THIS PROJECT WAS FUNDED BY:

ECOLOGICAL STUDY OF THE DELVIN RIVER

EXECUTIVE SUMMARY

FOR: HANS VISSER, BIODIVERSITY OFFICER
FINGAL COUNTY COUNCIL

BY: FLYNN, FURNEY ENVIRONMENTAL CONSULTANTS

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1. Introduction

The following report summarises the findings of a detailed ecological assessment of the Delvin River carried out by Flynn, Furney Environmental Consultants on behalf of Fingal County Council's Parks Division.

The purpose of this study was to gather key information on the status of the river in terms of its ecology and hydromorphology. This data was to be used to draw up an overall picture of river quality and also to draw up a list of actions for the maintenance, improvement and protection of this watercourse.

Thus, the main aims of this survey may be summarised as to:

- Establish ecological baseline conditions for future monitoring purposes
- Prepare a list of actions that will protect and improve the river habitat of the Delvin River.

In order to achieve this, a number of objectives were established for this survey. These are summarised below.

- To carry out a detailed study Delvin River channel, recording key aspects of its shape, overall channel structure, flow patterns, vegetation and habitat quality. This would also include a survey of damaging or potentially damaging features or activities such as pollution sources, abstraction or bank erosion.

- To draw up a detailed list of actions that might be taken to address any of the features or activities as described above and produce an ordered ranking of these in terms of their urgency or necessity in terms of river and fisheries quality.

- To establish three monitoring sites within the river corridor. The purpose of this being to assess key ecological information at these sites and to use this as reference material for future works on the river.

- To undertake a detailed ecological assessment at each of these sites, including (where possible) a range of living indicator species. These were macro-invertebrates such as water insects, crustaceans and worms, vegetation, other organisms living on or in the water such as diatomic algae and also the overall character of the river corridor at these sites.

- To carry out a review of existing water quality data that has been gathered on the river by bodies such as the Environmental Protection Agency (EPA) and local authorities and to report on this in terms of river status.

- To record on sightings of or evidence thereof, and habitat of protected characteristic river species such as otters, dippers and kingfishers. All of these are animals that give an indication of the status and health of the river.

- To report on a detailed assessment of bat habitats along the river which focussed on eleven of the Delvin's bridges.

2. Project Context and Background

This study is planned to serve as a pilot scheme on ecological studies on rivers in the county of Fingal. Based upon this, other rivers within the county may be similarly assessed and included in the Fingal Biodiversity Plan.

The study also addresses the responsibility of the local authority and region in terms of current EU water policy and legislation. In particular in relation to a directive commonly known as the *Water Framework Directive*. This directive set a framework for comprehensive management of water resources in the European Community, within a common approach and with common objectives, principles and basic measures. The fundamental objective of the Water Framework Directive (WFD) aims at maintaining "high status" of waters where it exists, preventing any deterioration in the existing status of waters and achieving at least "good status" in relation to all waters by 2015. The Water Framework Directive (2000) represented a major shift in thinking about the way in which European waterbodies are managed. Ecological status replaced more traditional concepts such as pollutant concentrations as the primary criterion by which these waterbodies are assessed. The WFD defines 'ecological status' as: *an expression of the quality of the structure and functioning of aquatic ecosystems associated with surface waters*[1]. The WFD employs methods and criteria that are very much derived from the use of living things or 'biota' as indicators of the quality of waterbodies such as the Delvin. These 'biotic indicators' may be sampled and after analysis, compared with the biota of previously studied waterbodies that are free, to a known extent, of anthropogenic influences and associated impacts. These are 'reference' sites and the data gathered from these are used as a 'living yardstick' against which to compare future studies of the ecological status of rivers such as the Delvin.

A rigorous programme of sampling and analysis was carried out in Ireland between 2002 and 2004[2]. This examined the plant and animal species of over fifty rivers of known high status to produce a detailed description of the biota of watercourses over a range of geological conditions (their bedrock and 'hardness') and slope. This is known as a 'typology' and the Delvin River is described as river of *Type 32* within this. The range and type of living things found in this type of river were used in this present survey to compare the ecological status of the Delvin.

3. Project Actions and Results

The project works may be summarised in six main sections. These were:

1. Walkover Survey: A walkover survey of the entire river corridor
2. River Habitat Assessment: An assessment of river corridor habitats over 10 no. 0.5km stretches
3. Water Quality Review: A review of water quality data
4. Ecological Assessment: A detailed ecological assessment undertaken at the three reference sites.
5. Fisheries assessment: An assessment of fisheries quality of the river corridor

[1] European Union (2000) Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. *Official Journal of the European Communities,* **L327,** 1-73

[2] Kelly-Quinn, M., Bradley, C., Rippey, B. and Harrington, T. (2005) *Water Framework Directive Characterisation of Reference Conditions and Testing of Typology of Rivers*, EPA ERTDI Report Series No. 31

6. Bat Habitats: An assessment of bat habitats, focussing on 11 of the Delvin Bridges

The outcomes of these are summarised below:

3.1 The Walkover Survey.

This was a complete study of the entire river channel, the surveyors walking from source to sea. Using methodology from established survey guides from the UK (e.g. Joint Nature Conservation Committee, the Royal Society for the Protection of Birds) the survey recorded key information on channel character, water quality, types of riverbed, available habitat and vegetation types. The survey also recorded land use either side of the river, channel modifications, damaging activities and possible pollution sources.

