Catchments.ie, indications of water quality were also observed during the fieldwork. Information on fish was taken from the IFI website as well as various reports available online which were generally undertaken for Environmental Impact Assessment Reports (EIAR) for various projects around the city, the fieldwork also provided information on fish presence. Information on hydro morphology and instream habitats was gathered during the field surveying.

3.0. Distribution

Section 3 presents the outcomes of the surveys and desktop research and records distribution. Distribution is split into Watercourses and Coastal Areas. The watercourses are discussed under the headings of the six main river systems within the city (Bride North River System, Blarney Area, Curraheen River System, Glashaboy River System, Douglas River System, and the Lee River). Tributaries surveyed are detailed within the relevant river system below. The coastal areas are split into Lough Mahon and the Outer Harbour Area. Coastal areas within

Lough Mahon surveyed as part of this study included the Glanmire Area, Fota Island, Harper's Island, parts of Little Island, Rochestown and Passage West. Areas studied within the Outer Harbour Area included Monkstown, Ringaskiddy, Haulbowline Island, Rocky Island, Curraghbinny, Carrigaline, Crosshaven, Roches Point, White Gate, East Ferry, and Cobh.

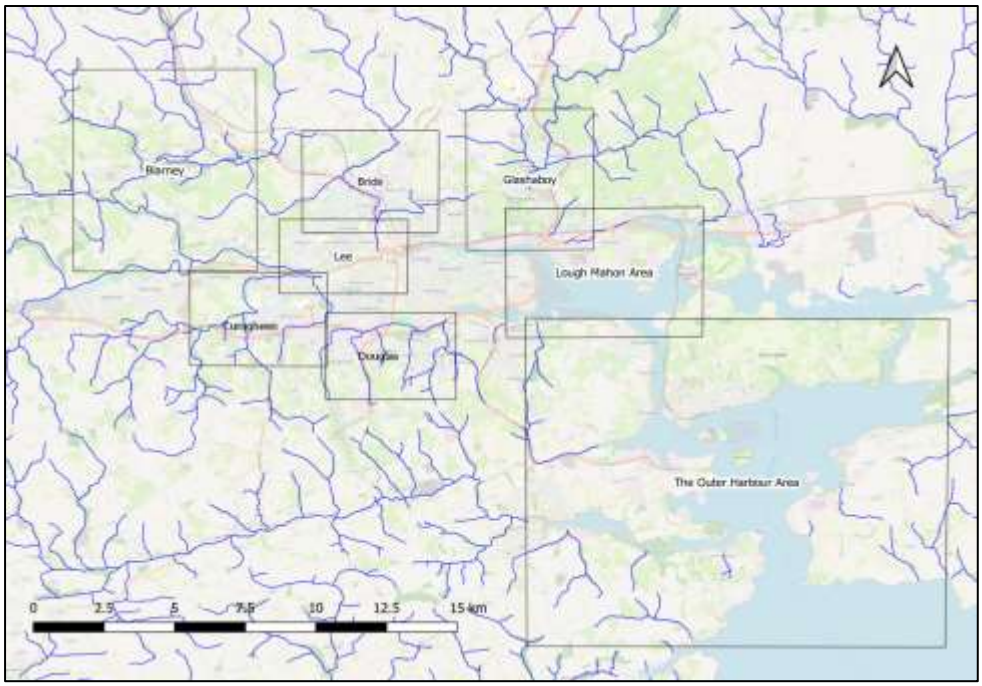

Figure 4: *An overview of the study area; the rectangles show the areas discussed below.*

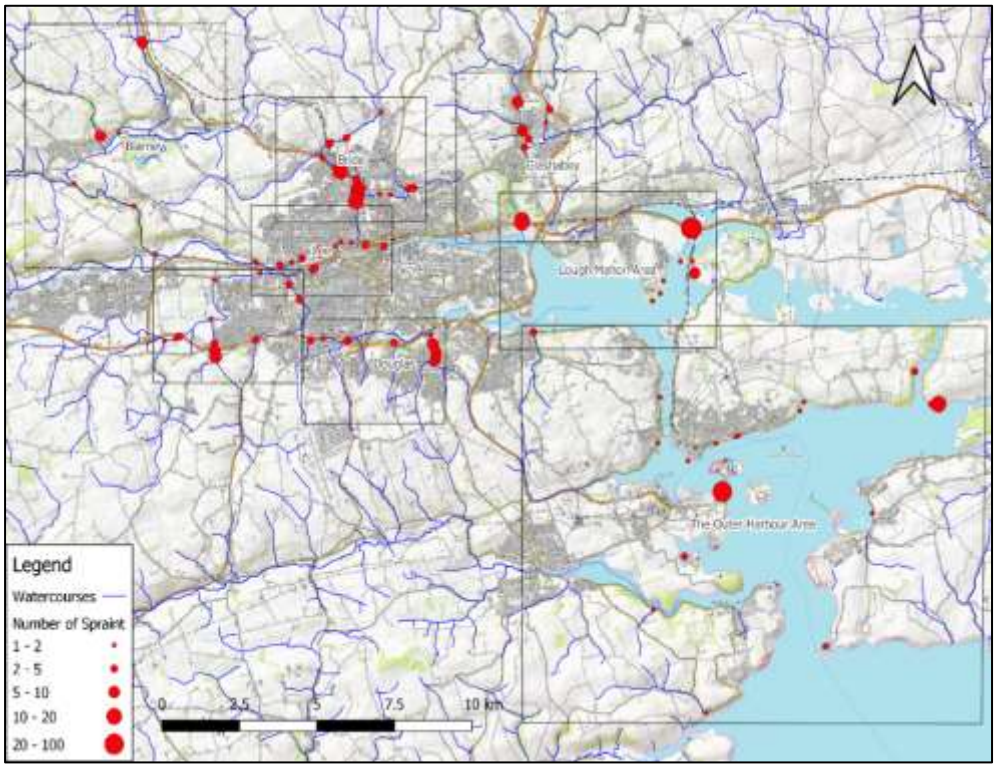

Figure 5**:** *Distribution of otter spraint in the study area*

3.1. Distribution

3.1.1. Watercourses

Bride River System[7]

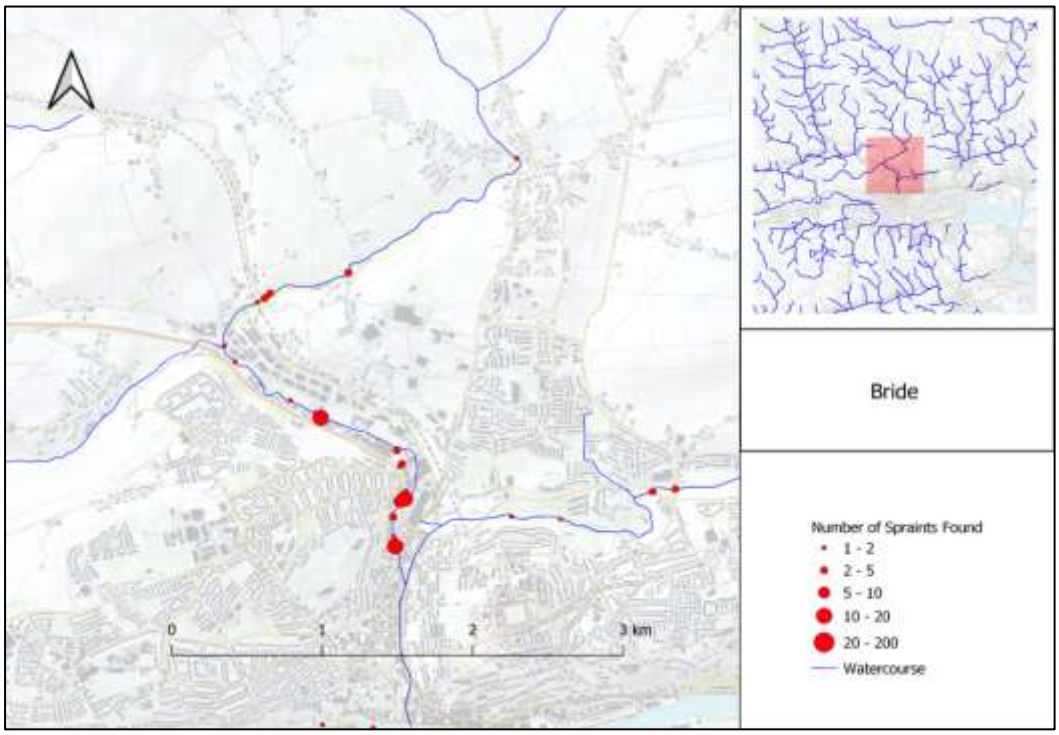

***Figure 6**: The Bride River System: spots, where spraints were found. Spraints are indicated in red, and the size of the red dot indicates the number of spraints found at each spot.*

The number of spraints observed in the main channel of the Bride suggested a high density of otter activity. From Blackpool up to the Glennamought confluence fourteen sprainting sites were noted, three of which contained more than ten spraints. This area is certainly considered important for otters and contained the highest density of activity of all riverine elements in the study area. The Glen River, which is suffering badly from water quality and fish passage issues[8], contained four sprainting sites. Five sprainting sites were found on the Glennamought, which was seen to have, secluded areas and good foraging opportunities for otters.

Geography

The river exists as three main channels; the Bride (city north) comes in from the west, the Glennamought from the north and the Glen River from the west. The watercourse becomes

[7] Including the Bride, the Glennamought, and the Glen Rivers

[8] a combination which can render a watercourse lifeless in terms of fish

the Kiln after the Glen joins in the Blackpool area. The Glennamought is the largest of these contributors, it's headwaters are rather steep, giving it a somewhat spatey flood regime.

Water quality[9]

There are no National Water Monitoring Stations within the catchment, which is a common trait of urban watercourses. No Q-values were found to have been published for the river system, and the "River Waterbody WFD Status" is classified as "Unassigned." In one survey for proposed housing development, the Glen River was given a Q-value of 2 in its upper reaches; sewage fungus was also present, and the entire channel of the Glen has an odour of household greywater.

Fish

A fisheries survey from 2014 (Hanley, 2016) of four sites within the catchment found brown trout, eel, and river lamprey. The sites were on the Bride river (three sites) and the Glennamought (one site). Brook lampreys are also likely to be present within the catchment. However, anadromous Atlantic salmon are not known from the catchment, likely as a result of the extensive and likely impassable culvert network downstream of Blackpool.

