



Swan River, Bray

Freshwater Ecology Survey &
Biodiversity Management Plan

March 2023

Final Version 01

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Table 1-1: List of acronyms and terminology used.

Acronym/ term	Definition
BoCCI	Birds of Conservation Concern Ireland 2020 -2026. This is a list of bird species in Ireland which are either red listed (high conservation concern) or amber listed (medium conservation concern). Please see Gilbert or https://birdwatchireland.ie/birds-of-conservation-concern-in-ireland/ for further information.
EPA	Environmental Protection Agency
European site	Special Areas of Conservation (SAC) and Special Protection Areas (SPA) are sites of European importance which have been designated under European legislation. Collectively they are referred to as European sites. SACs were designated under the Habitats Directive for habitats and species (but not including bird species). The Birds Directive protects all wild birds and their nests, eggs and habitats within the European Union. SPAs are classified under the Birds Directive to protect birds that are rare or vulnerable in Europe as well as all migratory birds that are regular visitors.
IFI	Inland Fisheries Ireland
LAWPRO	Local Authorities Waters Programme
Left bank/ right bank	If standing in the water facing downstream the bank to the left is referred to as the left bank.
NBDC	National Biodiversity Data Centre
NPWS	National Parks and Wildlife Service
OSI	Ordnance Survey Ireland
Otter terminology	<p>Couche – otter need access to safe resting places. A couche is an above ground resting place such as amongst reeds, grass or scrub with a well-worn path (slide) into the water.</p> <p>Holt - an underground otter resting location. Otters rarely dig their own hole but make use of existing features such as a hollow amongst bankside tree roots, gaps amongst rocks/boulders or burrows formed by other mammals. Otter will even use man-made structures such as gaps under road bridges.</p> <p>Slide - a well-worn path down a river bank that otter regularly use to access the water.</p> <p>Spraint - Otter use their poo or spraint to mark their territory. This is usually on a prominent feature such as instream boulders or bridge sills.</p>
Riparian zone	An area of vegetation which acts as the interface between terrestrial and river ecosystems. These zones are important in providing bank stability, flood attenuation, habitats for range of species and water quality management but also as green spaces for people.
River birds	This is a term used to describe birds that are strongly associated with rivers and streams. In this report the term mainly refers to dipper, grey wagtail and kingfisher.
Rhizomes	Some plants have modified underground stems that send out roots and shoots e.g., Japanese knotweed.
Third Schedule Invasive Species	This is a list of invasive species appearing on the third schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 [S.I.477/2011]. The regulations prohibit the planting, dispersal or allowing to disperse or spread or causing to grow of any plant listed within the third schedule.
TPO	Tree Preservation Order
WFD	Water Framework Directive

1. INTRODUCTION

1.1. Background

Mayfly Ecology was commissioned by Bray Tidy Towns and the Swan River Conservation Group to undertake a baseline ecological survey of the Swan River, Bray, Co. Wicklow.

The purpose of the survey was to understand the biodiversity associated with the Swan River. This information was then used to inform the biodiversity management plan contained within this report.

This report ultimately aims to give the reader an understanding of the ecological sensitivities or potential pressures acting upon the Swan River to help inform any future conservation or enhancement works.

1.2. River Location and Description

Current Ordnance Survey Ireland (OSI) and the Environmental Protection Agency (EPA) mapping shows the Swan River starting at the Boghall Road however it rises further south and this can be seen on Historic 25" mapping (1910). The river rises south of Bray at the foothills of the Little Sugar loaf in the Kilruddery estate. From here it flows in a northward direction through Bray before entering the Dargle River opposite the Peoples Park.

The river rises in an agricultural landscape however it becomes quickly characterised by a suburban/urban development forming a feature of many housing estates within Bray. From Kilruddery, the Swan flows along Hollybrook housing estate before disappearing under the Southern Cross Road. The river reappears after it passes under the Boghall Road and flows along Wheatfield and Giltspur housing estates. It then flows through a wooded area known locally as Germans Wood and past the ruins of Old Court Castle. From here it passes under the Killarney Road flowing through Glenlucan housing estate. Finally, it flows under the Herbert Road and Glenwood housing estate before finally reaching the Dargle.

The Swan has been modified for almost its entire reach with weirs, culverts, embankments, underground diversions and channel straightening evident throughout the river. As it flows through Germans Wood the surrounding landscape is mature broadleaved woodland and the river has briefly some natural flow characteristics.

Figure 1-1 below shows the location of the Swan River and the dashed line represents the unmapped section of the river.



Figure 1-1: Map showing the course of the Swan River. The dashed line is an approximate outline of the unmapped sections.

2. METHODOLOGY

2.1. Desktop Review

A desktop review was completed to gather baseline water quality and ecological information for the Swan River and surrounding environs. This included a review of;

- Existing water quality
- Records for protected species and habitats and
- Existing biodiversity policies and objectives which are applicable to the Swan River

The sections below briefly describe how each of these reviews were undertaken and the following sources were consulted to conduct the desktop review.

- Environmental Protection Agency (EPA) online mapping tools (<https://gis.epa.ie/EPAMaps>) and (<https://www.catchments.ie/maps/>) for water body information and mapping;
- Environmental Protection Agency (EPA) catchment characterisation report (EPA 2021) Available online (<https://catchments.ie/wp-content/files/catchmentassessments/10%20Ovoca-Vartry%20Catchment%20Summary%20WFD%20Cycle%203.pdf>)
- Inland Fisheries Ireland WFD fish monitoring reports and online mapping tool (<http://wfdfish.ie/>);
- National Parks and Wildlife (NPWS) website for Conservation Objectives, Site Synopsis and any other relevant reporting for European Sites (<https://www.npws.ie/protected-sites>);
- NPWS online mapping and data resources for latest European Site boundaries and relevant species/habitat mapping (<https://www.npws.ie/maps-and-data>);
- NPWS published report regarding conservation status of habitats and species in Ireland protected under the Habitats Directive (NPWS 2019a, 2019b and 2019c);
- National Biodiversity Data Centre (NBDC) online mapping tool for distribution records for QI and SCI species of European sites, invasive species and any other protected species (<https://maps.biodiversityireland.ie/Map>);
- Geohive online Environmental Sensitivity Mapping tool (<https://airomaps.geohive.ie/ESM/>);
- Any local surveys of flora, fauna and habitat available using the Heritage Councils mapping website (<https://heritagemaps.ie/WebApps/HeritageMaps/index.html>).

2.1.1. Existing water quality

A review of existing water quality was conducted and a summary of the current Water Framework Directive (WFD) status and EPA biological monitoring results is given in the results.

2.1.2. Records of protected species and habitats

The review also included a search of records for protected aquatic species which are listed on Annex II of the EU Habitats Directive (92/43/EEC) such as; Atlantic salmon (*Salmo salar*), river lamprey (*Lampetra fluviatilis*), brook lamprey (*Lampetra planeri*), sea lamprey (*Petromyzon marinus*), freshwater pearl mussel (*Margaritifera margaritifera*) and white-clawed crayfish (*Austroptamobius pallipes*) as applicable. The search also included the semi-aquatic mammal, otter (*Lutra lutra*).

Records for any other fish species such as brown trout (*Salmo trutta*) were also noted.

The European eel (*Anguilla anguilla*) is not listed on Annex II of the Habitats Directive but the numbers of juvenile eel reaching coastlines of Europe have undergone significant declines and it has now been classed as critically endangered on the IUCN Red List of Threatened Species. The desktop review also included a search of records for this species.

The desktop review included a search for any aquatic/ riparian habitats listed on Annex I of the Habitats Directive such as water courses of plain to montane levels with the *Ranunculus fluitantis*; and *Callitriche-Batrachion* vegetation. It also included a search of any aquatic plants under the Flora Protection Order (S.I 235, 2022).

2.1.3. Biodiversity policies and objectives specific to Co. Wicklow

Finally, a review of any biodiversity policies or objectives specific to Co. Wicklow was conducted. Any policy or objective which was considered relevant to this report is summarised within the results. These policies and objectives were taken into account when developing the proposed actions for biodiversity management in order to help enhance, promote or protect existing biodiversity within the Swan River.

2.2. Freshwater Ecology Survey

This report was informed by the following freshwater ecological surveys. Detailed methodology for each of these surveys is given below in sections 2.2.1 -2.2.3.

- General habitat survey,
- Biological quality survey - macroinvertebrate,
- Fisheries habitat assessment

The freshwater ecology survey was conducted on the 28th August 2022 by Mayfly Ecology. Seven sites in total were investigated. Site 1 is the uppermost site and Site 7 is the furthest downstream site just before the river enters the Dargle River. A macroinvertebrate kick sample was taken at Sites 2, 4, 6 and 7 where conditions were suitable.

Table 2-1 below gives the GPS coordinates for each survey site and **Figure 2-1** below shows a map of the sampling locations.

The presence or signs of Annex I habitat or Annex II species or other protected species were noted such as those protected under the Wildlife Act 1976 (as amended), Flora Protection Order 1980 (as amended) or any other species or habitats that are rare.

Table 2-1: Coordinates for each site surveyed

Site name	GPS coordinate (lat/long)	Kick sample
Site 1 – Kilruddery Estate (main channel)	53.17934, -6.11400	No
Site 2 - Kilruddery Estate (side channel)	53.18124, -6.10772	Yes
Site 3 - Hollybrook Estate	53.1833, -6.11040	No
Site 4 - Giltspur Brook Estate	53.19112, -6.11384	Yes
Site 5 - Weir in German Woods	53.19434, -6.115124	No
Site 6 - Killarney Road	53.19747, -6.11610	Yes
Site 7 - Glenwood Estate	53.20174, -6.11846	Yes



Figure 2-1: Map showing the location of sampling points along the Swan River.

2.2.1. General river habitat characteristics

At each sampling location the general river habitat characteristics were recorded broadly following those listed within the Environment Agency's 'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual' (EA, 2003) and Northern Ireland Environment Agency's 'River Hydromorphology Assessment Technique (RHAT) Training Manual (NIEA, 2014). Characteristics recorded included;

- Substrate type, degree of overlying sediment and note of sediment generated when substrate disturbed.
- Flow conditions and velocity.
- Riparian zone structure which includes a list of the dominant bankside vegetation and degree of shading along the river.
- Macrophytes and macroalgae present within the river.
- General hydromorphological characteristics including; river depth, width, bank height, signs of erosion or modification and barriers to connectivity.

In addition, hand held probes were used to record physiochemical parameters insitu. Probes used included Oxygaurd Handy Polaris and Hanna Combo which were calibrated before use.

- Dissolved oxygen (% and mg/l).
- pH (pH unit).
- Temperature (°c).
- Conductivity (µS/cm).

This information collected was used to help assign the fisheries habitat assessment and help identify any existing local pressures on the river system.

2.2.2. Biological quality survey - Macroinvertebrates

Macroinvertebrates were sampled at four locations, Site 2, Site 4, Site 6 and Site 7.

Macroinvertebrates were collected using a two-minute (or longer may be required in certain substrate conditions) kick sampling method with a standard hand net (0.5 mm mesh). The survey technique adhered to ISO Standard 10870:2012 and CEN FprEN 16150:2011 for kick sampling and utilised the EPAs standard protocol. Stone washing (1 minute) was also undertaken to ensure collection of species which cling to rock surfaces. The collected sample was tipped into a white tray and macroinvertebrates identified in the field to the lowest taxonomic level possible.

Q-values were assigned as per EPA published guidance (McGarrigle *et al.*, 2002, Toner *et al.*, 2005) with the surveyor taking into account river typology, seasonality and habitat conditions as per EPA guidance. The information collected during the general river habitat characteristic survey was used to inform Q-value assignment. The Q-value is based on macroinvertebrate sensitivity to pollution with Group A taxa being the most sensitive and Group E taxa being the most tolerant.

- Group A – Sensitive
- Group B – Less sensitive
- Group C – Tolerant
- Group D – Very tolerant
- Group E – Most tolerant

The Q-value mainly reflects the effects of organic pollution (i.e., deoxygenation and eutrophication) but where a toxic effect is apparent or suspected the suffix '0' is added to the biotic index (e.g., Q1/0, 2/0 or 3/0). An asterisk after the Q value (e.g., Q3*) indicates heavy siltation of the substratum.

The macroinvertebrate survey for this report was conducted in August. The Q-value is usually applied in summer/autumn when anthropogenic pressures are greatest on macroinvertebrates due to lower flows and higher temperature. Therefore, no adjustments for seasonality needed to be applied.

Table 2-2: Relationship between the Q-value and water quality (Table adapted from EPA river quality survey reports).

Q-value	Biological Quality ¹	Pollution Status	Condition
Q5, Q4-5	High	Unpolluted	Satisfactory
Q4	Good	Unpolluted	Satisfactory
Q3-4	Moderate	Slightly polluted	Unsatisfactory
Q3, Q2-3	Poor	Moderately polluted	Unsatisfactory
Q2, Q1-2, Q1	Bad	Seriously polluted	Unsatisfactory

2.2.3. Fisheries habitat assessment

A fisheries habitat assessment was conducted to assess the likely suitability of a stretch of river to support the species. The assessment was conducted with consideration of the following protected Annex II species; Atlantic salmon (*Salmo salar*) and lamprey (*Lampetra planeri*) but also considered

¹ The Q-value has been developed for rivers only. It does not equate to WFD Status however, in Ireland it is often the driving element in status assignment. It is the most common biological index that is used to calculate Ecological Status for rivers. The other biological indicator used in rivers is fish and monitored by Inland Fisheries Ireland.

other species such as the critically endangered European eel (*Anguilla anguilla*) and brown trout (*Salmo trutta*).