For the purposes of reporting these findings, the surveyors divided the river into eight sections or 'reaches'. These sections were assigned on the basis of the overall character of the river and habitat quality. However, the presence or extent of river modification was the key determinant in this, having a great impact on all other factors. These reaches are briefly described below.

Reach 1 extends from the source of the river in the townland of Pluckhimin North to Glebe East. The section is dominated by modifications which included channel straightening and widening, some of these works dating back to the late 19th Century. More modern drainage works were also seen and these have led to severe habitat loss for much of the reach.

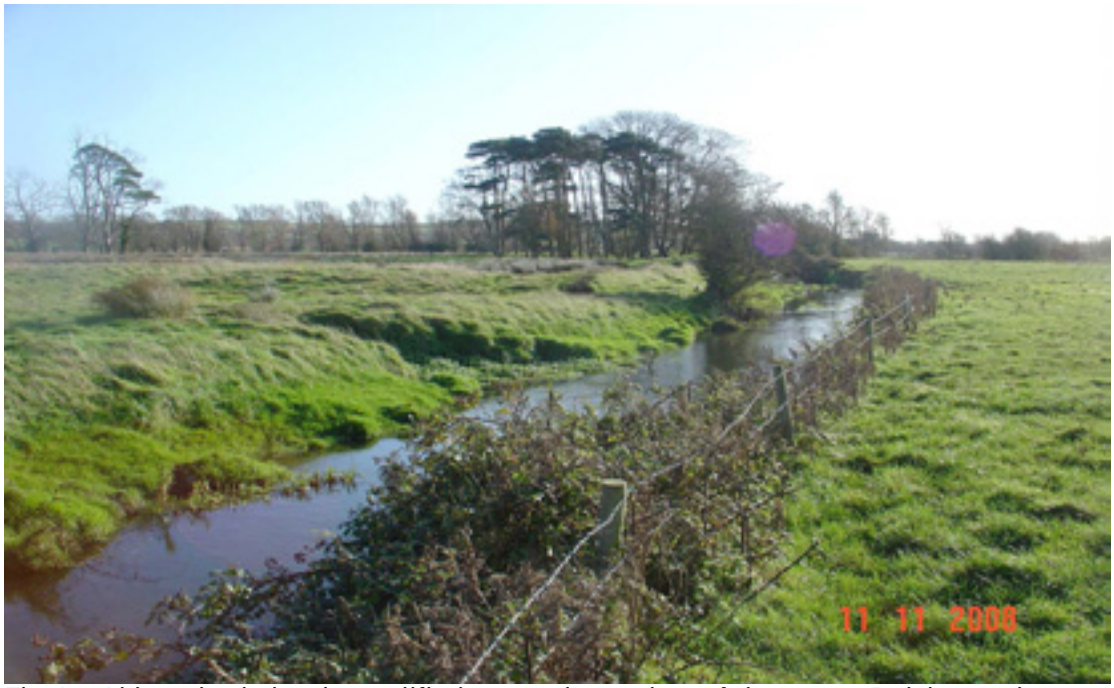

Fig 1. Although obviously modified, several stretches of the upper Delvin reaches are beginning to naturalise.

Reach 2, from Glebe East to Naul North showed a change in riverbed type and a more naturalised state of river is developing. The surrounding lands show a more diverse environment which included an active floodplain and natural channel features were also recorded. However, major damage took place during the start of the survey in the form of dredging and straightening for drainage purposes. This was seen to directly impact upon a significant part of the section and have a number of 'knock-on' effects such as sedimentation and flow rate increases downstream.

Reach 3 runs between two of the most significant features of the Delvin, both are waterfalls of over 10m in height. One of these is natural, occurring at a geological fault line and is located just north of Naul. This fall effectively isolates the river upstream as no river animals would be able to migrate past it. Water is abstracted for local use here and a water treatment works discharges downstream of this. A second waterfall, this manmade, is found at the end of this reach. A hydroelectric unit has been located here. This waterfall would also have a significant barrier effect on an albeit short stretch of river upstream .

Reach 4 extends from Naul (north) to Reynoldstown East. Within this reach the most significant manmade feature is Conley's Quarry and its associated tipping areas. The works pose a real and immediate risk to the river from siltation and sedimentation. These could have long-term impacts at this site and for much of the river downstream. However, the river channel does have a diversity of instream habitats and includes a wooded valley with a mixture of indigenous species.

Reach 5 from Reynoldstown to south of Stamullin was seen to have the highest ecological value of any of the river corridor. This is due in the main to the unmodified nature of the section, the range of habitats present and the extent of naturalisation that has occurred. However, the lack of characteristic species including fish species such as trout indicated poor water quality.

Fig 2: Riffles with a diversity of cobbles and gravels are present throughout the Reach 5 and provide an excellent environment for invertebrates, plants and spawning medium for salmonids and other indigenous fish species.