Hydro morphology and instream habitats

The river Bride has undergone large-scale culverting, from Blackpool down to the confluence with the Lee. This culverting consists of a number of exceptionally long sections where the river is forced underground. This stretch may be largely impassable to migratory fish, starving the river of salmon and sea trout, which would almost certainly be present were it not for these features. Above the culverted section, the river has been realigned, channelised, and the connectivity with its floodplain is constricted. That said it still contains some reasonable instream habitats with some great holding habitats for adult salmonids, some were observed to contain shoals of trout during the walkover. The spawning habitat in this section is somewhat reduced in quality by the presence of urban run-off, however, this is offset by the high-quality spawning and rearing habitat in the Glennamought, which provides the lower section of the Bride with fish. The Glennamought is in good to excellent condition hydro morphologically despite some localised gabion basket walls. The river system works well with the high-quality spawning and rearing habitats in the upper catchment populating the lower sections with fish; it is important to maintain this connectivity.

[9] Please see appendix 1 for a table describing water quality across various categories such as Q Values, Water Framework Directive Status, Pollution Status and Condition

Blarney Area

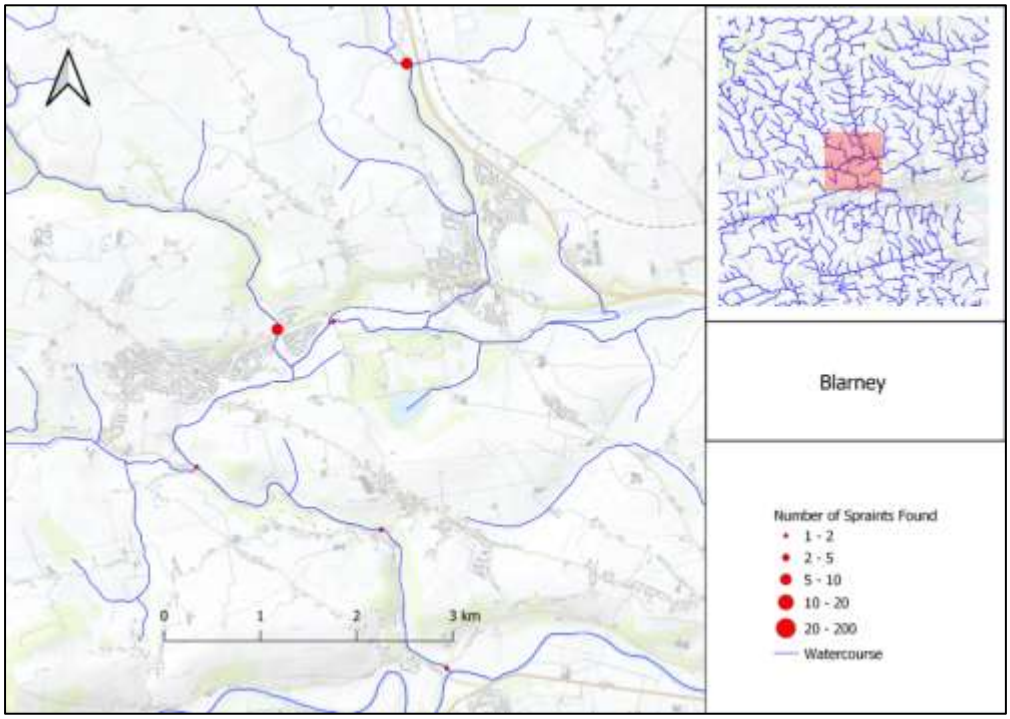

***Figure 7**: The Blarney Area.*

No spraints were found within the town of Blarney and no spraints were found in the wetlands to the east of Blarney, although this was put down to the difficulty in accessing the entire perimeter of the wetland and searching it thoroughly. The majority of bridge sites that were checked downstream of Blarney Town had evidence of otter activity. Wooded glens exist throughout this catchment and are important for otters in terms of safe breeding areas.

Geography

The Martin River catchment has an area of 90km^2. It rises in Lissard and flows parallel with the N20, into Blarney. Its geology is primarily sandstone and siltstone. The Blarney River rises in the Boolybeg, north of Cork City in an agricultural environment of tillage and pasture. It travels south parallel to the old Mallow Road before flowing under the N20 and heading west by Clogeenmilcon sanctuary. It skirts the southern boundary of Blarney where it is joined by its tributary, the river Martin. Shortly after they join the Shournagh River. The Shournagh then turns west through the Muskerry Golf Club course before swinging southeast and flowing alongside Cloghroe Road, under the Lee Road bridge and discharging into the river Lee. This combined water course largely avoids dense urban environments and retains much of its riparian cover along much of its course.

Water quality

The first EPA monitoring station on the Blarney River is located northwest of Killeens cross. In 2017 the river had a Q-value score of 4 which is defined as good or unpolluted by the EPA. Further downstream a more recent test undertaken in 2020 at Bawnafinny Bridge achieved a Q-value score of 4-5 which is a high WFD status and is considered unpolluted and satisfactory. The remaining two EPA water monitoring stations, downstream on the Shournagh at Tower bridge and Bannow bridge, retain this high-water quality status with both achieving Q-values of 4-5 in 2020.

Fish

In the 1990s there were numerous fish kills in the Martin, Blarney and Shournagh rivers due to agricultural slurry seeping into the rivers. However, since then water quality has since been restored and fish stocks have regenerated. An electrofishing survey by Inland Fisheries Ireland in 2018 was undertaken on seven sites within the Martin River catchment (IFI, 2022). Six species of fish were recorded, brown trout and salmon being the most abundant species. Salmon were found in two age classes, 0+ and 1+. Brown trout were found in three age classes 0+, 1+ and 2+. The European eel, lamprey, stone loach, and three-spined stickleback were also present during the surveys.

Hydro morphology and instream habitats

The river system is in relatively good condition hydro morphologically. Areas surveyed during the current survey exhibited good instream habitat diversity. Steep valley slopes and wooded glens are a feature of this catchment. The riparian cover is generally good. In terms of fisheries, there are holding pools and spawning areas for adult salmonids as well as rearing areas for juveniles. There is good eel habitat with plenty of submerged large stones, tree roots and other refuges. There is some optimal and sub-optimal lamprey habitat within the watercourse.

Curraheen River System[10]

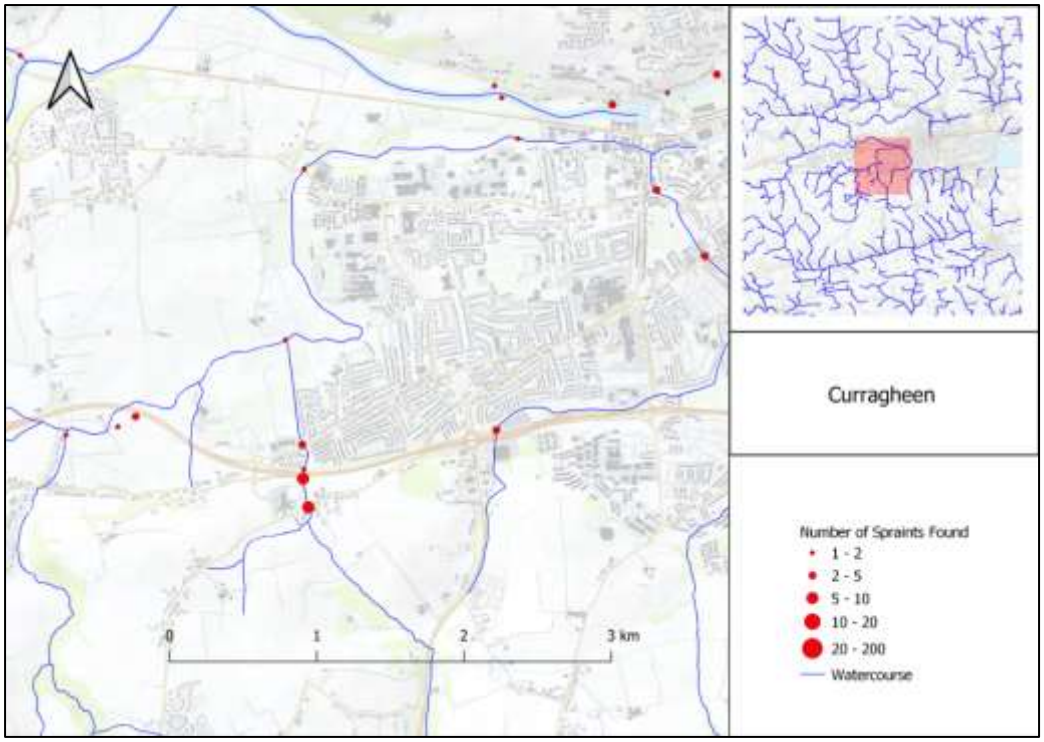

***Figure 8**: The Curraheen River System.*

Four sprainting sites were found within a small area of the Twopot river; this area is likely to be important for otters and may serve as a breeding site for some years. It is an area that is secluded, with excellent cover, and lies within an area of the Twopot river which has good fishing potential. Six spraints were found along the Curraheen main channel. The Glasheen yielded three spraints at various bridge crossings.

Geography

The Curraheen River rises in the townland of Knockpoge approximately 4km south-south-west of Curraheen village. It flows in an easterly direction for about 2km to Abbey Bridge, where it heads northwards and twists through wooded glens until it reaches the outskirts of the city. Just upstream of the South Ring Road the Curraheen River is joined from the west by a river of approximately equal size, the Maglin River. From here, the Curraheen flows in an easterly direction towards Bishopstown where it is joined from the south by the Twopot river. Approximately 3km downstream, the Curraheen joins the southern arm of the Lee in the Victoria Cross area. The catchment area is 37km² including the Twopot river. The length of the

[10] including the Twopot and the Glasheen

river channel and its tributaries are 40km. According to CORINE, most of the land use within the catchment, particularly the upper catchment, is agricultural pastures. A significant section of the lower catchment is classified under CORINE as 'artificial surfaces,' particularly the Glasheen River.