A 100m stretch of river was surveyed at each sample location. The ability for the habitat to support all life stages was assessed such as spawning, nursery, juvenile and adult.

A rating of habitat suitability for the species in question was applied ranging on the scale of Bad I to Excellent Fisheries Habitat Potential. The rating was calculated following consideration of the information collected from the biological quality survey, general river habitat characteristics as well as knowledge of the habitat requirements for the species in question. The definition for each rating is given below in **Table 2-3**.

This rating is broadly based on the procedure developed by Kennedy (1984) for salmon however it has been modified to incorporate; other species, published guidance documents relevant to each species and broadly follows elements of methodology for fisheries assessment used in published reports (Conservation Services 2004, O’Grady 2006) when characterising habitats.

This rating assesses the physical suitability of the habitat within the reach surveyed for the species in question but also the current water quality conditions are taken into consideration. The presence of the species will also depend on accessibility of the section of river. As far as practical any barriers to upward migration to the site were identified.

Table 2-3: Definition of each fisheries habitat potential rating assigned following the fisheries assessment.

Fisheries Habitat Potential Rating	Definition
Bad	<p>It is considered that the section of watercourse surveyed is unlikely to contain any supporting habitat for the species in question at any life stage or; there are significant long-term pressures (such as water quality) preventing the survival of the species in question.</p> <p>A significant physical man-made barrier(s) such as dams/weirs/ culverts may prevent migratory species from accessing the section or pose a barrier of free movement of non-migratory species between sections. Where poor to excellent habitat is present but artificial barriers prevent access, the habitat rating is caveated with an asterisk e.g., Good* (if barriers are removed) for that species.</p> <p>If there is potential for isolated populations of non-migratory species (e.g., brook lamprey, brown trout, or white-clawed crayfish) to be present the significant barrier should be noted but a rating of Poor is applied for these species.</p> <p>Bad biological quality (Q1, Q1-2 or Q2), bad physiochemical quality such as sustained extreme dissolved oxygen levels, and/or extreme flow conditions. Outfall pipe(s) may be present with discoloured (grey) water discharging. Sewage fungus may be present indicating gross pollution</p>
Poor	<p>The section of watercourse surveyed has rare or infrequent habitats for the species in question and conditions are well below optimal. If the species in question is present the survey section is considered to only support very small numbers.</p> <p>Substrate is largely sediment dominated and where present spawning gravels are heavily silted and/or confined to small pockets with risk of destabilisation. There may be signs of recent dredging/instream activities resulting in disturbance of spawning gravels.</p>

Fisheries Habitat Potential Rating	Definition
	<p>Lamprey nursery habitats are very shallow ($\leq 10\text{cm}$), with little organic debris or sand. All lamprey nursery habitats identified are located in sub-optimal areas e.g., cattle access points, submerged tree roots with trapped silt/organic material, rooted macrophytes in unstable areas. All lamprey nursery areas are at risk of destabilisation in annual high flows and/or drying in low flows.</p> <p>There may be little to no habitat heterogeneity, limited woody debris instream, excessive macrophyte growth, no overhanging vegetation or long sections tunnelled by dense vegetation.</p> <p>There may be intermittent pollution, extreme oxygen conditions and/or poor biological quality (Q2-3 to Q3) present. Seasonal low flows may result in adults leaving the survey section to find deeper waters.</p> <p>Physical man-made barrier(s) such as dams/weirs/ culverts may only be passible during certain flow conditions. Isolated populations of non-migratory species (e.g., brook lamprey, brown trout, white-clawed crayfish) may be present but at risk due to low genetic diversity.</p> <p>Populations are at risk and may be unsustainable in the longer term because of occasional pressures associated with the additive effect of high temperature and oxygen, as prolific growths of benthic macroalgae which are characteristic features of poor (Q2-3, Q3) biological quality ratings (McGarrigle, 2001).</p> <p>Non-salmonid fish species such as three-spined stickleback tend to dominate these Q2-3 waters (Kelly <i>et al.</i>, 2007). Although salmonids and lamprey can be found in poor biological quality (Q3) this is not considered a good supporting condition particularly for salmon. They may be present only in very low numbers however if present it would indicate the potential for recolonisation from neighbouring clearer habitats should habitat and water quality improve.</p>
Moderate	<p>It is considered that the section of watercourse surveyed could support the species in question but conditions are sub-optimal.</p> <p>Coarse substrate is present for spawning but there may be moderate sedimentation of spawning gravels. Only shallow sediments ($<15\text{cm}$ $>10\text{cm}$) are available for lamprey ammocoetes. Most of the nursery habitats are located in sub-optimal areas e.g., cattle access points, submerged tree roots with trapped silt/organic material, rooted macrophytes in unstable areas. With most but not all areas at risk of destabilisation in high flows and/or drying in low flows.</p> <p>There is some habitat heterogeneity with riffles and pools occasional providing cover for salmonids or other suitable cover occasional (e.g., overhanging trees, boulders). Small section of the survey area might be tunnelled creating a dark channel but not the entire survey area.</p> <p>Poor to moderate biological quality (Q3, Q3-4) is present. Brown trout and lamprey can be found in these conditions. Rivers with deeper uniform glide habitats particularly favouring trout over salmon. Although salmon habitat may also be present a biological quality rating below a Q4 is considered sub-optimal supporting conditions.</p>
Good	<p>Supporting habitat identified for the species in question is frequent to abundant and of good quality. There may be degradation of some spawning gravels such as slight</p>

Fisheries Habitat Potential Rating	Definition
	<p>siltation. There may have been some anthropogenic interference in small sections of the reach surveyed in the past but habitats are intact or appear to be recovering well.</p> <p>Good habitat heterogeneity present with riffle/glide/pool sequence. Overhanging vegetation present but no dense tunnelled sections. Good cover and refuges are frequent to abundant within the survey section.</p> <p>Physiochemical parameters and biological quality are suitable for the species in question. For example, a biological quality of Q4 is considered good supporting conditions for salmonids while a Q3-4 is supporting biological condition for white-clawed crayfish.</p>
Excellent	<p>Habitat conditions are unpolluted with little to no siltation and appear natural or have fully recovered from historical interference.</p> <p>Spawning gravels are abundant to dominant or were present form significant spawning areas due to their high quality. No artificial barriers to migration are visible. There is habitat heterogeneity with riffle/glide/ pools. With optimal refuges and cover for species in question.</p> <p>Natural flow dynamics have resulted in areas of silt deposition with slow backwatered flow such as, meanders, side channels or sandy/silty bars. Slow flowing margins with rooted macrophytes may also be common and are in stable condition (not at risk of movement during flood events or drying). These areas may be large or small but frequent supporting lamprey nursery habitats.</p> <p>Artificial structures such as bridge piers or weirs can result in silt deposits forming large lamprey nursery habitats but should not form a barrier for adult migration.</p> <p>Physiochemical and biological quality conditions are optimal for species in question. For example, High biological quality (Q4-5, Q5) particularly supports excellent salmonid conditions. There are no signs of significant pressures such as nutrient or hydromorphological pressures.</p>

2.3. Invasive Species Survey

Any invasive aquatic or riparian plants listed on the Third schedule of the EC (Birds and Natural Habitats) Regulations 2011 (S.I.477/2011) were noted. Should any invasive plant species be present disturbance of the area is avoided.

For all freshwater ecological surveys, the surveyor employs strict biosecurity methodology. The surveyor is familiar with invasive plant and animal species that occur in Ireland and before any site is visited a review of any aquatic or terrestrial invasive species records is conducted using the National Biodiversity Data Centres (NBDC) online mapping tool to assist in biosecurity planning.

The surveyor employs the Check – Clean – Dry protocol as recommended by Inland Fisheries Ireland. Before leaving the sampling site all equipment (waders, nets, buckets, trays etc) are checked and any visible debris removed. Equipment is then cleaned using a solution approved for use near water and recommended dosage (Virkon® Aquatic). All equipment is then stored and allowed to dry thoroughly before reuse. The surveyor holds a second set of gear which is used if sampling more than one catchment in a day.

2.4. Otter Survey

At each of the sample sites (Sites 1-7) a walkover survey for otter was conducted. This survey broadly followed the standard otter survey methodology described within Lenton *et al.* (1980) and National Otter Surveys of Ireland conducted by the National Parks and Wildlife Service (Bailey & Rocheford 2006, Reid *et al.* 2013). However, rather than surveying a 600m stretch from an accessible point (usually a bridge) the survey area was focused on detecting otter activity along the Swan River and riparian zone at each survey site. This was conducted by walking up and downstream of the survey site and covering as much of the river as was possible.

The detection of spraint, tracks, couches, slides and holts were used to determine otter activity. Any of these field signs were noted and GPS co-ordinates taken.

2.5. River Birds

At each site during the walkover survey for otter a bird survey was also conducted. This survey focused on the birds strongly associated with river environments; dipper (*Cinclus cinclus*), grey wagtail (*Motacilla cinera*) and kingfisher (*Alcedo atthis*). These three birds are referred to as river birds in this report.

Any other birds identified were also noted. This was a single walkover survey only and focused on visual confirmation or identification of any potential nesting locations e.g., dippers / grey wagtails often nest under bridges while kingfisher nest in hollows in tall exposed banks.

3. DESKTOP REVIEW RESULTS

3.1. Existing Water Quality

The Swan River is a small tributary of the Dargle River with both waterbodies forming part of the larger Avoca-Vartry² catchment, Hydrometric Area 10. The Swan is mapped by the EPA as being part of the Dargle_040 waterbody which includes the section of the Dargle River flowing along the Peoples Park downstream to Bray Harbour.

There is no EPA biological monitoring station located within the Swan River. The monitoring station for the Dargle_40 waterbody is located within the Dargle River just upstream and downstream of the confluence with the Swan River both these stations however have not been monitored recently. The most recent Q-value was taken further upstream in the next waterbody 1km upstream of Bray Bridge a Q4 was assigned indicating Good biological quality. **Table 3-1** below summaries the Q-value for the closest stations to the Swan River.

A Water Framework Directive (WFD) status of Good is assigned (2016-2021 status) and the Dargle_040 waterbody is considered to be “Not at Risk” of failing WFD objectives (3rd cycle risk). Its WFD objective is to achieve at least Good Ecological Status.

Table 3-1: Summary of most recent Q-value results for the monitoring stations closest to the Swan River.

Waterbody name	Station code & name	Q-value 2012	Q-value 2015	Q-value 2018	Q-value 2019	Q-value 2020	Q-value 2022
Dargle_030	10D010250 1km u/s Bray Br	-	3 (Poor)	3-4 (Moderate)	4 (Good)	4 (Good)	4 (Good)
Dargle_040	10D010260 Peoples Park u/s Swan rv conflu	4 (Good)	-	-	-	-	-
Dargle_040	10D010270 Peoples Park d/s Swan Rv Confluence	-	4* (Good with sedimentation issue)	-	-	-	-

There are 23 Areas for Action (AFA) within the Avoca-Vartry catchment listed in the draft 3rd Cycle Catchment Report (EPA 2021). These areas are proposed for focused action and collaboration by local authorities, public bodies, and stakeholders as part of implementation of the 3rd Cycle WFD in Ireland. The Dargle_040 has now been included as one of these areas under the category of restoration.

The rock type underlying the Swan is Cambrian greywacke and quartzite. The underlying groundwater body is named the Wicklow groundwater body which is currently at Good WFD Status and Not at Risk of failing WFD objectives (2016-2021 WFD Status).

3.2. Records of Protected Species and Habitats

The Swan River is not located within any European Site, Natural Heritage Area, national park or any other protected site. The closest protected site is the Dargle River Valley proposed Natural Heritage Area (Code 001754) which is located within the Dargle River 2.6km upstream where the Swan enters

² Also spelt Ovoca- Vartry catchment

the Dargle. Bray Head Special Area of Conservation (Code 000714) is located 1.3km west of the Swan River (as the crow flies) and is protected for dry heath habitats and vegetated sea cliffs.

A summary of the desktop review for protected species and habitats is given below in **Table 3-2**. The available information for the Swan River was quite limited but please note that an absence of records does not necessarily mean a species or habitat is absent from the area.

The desktop search was for publicly available records online, other records may exist within private databases. The Swan River is quite a small river which has not been extensively monitored or studied and is one reason why records are limited. As is the case for a lot of small river habitats in Ireland, records are often reliant on keen eyed local members of public.

Table 3-2: Summary of desktop review for protected species and habitats within or adjacent to the Swan River.

