Comhshaol, Oidhreacht agus Rialtas Áitiúil
Environment, Heritage and Local Government

27th January 2011

Alan McGinley,
Jacobs Engineering Ireland Ltd,
Merrion House,
Merrion Road,
Dublin 4

Your Ref: 32102600/15.02
Our Ref: G2010/637

Re: Consultation re: N8/N25 Dunkettle Interchange Improvement Scheme

A Chara,

I refer to your recent notification with respect to the above proposed development application. Outlined below are the natural and built heritage observations and recommendations of the Department of the Environment, Heritage and Local Government.

Natural Heritage

In the draft Cork Harbour Study, one option for this node is to develop a narrow strip along, but within, the Cork Harbour Special Protection Area (SPA). It is recommended that a Screening for Appropriate Assessment, a requirement to comply with Article 6(3) of the EU Habitats Directive (Council Directive 92/43/EEC) is carried out (see the guidance document, Appropriate Assessment of plans and projects – guidance for planning authorities, available on the Department's website: www.npws.ie/en/WildlifePlanningtheLaw/AppropriateAssessment/).

Please also note that, although not yet commenced, the provisions of the Planning and Development (Amendment) Act 2010 relating to Appropriate Assessment will probably apply to this application.

If such an option is envisaged, then regional staff of the National Parks and Wildlife Service (NPWS) will be available to meet you; please contact Jervis Good, NPWS (jervis.good@environ.ie).

Architectural Heritage

The European Directive of 1997 together with the national regulations which give effect to that Directive means that architectural heritage is a matter to be taken into account in environmental assessment. In that regard the proposed development must consider "material assets, including the architectural and archaeological heritage, and the cultural heritage."

Since the adoption of the European Communities (Environmental Impact Assessment) (Amendment) Regulations 1999, S.I. 93 of 1999, which came into effect on the 1st May 1999, assessment of impact on 'architectural heritage' is now an integral part of the environmental impact assessment process. This requirement is also included in the later Planning and Development Regulations.

Environmental impact assessment is an incremental process that begins with first proposals and continues until the final collation of either an Environmental Impact Statement or an environmental impact assessment report.

It is assumed that any Route Selection Report for an enhanced Dunkettle Interchange will attempt to avoid any significant constraints in the area. In that regard, establishing both the overall and detailed implications of a proposed road scheme provides an opportunity to identify and "design out" early in the route selection process any negative impact on structures of the architectural heritage merit in the locality. This is a proactive process and not simply a case of establishing a route and then trying to mitigate any perceived impact on structures of architectural heritage merit.

In that regard, it should be noted that a route survey for engineering purposes at project planning stage intended to set out any such constraints will identify most of the significant elements of the built environment either on or in the vicinity of the proposed route. Part of this process should incorporate the identification of structures of architectural heritage merit, if any, to be avoided in establishing the final preferred route or scheme.

This will likely include the examination of both mapping and aerial photographs. Use of this material should allow the early identification of those elements of architectural heritage merit which are present along or in the vicinity of the optimal scheme. An assessment of the architectural heritage merit of these elements should indicate if they are a constraint in themselves or should merely be avoided in setting out a road proposal.

It is recommended that the investigation and assessment of any impact on architectural heritage is carried out by someone with a competence to make that assessment. It is also recommended that this expertise is engaged early in the design process.

Unless major features such as the demesne lands of a country house, the country house itself, or other structures or large-scale features exist, it is unlikely that the presence of structures of architectural heritage merit will amount to a constraint as such. It may well be possible to have the alignment of the proposed road scheme adjacent to either a protected structures or a structure of architectural heritage merit as long as there is no significant negative impact.

It is assumed that an approach will be taken in setting out the optimal route to generally route the proposed road scheme away from most, if not all, structures which might be encountered. If so, it follows that avoiding impact on structures of architectural heritage merit simply removes any cause for concern leaving no further issue to be addressed. In the case of demesne lands or designed landscapes, it will be necessary to determine on the ground what is still extant and needs to be avoided. Making first reference to historical maps in order to establish the present is likely to prove misleading.

It should be noted that assessment of impact on architectural heritage is not the same as simply transcribing measures appropriate to assessment of impact on archaeological heritage. In that regard attempting to carry out a desktop study of known sources in the first instance is likely to be the least satisfactory approach in making an assessment of impact on architectural heritage. There is also little point in referring to or making an assessment of structures which are at some remove from the optimal routes.

Similarly, given the somewhat localised nature of the proposed improvement scheme, there would appear to be little point in consulting documentary sources for the purpose of first determining if

there will be an adverse impact on any structure of architectural heritage merit in the vicinity of the proposed road scheme. A field survey for engineering purposes should have already established what structures exist in proximity to the road proposal. It would seem that making an assessment of the significant impact, if any, on those structures would be the most practical approach, particularly if any are of architectural heritage merit.

In that regard it should also be noted that assessment of impact on architectural heritage goes considerably beyond the identification of structures of architectural heritage merit included in the Record of Protected Structures (RPS) of the development plan. Entries in the RPS will indicate those structures which are already known to and deemed by the planning authority to be of special interest. However, other structures of architectural heritage merit may exist in a locality which either have not yet come to the attention of the planning authority or which the planning authority has not yet had an opportunity to include in the RPS.

Similarly, simply taking note of the content of National Inventory of Architectural Heritage surveys for the area will not necessarily identify all structures of architectural heritage merit with might suffer an impact. This merely highlights the limitations of desk-top surveys. As stated above, an assessment of the aerial photographs for the proposed road proposal or engineering surveys should readily identify any particular issues relating to structures encountered on the propose route.