Water quality

There are two National classified Water Monitoring Stations, on the Curaheen river, one at the crossing with Model Farm Road and one in the Victoria cross area; no water quality data is available from these stations. No Q-values have been published, and the "River Waterbody WFD Status" is "Unassigned." In a survey conducted by Rory Dalton in 2017, water quality in the Curraheen upstream of the urban sprawl was Q4 at one site and Q4-5 at the other site. The Maglin upstream sample scored a Q3-4. There are no IE, IPC, or IPCC facilities [Industrial Emissions (IE), Integrated Pollution Control (IPC) and Integrated Pollution Prevention Control (IPPC) – EPA licensed facilities] discharging into the river; however, there is one discharging into the Twopot River, which joins the Curraheen River downstream of the site. There is no Urban Wastewater Treatment Plant (UWWT Plant) discharging into the river system. There are no licensed waste facilities within the catchment (this includes landfills, transfer stations, hazardous waste disposal and other significant waste disposal and recovery activities). The site straddles the Ballincollig ground waterbody and the Lee Valley Gravels ground waterbody, both currently having 'Good' status. The former is classified as 'At Risk' and the latter is categorized as under review.

Fish

A fisheries survey of fifteen sites on the Curraheen River was conducted by Kelly et al. (2007). They found salmon and trout in all sites. An electrofishing survey conducted by Ryan Hanley (2016) on the Curraheen River in 2014 found eight species at one site and five species at another; these sites were near the confluence with the Lee. The section of the channel they surveyed was found to have a good nursery habitat for lamprey and an excellent adult trout habitat. Brook lamprey (*Lampetra planeri*). Brown trout were the most abundant species present, with a single river lamprey transformer recorded. Small numbers of Atlantic salmon, flounder and stone loach were present, and a number of European eel were also captured. There have been two fish kills in the catchment in the recent past, approximately seven hundred fish were killed over a 2km stretch in the Bishopstown area in 2016 after a failure at a sewage pumping station. Approximately 240 fish were found dead in the same area in 2011, details on the causes of this fish kill are not given.

Hydro morphology and instream habitats

The Curraheen River is in relatively good condition hydro morphologically. It largely evades close settlement until its extreme low reaches in the Victoria cross area where it has been channelised and straightened. The upper and middle sections of the main channel exhibit relatively good instream habitat diversity. The soil within the catchment is coarse loamy drift with siliceous stones, which is classified as well draining. The sub-soils within the catchment are mainly Devonian sandstone till deposited here during the ice ages. The subsoil provides a good mix of cobble, gravel and sand which combine to make a decent quality riverbed. In terms of fisheries, there are ample holding pools and spawning areas for adult salmonids as well as rearing areas for juveniles. There is good eel habitat with plenty of submerged large stones, tree roots and other refuges. There is optimal and sub-optimal lamprey habitat within the watercourse. Above the confluence with the Maglin, the Curraheen passes through a wooded valley and research from aerial photography shows reasonable riparian buffer zones. The riparian cover on the main channel is good with a relatively consistent cover of scrub and treeline. Hydro morphologically, the Glasheen is in poor condition. It has been subject to multiple major mechanical alterations and is suffering badly as a result. It is straightened, culverted, and narrowed all along its length, and instream habitat diversity is quite poor. The Twopot river exhibits high-quality instream habitats, with a lot of diversity.

Glashaboy River System

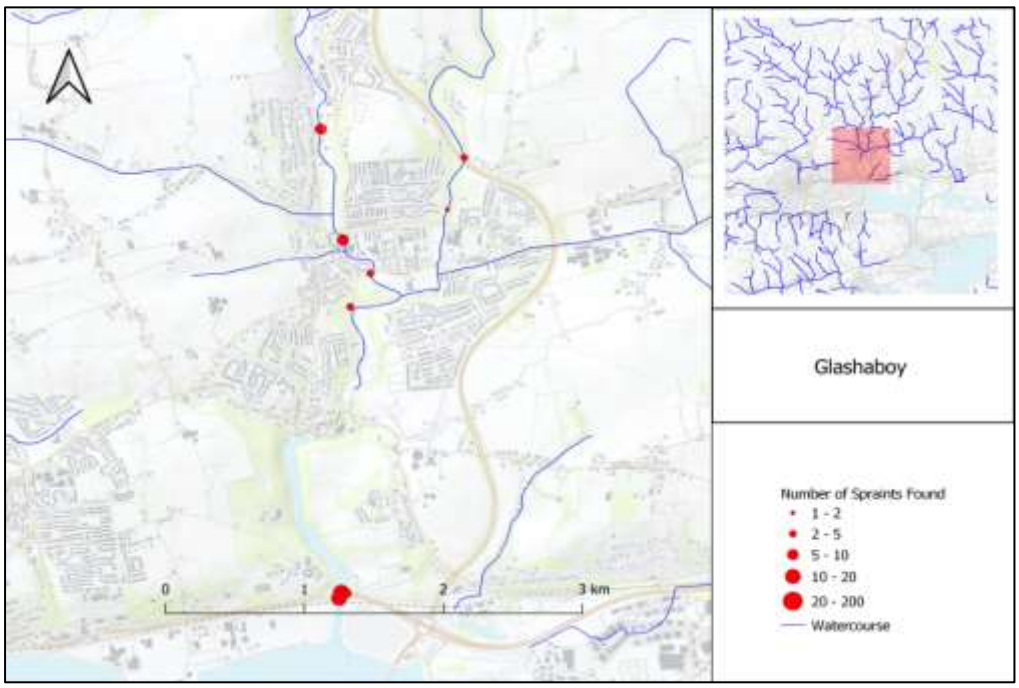

***Figure 9**: The Glashaboy River System was surveyed within the Glanmire area.*

Two spraint sites were found to be present on the Butlerstown River; both were found around bridges. Four sprainting sites were found on the main channel as it flows through the urban fabric of Glanmire and its hinterlands. Two of these sprainting sites were quite active and moderately used. A spraint site was found on the headrace generated by the weir near John O'Callaghan Park; this was accompanied by an area of mud where several footprints were observed. At the mouth of the Glashaboy Estuary there was also a lot of sprainting activity: certainly, to be considered as a major area for otters. The wooded glens of this river system provide an excellent breeding opportunity for otters.

Geography

The Glashaboy River System exists as a fan of tributaries draining the rolling hills to the north and northeast of Cork City. The main channel rises at an altitude of 300m in the townland of Bottle Hill approximately 2km east of Lissavoura Crossroads on the N20. It flows in a south-easterly direction and joined by a number of small tributaries until it reaches Glanmire. In Glanmire, it is joined by the other main arm of the river system; the Butlerstown River. The Butlerstown River rises in Watergrasshill and drains the area to the east and northeast of Glanmire. It becomes tidal in the southern outskirts of Glanmire and soon after opens into a narrow estuary with exposed mudflats; it joins the Lee Estuary in the vicinity of the Jack Lynch Tunnel. The catchment area is 141km^2. The length of the main channel and its tributaries is 17km. River flow volume averages between 1m^3/s and 2m^3/s in the summer and 5-6m^3/s in the winter months; it varies between 0.24m^3/s in extreme droughts and 17.5m^3/s in extreme floods. The catchment is steep, and as such the river likely experiences a spate-style flood regime, though this is likely modulated to some extent by the sizeable percentage of broadleaf woodland within the steeper parts of the catchment. The soil within the catchment is deep mineral brown earth and brown podzols and is classified as well draining. The sub-soils within the catchment are mainly Devonian sandstone till. According to CORINE landcover maps, most of the land use within the catchment, particularly the upper catchment, is agricultural pastures. The steeper slopes of the valleys are classified as 'mixed forest and semi-natural areas. A significant section of the lower catchment in the Glanmire area is classified as 'artificial surfaces.'

Water quality

There are 12 National Water Monitoring Stations on the river, eleven of which are above "Good Status" and five of which achieved "High Status." A single station in the upper

catchment achieved “Poor Status.” The “River Waterbody WFD Status” is classified as “Good.” The watercourse is within the Ballinhassig East ground waterbody, currently having a “Good” status. It is classified as “At Risk.”

Fish

A fisheries survey of fifteen ten sites on the river was conducted in 2016 (ARUP, 2016) as part of an EIAR for a flood relief scheme. The survey found salmon and trout in most sites, as well as eel, stickleback, stone loach, and river/brook lamprey ammocoetes. A single koi carp was captured, most likely a pet which had been released. Downstream in the tidal stretch, flounder and grey mullet were part of the assemblage. The instream habitats across all sites showed a good degree of variance.

Hydro morphology and instream habitats

In general, the Glashaboy is in good condition hydro morphologically. It largely evades close settlement until the Glanmire area where it has been channelised and straightened, and connectivity to the flood plain has been disrupted by close quarter wall construction, leaving it short on mobile gravels, and leaving the river corridor confined. The upper and middle sections of the main channel and the Butlerstown River exhibit good to excellent instream habitat diversity. In terms of fisheries, there are ample holding pools and spawning areas for adult salmonids as well as rearing areas for juveniles. There is good eel habitat with plenty of submerged large stones, tree roots and other refuges. There is optimal and sub-optimal lamprey habitat within the watercourse. Riparian cover on the main channel is good to excellent with extensive broadleaved woodlands covering a part of the valley floor and slopes. Within the wooded areas, hydro morphology is generally excellent, driven by natural processes including the presence of large dead wood.

Douglas River System[11]

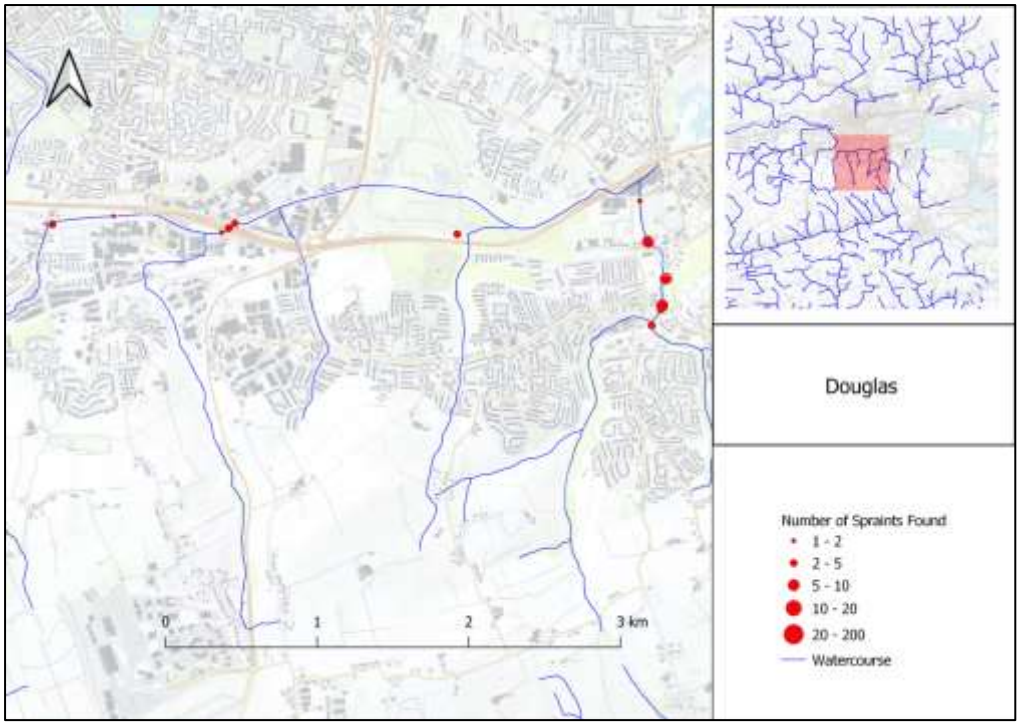

***Figure 10**: The Douglas River System.*

Within this catchment, the highest rate of otter activity was found in the Moneygurney stream, with six sprainting spots found within 1km of the river, all of which had a good degree of riparian cover. The main channel reaching inland is referred to as the Tramore River in OSI mapping, and the Douglas River in EPA mapping. Five spraint sites were found within the section between Togher and the western end of Tramore Valley Park; three of these were concentrated around the South Ring Road bridge crossing. Within Tramore Valley Park one spraint was found at a pedestrian bridge crossing.