Species/Habitat	Designation ³	Records
Pine martin (<i>Martes martes</i>)	-Annex V of the EU Habitats Directive (92/43/EEC). -Irish Wildlife Act (1976 as amended).	Although not a species whose lifecycle is tied with freshwater it is an important record to note given its proximity to the Swan River and riparian woodland habitats which are associated with this river. NBDC Records of pine martin (2012 and 2015) within Kilruddery Estate <100m from the Swan River
Common frog (<i>Rana temporaria</i>)	-Annex V of the EU Habitats Directive (92/43/EEC). -Irish Wildlife Act (1976 as amended).	Records of common frog within garden pond <100m from Swan River just at Killarney Road.
Otter (<i>Lutra lutra</i>)	-Annex II & IV of the EU Habitats Directive (92/43/EEC). -Irish Wildlife Act (1976 as amended).	Record (2012) of live animal within the Swan River at Glenwood estate just upstream of the Dargle. There are also records of otter within the Dargle just downstream of the Swan confluence indicating that otter are in the vicinity of the Swan River. Further upstream within Kilruddery estate Lord Meath's Kilruddery Natures Diary indicates that otter have been spotted within the estate and the diary notes that " <i>The other mustelid which occurs occasionally is the otter. The Swan River, which is culverted by urbanisation north of Killruddery, is one route for their journey to arrive into the estate</i> ". It is unconfirmed what year this sighting was noted or exact location within the Swan.
Kingfisher (<i>Alcedo atthis</i>)	-Annex II of the EU Habitats Directive (92/43/EEC) -Amber listed on Birds of Conservation Concern in Ireland (2020- 2026)	No records within the Swan River but kingfisher has been recorded in the surrounding area with a 2017 NBDC record on the Dargle River just where the Swan enters.

³Annex I – habitat types whose conservation requires the designation of Special Areas of Conservation.

Annex II – animal or plant species whose conservation requires the designation of Special Areas of Conservation.

Annex IV – animal or plant species in need of strict protection

Annex V – animal or plant species whose taking in the wild and exploitation may be subject to management measures.

Species/Habitat	Designation ³	Records
Grey wagtail	-Red listed on Birds of Conservation Concern in Ireland (2020- 2026)	Multiple NBDC records (2016) of this species at Kilruddery House and Gardens
Daubenton's bat (<i>Myotis daubentoniid</i>)	-Annex IV of the EU Habitats Directive (92/43/EEC). -Irish Wildlife Act (1976 as amended).	Often referred to as the water bat, the Daubenton's is closely associated with slow moving rivers feeding on insects emerging from the water. No records of Daubenton's along the Swan River but there are a number of NBDC records over the Dargle around Bray Bridge (2004, 2009 & 2014).
Sea and brown trout (<i>Salmo trutta</i>)	-	There are no records of sea or brown trout within the Swan River. The Dargle River however is considered to be one of Irelands premier sea trout rivers. A fish survey conducted by Inland Fisheries Ireland (IFI) in 2009 recorded both brown and sea trout just upstream of Bray bridge (CRFB, 2009). Another IFI survey in 2018 found brown trout to be the most common fish species further upstream the Dargle near Tinnahinch (Matson <i>et al.</i> , 2019). The Swan has the potential to act as important supporting habitat for trout should appropriate conditions be present.
Atlantic salmon (<i>Salmo salar</i>)	S.I. 293: European Communities (Quality of Salmonid Waters) Regulations, 1988. Annex II & V of the EU Habitats Directive (92/43/EEC)	The Swan River is not listed as a Salmonid River under the salmonid regulations and there are no records of salmon within this river. However, it is it is connected with the Dargle River which is designated as a salmonid river. A fish survey conducted by Inland Fisheries Ireland (IFI) in 2009 found salmon to the most abundant species recorded just upstream the Swan River confluence (CRFB, 2009). Another IFI survey was conducted in 2018 further upstream near Banaha and identified salmon here also (Matson <i>et al.</i> , 2019). Therefore, the Swan has the potential to act as important supporting habitat should appropriate conditions be present.
Sea/river/brook lamprey (<i>Petromyzon marinus</i> , <i>Lampetra fluviatilis</i> , <i>Lampetra planeri</i>)	Annex II of the EU Habitats Directive (92/43/EEC) (all three species) Annex V of the EU Habitats Directive (92/43/EEC) (river only)	There are no records of these species occurring with the Swan River. Given the Swan is a small narrow river it is unlikely to support sea lamprey. Little information could be found regarding these species within the Dargle river either. A review of lamprey distribution in Ireland noted unspecified lampreys within the middle reaches of the Dargle and its tributary (Kurz & Costello, 1999). It is considered likely that river, brook and potentially even sea lamprey are utilising the Dargle River.
European eel (<i>Anguilla anguilla</i>)	IUCN Red listed as a critically endangered species	There are no records of European eel within the Swan River. There are records of European eel within the Dargle. A fish survey conducted by Inland Fisheries Ireland (IFI) in 2009 found European eel to be the second most abundant species recorded just upstream the Swan River confluence (CRFB, 2009).

Species/Habitat	Designation ³	Records
Habitats	Annex I of the EU Habitats Directive (92/43/EEC)	There are no mapped Annex I habitats within the Swan River. There are tidal mudflats (1140) mapped along the Bray coastline which are hydrologically connected 1.3km downstream of the Swan confluence with the Dargle.
Protected Aquatic plants	(Flora Protection Order 2022)	Following desktop review, no protected aquatic plants have been recorded within the Swan River.
Woodlands/Trees	Tree Preservation Orders (TPO)	TPO B5 Oldcourt House and Vevay House, Swan River Valley <i>'including row of mature oak and beech trees along the western boundary of Charnwood Estate; stand-alone mature oak in open area to west of Charnwood, to east of Swan River valley woodland.'</i> TPO B10 Swan River valley to Bray Bridge (The Maltings).

3.3. Biodiversity policies and objectives specific to Co. Wicklow

There were a number of biodiversity policies within the Co. Wicklow Biodiversity Action Plan (2010-2015), Wicklow Heritage Plan 2017 -2022 and Wicklow Development Plan (2022- 2028) which were considered relevant to this report. These are summarised below.

3.3.1. Wicklow County Development Plan 2022- 2028

Access to the full plan is available online at <https://www.wicklow.ie/Living/CDP2021>

CPO 17.14 Ensure that development proposals support the protection and enhancement of biodiversity and ecological connectivity within the plan area in accordance with Article 10 of the Habitats Directive, including linear landscape features like watercourses (rivers, streams, canals, ponds, drainage channels, etc), woodlands, trees, hedgerows, road and railway margins, semi-natural grasslands, natural springs, wetlands, stonewalls, geological and geo morphological systems, features which act as stepping stones, such as marshes and woodlands, other landscape features and associated wildlife where these form part of the ecological network and/or may be considered as ecological corridors or stepping stones that taken as a whole help to improve the coherence of the European network in Wicklow.

CPO 17.15 To protect and enhance wetland sites that are listed as being of C+ or higher importance in the County Wicklow wetlands survey and any subsequent updates or revisions thereof and to implement the recommendations of the County Wicklow wetlands survey.

CPO 17.17 Work with statutory authorities to prevent and control the spread of invasive plant and animal species and require, where appropriate Invasive Species Management Plans to be prepared as part of the development management process where necessary

CPO17.24 To ensure and support the implementation of the EU Groundwater Directive and the EU Water Framework Directive and associated River Basin and Sub-Basin Management Plans and Blue Dot Catchment Programme, to ensure the protection, improvement and sustainable use of all waters in the County, including rivers, lakes, ground water, coastal and estuarine waters, and to restrict development likely to lead to a deterioration in water quality. The Council will also have cognisance of, where relevant, the EU's Common Implementation Strategy Guidance Documents No. 20 and 36 which provide guidance on exemptions to the environmental objectives of the Water Framework Directive.

CPO 17.25 Ensure that floodplains and wetlands are retained for their biodiversity and ecosystems services value and resist development and activities that would interfere with the natural water cycle to a degree that would interfere with the survival and stability of these natural habitats.

CPO 17.26 Protect rivers, streams and other water courses by avoiding interference with river / stream beds, banks and channels and maintaining a core riparian buffer zone of generally 25m along watercourses (or other width, as determined by the Planning Authority having particular regard to 'Planning for Watercourses in the Urban Environment' by Inland Fisheries Ireland for urban locations) free from inappropriate development, with undeveloped riparian vegetation strips, wetlands and floodplains generally being retained in as natural a state as possible. Structures such as bridges should be clear span, and designed and built in accordance with Inland Fisheries Ireland guidance

3.3.2. Wicklow County Heritage Plan 2017 -2022

Access to the Wicklow Heritage Plan 2017- 2022 is available online at <https://www.wicklow.ie/Living/Services/Arts-Heritage-Archives/Heritage/County-Heritage-Plan>

3:6 Support the implementation of the All Ireland Pollinator Plan in county Wicklow through engagement with the National Biodiversity Data Centre (NBDC) and with target audiences.

3:8 Undertake awareness raising initiatives to highlight the threat of invasive species and liaise with relevant stakeholders to develop appropriate recording and control initiatives.

3:11 Support the implementation of actions in the County Wicklow Biodiversity Action Plan 2010-2015 and the review and update of this Plan as required.

4:3 Encourage 'Citizen Science' in Wicklow through the promotion of the various recording initiatives available, the work of the National Biological Data Centre (NBDC) and the tracking of 'actions for pollinators' by Tidy Towns and other groups.

4:10 Support the ongoing rollout of the recommendations of the Wicklow Bridges Project and work in partnership with relevant stakeholders on initiatives to enhance the water quality, habitat value and recreational use of Wicklow's water bodies

3.3.3. County Wicklow Biodiversity Action Plan 2010 - 2015

Access to the County Wicklow Biodiversity Action Plan 2010-2015 is available online at <https://www.wicklow.ie/Living/Services/Arts-Heritage-Archives/Heritage/Natural-Heritage/Biodiversity-in-Wicklow/Biodiversity-Plan>

Action 17 Undertake a campaign on alien invasive species in the county, taking account of national priorities, benefits of taking action, the need to ascertain the current status in county Wicklow and the role of various agencies and groups in reporting and controlling them.

Action 20 Support the development of a 'green corridors' strategy for the council, underpinned by Article 10 of the EU habitats Directive and identification of 'Biodiversity hotspots', to encourage integrity and connectivity between important sites and habitats. Including policy protection approaches for river corridors and hedges / verges.

Action 21 ensure the Wicklow County Council uses its powers of enforcement under the Waste Management Acts, bye laws and other relevant legislation, to control illegal dumping, pollution and inappropriate recreational activities

Action 24 Support appropriate re-introduction programmes in the county, undertaking appropriate council action is taken to ensure environmental conditions are maintained.

Action 26 encourage and facilitate targeted management or study projects for important species, habitats and ecosystems where appropriate. Priority should be placed on facilitating studies relating to coastal biodiversity and to species, habitats and ecosystems most vulnerable to the effects of climate change.

3.3.4. Bray Municipal District Local Area Plan 2018 -2024

Access to the Bray Municipal District Local Area Plan 2018-2024 is available online at <https://www.wicklow.ie/Living/Services/Planning/Development-Plans-Strategies/Local-Area-Town-Settlement-Plans/Bray/Bray-Municipal-District-Local-Area-Plan-2018-2024>

RO9 To promote and support the development of enhanced or new greenways at the following locations and require development in the vicinity of same to enhance existing routes and / or provide new links [among the list is the following]

- Bray - Swan River Kilruddery to Dargle River

GI3 To minimise alterations or interference with river / stream beds, banks and channels, except for reasons of overriding public health and safety (e.g., to reduce risk of flooding); a buffer of generally 10m along watercourses should be provided (or other width, as determined by the Planning Authority) free from inappropriate development, with undeveloped riparian vegetation strips, wetlands and floodplains generally being retained in as natural a state as possible. In all cases where works are being carried out, to have regard to Regional Fisheries Board “Requirements for the protection of fisheries habitat during the construction and development works at river sites”. New river / watercourse road crossings and / or piping shall be strongly resisted except for reasons of overriding public health and safety.

GI4 To promote the preservation of trees, groups of trees or woodlands in particular native tree species, and those trees associated with demesne planting, where considered to be viable, safe and in line with sound arboricultural management, in the interest of amenity or the environmental, as set out in the Heritage Schedules of this plan.