Reach 6 passes Stamullin and the most populated part of the river corridor. River modifications were apparent here but the stream maintains some of it natural characteristics. A form of buffer zone protects part of the river here from the effects often found within urbanised areas. A sluice and weir device was noted here. An area upstream of the village is used for 'paintball' events and has resulted in some bank erosion.

Reach 7 extends from north of Stamullin at the M1 overbridge as far as Gormanston Bridge. The upper part of this reach is surrounded by land which is grazed by cattle. There was much evidence of damage by stock to the banks due to poor fencing. This was seen to impact on the bed and downstream. As the river passes through Gormanston College, more modification such as straightening and realignment may be seen. However, the river retains much of its natural character here inside the channel and on its bed. Some impact from the

recreational (sporting) activities of the college can be seen on the banks here but these would not have significantly negative impacts and could be readily addressed.

Reach 8 is the final section described and extends from Gormanston Bridge to the sea at Knocknagin. Although a degree of modification in the form of river reinforcement was seen, there were a range of habitats recorded and a high degree of naturalisation on the banks and margins. Some of this vegetation forms a semi-natural 'buffer-zone' that is valuable in protecting the river here. Suitable riverbed habitat for salmonid species such as trout and seatrout were also noted. There is a small weir at Knocknagin that marks the tidal zone of the river.

Part of the survey brief required the recording of any characteristic animal species of the river corridor. This included the otter, Ireland's largest carnivore and very widespread on Ireland's rivers and the birds kingfisher, grey wagtail and dipper. Although suitable habitat exists for all of these bird species, dippers were only seen twice and the kingfisher was observed only once. Considering that a c 20km river corridor was intensively studied, this number of sightings is very low. This may be due in part to the extent of bank modifications that have occurred, as all of these bird species depend on a certain quality of bank habitat. The lack of prey species such as freshwater insects and fish would also appear to be a factor in the absence of these animals. The lower reaches of the Delvin would probably provide habitat for the otter a highly protected species in Europe. However, no otters or signs of otter activity were observed. It is unlikely that the upper reaches of the Delvin above Naul could support otter populations.

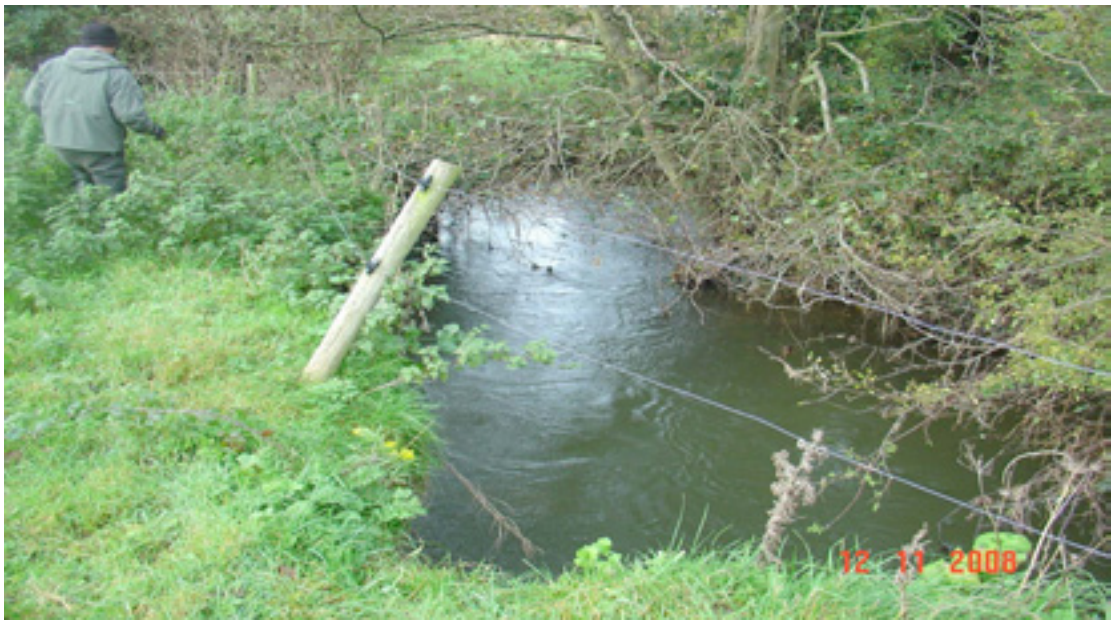

Fig 3. Poorly placed fencing can result in serious damage to river banks

3.2 River Habitat Assessment

This was a detailed study of ten half-kilometre lengths of the river. This was carried out using an established survey system (the River Habitat Survey, or RHS) from the UK's Environment Agency[3]. In this system, every stretch is studied in detail ten times, recording key information on channel shape, vegetation, land-use and modification. A ranking and scoring system can then be applied to each stretch.

The outcomes of this survey are summarised below.

[3] Environment Agency (2003) *River Habitat Study in Britain and Ireland: Field Survey Guidance Manual 2003*. Environment Agency, HMSO, London.

Modifications to the riverbanks such as resectioning and straightening was found in the majority of the 10 lengths studied. Man-made materials were used in bank works on 40% of the areas under survey. Damage from livestock was not seen to be widespread on the river. The vast majority of the river corridor was surrounded by agricultural lands which are under grazing (for beef or dairy cows) or tillage such as barley. Some amounts of native and mixed woodland were noted and coniferous forestry was not seen to be significant in terms of river habitat quality.