Geography

The Tramore/Douglas River rises in the Gortagoulane in an area of agricultural activity and is classed as a Tidal River CW2. Its catchment of roughly 21km² is 41% urban or suburban in nature. Its adjoining tributaries flow north gathering water from agricultural lands. From its source it flows north into Togher and turns east to flow alongside the south ring road, the N40, at a low gradient towards Douglas. It is culverted under the N40 where it is joined by the Ballybrack stream. The Moneygurney rises near Carrs Hill and flows north – northeast alongside Carrigaline Road before turning west into Ballybrack Valley and subsequently

[11] including the Tramore, Ballybrack and Moneygurney

Ballybrack woods. It enters Douglas in a heavily channelised condition, and flows through Douglas Community Park, before joining the Tramore River by flowing through a culvert beginning under Church Street. The combined rivers of the Douglas system flow to a discharge point at Douglas Estuary and Lough Mahon. The combined catchment size is 34km^2. The soil within the catchment is fine loamy drift over sandstone bedrock in the upper reaches of the Douglas River system, with fine loamy drift with siliceous stones in the lower sections. The upper section of the Tramore flows through improved agricultural grassland with a relatively poor riparian buffer zone. However, once it exits the Togher culvert system and flows alongside the N40 the riparian cover improves with mixed treeline and bankside vegetation existing to where the river enters Tramore Valley Park. Here there is a good cover on both sides of the river that provides good otter habitat. Shortly after it becomes artificially channelised and culverted. The upper catchment is defined under CORINE 2018 as agricultural areas, with the mid catchment classified as artificial surfaces. The Ballybrack stream has good riparian cover through Ballybrack valley and woods which acts as a buffer zone preventing potential pollutants from entering the stream and negatively affecting the water quality and provides suitable cover for trout and foraging otters. The stream then enters an urban environment where it flows through an artificial channel to its discharge point at a culvert. Under CORINE the upper reaches are classified as agricultural areas with the lower reaches defined as artificial surfaces. A significant section of the lower catchment is classified under CORINE as 'artificial surfaces,' particularly the Glasheen River.

Figure 11: *The final course of the Tramore River, in artificial channel, before it enters the culvert at Douglas.*

Water quality

As there are no EPA water quality monitoring stations on the Tramore River there is no biological water quality information available. The overall ecological status is classified as moderate and is considered at risk of not achieving good ecological status. Three sampling events, taken at three separate locations, near the Kinsale Road landfill, the Ballybrack and Moneygurney sections were classed as having a moderate overall ecological status and at risk of not achieving good status. The watercourse is identified as being at risk of diffuse pollution (EPA, 2009).

Fish

An electrofishing survey conducted by Dixon-Brosnan on the Tramore river in 2017 found three species within the main channel: Brown trout, European eel, and three-spined stickleback. Trout were found in areas with bank-side cover. Parts of the river which are shallow and without cover were found to be devoid of fish. The Tramore River was considered an unlikely watercourse for the presence of Atlantic salmon due to poor water quality, limited channel size, lack of holding pools, barriers for migrating fish and limited spawning habitat. This survey also found potential habitat for brook lamprey but states that migration barriers make the presence of lamprey unlikely, and none were found during the fish stock survey. The Ballybrack stream forms from a confluence of the Grange and the Moneygurney. The Ballybrack valley and Ballybrack woods sections contain natural riffle and glide sequences, a gravel substrate and with good riparian cover in sections providing decent habitat for spawning salmonids. The stream enters Douglas River an artificial channel and continues by Douglas Community Park where brown trout were found in pools. A concrete apron and a heavily culverted lower section make it unlikely that this stream supports migratory species, such as sea lamprey, river lamprey or salmon (Dixon-Brosnan 2017). Grey mullet and flounder are present in the tidal section of the Douglas River system.

***Figure 12**: A comparison of good riparian habitat and poor riparian habitat within the Douglas Catchment.*
Left image: The Ballybrack stream, in Ballybrack woods, with good riparian cover.
Right image: Ballybrack flowing into Douglas with poor riparian cover.

Hydro morphology and instream habitats

The Tramore River is in poor condition, hydro morphologically. The upper course retains its natural course as it flows through improved agricultural grassland; however good riparian cover is absent along much of its banks. Once it reaches Togher the effects of heavy culverting and channelling can be seen. Much of its length is channelised or culverted within the urban environment through which it flows. In channelised areas, the substrate is generally soft. A number of weirs and riffle sections with rock and gravel substrate are present however much of the channel is shallow and lacking in bankside cover. In some areas, the riverbed is artificially constructed from concrete. Barriers and culverting in the lower course make this river unsuitable for migrating species. As it reaches the estuary the substrate consists of fine silt and some gravel, with fluctuating silt levels typical of a tidal estuary.

The Moneygurney and Ballybrack streams retain a natural course through Ballybrack valley and woods, with riffle and glide sections and a gravel bed with larger stones. There is a suitable salmonid and lamprey spawning habitat and potential lamprey ammocoete habitat. A well-developed riparian cover throughout this area creates quality habitats and rich biodiversity is

present. The culverting of its lower course and the size of the stream suggests it is unlikely to be used by migrating fish species such as salmon and lamprey.

Lee River[12]

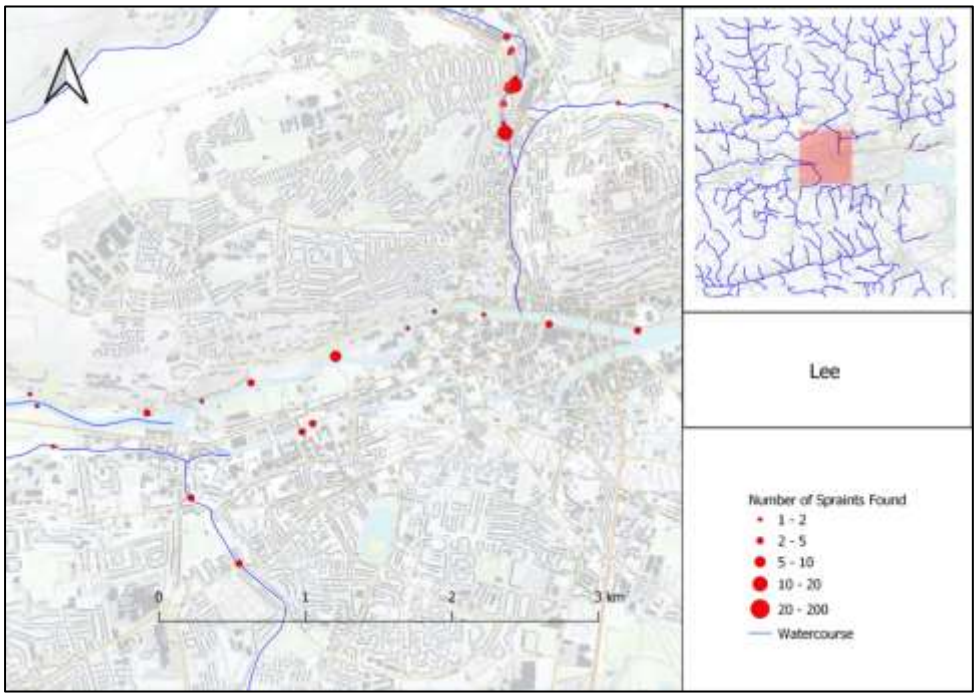

***Figure 13**: The Lee River within the urban and peri-urban area.*

The abundance of food and the amount of riparian cover along the river Lee make it a valuable habitat for the otter. Three sprainting sites were found upstream of where the river splits into the north and south channels. In the south channel, two sprainting sites were found; both within the grounds of UCC. On the northern channel, eight sprainting sites were found. Near the Mardyke Bridge there is an isolated section of deciduous woodland free from disturbance that may be very suitable for breeding otters.

Topography

The Lee rises in the Shehy Mountains flowing from the lake of Gougane Barra, past Ballingeary and into Lough Allua. It then flows northeast to the Gearagh. After the Gearagh it enters the Carrigadrohid feeder reservoir and flows subsequently, into the larger Inniscarra reservoir. From here its course heads east through Ballincollig Regional Park and under Inniscarra bridge. It then flows parallel to the Carrigrohane road, a section commonly called the Carrigrohane

[12] including the Carrigrohane Straight.

straight. The river flows over the Lee weir and here it is split into the north and south channels. The two channels re-join at the docks and flow into the estuary and finally Cork Harbour. The catchment area of the Lee is 1250km² and it has a total length of 90km.

Water quality

A brief synopsis of the greater Lee catchment is that, as of Cycle 3 of the Water Framework Directive, there are fifteen waterbodies achieving “High Status”, fifty-nine achieving “Good Status”, twenty-three achieving “Moderate Status”, five at “Poor Status” and one at “Bad Status”. There are thirty-three waterbodies that do not have status assigned for Cycle 3. All waterbodies must achieve at least Good Ecological status. Seven sites were sampled for water quality along the length of the river Lee in 2020. The most recent assessment by the EPA is that water quality in the river Lee is satisfactory along its entire length of its main channel. The testing in 2020 is the first time all sites sampled have been satisfactory since 1986. The samples achieved a Q-value score of 4-5 which is considered unpolluted and satisfactory.