GI5 To promote the development of a series of major open spaces and recreational areas linked by green corridors where feasible (see Map GI1), in the Bray MD area as follows:

- On the Kilruddery estate as part of SLO 1 linking along the Swan River, through the OS to the west of Hollybrook Park; from the Bray SCR, through SLO 6 or SLO 9 onto the Boghall Road; continuing through new and proposed residential areas onto Herbert Road and onto the River Dargle; in particular, (a) any new development at or in the vicinity of Oldcourt House shall make provision for the continuation of the green corridor between Giltspur Brook and Rycroft; (b) any infill development along Herbert Road adjacent to the green corridor shall make provision for green link between Herbert Road and the Dargle corridor

SLO9In conjunction with the development of SLO 9 adjacent, the development shall be so designed as to provide for a ‘green route’ link between Boghall Road and Bray SCR (‘Swan River green route’)

B4 To support the protection and enhancement of biodiversity and ecological connectivity within the plan area in accordance with Article 10 of the Habitats Directive, including linear landscape features like watercourses (rivers, streams, canals, ponds, drainage channels, etc), woodlands, trees,

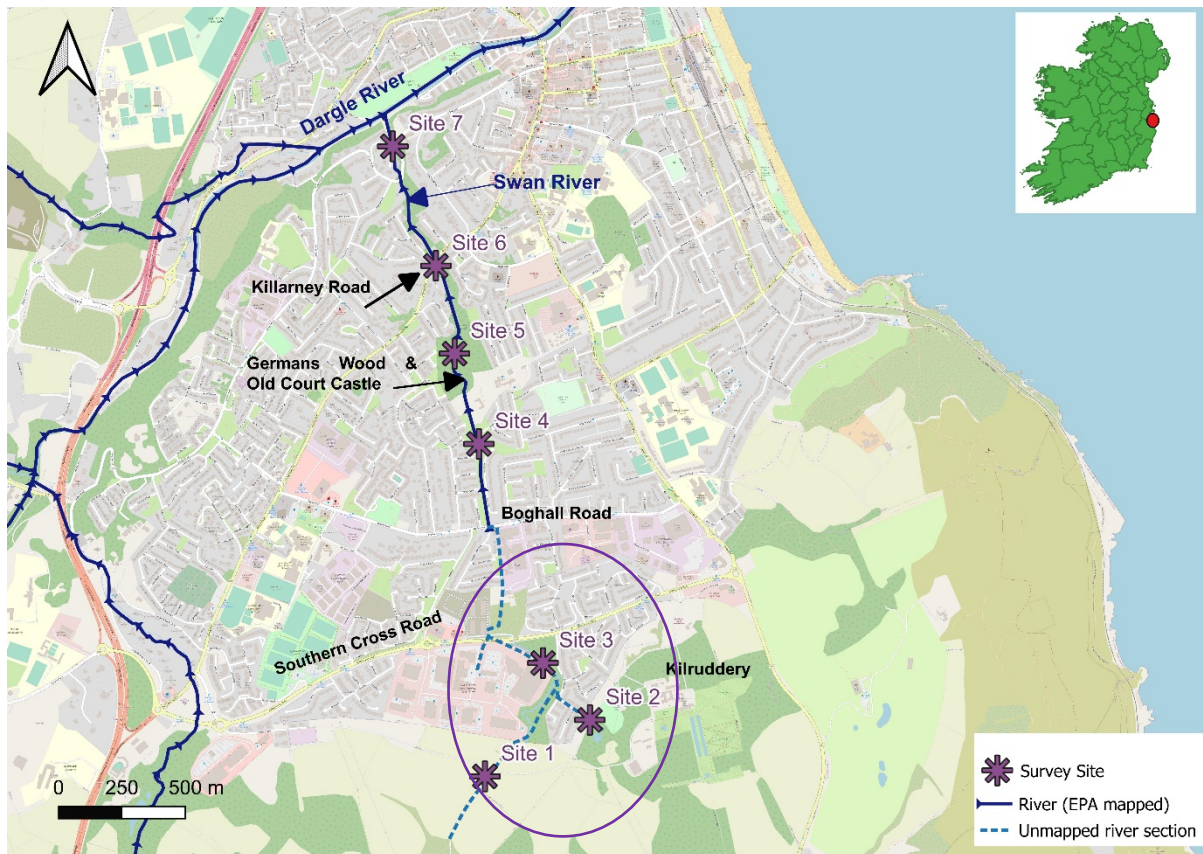
hedgerows, road and railway margins, semi-natural grasslands, natural springs, wetlands, stone walls, geological and geo-morphological systems, features which act as stepping stones, such as marshes and woodlands, other landscape features and associated wildlife where these form part of the ecological network and/or may be considered as ecological corridors or stepping stones that taken as a whole help to improve the coherence of the Natura 2000 network.

4. FIELD SURVEY RESULTS

The following section summarises the results of the survey starting from the furthest downstream site (Site 7) working upstream towards Site 1. For ease of reference the Swan River is split into three sections, the lower reaches (Sites 7 and 6), middle reaches (Sites 5 and 4) and upper reaches (Sites 3, 2 and 1). The results for each of these sections is discussed below, Fossitt codes are assigned to the habitats identified as per Fossitt, 2000.

The survey was conducted on a sunny day and there had been no rainfall in the days preceding the survey.

4.1. Upper Reaches – Sites 1, 2 & 3



4.1.1. General characteristics

The main channel of the Swan at **Site 1** was completely dry at the time of survey. The channel here has been modified into straightened drainage channel with steep vertical banks and cut off from a floodplain. A narrow treeline (WL2) consisting of mature broadleaves line the top of both banks with an understory consisting of thick bramble (*Rubus fruticosus* agg.) with ivy (*Hedera helix*), ferns and dog-rose (*Rosa canina*). The surrounding land is tilled land (BC3) and improved agricultural pasture (GA1).

Site 2 is a small tributary channel of the Swan River rising just south of Kilruddery Gardens. Here there was flow present and at the time of survey. The river flows through a section of dense scrub and woodland and is diverted under a dirt track via two small pipe culverts by squirrel scramble. Only the section downstream of this culvert is visible. Here the river bed is characterised by deep silt and flow is very slow to stagnant. The river width was 2m with a floodplain area present. The only aquatic vegetation observed growing here was waterdrop hemlock (*Oenanthe crocata*). The river here is bordered by a small woodland area consisting mainly of alder (*Alnus glutinosa*) with creeping buttercup (*Ranunculus repens*), sedges (*Carex* sp.) nettle (*Urtica dioica*), common hogweed (*Heracleum sphondylium*) and willowherb (*Epilobium* sp.) and is classified as wet willow-ash-alder woodland (WN6). The river flows through a culvert with a large trash screen and is diverted under a section of Hollybrook estate.



Plate 4-1: Main channel of the Swan River in Kilruddery estate which was dry at time of survey (Site 1).



Plate 4-2: Small tributary stream of the Swan at Kilruddery estate (Site 2).



Plate 4-3: Culvert which the small tributary channel is diverted under Hollybrook estate (Site 2).



Plate 4-4: Silty substrate typical of Site 2.

The Swan then reemerges and flows along the western boundary of Hollybrook estate (**Site 3**). The channel is narrow (1m width) and has been modified being straightened and deepened with 1-2m high banks. Instream characteristics were very uniform with little habitat heterogeneity or complexity which is required to create diverse habitats for a wider range of aquatic species and habitats. The flow was slow to stagnant with shallow water (0.2m) at the time of survey. The substrate consisted mainly of silt and it was difficult to walk along the river here as the silts were deep and sinking in sections. The channel is quite heavily shaded and no aquatic vegetation or algae was recorded with the exception of American skunk cabbage (*Lysichiton americanus*) which is listed a Third Schedule invasive species.

There is good woodland habitat located along the river bank and of particular note is an area of mixed broadleaved woodland (WN2) mainly consisting of holly (*Ilex aquifolium*) and oak (*Quercus sp.*) mixed with hawthorn (*Crataegus monogyna*), sycamore (*Acer pseudoplatanus*), ash (*Fraxinus excelsior*) and beech (*Fagus sylvatica*). This woodland is wedged between the industrial complex and the housing estate, it follows the length of Hollybrook estate (approximately 410m) forming an important wildlife corridor connecting in with Kilruddery estate to the south. The area unfortunately is subject to a lot of rubbish dumping and the southern cross roads cuts off this linear corridor from lands to the north. At the end of Hollybrook the Swan actually takes an almost 180 degrees turn and disappears under the industrial complex. Where it re-emerges and passes under the Southern Cross Roads could not be located. The next location where surface water was visible again is at the Boghall Road.



Plate 4-5: Swan River as it flows through Hollybrook estate (Site 3).



Plate 4-6: Silted substrate of Swan River as it flows through Hollybrook estate (Site 3).



Plate 4-7: Woodland area within Hollybrook estate (Site 3).



Plate 4-8: American skunk cabbage growing along the edge of the Swan River at Hollybrook estate (Site 3).



Plate 4-9: Section of the Swan River just before it is diverted under the industrial estate. Yellow arrows indicate direction of flow highlighting sharp turn the river takes (Site 3).



Plate 4-10: Close up of the pipe culvert which conveys the Swan under the industrial estate (Site 3).

4.1.2. Biological water quality

Dissolved oxygen (DO) conditions at **Site 2** were 8.36mg/l and slightly lower further downstream at **Site 3** as the river flowed through Hollybrook (7.80mg/l). Although conditions observed were slightly low and not optimal for salmonids (require 9mg/l >50% of the time) they are not overly concerning. When DO falls below 6mg/l this can start to have deleterious effects upon salmonid fish dependent on the amount of time low levels are sustained for. When river bed sediments were disturbed, a foul smell was apparent indicating anoxic or low oxygen conditions within the stream bed.

The macroinvertebrate kick sample was conducted at **Site 2**. It consisted of pollution tolerant species (Groups C -E). No sensitive species were present (Group A). One Group B taxon was present but as this was a single specimen it was not counted toward the Q-value. Species richness was low with only 7 species present. Waterhog louse (*Asellus aquaticus*), freshwater shrimp (*Gammarus sp.*) and non-biting midge larva (Chironomidae) were the most common species making up the sample. The remaining species were present in in very low numbers. A Q2-3 was assigned indicating Poor biological quality, please see **Appendix A** for full list of macroinvertebrates and abundances.

4.1.3. Fisheries habitat

The upper reaches of the Swan River is unsuitable for large migratory species such as salmon, sea trout or sea lamprey. Notwithstanding the fact that multiple downstream barriers prevent the upward migration of these species there is a lack of habitat and poor biological water quality to support these species.

Suitable habitat for juvenile lamprey (river and brook) is present with silted backwatered margins. However spawning substrate is scarce. Migratory river lamprey are likely absent from the entire Swan River due to significant barrier present where the Swan enters the Dargle. **Table 4-1** below summaries the fisheries habitat rating assigned to the upper reaches.

Table 4-1: Summary of the fisheries habitat potential rating assigned to the upper reaches of the Swan

Species	Fisheries Habitat Rating	Reasoning
Salmon / sea trout / sea lamprey	Bad	Multiple barriers are present downstream which prevent these species from accessing the upper reaches of the Swan.

Species	Fisheries Rating	Habitat	Reasoning
			Should barriers be removed there are no habitats identified supporting salmon. This is a very narrow and small channel in the upper reaches of the Swan with dense shading, no suitable spawning substrate present, poor water quality, heavily silted conditions and little instream habitat cover for juveniles.
Brown trout	Poor		<p>There may be a very small isolated population present along Hollybrook however multiple barriers are present downstream which prevent movement of resident brown trout populations with the Swan. Populations are significantly at risk from poor genetic diversity or pollution events given trout would not be able to recolonise from downstream habitats.</p> <p>Section of the main channel dries out completely in summer forcing fish to migrate out of the area however they may utilise the areas for spawning if flow returns in winter.</p> <p>Poor biological quality is not ideal supporting condition. However, trout are more tolerant of these conditions compared to salmon.</p>
Lamprey (brook)	Moderate		<p>There may be a very small isolated populations present along Hollybrook however multiple barriers are present downstream which prevent movement of resident brook lamprey populations with the Swan. Populations are significantly at risk from poor genetic diversity or pollution events given lamprey would not be able to recolonise from downstream habitats.</p> <p>Small infrequent patches of silted backwater areas are present along Hollybrook for juvenile lamprey but these are not deep 0.05-0.01m and these sediments are at risk of destabilisation during high flows given the straightened nature of the channel. Spawning substrate available upstream but again sparse and moderate siltation degrades habitat. Section of the main channel dries out completely in summer forcing lamprey to migrate out of the area however they may utilise the areas for spawning if flow returns in winter.</p> <p>Water quality issues reduce habitat suitability for all life stages also.</p>
Lamprey (river)	Moderate* (if all barriers removed)		Although there is habitat present which would support river lamprey, they would not be able to access the Swan due to a barrier at the Dargle confluence and also within the channel.
European eel	Moderate		Limited refuges present for juveniles and larger adults. Water quality requirements for European eel have not been set and poorly understood. European eels are in general found in most lowland rivers in Ireland.

4.2. Middle Reaches – Sites 4 & 5



4.2.1. General characteristics

The middle reaches of the Swan stretch from the Boghall road downstream through Germans Wood. This part of the river has again been highly modified. From Boghall Road to Giltspur the river has been straightened and a retaining wall is present along the right bank next to the Boghall road. As it flows through Germans Wood past the Old Court Castle ruins there is some natural sinuosity briefly before the river is straightened again.

At **Site 4** the channel is 2m wide and water depth was very shallow (0.05 -0.1m). Owing to the straightened channel flow mainly consisted of a shallow glide with some riffles. Pools were largely absent and confined to the outfalls/inlets of the culverts.

The banks are in general high and steep (1-1.5m). At Wheatfield estate there is with a continuous treeline (WL2) along the right bank consisting of mainly of alder (*Alnus glutinosa*). This treeline, albeit narrow, forms a near continuous corridor from the Boghall Road to Germans Wood. The left bank is bordered with amenity grass (GA2) and planted trees (WD5) but the first 1-2m next to the bank has been left un-mowed with a mix of thistle (*Cirsium* sp.), broadleaved dock (*Rumex obtusifolius*), nettle (*Urtica dioica*) and colonising alder trees.

Further downstream toward Giltspur bramble (*Rubus fruticosus* agg.) scrub has tunnelled sections of the river created heavily shaded conditions here. Bankside vegetation consists of elder (*Sambucus nigra*), bramble, poplar (*Populus* sp.), common figwort (*Scrophularia nodosa*), sedges (*Carix* sp.), bindweed (*Calystegia sepium*), ivy (*Hedera helix*), nettle and amenity grassland. A small area of wet ground along the right bank is present with branched bur-reed (*Sparganium erectum*), reed canary

grass (*Phalaris arundinacea*), alder, nettle, meadowsweet (*Filipendula ulmaria*) and creeping buttercup (*Ranunculus repens*) forming a small area of wet grassland (GS4).