Natural flow characteristics were noted over much of the river. Flow patterns were seen to be influenced by instream works such as dredging and overdeepening. Instream vegetation could not be observed due to lack of visibility and high water levels for most of the sections. Features such as vegetated side-bars of the stream were common in the middle reaches of the river. All of the sections studied had substrate that could not be seen due to the water levels or access difficulties. However, substrate materials suitable for a range of species including insects and fish was judged to be present over most of the sections. Silt and sand deposits were most extensive at Commons Lower in the upper reaches of the river.

Just under half of the river corridor was seen to have poor tree coverage on one or both banks. Semi-continuous treelines were recorded at half of the sites under study. Shading of the channel occurred at all sites but this was only deemed to be excessive at one location.

The results of this survey were collated and analysed using standard methodology given by the RHS system. In this, the various sites under study can be assessed using derived indices which rate the degree of modification of each site and the quality of the habitats at each. These are the Habitat Modification Index (HMI) and Habitat Quality Assessment (HQA). The tables below show the significance of these in terms of site description.

The Habitat Modification Index (HMI)

Descriptive category of channel	HMI Class
Pristine	1
Semi-natural	1
Predominantly unmodified	2
Obviously modified	3
Significantly modified	4
Severely modified	5

Habitat Quality Assessment (HQA).

HQA score category	HQA Class	Description
0 – 20%	5	Very Poor
20-40%	4	Poor
40-60%	3	Fair
60-80%	2	High
80-100%	1	Very High

By applying these indices to each of the ten sites under study, the habitat assessment of each could be derived. This is summarised in the table below.

Summary of Habitat Assessment of RHS Sites.

Site No. and Name	**HQA**	**Habitat Quality Description**	**HMI**	**Modification Category**
1 Moorepark	4	Poor	3	Obviously modified
2 Commons Lower	4	Poor/Very poor	5	Severely modified
3 Cockles Bridge	4	Poor/Very poor	5	Severely

				modified
4 Bodingtown Bridge	3	Fair	4	Significantly modified
5 Naul	3	Fair	4	Obviously modified
6 Old Mill Bridge	1	Very High	1	Seminatural
7 Gibblocks Town	1	Very High	1	Seminatural
8 Stamullin	2	High	2	Predominantly unmodified
9 Gormanstown	3	Fair	3	Obviously modified
10 Knocknagin	2	High	2	Predominantly unmodified

It may readily be seen that the higher quality habitat areas are to be found from Naul and downstream. The highest quality habitat is to be found in the mid reaches of the river downstream of Naul. The poorest habitat is to be found in the upper reaches, anthropogenic modifications being largely responsible for this.

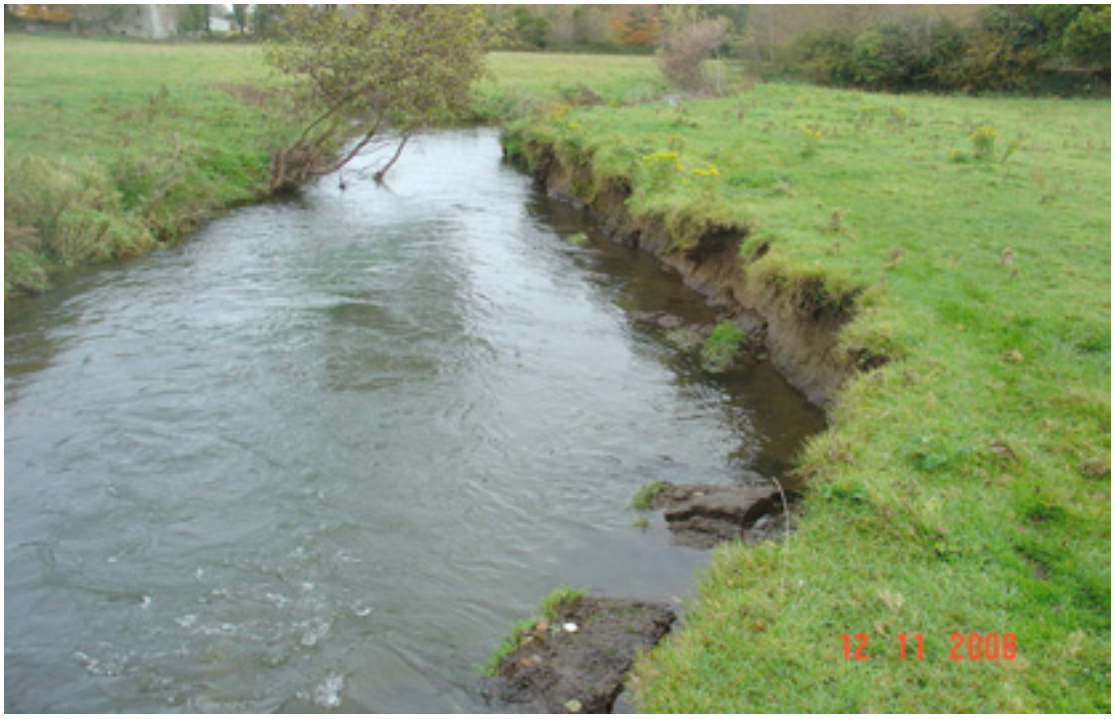

Fig 4: Bank erosion in action. Damage from livestock grazing has led to ongoing damage.