Fish

An electrofishing survey was undertaken by Ryan Hanley (2016) in connection with the Lower Lee Drainage Scheme. A total of eight fish species were recorded at one site by Lee Road, to the west of the city. Minnow, roach, Atlantic salmon, and brown trout were found to be the most frequently caught species with gudgeon, perch, stone loach, and a single European eel also recorded. The river Lee is a designated salmonid watercourse under S.I. No. 293/1988 - European Communities (Quality of Salmonid Waters) Regulations, 1988. No lamprey was recorded during this survey however it is likely that this result reflects the habitat surveyed rather than the lack of lamprey in the river. Both brook and river lamprey were found in the river downstream of the Inniscarra dam. The Upper Lee Estuary covers an area of 0.25 km^2, beginning at the weir in Lee Fields and extending downstream to the Albert Street Bridges. Seven fish species were recorded by IFI here in 2008 with common goby being the most abundant, followed by sand goby and flounder. Other species recorded were Nilsson's pipefish, European eel, three-spined stickleback, scad, and plaice (IFI, 2022).

Hydro morphology and instream habitats

The hydro morphology of the river lee has changed over the centuries by human activity which on occasion has had negative impacts on migratory fish and salmon stocks However, the remit of this study is the area of the Lee within the urban setting. The riparian cover on the main channel is quite good until it enters the inner city, with a consistent cover of scrub and treeline. The stretch of river

between Carrigrohane and the city provided moderate nursery, good spawning, and moderate holding salmonid habitat.

3.1.2. Coastal Areas

Lough Mahon

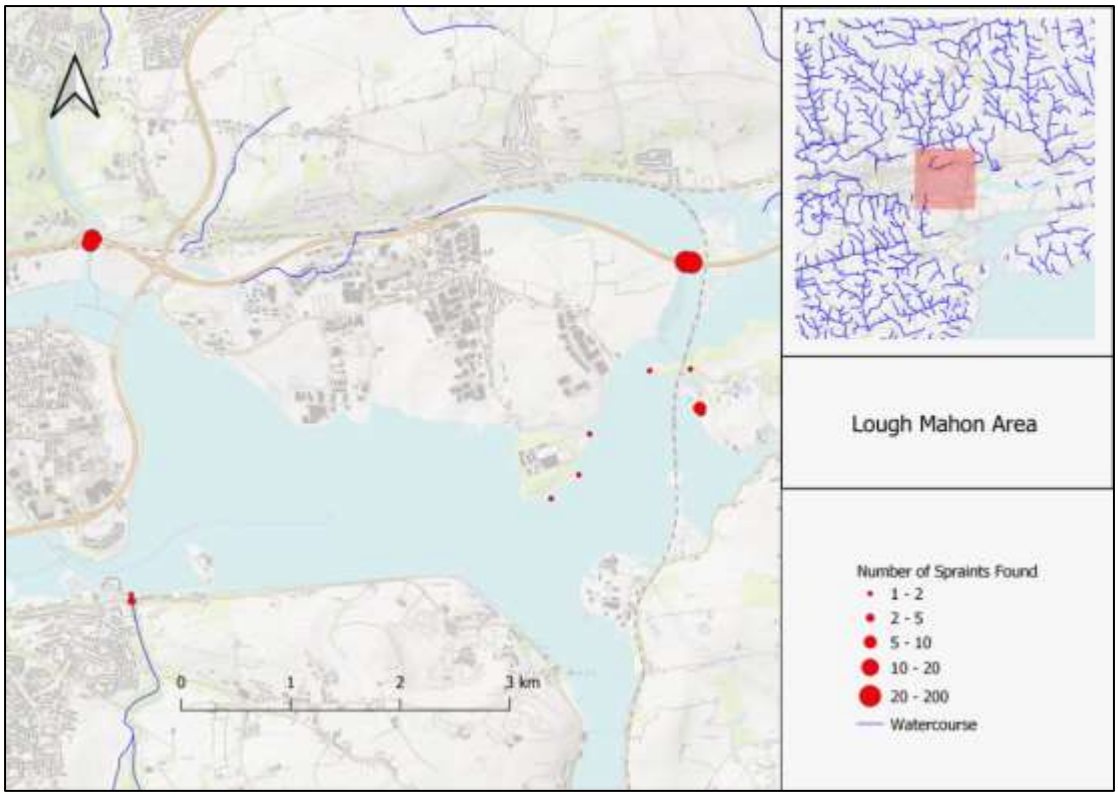

***Figure 14**: The Lough Mahon Area.*

Lough Mahon, or the Inner Harbour Area, has an area of 12km^2. The Rivers Lee, Glashaboy and Douglas discharge into Lough Mahon, all of which were surveyed as part of this study. Coastal areas within Lough Mahon surveyed as part of this study included the Glanmire area, Fota Island, Harper's Island, parts of Little Island, Rochestown and Passage West. Two highly active areas were identified. One was at the mouth of the Glashaboy estuary. The second was at the bridge between Harper's Island and Little Island. By far the largest amount of localised sprainting in the study site was found here. Given the quantity of broken shells, it appears as if the otter (or otters) has access to a large and plentiful supply of mussels, which are most likely flourishing on the loosely placed rock armour that protect the base of the bridge between Little Island and Harper's Island.

There was otter activity at the western end of Fota Island, with four sprainting sites. There were two sprainting sites at Rochestown, both of which were found where a small second-order stream enters the sea. Other than these sprainting sites, no activity was found in the whole Rochestown/Passage West area. That said, there is a homogeneity of potential sprainting features within that stretch that could lead a surveyor to miss spraints.

It should be noted here that, because surveyors were covering a large study area, initially with the aim of gathering a wide distribution of spraint for DNA analysis and subsequent population assessment, areas were not studied in high resolution, opting instead to select the most likely areas where spraints would be found. A dedicated high-resolution survey of the same area where invested time would almost certainly yield more spraint. According to the EPA website, this transitional water body is of "Intermediate Water Quality."

The Outer Harbour Area

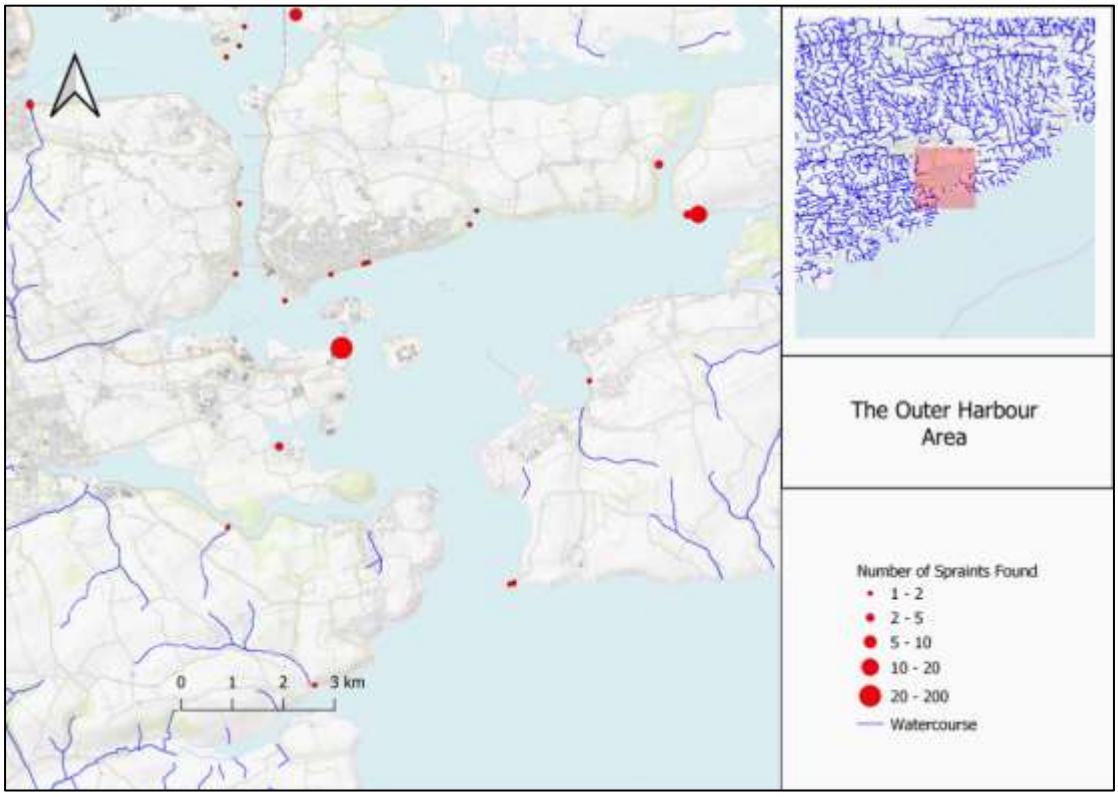

***Figure 15**: The Outer Harbour Area.*

Areas studied within the outer harbour area included Monkstown, Ringaskiddy, Haulbowline Island, Rocky Island, Curraghbinny, Carrigaline, Crosshaven, Roches Point, White Gate, East Ferry, and Cobh. Monkstown had little otter activity, with two sprainting spots found. A

sprainting spot in Ringaskiddy, had over thirty spraints present, in the nearby vicinity. There were good foraging habitats within the wider Ringaskiddy area which were unexpectedly found to be free of evidence of otters, which may be perhaps due to lack of access to fresh water being an issue in the area in the summer months when the surveys were conducted. A number of spraints were found in Curraghbinny wetland; this area provided an excellent opportunity for otters, with varied foraging opportunities for otters including coastal and wetland habitats, and cover and seclusion. In the Crosshaven area, two sprainting sites were found where streams enter the sea. Four sprainting sites were found in East Ferry, one of which yielded a considerable number of spraints. The Cobh area had six sprainting sites, which was found within the wetlands to the east. According to the EPA website, this coastal water body is "Unpolluted."

The Diet of Coastal Otter

In order to consider coastal habitats of conservation value for the use of otters, it is important to understand prey availability provided by the various habitats in Cork Harbour and to determine the preferred prey taken by otters. Catchability appears to be a key factor in the diet of coastal otters. The majority of a coastal otter's diet seems to consist of bottom dwelling fish, which are slower moving than fish that live in the mid-water. In winter however, when forced to hunt in more sheltered parts of the coast, fish such as pollack become a valuable resource for the otter. A study of the coastal foraging habits of the Eurasian otter in Pembrokeshire in southwest Wales used spraint analysis to determine the diet of coastal otters (Chanin, 1993). Eighty-five percent of prey taken by otters was predominantly, sticklebacks (12.8%), gobies (12.5%), eels (10.9%) and blennies (10.4%) and 6.6% of their diet was composed of crustaceans, amphibians (3.5%) and birds (3.3%). The spraints consisted primarily of *Carcinus sp*, from the crab family. Other fish remains discovered included brill, dab, eelpout, five-bearded rockling, flounder, four-bearded rockling, pipefish, plaice, wrasse, and unidentified Cottidae (Parry et al., 2010). Otters also take birds and, the vast majority were from the water rail family (Rallidae), such as coots and crakes. Another study of the diets and foraging habitats in Galway Bay found feather remains of both of water rails and anseriformes[13] (Murphy & Fairley, 1985).