Aquatic vegetation was present with a large amount of filamentous green algae present covering 20% of the riverbed in open sections (*Vauchia* sp. and *Cladophora* sp.) indicating nutrient enrichment. Fools water-cress (*Apium nodiflorum*), watercress (*Nasturtium officinale*) and hemlock water-dropwort (*Oenanthe crocata*) were also present but rare.

The riverbed consists of cobble and coarse gravel. Boulders were present but limited. Moderate siltation of the substrate was still evident but did not form the dominant substrate in comparison to the upper reaches.



Plate 4-11: Swan River as it emerges from flowing under the Boghall road (Site 4).



Plate 4-12: Pipe discharging grey water at the Boghall Road culvert.



Plate 4-13: Swan River as it flows along Wheatfield estate, unmapped tributary can be seen entering via a culvert on the right (Site 4).



Plate 4-14: Swan River at Giltspur Brook (Site 4).



Plate 4-15: Swan River just before it flows out of Giltspur and into Germans Wood.



Plate 4-16: Pipe culvert where Swan River flows into Germans Wood

A tall wall divides Giltspur from the German Woods and the Swan flows through a small pipe culvert with rubbish built up at the trash screen. This culvert is undersized and together with the wall forms a barrier to movement for some wildlife to and from Germans Wood (e.g., small mammals such as hedgehogs).

The habitats within **Site 5** are starkly different to the suburban/ urban ones upstream. Here the Swan flows through a mature mixed broadleaved woodland (WD1) which oak (*Quercus* sp.), horse chestnut (*Aesculus hippocastanum*), beech (*Fagus sylvatica*), holly (*Ilex aquifolium*), yew (*Taxus baccata*) and willow (*Sallix* sp.). This woodland not only contains large old trees but also standing and fallen deadwood creating habitats for a range of species from insects and fungi feeding on decaying wood to providing potential bat roosts amongst the cracks and hollows in the trees. Stands of cherry laurel (*Prunus laurocerasus*) are also present within sections of the woodland. This is a non-native invasive species with a risk of high impact in Ireland.

A large weir is present just downstream of the Old Court Castle ruins. The main structure is approximately 3m high with a small amount of flow directed through two outfalls at the top. The main flow of the river at the time of survey was directed through a short mill race and cascades down bedrock to the river below. The weir has slowed and impounded water upstream creating a wide waterlogged area where wet willow woodland has formed (WN6). American skunk cabbage is again present here and is quite common upstream the weir.

This section of river has good habitat heterogeneity with woody debris and a developed riffle /glide/pool sequence. Substrate is dominated with cobble and coarse gravel with some boulder. Siltation is again still moderate.



Plate 4-17: Swan River in German Woods just upstream of the weir. American skunk cabbage is seen growing in the foreground (Site 5).



Plate 4-18: Weir at Germans Woods. The main flow on the left is over bedrock (Site 5).

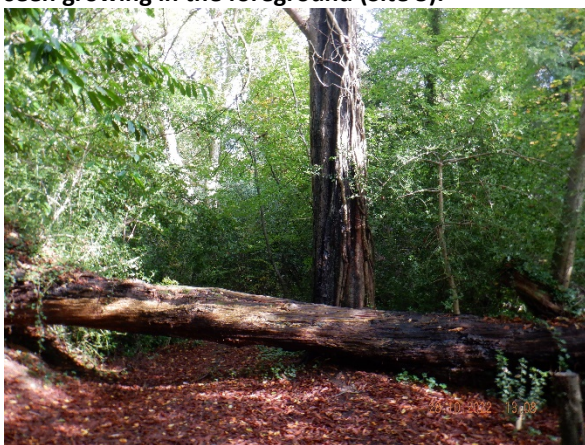


Plate 4-19: Typical habitat within German Woods with mature woodland and deadwood (Site 5).



Plate 4-20: Swan River downstream of the weir in German Woods (Site 5).

4.2.2. Biological water quality

The filamentous green algae growth indicates nutrient enrichment issues within the Swan River. Directly at the Boghall Road culvert there is a second pipe culvert and at the time of survey this was discharging grey coloured water (**Plate 4-12**). The water was coloured grey for approximately 20m downstream of this discharge. Dissolved oxygen conditions were quite low in this section of the river at 6.66mg/l. No sewage fungus was observed. Another pipe discharging grey water was observed along Site 5 downstream of the weir between the boundaries of Giltspur Wood and Glencourt estates again no sewerage fungus was observed here.

The macroinvertebrate kick sample was taken at **Site 4**. Species richness was very low with only 7 species present. No species sensitive to pollution were present (Class A or B). Only one species was common and this was the freshwater leech (*Erpobdella octoculata*) which is considered very tolerant to pollution. A Q2-3 was assigned indicting poor biological quality however given the number of the class D taxon present it was considered that this location is only just achieving poor and is bordering on bad biological quality.

The grey water, low DO, filamentous green algae and poor biological quality indicate there is a clear impairment to water quality here. The presence of grey water discharging from a pipe would indicate unidentified sewer misconnections.

4.2.3. Fisheries habitat

Barriers to fish movement are present within the middle reaches of the Swan. There is a large weir structure downstream of the Old Court Castle ruins approximately 3m high (**Plate 4-18**). The main flow is diverted along the right side of the river traveling down a steep millrace with laminar flow and then turns at a right angle flowing over bedrock. The bedrock forms an approximate 2m drop into a plunge pool. There is no resting location between the millrace and the falls.

The structure forms a complete barrier for small cyprinid fish and lamprey. Following the guidance criteria for a quick assessment of fish barriers; any structure with a drop >1.4m and pool depth ≤ 0.3 x hydraulic head for salmon and a drop >1.4m and pool depth ≤ 0.3 x hydraulic head for trout is considered that it will achieve passability score of 0.0 i.e., the structure is impassable (SNIFFER, 2012). This weir meets the criteria of being classed as impassable for salmon and trout. Please note this is a general quick assessment tool and further calculations including velocities are used to calculate a final score. Eel are likely the only aquatic species that can traverse this weir.

A second barrier is in the form of the undersized pipe culvert with very shallow flow with woody debris and rubbish blocking the inlet. This represents a partial barrier to fish.

Three-spined stickleback were present within the Swan at **Site 4**. **Table 4-2** below summaries the fisheries habitat rating assigned.

Table 4-2: Summary of fisheries habitat rating assigned to the middle reaches of the Swan

Species	Fisheries Rating	Habitat	Reasoning
Salmon / sea trout / sea lamprey	Poor* (should be removed)	-Bad barriers	<p>It is considered unlikely that these species are currently present within the middle reaches of the Swan.</p> <p>From German Woods to the weir there is some habitat heterogeneity with riffle /glide /pool sequence. Some juvenile habitat is offered with boulders, tree roots, overhanging trees. Sections with deep pools present for adults.</p> <p>Any sections with spawning substrate are degraded with moderate siltation. The poor biological quality is not ideal supporting condition particularly for salmon who require Q4 (Good) or above. The habitat is rated as Poor* here due to downstream barriers.</p> <p>The stepped weir at the Swan confluence with the Dargle is considered a full barrier for sea lamprey to even access the Swan. It is considered a partial barrier for salmon and sea trout.</p> <p>This weir within Germans Wood is considered impassable for all three species and upstream habitats are inaccessible. Upstream of the weir and into the housing estate habitat is further degraded with little habitat heterogeneity and very shallow summer flow. Upstream of the weir the Swan is considered to have no supporting habitats for these species.</p>
Brown trout	Moderate		<p>From German Woods to the weir there is some habitat heterogeneity with riffle /glide /pool sequence. Juvenile habitat with boulders, tree roots, overhanging trees. Sections with deep pools present. Cover is less abundant further upstream with very shallow summer flow and limited pools for bigger adults and trout would have to migrate downstream to access deeper waters.</p>

Species	Fisheries Rating	Habitat	Reasoning
			<p>Spawning substrate present however moderate siltation degrades this and poor biological quality is not ideal supporting condition. However, trout are more tolerant of these conditions compared to salmon.</p> <p>Barriers present in the middle reaches. Populations are significantly at risk from poor genetic diversity or pollution events given trout would not be able to recolonise from downstream habitats due to barriers. Habitats and current water quality may only support a very small population of brown trout if present.</p>
Lamprey (brook)	Moderate		<p>Small infrequent patches of silted backwater areas are present for juvenile lamprey but these are not deep 0.05-0.01m and these sediments are at risk of destabilisation during high flows given the straightened nature of the channel. Spawning substrate available but moderate siltation degrades habitat.</p> <p>Water quality issues reduce habitat suitability for all life stages also.</p>
Lamprey (river)	Moderate* (if all barriers removed)		<p>Although there is habitat present which would support river lamprey, they would not be able to access the Swan due to a barrier at the Dargle confluence and also barriers within the channel.</p>
European eel	Good		<p>Good habitats present particularly along German woods with abundant refuges for juveniles and adults. Water quality requirements for European eel have not been set and poorly understood. European eels are in general found in most lowland rivers in Ireland.</p>

4.3. Lower Reaches – Sites 6 & 7



4.3.1. General characteristics

The lower reaches of the Swan include the section from Glencourt estate downstream to the confluence with the Dargle and includes **Site 6** and **Site 7**. The entire section has again been modified with straightening and bank reinforcement. Along Glencourt estate high gabion baskets form the left bank. Despite the modifications the channel has retained some natural characteristics. Good habitat heterogeneity exists with a boulder and cobble dominated substrate and a range of flow types are present (riffles / glides / pools) across the entire lower reach.

The lower section is confined to 1-2m wide channel with no access to a natural floodplain. The water depth was very shallow at the time of survey (0.15 -0.2m). However, heavy erosion is evident in sections with exposed steep banks indicating this is a flashy system rising quite high when in flood. Substrate was cobble / coarse gravel dominated with moderate to heavy siltation.

The lower reaches are heavily shaded with a continuous treeline (WL2) of overhanging mature broadleaves and bramble scrub (WS1). Trees consist mainly of beech (*Fagus sylvatica*), alder (*Alnus glutinosa*), ash (*Fraxinus excelsior*), sycamore (*Acer pseudoplatanus*) and elder (*Sambucus nigra*). This treeline is narrow for most of the lower section however, one section does have a wider riparian zone. This is located along the right bank from Glencourt estate down to Killarney Road and is a continuation of the broadleaved woodland (WD1) of Germans Wood about 30m wide in sections.

The woodland here and treeline form important continuous wildlife corridor along the entire lower reach providing vital habitat and commuting pathways for species in an otherwise very suburban and built-up landscape. This habitat also provides good source of woody debris and leaf litter instream which are essential source of food and habitat for a range of aquatic species.

Very little aquatic plants were observed growing instream with common water-plantain (*Alisma plantago-aquatica*) and the liverwort *Conocephalum* sp. observed only at Site 7. The distinctive red encrusting algae, *Hildenbrandia* sp. was present throughout the lower reaches which grows well in shaded conditions. In addition, freshwater sponges were very common growing on the cobbles and boulders throughout the lower sections of this river (see **Plate 4-23**, **Plate 4-27** and **Plate 4-28**)

The Swan River enters the Dargle River via a large stepped weir (**Plate 4-30**).



Plate 4-21: Swan River just downstream of Germans Woods (Site 6).



Plate 4-22: Gabion baskets and concrete reinforcement along the bank as the river flows past Glencourt estate (Site 6).



Plate 4-23: Typical substrate of the Swan in the lower reaches with pink circle highlighting freshwater sponge (Site 6).

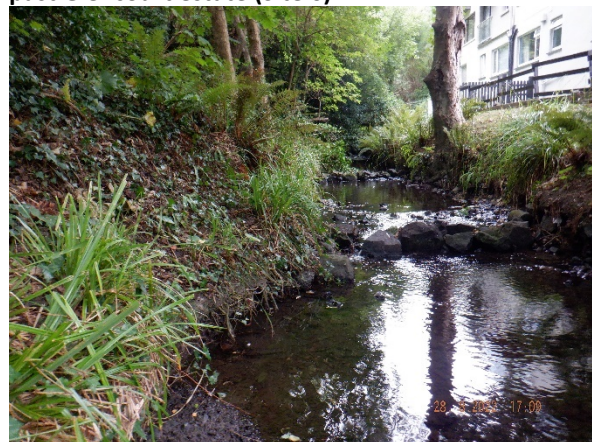


Plate 4-24: Swan River just before it flows under Killarney Road with small rock weirs (Site 6).



Plate 4-25: Swan River as it flows under Killarney Road (Site 6).



Plate 4-26: Swan River with weir and culvert at Glenwood estate just visible in background. Red coloured substrate are cobbles with the encrusting algae, *Hildenbrandia* sp. (Site 7).



Plate 4-27: Typical substrate in the lower reaches with pink circle highlighting freshwater sponge (Site 7).



Plate 4-28: Close up of freshwater sponge on top of a cobble.



Plate 4-29: Typical section of the Swan at Site 7.