3.3 Water Quality Review

The consultants gathered all available information on the quality of the Delvin's water for as far back as data existed. For the assessment given by sampling a living component of the river, its macro-invertebrates (such as insects, molluscs and worms), data were found dating back to 1978. However, most of the relevant data on the physical and chemical nature of the water came from 1998 onwards to 2008. The results of these data are summarised below.

Q-values

This is a quality rating that is given to watercourses arising from sampling and analysis of certain types of living things found mostly on the bed of the river under study. Samples are gained by literally kicking the stones and gravel of a part of the river and the living things such as insects and snails found on these are netted, counted and identified. Because many types of pollution common to Irish rivers are organic in nature, there is often a knock-on effect on the amount of oxygen available in these waters. This is because the polluting material may often have the effect of enriching the water (e.g. with fertilisers) and thereby feeding microorganisms as the pollutant breaks down. This can have dramatic changes on the type and numbers of certain other creatures, including macroinvertebrate such as the larval forms of insects such as mayflies, stoneflies as well as snails and worms. By examining the macroinvertebrates in a certain part of the river and enumerating them in terms of those more or less sensitive to low concentrations of oxygen dissolved in the water (invertebrates in Group A are most sensitive and D the least sensitive and most tolerant), ecologists can determine a great deal about the quality of the water and then classify it in terms of another classification, i.e. classes from A to D, A being the highest quality and D the lowest.

This kind of monitoring has been carried out on the Delvin by the Environmental Protection Agency or local authority scientists since 1978. The results reviewed showed that the upper reaches of the river (upstream of Naul) continue to be moderately polluted. Downstream of this, the river has been seen to improve although remaining slightly to moderately polluted at the two other sampling stations. This indicates that the water is mostly Class B downstream of Naul while upstream of this, Class C water.

Physicochemical Water Quality

A large body of statistics was reviewed which contains the physical and chemical properties of the Delvin River found in sampling programmes going back as far as 1998. These are the 'physicochemical water quality' results. Recent data on Phosphate (P) concentrations show that the river has exceeded target (quality in terms of concentration of P) values several times. While an improvement over the last four years (since 2004) was seen, the river has yet to improve to target standards. Data over a wider range of parameters based on sampling in 2008 showed a broad improvement over the preceding year (2007) when nutrient levels (e.g. P and Nitrite) were recorded as being too high and dissolved oxygen too low to sustain the salmonid fish species (e.g. trout and salmon). Monitoring of dangerous substances from 2006-2008 showed no evidence of pollution with these substances. Data from the National Rivers Monitoring Programme (from 2004) showed that while evidence of organic pollution existed at several sites, this was not serious in nature and generally allowed for suitable quality habitat for salmonid species. Data from the same programme over the preceding period (2001-2003) showed further evidence of organic pollution. Nitrites in particular, were too high for trout and salmon throughout this period and two trends indicating pollution events were noted. For the period from 1998 to 2000, data from Meath County Council showed that organic pollution was common with nitrite and ammonium, both commonly arising agricultural pollutants, exceeding guide limits on many occasions.

3.4 Ecological Assessment of 3 Reference Sites

The three ecological reference sites were chosen at Moorepark (close to source), at Bodingtown Bridge (a bridge to the south west of Naul that is also an EPA monitoring site)

and south of Stamullin village. These three sites were examined under a number of criteria. These included the habitat quality of the sites, the degree of modification (or lack of) at each, the presence and relative abundance of living indicators including macroinvertebrates, the larger algae, so-called phyto-plankton or benthic diatomic organisms and water quality. The larger plants often referred to as macrophytes and lower plants such as stoneworts and mosses could not be properly surveyed, as channel depths were too high to allow them to be observed. The results of this may be summarised as follows.

Sites 1 and 2 were seen to be the most heavily modified. Both had been subject to channel works such as straightening and over-deepening. A reasonable quality of substrate (on the river bed) was found at both sites, however. Site 3 was the least modified and included most by the way of natural river form, flow and habitats.

The bankside vegetation was most diverse at Site 3 and least diverse at Site 1. Very little in-stream vegetation was observed at site 1 while some algae and unidentified mosses were observed on the substrate at Site 2. Water levels were deepest at Site 3 and did not allow for these lower plants to be adequately surveyed. However, it was noted that the best habitat areas for mosses, ferns and liverworts occurred at this site.

Macroinvertebrate sampling (the 'kick-sampling' described above) showed that the greatest diversity of species or groups was found at Site 3. This site also showed the greatest amounts of invertebrates with lower tolerance to poor water conditions, namely, those of the B and C groups such as caddis-flies and mayflies (no A Group species were found at any of the sites. The site at Bodingtown (Site 2) contained the greatest number of invertebrates but the majority of these belonged to the same species (a freshwater crustacean, belonging to the D group: not sensitive to pollution) and only a very small proportion of the organisms found were in any way sensitive to pollution. This result showed a significant decline in quality compared with previous data. This however, was not reflected in the physicochemical water data. It is highly likely that the dredging which took place on the 28th October was responsible for the poor results achieved at this site. The siltation of the river bed can block spaces between stones, reduce oxygen levels and effectively crowd out, starve or drown many species that would be attached to rocks. At the same time, pockets of silt can build up and provide habitat for creatures that require less oxygen at the expense of the more sensitive species. Site 1 (Moorepark) also had more individual organisms and the greatest majority of these were Group C crustaceans and fly larvae. Only small numbers of Group B species were found and the water was classified as Q3.