[13]Wildfowl including ducks, geese, and swans

Fish and their Habitats within the Cork Harbour Area

A number of fish stock surveys were undertaken by Inland Fisheries Ireland within the harbour, as part of monitoring for the Water Framework Directive. Beach seine, fyke net and beam trawl methods were used. For the purpose of this report, the results for the Glashaboy estuary, the Northern Channel Great Island area, the Lower Lee Estuary and Lough Mahon are summarised below, as these areas represent the main habitats found within the greater harbour area.

Glashaboy Estuary

The Glashaboy is a small estuary of 0.12km^2 where the Glashaboy River discharges into Cork Harbour. Both sides of the estuary are heavily wooded although the Glanmire Road separates the forestry from the channel on the west bank. The Glashaboy Estuary is long and narrow with mainly riverine characteristics. Its substrate is mostly mud covering a mix of gravel and stones (Kelly, 2010). The Glashaboy Estuary is a part of the Cork Harbour SPA and supports a large number of wintering wildfowl (NPWS, 2014). A total of three fish species were recorded in the Glashaboy Estuary. Sand goby was the most abundant species, followed by thick-lipped grey mullet and flounder.

Lower Lee Estuary

The Lee Estuary is 0.89 km^2 in area. It separates the south side and the north side of the city. The Lower Lee Estuary begins at the Albert Street Bridges and extends downstream to the mouth of the Glashaboy River (IFI, 2022). A total of nine fish species were recorded in the Lower Lee Estuary during this survey. Sand goby was the most abundant species followed by common goby and thick-lipped grey mullet. Other species recorded were sand goby, common goby, thick-lipped grey mullet, cod, flounder, fifteen-spined stickleback, five-bearded rockling, plaice and pollock.

Northern Channel Great Island

The North Channel, Great Island transitional water body covers an area of 7.96km^2 and is located north of the Great Island and East Ferry (including the East Ferry channel). This waterbody has been classified as eutrophic, while the area around Harper's Island is classified as being of intermediate water quality (EPA, 2021). It has a substrate composed mainly of mud, with areas of gravel and stones (IFI, 2022). The west side of the upper estuary contains extensive mud flats. The North Channel, Great Island transitional water body is within the

boundaries of the Great Island Channel SAC and Cork Harbour SPA. A total of 23 fish species were recorded in North Channel Great Island in October 2010 with sand goby being the most abundant species followed by common goby, sand melt and thick-lipped grey mullet. Other species recorded were plaice, two-spot goby, corkwing wrasse, cod, five-bearded rockling, long-spined sea scorpion, flounder, painted goby, ballan wrasse, fifteen-spined stickleback, European eel, haddock, pollack, lesser spotted dogfish, goldsinny wrasse, dab, short-spined sea scorpion, sprat, and greater pipefish.

Lough Mahon

A total of sixteen fish species were recorded in Lough Mahon. Sprat is the most abundant species, followed by sand goby and two-spotted goby. Other fish recorded include sand smelt, cod, flounder, plaice, scad, European eel, thick-lipped grey mullet, common goby, common dragonet, five-bearded rockling, gunnel (butterfish), fifteen-spined stickleback and greater pipefish.

4.0. Recommendations and Requirements

This section of the report outlines the requirements of otters, as well as recommendations, within the study area under a series of headings. It sets out practical advice on how these animals, and the habitats upon which they depend, should be treated within the study area going forward. It is recommended that guidelines for the treatment of otters be created for use by planners and developers. This guidance would be extremely beneficial to otter conservation and assist in providing good quality habitats.

4.1 Habitats and Otter

Instream Habitats

Varied instream habitats support all naturally occurring trophic structures of the aquatic environment upon which the otter ultimately depends. In an unmodified watercourse, erosion and deposition shape the channel, and together with a variation in flow, create a mosaic of habitats. These include riffles, runs, glides, pools, and backwaters. Topography determines the channel type[14], and where the various instream habitats occur along its course. Riffles are areas of fast turbulent flow where rocks often protrude during low flows. Runs are less turbulent, with a riffled surface. Glides are areas of smooth laminar flow. Pools are deep

[14] bedrock channel, step-pool channel, riffle-pool-glide channel, lowland meandering channel

areas of the channel where flow is often barely perceptible. Backwaters are areas cut off from the main flow. The top of riffles is generally used by adult salmon, trout and all three lamprey species to spawn. Riffles are also used as a nursery area for juvenile salmon and trout. Glides and runs are used by parr[15]. Pools are used as holding areas for adult salmonids, and in lowland meandering rivers pools will often support coarse fish (roach, perch, bream etc.). Beds of deposited fine sediment support ammocoetes[16]. Pools and backwaters will support minnow and stickleback, particularly where there is emergent vegetation for cover and spawning. It is recommended that riverbed sediment must be clean and free of silt to facilitate spawning and to provide refuge to allow for a thriving invertebrate population upon which all trophic levels depend. In summary, varied instream habitats are crucial in maintaining healthy fish populations upon which otters can prey.

Threats and pressures:

- Development
- Catchment use, particularly over-intensification of farming and land drainage
- Flood and river management schemes
- Gravel extraction

Recommendation:

It is recommended that a condition of planning is devised for proposals that may impact on otter population which recommends instream and riparian rehabilitation works be conducted in appropriate locations so that the proposed development will have Ecological Net Gain. It should be noted that instream rehabilitation is a case-specific issue and entails bespoke design rather than generic design, and as such an experienced aquatic ecologist or fisheries scientist should design it.

In locations that may impact the otter population developments should integrate a "Sustainable Drainage System" or SuDS into their project design. A well-designed SuDS will drastically reduce sediment run-off and other pollutants from a development to a watercourse. The SuDS manual offers a comprehensive and scientific approach to sustainable project design, including detailed methodologies, calculations, and a scoring system to rate the efficacy of the design. The SuDS element of an application should be bespoke rather than

15 young salmonids
16 juvenile lamprey

generic in order that it functions properly, and this should be quite evident upon reading the site-specific SuDS document.

In terms of agriculture, instream habitats can be greatly improved by the planting of a riparian buffer zone; this is widely regarded as the single most effective tool to negate the issues regarding diffuse pollution from farms. Farmers can be advised that funding for tree planting is available under the Native Woodland Scheme.

Riparian Habitats and Vegetation

Riparian vegetation is a crucial element of the environment for otters as cover for foraging, resting, and breeding. It is an integral part of the river network. It protects and stabilises riverbanks while intercepting nutrients, sediment, and other pollutants. It regulates water temperatures which are important for maintaining healthy oxygen levels and avoiding fish and macroinvertebrate mass mortality. Trees often fall into the river changing the erosional and depositional regime, and hence increasing instream habitat diversity. Natural riparian zones support complex communities of plants, fungi, insects, birds, amphibians, and mammals. Healthy riparian zones contribute to biodiversity on all levels from local to national. They provide essential corridors through the landscape for all manner of insects and animals. They provide linkages between fragmented habitats.

Threats and pressures:

- Development
- Catchment use, particularly over-intensification of farming
- Vegetation management by state bodies or private operatives.
- Various forms of flood management

Recommendation:

In terms of development near watercourses, a riparian planting scheme should be considered during the planning process, along with the instream rehabilitation plan as outlined in the instream habitats section above. Inland Fisheries Ireland[17] offers broad guidance on riparian planting for urban watercourses with respect to planning and development and recommends

17 https://www.fisheriesireland.ie/sites/default/files/migrated/docman/IFIUrbanWatercoursesPlanningGuide.pdf

three buffer zones. The first is an inner buffer zone of 10m width from the water; if this zone is already in good condition ecologically, it should be left undisturbed, if it is in poor condition should be improved with native riparian plants and trees, and perhaps appropriate landscaping in the form of the channel requires it. The end goal of the inner buffer zone is to have a relatively undisturbed vegetated riparian zone which will function as a corridor for wildlife. This zone should be densely vegetated to exclude dogs and minimize disturbance. The middle zone, 15+m, is to be slightly more amenity focused and should include a footpath/cycle lane which will provide pedestrian access to the development, as well as an urban river walk for public use. If sufficient walkways link up through visionary town planning, it will create greenways throughout the city. The middle zone may also include benches and should be planted with native trees. The outer zone is where the development integrates with the riparian corridor, it can include managed grass/lawn, and SuDS features such as swales and soak-aways. Within an urban setting, this guidance is far better than what preceded it, which is building right up to the riverbank.

In terms of agriculture, it may be possible to advise or facilitate the planting of a riparian buffer zone if certain areas where buffer zones are required are identified. Farmers can be advised that funding for tree planting is available under the Native Woodland Scheme and that a comprehensive document called Woodland for Water [18] details an entire process from planning to planting, care and sustainable harvesting. The Native Woodland Scheme provides initial set-up grants and 15-year premiums (annual grants) to farmers and other landowners to afforest with native woodland. (In all, the grants are comparable to what is being offered for setting up non-native Sitka spruce plantations, except the land will be populated with a beautiful native forest). In addition, the NPWS Farm Plan Scheme is available which aims to:
1) Deliver actions that benefit habitats and species in Special Areas of Conservation and Special Protection Areas, known collectively as Natura 2000 sites. 2) Support farmland biodiversity more generally. 3) Provide a platform for trialling new conservation approaches which can be delivered on a wider scale.