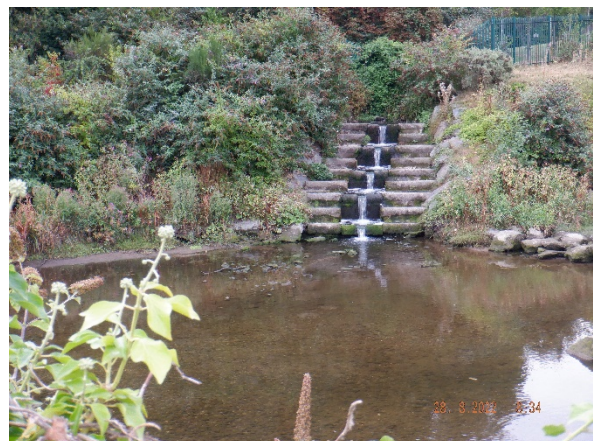


Plate 4-30: Weir the Swans confluence with the Dargle river.

4.3.2. Biological water quality

A kick sample for macroinvertebrates was taken at both Site 6 and Site 7. At **Site 6** The macroinvertebrate sample consisted of pollution tolerant species (Groups C -E). No sensitive species were present (Group A). One Group B taxon was present but as this was a single specimen it was not

counted toward the Q-value (the cased caddisfly, Limnephilidae). Species richness was very low with only 8 species present. Blackfly larvae (Simuliidae), non-biting midge larvae (Chironomidae) and the very pollution tolerant worm (Tubificidae) were the most common species making up the sample. The remaining species were present in very low numbers. A Q2-3 was assigned indicating Poor biological quality,

Further downstream conditions did not improve at **Site 7** before the Swan entered the Dargle. Here again the sample was characterised by pollution tolerant species (Groups C -E). No sensitive species were present (Group A or B). Species richness was still very low with only 9 species present. This time two (Group C) mayfly species, *Seretella ignita* and *Baetis rhodani/ atlanticus* as well as blackfly larvae (Simuliidae) were the most common species making up the sample. The remaining species were present in very low numbers. A Q3 again assigned indicating poor biological quality. While this is a slight improvement compared to Q2-3 assigned upstream the results indicates that the Swan River is in poor biological condition from the upper reaches all the way down to the Dargle. Please see **Appendix A** for full list of macroinvertebrates and abundances.

4.3.3. Fisheries habitat

A stepped weir is present where the Swan River enters the Dargle approximately 2-2.5m in height. This presents an immediate obstacle to fish species entering the Swan River. The weir has been designed with a series of drops with shallow flow over each step.

While some stronger swimming fish such as salmonids may be able to traverse this system to access upstream habitats there are; no deep pools between the steps to allow fish to rest in between leaps and access is only likely possible during certain flow conditions. It is considered a partial barrier to salmonids and a full barrier to weaker swimming fish such as lamprey. Lamprey cannot make leaps like salmon/trout and even a step as low as 10cm can be a barrier. This weir has a series of steps >10cm making the Swan inaccessible to migratory river lamprey. Other barriers to lamprey exist within the lower reaches with a 0.4cm drop at a culvert by Glenwood estate and a 0.25cm drop and the culvert under Herbert Road.

However, an isolated population of the non-migratory brook lamprey may be present within the Swan. This species does not migrate out to sea as adults spending their entire lifecycle within freshwater. The population though is a risk however given migration within the Swan River itself is confined due to the barriers that are present.

A European eel was present in the kick sample. Eel migrate as juveniles from the sea and into freshwaters and unlike lamprey have a far greater ability to navigate obstacles even traveling overland. The presence of eel indicates that this species can navigate the weir and are present within the lower reaches of the Swan.

Three-spined stickleback was present in the kick sample at **Site 6**, this small fish has the ability to survive in poor water quality. **Table 4-3** summarises the fisheries habitat rating assigned.

Table 4-3: Summary of fisheries habitat rating for the lower reaches of the Swan River.

Species	Fisheries Habitat Rating	Reasoning
Salmon/ sea trout / sea lamprey	Poor*	There is some habitat heterogeneity with riffle /glide /pool sequence. Some juvenile habitat with boulders, tree roots, overhanging trees. Sections with deep pools present. However moderate to heavy siltation degrades spawning substrate and poor biological quality is not ideal supporting condition particularly for salmon who require Q4 (Good) or above.

Species	Fisheries Rating	Habitat	Reasoning
			<p>The habitat is rated as Poor* here due to downstream barriers. The stepped weir at the Swan confluence with the Dargle is considered a full barrier for sea lamprey to even access the Swan. It is considered a partial barrier for salmon and sea trout.</p> <p>Given the water quality, degree of siltation and small size of the Swan River it is considered that the Swan is unlikely to support a large population of these species, however, should water quality conditions improve and barriers removed salmon or sea trout may spawn in the lower reaches in small numbers.</p>
Brown trout	Poor		<p>Good habitat heterogeneity with riffle /glide /pool sequence. Good juvenile habitat with boulders, tree roots, overhanging trees. Sections with deep pools present. However moderate siltation degrades spawning substrate and poor biological quality is not ideal supporting condition for these species, particularly salmon.</p> <p>Conditions favour trout which are slightly more tolerant of these conditions compared to salmon</p>
Lamprey (brook)	Moderate		<p>Slow backwatered silted sections for juvenile lamprey are present but infrequent. Sediments are at risk of destabilisation during high flows given the straightened nature of the channel. Spawning substrate available but moderate to heavy siltation degrades habitat.</p> <p>Water quality issues reduce habitat suitability for all life stages also.</p>
Lamprey (river)	Moderate* (if all barriers removed)		<p>Although there is habitat present which would support river lamprey, they would not be able to access the Swan due to a barrier at the Dargle confluence and also within the channel.</p>
European eel	Good		<p>Good habitats present with abundant refuges for juveniles and adults. Water quality requirements for European eel have not been set and poorly understood. European eels are in general found in most lowland rivers in Ireland.</p>

Table 4-4: General habitat characteristic for each site surveyed.

Site No.	Bank height (m)	Bank width (m)	Depth (m)	Substrate (%)	Substrate Siltation	Shading	River habitat (%)	Physico-chem	Q-value	Note
Site 1 Kilruddery estate (main channel)	1.5	1	Dry	n/a	n/a	Heavy	Dry	Dry	n/a	<ul style="list-style-type: none"> No water within the channel
Site 2 Kilruddery estate (side channel)	0.5	2	0.05-0.1	Cobble: 5 Coarse gravel: 5 Silt: 85	Heavy	Moderate	Glide: 100	DO: 82.2% / 8.36 mg/l Temp: 14.8°C Conductivity: 439µS/cm pH: 7.95	n/a	<ul style="list-style-type: none"> Three-spined stickleback
Site 3 Hollybrook estate	1-2	1	0.20	Coarse gravel: 10 Fine gravel: 10 Silt: 80	Heavy	Heavy	100% glide	DO: 77.5% / 7.80 mg/l Temp: 15.4°C Conductivity: 398µS/cm pH: 7.92	n/a	<ul style="list-style-type: none"> Litter abundant Soft sinking substrate Very slow to stagnant flow
Site 4 Giltspur brook	0.5-1	2	0.05 - 0.1	Boulder: 5 Cobble: 35 Coarse gravel: 25 Fine gravel: 20 Sand: 5 Silt: 10	Moderate	Light	Riffle: 39 Glide: 60 Pool: 1	DO: 65.9% / 6.66 mg/l Temp: 15.2°C Conductivity: 490µS/cm pH: 7.83	Q2-3	<ul style="list-style-type: none"> Grey squirrel 20% filamentous green algae Pipe discharging grey water Three-spine stickleback
Site 5 Germans Wood	0.5	2	0.25	Boulder: 5 Cobble: 35 Coarse gravel: 30 Fine gravel: 20 Sand: 5 Silt: 5	Moderate	Moderate	Riffle: 30 Glide: 50 Pool: 10	Not taken	n/a	<ul style="list-style-type: none"> Cherry laurel Pipe discharging slight grey water Natural debris dams Large weir
Site 6 Killarney Road	1-2	2	0.1 - 0.25	Boulder: 5 Cobble: 40 Coarse gravel: 30 Fine gravel: 10 Sand: 4 Silt: 6	Heavy - moderate	Moderate	Riffle: 25 Glide: 60 Pool: 15	DO: 83.9% / 8.38 mg/l Temp: 15.8°C Conductivity: 493µS/cm pH: 7.82	Q2-3	<ul style="list-style-type: none"> Freshwater sponges Three-spined stickleback

Site No.	Bank height (m)	Bank width (m)	Depth (m)	Substrate (%)	Substrate Siltation	Shading	River habitat (%)	Physico-chem	Q-value	Note
Site 7 Glenwood estate	1	1	0.20	Boulder: 20 Cobble: 30 Coarse gravel: 20 Fine gravel: 15 Sand: 5 Silt: 5	Moderate	Moderate - heavy	Riffle: 30 Glide: 40 Pool: 20	DO: 94.8% / 9.90 mg/l Temp: 13.8°C Conductivity: 605µS/cm pH: 8.24	Q3	<ul style="list-style-type: none"> • Freshwater sponges • European eel • Bullfinch • Jay

4.4. Third Schedule Invasive Species

Three invasive species listed on the Third Schedule were identified during the survey. These were Japanese knotweed (*Fallopia japonica*), rhododendron (*Rhododendron ponticum*) and American skunk cabbage (*Lysichiton americanus*). The first two species have been classed as having a risk of high impact in a risk assessment of invasives of Ireland (Kelly *et al.*, 2013). American skunk cabbage is classed as having a risk of medium impact.

Japanese knotweed was located off the main Killarney Road down a small laneway also called the Killarney Road (53.19678, -6.11597). It is currently a small infestation set back 15m from the river. Left unmanaged however, it has the potential to spread further. If it reaches the banks of the Swan the water provides an ideal method of transportation for this plant to invade habitats further downstream. The main risks associated with knotweed growing along stream banks is that it outcompetes native plants creating stands of a single species rather than a mixed riparian habitat. When the plant dies back in winter it leaves banks exposed and vulnerable to erosion introducing sediment into the river system.

Knotweed spreads easily when disturbed via fragmentation of rhizomes (underground modified stems) and should not be cut or trimmed as a control method. It should be treated using proper application of herbicides approved for use near water by a qualified user.



Plate 4-31: Pink circle highlights Japanese knotweed identified close to the Swan River. (image courtesy of google street view Aug 2022).

Rhododendron was present along the left bank of the Swan in Glenlucan estate, this consisted of two small specimens which looked to have been planted as part of landscaping. It can form very dense thickets and out-compete native plants for space and resources, especially for sunlight.

Rhododendron can also prevent access to sites by the sheer mass of plant material blocking paths and right of way.

The main mechanism of dispersal is that it spreads by layering and suckering. The fruits may also be eaten and dispersed by birds. Given the current small size of the plants and much lower risk of spread compared to Japanese knotweed, the plants can be easily removed or trimmed to ensure they do not overtake the existing vegetation present.

American skunk cabbage is a large plant and derives its name due to the foul smell the flowers emit to attract insects or when leaves are crushed. It is slow growing only forming flowers after three years. It favours damp wet areas in woodlands, stream-sides and pond margins and can form dense stands outcompeting native marginal plants. Its preference for wet soils means that the seed can easily be dispersed via waterbodies and like knotweed it can also disperse by fragmentation of its rhizomes.

One single plant was identified at Hollybrook estate (53.18328, -6.11052) while numerous plants were present further downstream in Germans Wood just upstream of the weir (53.19382, -6.11552).



Plate 4-32: American skunk cabbage in wet woodland area of Germans Wood.

The only Third Schedule animal species identified was the grey squirrel (*Sciurus carolinensis*) at Giltspur Brook. This species has become established in Ireland since their release in 1911 at Co. Longford. The presence of greys in Wicklow is well known and it unfortunately outcompetes the native red squirrel and can transmit squirrel pox virus which the reds have no immunity to. Red squirrels are still present around Bray and studies completed partly in Wicklow have noted that recovery of pine martin has led to a comeback in red squirrel populations (Sheehy & Lawton 2014).



Plate 4-33: Grey squirrel identified in Giltspur Brook.

Other non-native species identified include winter heliotrope (*Petasites pyrenaicus*), montbretia (*Crocsmia X crocosmiflora*), cotoneaster (*Cotoneaster spp.*), snowberry (*Symphoricarpos albus*) and butterfly bush (*Buddleja davidii*) but were not seen to have reached noxious levels.

Stands of cherry laurel (*Prunus laurocerasus*) are also present within sections of the woodland at German Woods. Although not a third schedule species this is a non-native invasive species with a risk of High impact in Ireland. When left unmanaged laurel will outcompete native tree species. Its fast growing and where gaps in the woodland exist laurel will replace native tree seedlings creating dense stands eventually replacing the native canopy. Few other species will grow under the laurel and it becomes the dominant species, this is due in part to the fact that laurel can deposit cyanide-based chemicals into the soil which inhibit other trees from growing. Its evergreen leaf cover also creates dense shade which further inhibits natural regeneration by other tree species. It is often planted as hedging around borders where its risk of impact is quite low however where it has escaped to woodlands such as Germans Wood it is important to control its spread.

4.5. Otter Survey

No signs of otter were identified at any site along the Swan River. There is good riparian habitat available for otter resting locations along the Swan in particular from Killarney Road up to the Germans Wood.

One reason for lack of otter signs may be due to the fact that otter are simply not able to access the Swan River from the Dargle. The Swan enters the Dargle via a large stepped weir, while the weir itself would not present a barrier to otter, the green palisade fencing spanning the top of the weir may be

a barrier. The fencing here was covered in dense scrub and the time of survey making it difficult to assess whether a gap that otter could fit through was present.