Macro-algae

The macro-algae (the larger non-microscopic algae) were sampled at each of the three reference sites by scraping and plucking visible vegetation and debris from stones gathered from the river bed. These were sent to the UK for specialist analysis. Results were surprising in that only one species was recorded, *Cladophora* a common filamentous algae, and this was found at only one site, Stamullin (Site 3). The relatively high concentrations of nutrients such as nitrate and phosphate would usually tend to encourage vigorous growth of this species and others. It is thought that the exceedingly high rainfalls of the summer (2008) along with the high flows in river flood conditions in the autumn could have had the effect of scouring the river bed. This is a purely physical process and involves the washing downstream of rocks under a certain size and weight. The friction between these and between these and the bed 'scrubs' away living matter, including algae which washes downstream to slower reaches.

Benthic Diatoms and The Trophic Diatom Index

Benthic diatoms or diatomic algae are microalgae that exist in a film on materials on riverbeds and banks. This film is actually a living layer or bio-film containing many types of organisms, the most abundant of which are usually the diatoms. The film is a 'slimy' substance that is found on just about any kind of material that lies unmoving on a river bed. Varying species and groups of species of diatoms are found in water of different chemistry (e.g. hard and soft waters) and also of different quality. Analysis of the diatomic community at the right part of

the river can give valuable information on the state of the water quality, particularly in relation to enrichment of water with nutrients or organic material. A classification system for assessing water quality using diatoms has been established. This is the *Trophic Diatom Index* (TDI). This, and another index: the *Ecological Quality Ratio* (EQR) are used for the assessment of river and lake water quality. Diatoms are now widely used across the EU as part of the WFD requirements and are particularly useful in assessing the impact of pollution sources such as wastewater plants or agricultural runoff.

As part of this report, the diatoms were sampled at the three reference sites by brushing off the bio-film with toothbrushes into sample bottles. These were then sent to a specialist in the UK for analysis. The results indicated that nutrient enrichment is a problem at all three sites, the samples being dominated by species or assemblages of species that are tolerant of enrichment. The less tolerant species were in small numbers or absent. The TDI and EQR both indicate bad quality water at sites 2 and 3 and poor quality water at site 1.

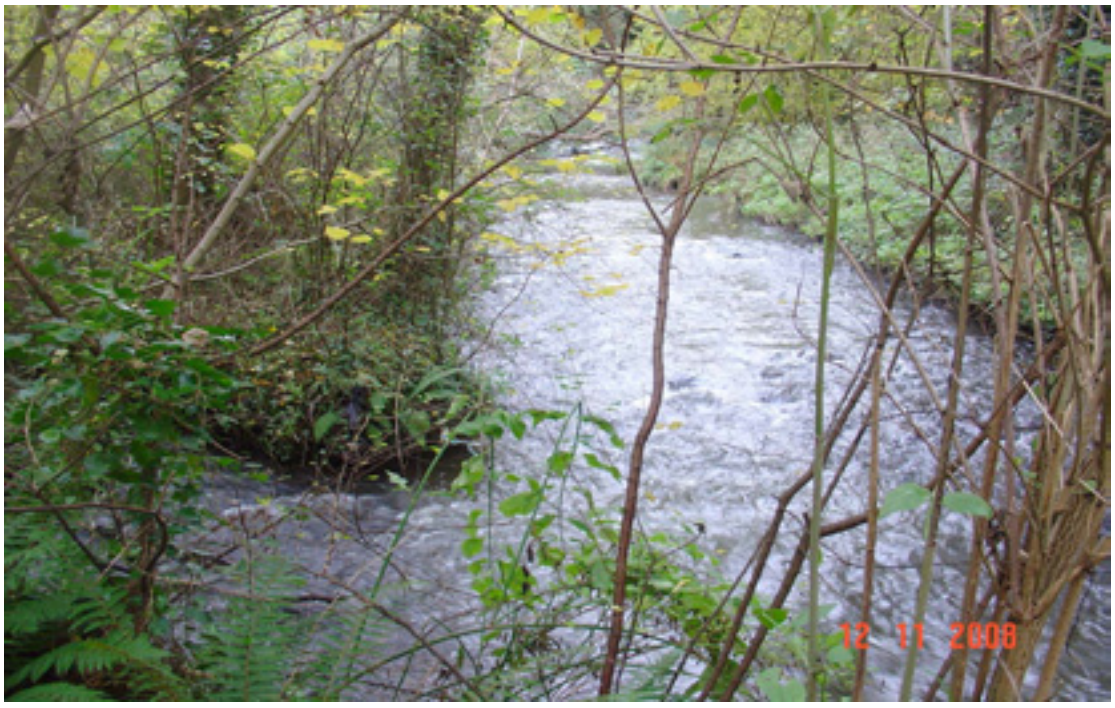

Fig 5. High quality habitat with a range of natural characteristics exists in some parts of the lower reaches.