Woodland

Woodlands in the past covered temperate regions. Most habitats in Ireland will regenerate into woodland. Otters flourish in healthy river systems. Riparian woodland limits erosion as root systems acts as latices holding the soil and subsoil of the bank together, decreasing the

[18] https://www.teagasc.ie/media/website/crops/forestry/grants/Woodland-for-Water-April18.pdf

amount of sediment released to the river system. Fallen trees also create a diversity of habitat and cover for all aquatic creatures, and they contribute massively to biodiversity and river health. Trees deposit their organic matter mainly as leaves which float as a large single piece until they come to rest. Then, the organic matter is broken down by a massive variety of decomposers from fungi to invertebrates to lamprey ammocoetes. Through the reduction of erosion rates, combined with the deposition of their organic matter as leaves rather than freely available phosphorous and nitrogen, riparian trees reduce "siltation" of the riverbed creating a far healthier river, particularly in the intra-gravel void space, an area crucial to the early life stages of all native freshwater fish, and crucial to the larval stages of most aquatic invertebrates, and crucial to overall river health. Small pockets of woodland are present along watercourses in the city, and larger expanses of woodland are present in the upper valleys. Woodlands are also present adjoining parts of the coastal areas. As well as providing healthy rivers, woodlands provide cover for foraging, resting, and breeding for otters.

Figure 16: *An image of a woodland in the Glennamought Catchment; notice how the woodland promotes high-quality instream habitats by encouraging natural processes.*

Threats and pressures:

- Development
- Catchment use, particularly over-intensification of farming and non-native plantations

Recommendation:

The overall size or area of woodland within and surrounding the city should remain stable or increase. Additionally, riparian corridors which connect stretches of river to these woodland habitats should remain intact; otter breeding is highly likely to occur within quality woodlands and an intact riparian corridor is vital to ensure that the entire stretch of river is available to forage. The Native Woodland Establishment Scheme [19] and the Native Woodland Conservation Scheme are schemes which can enhance the protection of Ireland's native woodlands and biodiversity.

Boulders and Rock Armour

Otters have a complex relationship with artificially placed boulders and rock armour, which provide an excellent opportunity as a holt due to the potential of multiple potential escape routes. The construction of these installations is often destructive, releasing massive amounts of suspended solids into the aquatic environment.

Recommendation:

Small sections of rock armour, placed properly without altering the aquatic environment and with appropriate ecological assessment may have a net positive impact on otters. However, large-scale installation of these features has a net negative impact by reducing riparian cover, instream habitat diversity and foraging opportunity

Weirs and other barriers to fish passage

For hundreds of years, humans have been building weirs to gain height to provide the potential energy to drive a variety of applications from cereal mills to sawmills and the textiles industry. For thousands of years, palaeolithic man has been building weirs and other barriers in order to hunt fish. The areas downstream of barriers to fish passage can be very productive hunting grounds for otters, however, these structures can also be problematic to populations of the various fish species of a watercourse. The size and form of an obstacle determine what fish species it impacts upon, as well as parameters such as the depth of the water underneath it and the depth of the laminar flow running over it. Anadromous[20] and catadromous[21] species are badly impacted at a population scale as access from the sea is part of the life cycle,

[19] https://www.gov.ie/en/service/803ef3-native-woodland-conservation-scheme/
[20] Fish that migrate downstream from their natal stream to feed at sea and then return to freshwater to spawn
[21] Fish that are born at sea, migrate to freshwater to feed, and back to sea to spawn

and a barrier may restrict a large area, perhaps the vast majority, of a river system to a species or multiple species. Sea lamprey and river lamprey are considered particularly affected due to their swimming speed. Brook lamprey are potamodromous[22] and as such are not generally affected as badly, however, a high-resolution sub-catchment study carried out by the authors of this report on the Upper Blackwater and Owentarglin rivers observed that populations of brook/river lamprey were significantly decreased upstream and elevated downstream of what were quite small barriers, suggesting that the general downward drift of ammocoetes[18] was not adequately replaced by upstream migration of spawning adults (Dalton & Reidy, 2020).

Recommendations:

Although weirs and other barriers to fish passage are important hunting grounds for the otter, the improvement brought about by allowing access for migrating fish improves the entire river system; an improvement that can be enjoyed by a far greater distribution of otters.

Freshwater Bathing

Freshwater bathing areas are a critical aspect of coastal otter ecology. They are used to clean salt from the fur in order to keep the coat functional as an insulator underwater and to maintain its overall functionality. Bathing can take place in a wide variety of features including rivers, streams, drainage ditches, natural hollows, and if the food source is rich enough, springs, potholes, tractor wheel ruts, cattle troughs or a rainwater-filled depression in a coastal rock formation will suffice. It is important that the source is dependable in times of drought, and that it is deep enough to cover the otter and wide enough for them to swim around. Across the Cork Harbour area, coastal otter activity was found to be strongly correlated with the presence of freshwater; but it is worth noting that these observations were made during the summer. Whilst surveying exceptionally food-rich offshore islands containing large colonies of seabirds, the authors of this report have observed that otter activity is strongly and reliably concentrated around bathing pools and that areas of these islands which are free of freshwater are also largely free of signs of otter activity (Dalton & Healy, 2022). With all this in consideration, it is likely that a source of freshwater bathing exerts a certain pressure on coastal otters in terms of breeding, or at least, that a portion of otherwise optimal and safe breeding sites are not used due to the absence of freshwater bathing.

[22] Resident in freshwater all their lives but migrate within the channel

Recommendations:

It is recommended that future developments and planning applications in coastal areas should include surveys on the potential impact of otters and to ensure that freshwater bathing areas are provided especially in a coastal area of low disturbance and high food availability (which would be deemed as an optimal breeding site). If a source of freshwater is known to be absent, it may be possible to install a simple clay-lined natural pond, a pipe-fed cattle trough, or maybe block a drainage ditch to create a bathing pool. This could be put into place in suitable sites around the harbour. The impacts of these freshwater pools could be a future research project.

4.2. Breeding Sites and Natal Dens

This section aims to outline the ecological and environmental requirements for otter breeding sites and assess the condition and quality of selected sites within the Cork City and Harbour area, to identify areas and habitats with high conservation value as breeding sites. This assessment was made during survey work conducted between May 2021 and December 2021.

There is little published work specifically regarding otter breeding sites, it is, therefore, difficult to declare a site conclusively and confidently as a breeding site; even if cubs are sighted at a holt, it could be possible that the mother moved them from the natal site to this new location. However, it is worthwhile to attempt to highlight what is important in terms of the needs of a breeding area, given that breeding is crucial in maintaining an otter population.

A female otter tends to choose a breeding site within her territory range. A mature and experienced mother will choose a site which is not prone to flooding, has good cover, contains one or more suitable natal dens, and has abundant food resources. Ideally, the site is as free from disturbance as possible to provide a secure area for the cubs to play. A less dominant or young female, due to territory availability or simply inexperience, may choose a less-than-perfect breeding site.

Ecological Requirements for Otter Breeding Sites

Location

Desktop research has shown that from the few available studies and publications otter breeding sites can be located anywhere along a watercourse from small streams, to rivers, to estuaries and indeed coastal areas and lakes (Liles, 2003). The amount and type of cover are

important both to provide a safe area for the cubs to play near the natal den and to provide protection for the female otter as she moves between the natal den and the watercourse. The level of disturbance is also a determining feature of an optimal breeding site; however, observations suggest that its level of importance may be relative to the security offered by the natal den (Liles, 2003). For example, a female otter using an underground holt may tolerate disturbance within the vicinity of the natal holt, whereas disturbance near an above-ground, scrub natal den could prevent breeding.

Food Resource

Food abundance is a crucial factor for otters in choosing an optimal breeding site as the further a female otter must travel from the natal den to find food, the longer the cubs must be left unattended and unprotected. In both freshwater and marine environments, studies have shown that seasonal peaks in cub births coincide with maximum prey availability at the time when cubs begin to receive solid food. This is most likely to reduce the pressure on the hunting otter when demands from the cubs are at a peak. A lack of food may result in the mother abandoning one of her young.

Otters are adaptive and resourceful predators. They will hunt fish such as trout, salmon, stickleback, and eel. Frogs are taken seasonally, either during their spawning season or during hibernation when otters snatch them from the mud where they hide. Mammals such as voles, rats and rabbits can all become potential prey should the opportunity arise. Voles can be found along the banks of the watercourse and otters have been known to take rabbits in their burrows. Otters are also known to take waterfowl by either hunting them from below in the water or taking them while they roost. Otters will also hunt invertebrates such as crab, crayfish, and water beetles. In coastal territories, otters seem to focus more on smaller bottom dwellings, slower-moving fish, and crabs. This may be due to the catchability factor. With fast-swimming fish being difficult to catch in the deeper coastal waters, the otter must resurface for air. Coastal otters have also been observed in Co. Kerry predating on seabirds who have returned to their nesting burrows.

Natal Dens

It is important to note that there is a difference between a breeding site and a natal holt or den. A breeding site is an area of land, whereas a natal den however is a small space within this area of land where the mother rears her young for up to three months (Liles, 2003). The

natal den may be some distance from the main watercourse, for example, a small stream, or indeed they can be 150m to 500m from waterways and coastal shorelines (Chanin, 2003). This is done to remove the young from the immediate danger of flooding and of predators along the river. There is little sprainting near the natal den. Natal dens have been discovered in reed beds, tree trunks, young conifer plantations and areas of dense scrub. These natal dens are vital, of course, to the survival of the otter. However, in terms of conservation, it is the breeding site that should be the focus of attention. A secure and undisturbed breeding site leads to a safe and peaceful natal holt.

Potential Breeding Sites within the Study Area

Figure 17 presents a number of Potential Breeding Sites (PBS) considered by the surveyors as suitable for otters during the study. Breeding was not confirmed at any of the sites; this is simply an outline of areas suggested as having good potential as breeding sites. Potential Breeding Sites were identified mainly using the general breeding ecology criteria given by Liles, (2003). It is by no means an exhaustive study of potential breeding sites within the city and harbour area and is not intended to be definitive. It should also be noted that, in terms of the riverine Potential Breeding Sites, sites outside of the urban sprawl are not included, and there are undoubtedly key areas within the rural stretches of these rivers, particularly wooded glens. It is recommended that future research is also undertaken in this area.