Other barriers to otter movement are present along the Swan also. Although otter are at home in water they generally prefer not to swim through deep or long dark culvert and use mammal ledges were provided or alternatively will travel up the bank and cross the road. None of the culverts present along the Swan contain mammal ledges. Finally, otter are blocked from accessing land any further north than German Woods by a pipe culvert with a trash screen and high walls. The poor water quality observed (Q3 and Q2-3) within the Swan may have also resulted in a poor fisheries resource for otter discouraging the species from the Swan.

4.6. River Birds

No kingfisher, dipper or grey wagtails were recorded at any site during the survey in August.

5. BIODIVERSITY MANAGEMENT FOR THE SWAN RIVER

The Swan River has been heavily modified from the upper reaches all the way downstream to where it enters the Dargle. Despite these artificial modifications the Swan does have large areas of important habitats supporting biodiversity. The river along with its associated treelines and woodlands form a wildlife corridor and refuge in an otherwise very urbanised environment. Although a small river there is potential for the Swan to be an important supporting habitat for many species.

It is clear however, there are water quality issues effecting the Swan River. Addressing this poor water quality lies at the core of any measures to improve biodiversity of the Swan River. Many species such as otter, dipper or lamprey require unpolluted waters. While habitats can be enhanced for these species the determining factor in whether these species will recover within the Swan is water quality.

The following section identifies a management plan for conserving, restoring and enhancing biodiversity of the Swan River. The plan has been developed based on the results of the survey work described in this report. In addition, it has also been developed to align with biodiversity policies and objectives identified within **Section 3.3**.

The plan is split into goals which can be achieved in the sort-term (1-3 years), medium term (3-5 years) and long-term (5+ years). In general, short-term goals can be implemented by individuals and small community groups and are relatively low cost. Medium to long-term goals require greater organisation of resources, planning and co-operation between various agencies and groups.

5.1. River Bird Nesting Box Scheme

Dippers and grey wagtails can be encouraged to the Swan by the placement of nesting boxes. These birds often nest in cavities under bridges and culverts (see **Plate 5-1**). The Swan is intersected many of these structures but they lack the cavities which dipper or grey wagtail can use to make a nest. Artificial nest boxes can be placed under these structures to encourage nesting.

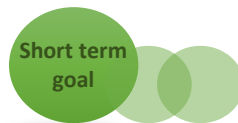


Plate 5-1: Example of a dipper nest under a bridge in the midlands. The dipper has used a cavity in the wall as a ledge to form the nest

The use of artificial boxes can be quite successful. In 2013 Wicklow County Council installed eleven nesting boxes as part of the Wicklow Bridges Project and eight of the eleven were occupied by dipper the same year. These boxes were made from recycled material from old car seats.

Nesting boxes can be purchased and are either made of wood or concrete, the latter being more expensive but longer lasting. The boxes are relatively simple and designs are available to make nesting boxes by hand and can be constructed by community groups or schools.

When using timber, it is important to use weatherproof wood (marine ply) or the boxes will not last more than a season. If the wood has been treated it should be ensured that non-toxic preservatives were used. **Figure 5-1** below shows an example of designs for a wooden box which are available in the report conducted for the Wicklow Bridges Project (Copland 2012) [https://dxqn7p4scykc.cloudfront.net/wp-content/uploads/sites/20/cms/w/Wicklow Dippers Report 2012.pdf](https://dxqn7p4scykc.cloudfront.net/wp-content/uploads/sites/20/cms/w/Wicklow_Dippers_Report_2012.pdf).

Boxes should be installed by an ecologist to ensure they are placed in the correct location. Monitoring of the boxes is important to track their success. During the breeding season it is vital that nesting birds are not disturbed as human interference may cause birds to abandon nest. Success can be tracked at the end of the breeding season by checking the boxes for nesting material and information submitted to NBDC.

ANNEX II: Design of Dipper nest box and Dipper platform

Two designs for providing nesting sites for Dipper are illustrated below. Both designs can be made from exterior grade (marine) plywood or from timber planks 225mm (9") wide and 25mm (1") thick (if timber is used, it should be treated with a non-toxic wood preservative (such as *Sadolin*)).

Artificial nest sites should be located above running water, and high enough above the water so that there is no risk of it getting washed away by high river levels. Such sites will often be used during winter by roosting birds, so winter water level should also be a consideration. They should also be positioned away from ledges where predators, such as Otter, Mink or Rat cannot get access to the nest.

Both designs require sturdy fixings to the structure of the bridge. In all cases, positioning should be carefully considered so as not to damage the bridge structure. Holes in brackets or back-boards should be lined up with appropriate fixing points on the bridge (such as gaps in stonework with solid, stable mortar) and fixed in place using screws with masonry plugs before attaching them to the box/platform.

1: Nest Box

This open-fronted nestbox (Fig 1) can be used where there is no cover above the proposed site (e.g. on the outside of a bridge parapet or where the bridge deck may be open). For ease of fitting, a back can be added to the box, made from a sheet of plywood or hardboard, or small metal brackets can be positioned as appropriate. A lip, no more than 50mm (2") high, can be added to the front of the box.

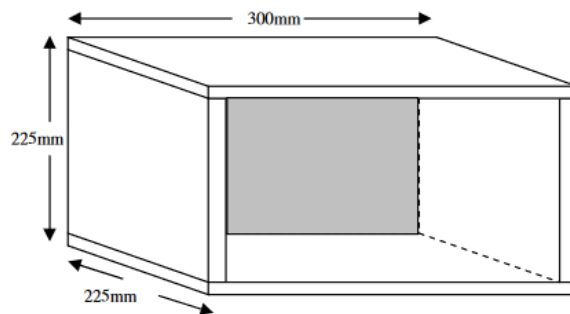


Figure 1: Dipper nesting box

2: Nest Platform

The platform (Fig 2) is designed for use under bridges where it will be sheltered from the weather. Its shape allows it to be fitted to vertical pillars or abutments, the underside of horizontal spans, or anywhere along the curves of an arch (Fig 3). The boards should all be the same shape and size. Depending upon the location, fixing can either be with a timber backboard (as illustrated) or with metal brackets (also illustrated – dotted lines). Similarly, the addition of brackets may be needed to support the boards depending upon position of fixing.

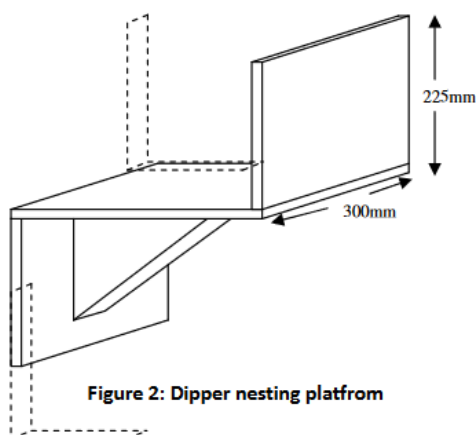


Figure 2: Dipper nesting platform

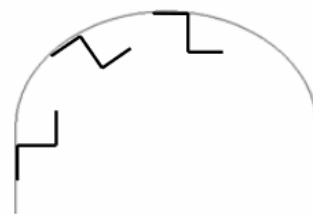


Figure 3: Siting of platforms under arch

Figure 5-1: Designs for two types of nesting boxes that dipper or grey wagtail will use (Copland 2012).

5.2. Signage

It can be the residents and community groups who know and understand the river best. They are often the first to notice signs of pollution or on a positive note an interesting new species.



Short term goal

The Swan River is suffering from poor water quality and its largely hidden nature has unfortunately led to an “out of sight, out of mind” attitude for many. Small pollution incidents can go unnoticed and unreported. Installing signage can be a first step highlighting the rivers presence and biodiversity potential.

1. Permanent signs can be installed on the major bridges that the Swan flows under (Herbert Road, Boghall Road, Killarney Road) and within the Peoples Park opposite the confluence with the Dargle. The signage would name the river and give a short text about biodiversity that can be seen at that location and/or the text can be developed with the assistance of local historian to display the historic information about the river.

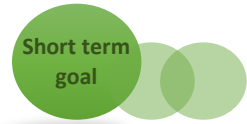


Plate 5-2: A local resident looking over the Killarney Road bridge at the Swan River below (photo taken with permission).

2. The Swan flows through many housing estates and there are opportunities here to install permanent biodiversity signage. For example, biodiversity signage at the woodland in Hollybrook identifying the types of trees that are present. Along Giltspur Brook or Wheatfield signage can be erected highlighting the aquatic insects identified within this report that live in the water. Importantly contact information for how to report pollution incidents should also be given on the signage. The information and images displayed on the signage should be developed with an ecologist to ensure accuracy.

5.3. Low Mow Areas

Long strips of amenity grassland are present along both banks of the Swan though Wheatfield and Giltspur Brook. These areas can be managed to encourage the growth of a more diverse range of grasses and wildflowers. These additional species would help support important pollinators such as bees, butterflies, hoverflies etc. Sections (5-8m width) of this grass running parallel with the river can be marked off for low-mow or wildflower meadow areas. The creation of low mow areas will work in tandem with Citizen Science measure in **Section 5.5** below.



Increasing plant diversity can be simply achieved by reducing the mowing regime to once in autumn (mid-September). At first this area will mostly be grass but it will consist of lots of species of grass with varying colour and height. Insects and birds will also still be attracted. While grass will dominate there will be some flowers too in the first year. The structure of the meadow will fluctuate over the years which makes it an interesting feature to watch change. With careful management more wildflowers will naturally colonise and a particular species may do well in one year and not the next. It will never be the same from one year to the next.

1. Mark off the area and **signage** should be erected so landscape managers are aware of the designated area and locals are informed of the reasons.
2. The front edge can be mown a little bit shorter to create a kind of **border** for aesthetics. In addition, small paths can be mown into the area to create little pathways.
3. The meadow will need to be **mown in autumn** after everything has had a chance to go to seed (around mid-September). The **cuttings need to be removed** and can be used for compost. This



Plate 5-3: Example of a low mow area and biodiversity signage. (image reproduced from NBDC website)

- is an important step as nutrients need to be removed, wildflowers need **low soil fertility** to thrive. If possible, rake the area to expose some soil for new seedlings.
4. The following year it may need a **cut in early spring** (end march) if there has been a lot of winter grass growth. Again, the cuttings should be removed.
5. Finally, to help reduce the grass and encourage wildflowers, **yellow rattle** can be sown. This is referred to as 'the Meadow Maker'. It is a hemiparasite meaning it will weaken the grass limiting its growth. This gives the wildflowers a chance to move in. Sow between September and November after the autumn cut about 0.5g - 1.5g per square meter. The grass should be cut back to 3-6cm in height and removed and raked to expose bare earth. Pinches of the yellow rattle seed are then dropped onto the exposed earth and pressed into the soil.

A full report detailing additional actions that local communities can take to create pollinator friendly habitats can be found on NBDC website https://pollinators.ie/wp-content/uploads/2021/08/Local-Communities_actions-to-help-pollinators-July-2021-WEB-JB.pdf

5.4. Invasive Species Management

Three invasive plant species listed as Third Schedule were identified during the survey, rhododendron, Japanese knotweed and American skunk cabbage. In addition, cherry laurel although not a third schedule species is a concern within Germans Wood.



The general approaches to treatment for each species are discussed below. Please note that the following applies to any invasive species management.

- Any treatment of invasive species must be undertaken by a suitably qualified invasive species specialist with appropriate training in herbicide use and following S.I. No. 438/2019 - European Communities (Sustainable Use of Pesticides) (Amendment) Regulations 2019.
- Any chemicals used must be DAFM approved herbicides and approved for use near water.
- Invasive species identified growing on public roads and footpaths should be reported to Wicklow County Council roadtrans@wicklowcoco.ie.

Rhododendron

The rhododendron plants identified are currently very small and given their location are not immediately concerning. They can be easily managed by **removing completely**. If the plants have grown too big to fully dig out then it should be cut to the stump and **chemical treatment** applied to the stump. This is done either by applying directly to the cut surface as soon as possible or stumps are drilled and the herbicide is applied to the drilled hole.

Japanese knotweed

The knotweed is located along the laneway of Killarney Road. It is unclear whether this section of land is actually private or part of the public roadway. **Signage** should be placed in-front of the stand indicating that disturbance and cutting should be avoided.

The knotweed should **not be cut or dug**. This is an ineffective method resulting in more vigorous growth the next year and rhizomes can be easily spread. Any cut material cannot be removed from the site unless it is by a licenced invasive species specialist. Therefore, the best method of treatment would be the use of herbicide using a **foliar spray** or **targeted stem injection** method.

While growth may be less vigorous after the first treatment, annual treatment of the knotweed infestation is required until no new growth is visible. **Treatment can last up to five years** and during this time the area should be **inspected annually** to monitor the control and ensure that the infestation has not spread.

American skunk cabbage

Hand digging of small plants has been shown to be successful where there are small infestations (Rotteveel, 2007) however the entire root system and rhizomes must be removed. This becomes difficult for larger plants which are deep rooted. Partial removal reportedly leads to vegetative reproduction and a high level of regeneration (Fuchs *et al.*, 2003). In addition, cut material cannot be removed from site unless by a licenced professional. **Chemical treatment** may be required in this location as plants identified looked to be well established. Any treatment using herbicide must be conducted by a professional with the appropriate training and approval to use herbicides. This is particularly important for the eradication of American skunk cabbage as it is growing directly along the margins of the river.