Assessing river quality with the RIVTYPE system

The EPA has recently (2004) adopted a system for describing and classifying rivers by means of some of the living organisms found in specific survey. This is known as characterisation and allows all rivers to be classified and placed within 12 primary types that are derived from the slope and geology of the river catchment. This system is known as RIVTYPE and is part of Ireland's obligation under the Water Framework Directive in gathering and assessing data on Ireland's rivers. Major studies have been carried out to produce databases of species that are typically found within rivers of a certain slope and of a certain alkalinity (or 'hardness') given them by their bedrock geology. The Delvin is a Type 32 River under this system, having a relatively shallow slope and medium hardness. This present study looked at three main groups that contribute to the RIVTYPE characterisation system. These are macroinvertebrates, macro-algae and benthic diatoms.

When the organisms found in the Delvin macroinvertebrate sampling were compared to those collected during the RIVTYPE study, it was found that they poorly correlated. Of 145 different

species or types of invertebrate found Type 32 rivers in the RIVTYPE project, only 31 were found in the Delvin. As the RIVTYPE project used known higher quality (i.e. generally Q5) waters, these results indicate overall poor diversity in the Delvin. Of the three reference sites, Site 3 (Stamullin) showed the closest correlation with the RIVTYPE data.

The results of the diatom sampling described in the previous section were compared with those collected for rivers of this type as part of the RIVTYPE programme. The results showed poor a correlation with the RIVTYPE database. The chief difference was in diversity, the Delvin samples revealed only 17 of the 51 species or groups found in this earlier work. This would suggest significantly poorer water quality in the Delvin as compared to the reference sites used for the RIVTYPE programme.

3.5 Fisheries Assessment

Normally, an assessment of the fisheries value of a watercourse would involve standardised quantitative sampling through electro-fishing. Fish would be stunned within set stretches and species, age, condition and communities would be recorded. This was not possible in the Delvin study as the season wherein such sampling had closed by date of project tender. Instead, the entire river was walked by surveyors wearing glasses with polarising lenses. These typically allow better visibility below the surface of the river and are commonly used in walkover fisheries surveys.

Results were surprisingly poor, only one species, the three-spined stickleback being recorded. No white-clawed crayfish, itself a useful indicator of water quality, were seen, despite intensive study of the substrate in suitable areas.

For the purposes of this part of the study, the river was discussed in terms of ‘upper’ and ‘lower’ reaches above and below Naul respectively. This is due to the presence of the waterfall just north of Naul, a major natural impediment to the migration of river fauna, including fish. It is believed that a combination of river channel modifications and poor water quality have led to the extremely impoverished nature of the upper reaches. At its most extreme, the river here has been acutely damaged due to dredging and channel straightening. This has not only had immediate and severe implications for the sections directly impacted upon, but also on other sections downstream and on the ability of this upper reach to recover in reasonable time. The waterfall and the manmade waterfall downstream pose a barrier to any upstream migration of any fish species. Although trout populations were reported by some parties as existing in the upper reach some decades ago, these are almost undoubtedly extinct. Habitat and physicochemical conditions in the upper reach are unlikely to sustain any salmonid species in their current condition.

The lower reach of the Delvin has a similarly impoverished fisheries status. This is despite the presence of a range of suitable habitats and habitat types including spawning beds. Seatrout are reported as running in the end of the reach closest to the sea at Knocknagin and brown trout have been stocked close to this area. Wild trout are also reported as being caught in this area. However, no salmonid species were seen in this present survey. It is thought that poor water quality , much of this perhaps due to landuse practice in the upper reach is largely responsible for this. Any measures to improve the river’s condition and potential for fisheries must address water quality and land management issues. This is particularly so in the upper reaches where rehabilitation work is required but also in the lower reaches where existing habitats must be protected and in some cases may be enhanced.

3.6 Bats

A survey specifically designed to detect the presence and activity of bats at eleven of the largest bridges of the Delvin was carried out on the 25 September 2008. Of a total of ten known Irish species, only four were recorded. Two of these, the common pipistrelle and the soprano pipistrelle were recorded at four and five bridges respectively. Both of these species are widespread around Ireland. The other two species, Leisler’s bat and Daubenton’s bat were each recorded at only one site. Given the character of the river, the results show a

comparatively low diversity of species and overall numbers active. Bat activity along rivers is a function of many aspects of the watercourse ecology and the results indicate only moderate diversity and rather poor quality habitat for bats overall.

4. Actions Recommended for River Habitat Management

A summary of the actions required to improve the ecological situation of the Delvin is given in tabular format in Appendix A of the survey report. Five of these are 'Priority 1' actions. That is, it is recommended that these be undertaken within one year of the issue of this report. These include the installation of fencing to prevent livestock damage, the creation of river buffer zones and the remediation of riverbank. Two actions are to be undertaken within two years of issue, both related to riverside trees and four others such as creation and maintenance of habitat areas within three years. Other actions were listed without prioritisation as they reflect the current conditions and require ongoing protection to be maintained.