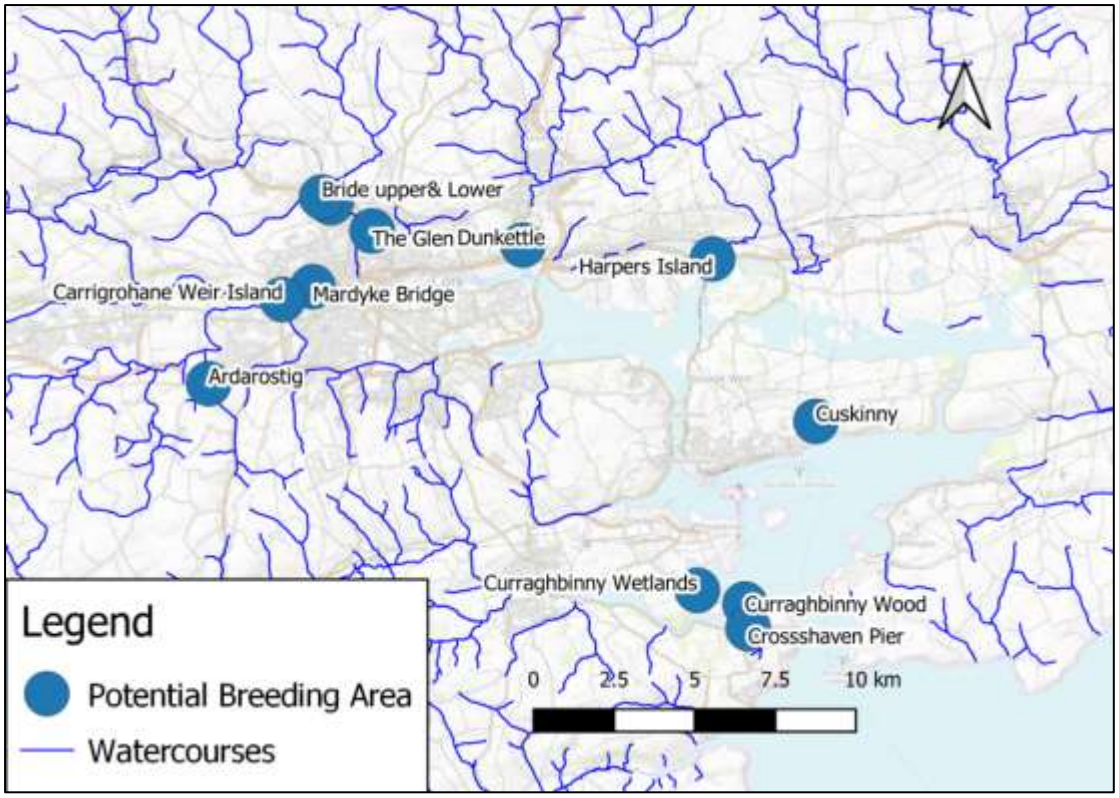

Figure 17: *Potential breeding sites within the study area. It should be noted that this list is not exhaustive, nor is it definitive, it simply outlines suitable areas for breeding otters mainly following the information provided in Liles, 2003.*

Riverine

Ardostig: This is a potential breeding site on the Twopot River, which offers excellent cover, and little disturbance, and lies within an area of the Twopot which has good fishing potential.

Bride Upper and Bride Lower: These two sites were chosen from the urban area through which the Bride flows. They are near one another and are very well-secluded for sites within an urban setting. As evidenced by the volume and frequency of sprainting, the Bride channel experiences substantial amounts of otter traffic, and footage of young has been captured on occasion.

Carrigrohane Weir Island: This potential breeding site has potentially good cover in the form of a very dense riparian willow woodland. The fact that it is an island secures it from most threats. The island was not visited during the study, so it could not be ascertained whether it would flood out. Additionally, the weir would offer excellent foraging potential.

Mardyke Bridge: The woodland to the west and north of Mardyke Bridge, on the northern bank, is nicely secluded thanks to the presence of an old headrace that leaves the main channel of the Lee at the Mardyke Bridge weir and re-joins at the Cooperage. This deep and heavily silted headrace channel appears to reduce and may even eliminate the presence of all but the most determined humans. This intertidal section of the Lee would provide exceptionally good foraging for otters.

The Glen: This area of the Glen River, west of Ballyvolane Fire Station, is exceptionally difficult to gain access to. The entire floor of the valley is covered in scrub and other vegetation, which eliminates human presence.

Coastal

Crosshaven Pier: There is ample feeding opportunity from the decks and nets of the fishing boats, which are easily accessed by otters, as well as from the coastal environs in general. No source of freshwater bathing was found during the visit, and an installed source of bathing water may increase the appeal of this site.

Curraghbinny Wetland: This lagoon is a potential source of a freshwater bathing site for otters[23] whilst providing a site with opportunities for food[24]. It has good access to the sea in the north and the east. It is very secluded, and access is difficult. The vegetation cover is good with a large expanse of reed skirted with dense scrub and other vegetation, there appears to be raised platforms of vegetated mud within the cover of the reeds which would offer ideal breeding habitat.

Currragebinny Woodland: This woodland is very secluded and would contain a chance for natal dens. It has access to the sea from all sides, however, there was no reliable source of freshwater.

Cuskinny: The site comprises about twelve ha of land incorporating the lower reaches of the Ballyleary Stream. The reserve includes habitats such as a lake, swamp, grassland, and woodland habitats and is of local nature conservation importance. The upper section of

[23] or very low salinity water
[24] Fish and a variety of birds

woodland is well-drained, and the ground is dry. These combined habitats offer many options for holt locations for a breeding otter. The area experiences truly little disturbance.

Dunkettle: There was also considerable sprainting activity. Pedestrian use of the area is limited, and, except for the road and the railway line, the area does not receive much physical disturbance.

Harper's Island: By far the largest amount of localised sprainting in the study site was found here. Given the number of broken shells, it appears as if the otter (or otters) has access to a large and plentiful supply of mussels, which are most likely flourishing on the loosely placed rock armour that protects the base of the bridge between Little Island and Harper's Island. The habitat for natal holts is plentiful, with the presence of rock armour as well as various patches of dense scrub across this uninhabited island.

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Appendices

Appendix 1: Water Quality Table

Q Value	WFD Status	Pollution Status	Condition
Q5 or Q4-5	High Status	Unpolluted	Satisfactory
Q4	Good Status	Unpolluted	Satisfactory
Q3-4	Moderate Status	Slightly polluted	Unsatisfactory
Q3 or Q2-3	Poor Status	Moderately polluted	Unsatisfactory
Q2, Q1-2 or Q1	Bad Status	Seriously polluted	Unsatisfactory

Appendix 2: Coastal Habitats

Mudflats & sandflats not covered by seawater at low tide

Intertidal mudflats and sandflats are submerged at high tide and exposed at low tide and are normally associated with inlets, estuaries, or shallow bays. The physical structure of these intertidal flats' ranges from mobile, coarse-sand beaches on wave exposed coasts to stable, fine-sediment mudflats in estuaries and other marine inlets. These habitats support diverse communities of invertebrates, algae, and eel grass (Zostera sp). Mudflats are usually located in the most sheltered areas of the coast where large quantities of silt from rivers are deposited in estuaries. In sheltered areas communities are typically dominated by polychaete worms, e.g., Arenicola and bivalve molluscs and may support high densities of the mud-snail Hybrobia ulvae. Sand flats occur on open coast beaches and bays where wave action or strong tidal currents prevent the deposition of finer silt. On more exposed coasts the biodiversity may be lower, and the communities dominated by crustaceans such as Bathyporeia. The strand line on most shores is characterised by Talitrid amphipods. Where Zostera occurs, faunal diversity is higher. The high biomass of invertebrates in such sediments often provides an important food source for waders and wildfowl, such as Knot (Calidris canuta), Dunlin (Calidris alpine) and Sanderling. Intertidal mudflats and sandflats can be part of a mosaic of habitats that occur in estuaries and shallow inlets and bays.

Salt Marshes

Salt marshes are stands of vegetation that occur in marine and brackish water conditions on a range of substrata that are wet, waterlogged or periodically submerged by the sea. They are typically found between the upper limits of the neap and spring tides in protected bays, estuaries, and other sections of sheltered coastline. The underlying sediments are mainly sands or muds, sometimes with mixtures of coarser material. (Fossitt, 2000). Atlantic salt meadow (ASM) (H1330) is the dominant saltmarsh habitat at within the Great channel Island SAC and is present in pockets around Cork Harbour. Several ASM communities are present. Some of the ASM is dominated by an unusual low-mid vegetation community dominated by Sea Aster (Aster tripolium). The sward height is quite tall due to the lack of grazing (10-20 cm). A second unusual vegetation type dominated by Lax-flowered Sea Lavender and Sea Milkwort is present, this is a lower saltmarsh community. A more typical grassy vegetation community is also present. This community is dominated by Red Fescue and is found along the upper salt marsh zone of some of the narrower bands of saltmarsh. Several sections are drained by small creeks leading from drainage channels from the adjacent woodland. There are some dead tree trunks lying on the saltmarsh (NPWS 2014)

Lagoons and saline lakes CW1

This category includes all enclosed bodies of standing brackish water that are wholly or partially separated from the sea by banks of sand, shingle, or rock, or by land barriers of rock or peat. Tidal

influence is much reduced by these physical barriers or is absent. Water levels in lagoons generally undergo seasonal fluctuations (high in winter and low in summer) (Fossitt, 2000).

Open marine water MW1

All areas of marine water along the open coast or around offshore rocks and islands that are less than 50% enclosed by land and excluding any of the coastal features described below (Fossitt, 2000).

Sea inlets and bays MW2

Semi-enclosed coastal waters, or indentations of the coast, which are usually sheltered and where the influence of freshwater is generally limited. Sea inlets and bays should be at least 50% enclosed by land. This category includes any narrows or rapids at the entrance to the inlets but note that estuaries - MW4 are excluded (Fossitt, 2000).

Straits and sounds MW3

Any relatively narrow channels linking two larger areas of sea and occurring between islands, or between islands and the mainland. Straits and sounds are often characterised by strong tidal currents (Fossitt, 2000).

Estuaries MW4

Estuaries are semi-enclosed bodies of water which have a free connection with the open sea. They differ from other coastal inlets in that seawater is measurably diluted by inputs of freshwater and this, combined with tidal movement, means that salinity is permanently variable. The mixing of two different water masses gives rise to complex sedimentological and biological processes and patterns (Fossitt, 2000).

Sea walls, piers, and jetties CC1

This category is used for all coastal constructions that are partially or totally inundated by sea water at high tide, or subject to wetting by sea spray or wave splash. It includes sea walls, piers, jetties, slipways, causeways, and other structures associated with ports and docks in urban or rural areas. Any other artificial structures that are exposed along the coast at low tide should also be included: coastal defences or groynes, wrecks, and pipes or pipelines (Fossitt, 2000).

Tidal rivers CW2

This category should be used for the lower reaches of rivers or streams, and any artificial watercourses, which are tidal and where there are regular fluctuations in salinity and turbidity, and the rate and direction of water flow. Only the areas that are influenced by brackish water conditions should be included here (Fossitt, 2000).