The plant produces a large seed bank which can be viable for 8 years and therefore **repeated treatment is required** until no new growth is visible.

Cherry laurel

Cherry laurel can be effectively managed using a combination of **cutting and chemical treatment** of stumps. This methodology involves the stems being cut as close to the ground as possible, but not so close that the stump is no longer visible. Herbicide is then applied directly to the cut surface as soon as possible after cutting. Delaying the application will reduce the effectiveness of the treatment. Alternatively, the stumps are drilled and the herbicide is applied to the drilled hole.

5.5. Citizen Science Initiatives

Citizen Science is research carried out by members of the public who volunteer to collect scientific data. These initiatives are aimed at engaging individuals or community groups in understanding and recording local biodiversity.

Continuous monitoring can help track changes whether this may be negative (such as water pollution) or positive (recording a new species for the area).



5.5.1. Butterfly recording schemes

The Irish Butterfly Monitoring Scheme is run by the National Biodiversity Data Centre. It tracks the population status of Ireland's widespread butterfly species based on a network of fixed routes (transects) established and walked by volunteer recorders. Each transect is walked on a weekly basis from 1st April to 31st September each year generating very detailed information on butterflies. The Irish Butterfly Monitoring Scheme is one of the monitoring schemes from 22 countries across Europe that contribute to the European Butterfly Monitoring Scheme.

A butterfly monitoring transect can be set up along the Swan River from the Boghall road through Wheatfield and Giltspur. This would work in tandem with the establishment of the low mow areas as recorders can track new species as a result of the additional pollinating plants. Online course and identification poster is available via NBDC <https://biodiversityireland.ie/surveys/butterfly-monitoring-scheme/>

Recording does not need to be limited to butterflies and records of other insects like moths, hoverflies can all be collected and submitted to NBDC.



Figure 5-2: Example of a butterflies of Ireland poster which is available to download for free from the NBDC.

5.5.2. Citizen Science Stream Index

The Citizen Science Stream Index (CSSI) is a newly developed index which can be used to monitor water quality with the Swan River. While there are other more accurate indices used in Ireland such as the Q-value or Small Stream Risk Score (SSRS) these involve a more in-depth knowledge of river systems and identification skills. The CSSI has been developed as an index that is accessible to beginners. It can be used to help track water quality changes or trends but also to increase awareness in the biodiversity that lives within the Swan River.

The CSSI is based on the presence or absence of six key aquatic invertebrates. Three pollution-sensitive invertebrates ('good guys') are commonly found in clean streams and three pollution-tolerant invertebrates ('bad guys') are commonly found in polluted streams (see **Figure 5-3**). The sampling methodology and scoring system can be easily taught at workshops.

The sampler uses a pond or kick net to take three 30-second kick-samples (the three samples should be a few metres apart) from a shallow (<20cm), gravelly, fast-flowing part of the stream. The invertebrates captured in each sample are examined in a white tray on the bankside. The six key invertebrates are easily spotted amongst the many other species in the tray, by their characteristic shape, colour or movement. The citizen will score each sample depending on which, if any, of the six key invertebrates occur in the tray. The three 'good guys' have a score of +1 each and the three 'bad guys' have a score of -1 each.




The score for each kick-sample can range from +3 (all three good guys and no bad guys) to -3 (all three bad guys and no good guys). When the scores from all three samples are added together, the CSSI ranges from +9 to -9. A traffic light system is used to rate the water quality.

Poor = CSSI score of -9 to -5

Moderate = CSSI score of -4 to +4

Good = CSSI score +5 to +9


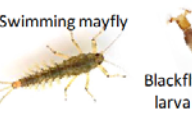


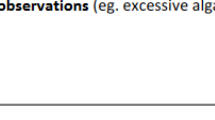
The 'good guys'







 <p>Stonefly 2 thin filamentous tails at end of abdomen</p>	 <p>Flattened mayfly 3 thin filamentous tails, wide head with large eyes on top and flattened body</p>	 <p>Green caddisfly Green caterpillar-like larva. Gills along abdomen give it a 'spiky' appearance</p>
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The 'bad guys'

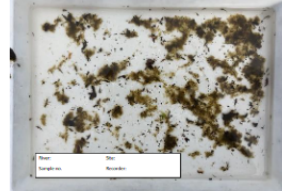
 <p>Leech Suckers at both ends & moves by stretching out body</p>	 <p>Snail Hard pointed or coiled shell covering body</p>	 <p>Waterlouse Looks like a woodlouse, crawls slowly along bottom</p>
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These invertebrates are found in most streams and are NOT scored for the CSSI

 <p>Freshwater shrimp</p>	 <p>Swimming mayfly</p>	 <p>Blackfly larva</p>	 <p>Brown caddisfly</p>	 <p>Pink caddisfly</p>
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	Sample 1	Sample 2	Sample 3
Stonefly (+1)		<input type="text"/>	<input type="text"/>
Flattened mayfly (+1)		<input type="text"/>	<input type="text"/>
Green caddisfly (+1)		<input type="text"/>	<input type="text"/>
Snail (-1)		<input type="text"/>	<input type="text"/>
Leech (-1)		<input type="text"/>	<input type="text"/>
Waterlouse (-1)		<input type="text"/>	<input type="text"/>
	Sum of scores 1	Sum of scores 2	Sum of scores 3
	<input type="text"/>	<input type="text"/>	<input type="text"/>

Citizens should also take a good, clear photo of one of the 3 samples, including a label in the tray, with information on the date, stream name, location and recorder.




CSSI Scores can be a 'traffic light' for water quality

CSSI score -9 to -5
Poor

CSSI Score -4 to +4
Moderate

CSSI Score +5 to +9
Good



Total score for the 3 samples = CSSI Score

Any observations (eg. excessive algae or fine sediment, cattle access nearby, surface foam, presence of trout/salmon etc):

Figure 5-3: Macroinvertebrates used in the CSSI and methodology for calculation of the score.

5.6. Addressing barrier to wildlife movement



5.6.1. Fish

There are a number of partial or complete barriers to the movement of fish within the Swan River. Of note is the stepped weir at the confluence of the Swan with the Dargle. This is impassable for migratory river lamprey and a partial barrier to salmonids.

The culvert at Herbert Road has a drop which is likely impassable for lamprey. The next large structure is the weir in old court which is a barrier for all fish species. Further upstream is the pipe culvert between German Woods and Giltspur. This is undersized with rubbish and debris blocking the entrance.

Remediation is required to allow migratory species such as salmon, river lamprey and sea trout to access to the Swan. In addition, the barriers prevent the movement of resident fish populations creating genetically isolated populations. These populations are also at risk from pollution events as the ability to re-populate is very limited.

Current water quality has significantly impaired the quality of fisheries habitat. While the removal of barriers is a positive step in opening up more habitat, sensitive fish species are unlikely to return until significant water quality improvements are made.

Any remediation works should be made in consultation with Inland Fisheries Ireland and other relevant authorities. The appropriate planning process should be adhered to following relevant guidance and legislation.

5.6.2. Mammal

The Swan River is an important wildlife corridor that could be used by mammals such as otter, badger, fox and hedgehog to move between habitats. The culverts and bridges however lack mammal ledges preventing movement. This either isolates species in small areas which may not be able to sustain a growing population or forces them to cross the road which brings its own associated dangers. One exception is a pipeline running along the side of the Killarney Road bridge which may be used as a makeshift ledge but is not ideal.

Mammal ledges can be introduced in the culverts and bridges to allow connectivity up and down the river. Of note is the pipe culvert and high wall between Germans Wood and Giltspur housing estate which isolates the two sections completely. Small gaps can be introduced to the wall to allow smaller mammals to move between habitats.

5.7. River Habitat



The Swan has been straightened throughout its entire length which has led to uniform flow and depth. Complex habitat with pools, riffles and glides is largely lacking due to the straightened nature of the channel.

Reprofiling the banks of this river to introduce a more sinuous profile is difficult given the river flows through heavily urbanised areas. However, increasing substrate roughness will create more natural channel characteristics with varied habitats such as riffle, glides and pools as well as the slow silty margins that are important for lamprey larvae. This will create habitat for a more diverse range of species such as macroinvertebrates which in turn support other species within the food web.

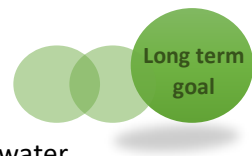
Any remediation works should be made in consultation with Inland Fisheries Ireland and other relevant authorities. The appropriate planning process should be adhered to following relevant guidance and legislation.

It is noted also that the Bray Municipal District Plan supports the development of the Swan River Greenway. Any development along a river must ensure the protection of water quality and the riparian habitats. In addition, ecological corridors and connectivity supporting the biodiversity of the Swan should not be severed.

Inland Fisheries Ireland have produced guidance document on planning for watercourses in the urban environment. This guidance has been developed to allow the protection of riparian zones and floodplains and should lie at the core of the development of a greenway.

The recommended buffer zone width for larger river channels (>10m) is 35m to 60m and for smaller channels (<10m) such as the Swan is 20m or greater. It is important that the buffer zone is wide enough to protect the ecological integrity of the river. Given the proposed greenway development it would be important to allow areas along the bank that remain secluded and free from disturbance for wildlife.

5.8. Addressing Water Quality



It is clear that the Swan is suffering from poor water quality and a number of point sources where observed discharging “grey water”. An improvement in water quality is required for this river. While this is the last goal within the biodiversity plan it is by no means an insignificant one. In fact, it is considered the most vital action that should be undertaken for the Swan River.

The WFD target for the Dargle_040 waterbody is to achieve at least good status. The biological quality of the Swan which is part of this waterbody is not achieving this.

In addition, the Swan will be part of the Dargle_040 Area for Action and will become part of an areas proposed for more focused actions in the 3rd cycle of the WFD which will be led by LAWPRO.

The sources of contamination need to be investigated and remediated. This can be done by using a combination of river walks to identify any outfalls or diffuse inputs combined with water chemistry and biological sampling. Discussion should also be had with Wicklow County Council/EPA/LAWPRO/Irish Water or any other authority which may have water quality data and knowledge of issues within these rivers to fully understand actions required to improve water quality

The task of improving water quality within the Swan may be difficult but it is achievable. It requires the interest and motivation of the local community to help drive effective investment and water quality management of the Swan.

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APPENDIX A MACROINVERTEBRATE SPECIES LIST

Table A-1: List of macroinvertebrates identified at Site 2 -Kilruddery Estate (side channel).

Site name	Macroinvertebrate	Abundance	Group	Pollution tolerance	Q-value
Site 2 – Kilruddery Estate (side channel)	Chironomidae	Common	C	Tolerant	Q2-3
	<i>Gammarus</i> sp.	Common	C	Tolerant	
	<i>Asellus aquaticus</i>	Common	D	Very tolerant	
	Ceratopogonidae	Few	C	Tolerant	
	<i>Hydracarina</i> sp.	Few	C	Tolerant	
	<i>Dicranota</i> sp.	Few	C	Tolerant	
	Tubificids	Few	E	Most tolerant	
	<i>Sericostoma personatum</i>	Single	B	Less sensitive	

Table A-2: List of macroinvertebrates identified at Site 4 -Giltspur Brook Estate.

Site name	Macroinvertebrate	Abundance	Group	Pollution tolerance	Q-value
Site 4 – Giltspur Brook Estate	<i>Erpobdella octoculata</i>	Common	D	Very tolerant	Q2-3
	Chironomidae	Few	C	Tolerant	
	<i>Gammarus</i> sp.	Few	C	Tolerant	
	Simuliidae	Few	C	Tolerant	
	Lumbricidae	Few	C	Tolerant	
	<i>Asellus aquaticus</i>	Few	D	Very tolerant	
	<i>Radix balthica</i>	Single	D	Very tolerant	

Table A-3: List of macroinvertebrates identified at Site 6 – Killarney Road.

Site name	Macroinvertebrate	Abundance	Group	Pollution tolerance	Q-value
Site 6 – Killarney Road	Chironomidae	Common	C	Tolerant	Q2-3
	Simuliidae	Common	C	Tolerant	
	Tubificids	Common	E	Most tolerant	
	<i>Baetis rhodani/atlanticus</i>	Few	C	Tolerant	
	Plantyhelminthes	Few	C	Tolerant	
	Ceratopogonidae	Few	C	Tolerant	
	<i>Asellus aquaticus</i>	Few	D	Very tolerant	
	Enchytraeidae	Few	D	Very tolerant	
	Limnephillidae	Single	B	Less sensitive	

Table A-4: List of macroinvertebrates identified at Site 7 – Glenwood Estate.

Site name	Macroinvertebrate	Abundance	Group	Pollution tolerance	Q-value
Site 7 – Glenwood Estate	<i>Serratella ignita</i>	Common	C	Tolerant	Q3
	<i>Baetis rhodani/atlanticus</i>	Common	C	Tolerant	
	Simuliidae	Common	C	Tolerant	
	<i>Gammarus</i> sp.	Few	C	Tolerant	
	Lumbricidae	Few	C	Tolerant	
	Plantyhelminthes	Few	C	Tolerant	
	<i>Asellus aquaticus</i>	Few	D	Very tolerant	
	<i>Erpobdella octoculata</i>	Few	D	Very tolerant	
	Tubificids	Common	E	Most tolerant	