All of the actions were proposed within the context of the overall functioning of the Delvin as an eco-system. They focused upon the management *for* fisheries and habitats rather than the management *of* these parts of the system. Wherever possible, the proposed actions took into account the river's natural ability to recover from damaging impacts and to regenerate habitat areas.

However, some immediate actions by the relevant local authorities are recommended. These should be carried out in tandem with consultation with local interest groups and landowners alike. It was concluded that the Delvin has the potential to recover in terms of fisheries status but more importantly as a wildlife corridor within an area of high agricultural activity. The inclusion of these actions in the Fingal County Council Biodiversity Plan will be a significant and positive step towards achieving this.

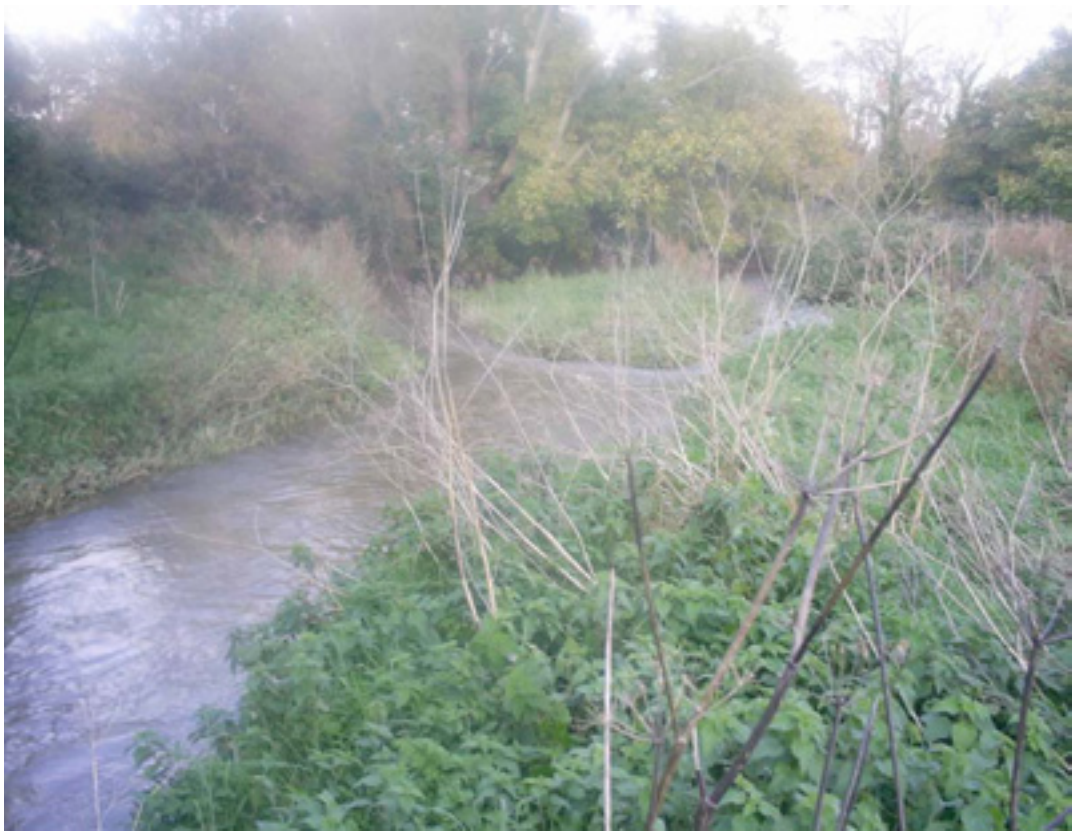

Fig 6. A vegetated mid channel bar, surrounded by a well-buffered riparian zone. Areas such as this are recommended to be maintained and protected.

5. Conclusion

The key conclusions of this study may be summarised as follows:

- Extensive modification to the river corridor was recorded. This has led to a depletion of habitat areas and types as well as impacting negatively upon water quality.

- Habitat modification was seen to be highest in the upper reaches of the river above Naul. There is a consequently poorer assembly of habitats in this area.

- Current drainage management practices continue to have negative impacts upon much of the upper reaches of the Delvin.

- Poorly managed and finished earthworks present a serious and immediate threat to one of the areas of higher quality habitat.

- Water quality is a serious issue in all parts of the Delvin. Evidence of enrichment of the river with excess nutrients of agricultural origin was indicated by the results of a variety of biological and physicochemical tests.

- A natural waterfall plays a pivotal role in the division of the upper and lower reaches of the river. One result of this is the unlikelihood of the upper reaches ever being colonised by a number of animal species.

- Damaging activities persist on the river. These include poor livestock management, removal of habitat areas and alteration to channel character.

- Fisheries value was seen to be extremely poor, despite suitable habitat areas existing in some stretches. However, the potential to recover at least in part exists.

- A number of actions are proposed. Some of these should be implemented immediately. Others may be undertaken over a longer timescale and complement the regeneration of habitat which could occur naturally if allowed. Relatively simple actions such as fencing and the creation of buffer zone would be among these.

- The above actions should be included in the Fingal County Council Biodiversity Plan and be undertaken with the view of the Delvin River achieving better ecological status and serving as a vital wildlife corridor.