As stated above, it should be noted that using historical maps to identify structures or features of architectural heritage merit in the first instance is likely to be of limited value. The use of first edition Ordnance Survey maps will give a depiction of the county as recorded some 150 years ago. Similarly, later editions of the Ordnance Survey maps will indicate the situation perhaps 70 or 100 years ago. It should be recognised that there have been very considerable changes and alterations to the all aspects of the physical fabric of the county in the intervening period. For instance, demesne lands which might appear to be an impediment as depicted on the first edition Ordnance Survey sheets may since have been dissipated. Railway lines or other features on later maps may have since been decommissioned and their footprint obliterated. Conversely, structures may have been erected over that timescale which may not appear on older mapping. Some of these structures might now be deemed to be of architectural heritage merit. Therefore it is recommended that recent mapping and aerial photographs are consulted in the first instance in order to establish what it might desirable to avoid in determining the optimal route for the proposed road proposal.

Where no structures of architectural heritage merit exist in the vicinity of the proposed road proposal, it is recommended that this is clearly stated in the associated Route Selection Report. Doing so will help establish the 'technical' completeness of the environmental impact assessment content of the constraints study.

It is recommended that the Guidelines issued by the National Roads Authority for assessing the impact of road schemes on architectural heritage are also consulted.

It may be useful to consult with the relevant Conservation Officer in Cork about any undue impact on structures of architectural heritage merit which might occur in setting out the proposed Route Selection.

Kindly forward any further information to the following address as soon as it issues:

The Manager,
Development Applications Unit,
Department of Environment, Heritage and Local Government,
Newtown Road,
Wexford

Alternatively, documentation associated with the above can be referred electronically to the DAU at the following address:

manager.dau@environ.ie

In addition, please acknowledge receipt of these observations by return.

Is mise le meas,

David Tuohy,
Development Applications Unit
Tel: (053) 911 7380
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JACOBS

Meeting Notes

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Meeting Location	NPWS Corl	**Client**	NRA
Meeting Date/Time	06.04.2011	**Project**	N8/N25 Dunkettle Interchange
Subject	Meeting to introduce N8/N25 Dunkettle Improvement Scheme to NPWS	**Project No.**	
Participants	Norita Casey (Jacobs Engineering) Cyril Saich (NPWS) Jervis Goode (NPWS)	**Notes Prepared By**	Norita Casey

Notes	**Action**
NPWS suggested the following: • Undertake bird counts in SPA in winter during medium to low tide • Contact Tom Gittings (Chairman of Cork Branch of Irish Wildlife Trust) for SPA bird counts – 086 3470366 • Check AA for Dunkettle House development • This project should aim for no net loss of foraging habitat • Compensation habitat may be required depending on impacts to habitats • Take a look at Cork Harbour Study 2010 (out for Public Consultation) • Call Nicholas Mansergh (Senior Planner) from Cork County Council (021 4285951) or (086 601 5510) in relation to this study and the Dunkettle Project • It may be worth finding a location for compensatory habitat within the options • It may be necessary to recreate foraging habitat or rule out impacts in the AA • It is possible to look as far as Mahon for compensatory habitat? • It will be necessary to include the cumulative impacts – check the draft Carrigaline and Middleton LAP, look at other developments • The Harpers island case is unrelated here • Look out for short-eared owl in Sept and October frequenting the SPA • If there needs to be a choice, minimise the impact on the SPA more than the Pfizer pNHA	SC/JE

JACOBS

Meeting Notes

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Meeting Location	NPWS, Cork	**Client**	NRA
Meeting Date/Time	15.07.11 @ 11.00	**Project**	N8/N25 Dunkettle Improvement Scheme
Subject	Meeting to discuss Ecological Scope of the N8/N25 Dunkettle Improvement Scheme EIS	**Project No.**	
Participants	Robert Fennelly (Scott Cawley) Aebhin Cawley (Scott Cawley) Norita Casey (Jacobs Engineering) Cyril Saich (NPWS) Jervis Goode (NPWS)	**Notes Prepared By**	Norita Casey

Notes	Action
NPWS commented as follows on Harper's Island • The Cork Harbour Study had compensatory habitat on Harper's Island • There are ongoing talks between the County Manager and NPWS Director to discuss ownership of the land on Harper's Island • Explore Harpers Island as compensatory measure for loss of intertidal habitat	JE/SC
Traffic Volumes EIS should assess impact of increased traffic volumes that the scheme will lead to (e.g. increased fauna mortalities) or if no net increase in traffic volumes as a result of scheme alone (i.e. scheme only aims to manage existing traffic better) then state this in EIS (NPWS).	JE/SC
Bird Surveys SC explained scope of full wintering bird survey programme undertaken within SPA and portions of wetlands, during high and low tide; bird counts were undertaken between December 2010 and March 2011. SC noted there will be no loss of wintering bird grassland feeding grounds in EcIA. NPWS were content with the scope of the bird surveys.	
Otters • NPWS require DMRB Guidance Note 10 on Otters to be followed for Otter mitigation • If otter derogation required then this must be submitted to NPWS before EIS is published • Liase with Sharon Casey of Cork Co. Co regarding otter mortality database • Include Otter underpasses on existing road in EcIA mitigation and detailed notes on otter field signs in EcIA to appease objectors. • Confirm nature of works at Glanmire Roundabout close to confirmed	JE/SC JE SC SC

breeding holt.	JE
Bats NPWS queried if there will be increases in bat mortality due to the scheme? SC described scope of bat survey and will take light meter readings of existing road to inform bat mitigation and impacts NPWS were content with the scope of the bat surveys.	SC
Additional NPWS survey requests NPWS suggested invertebrate surveys (requiring three invertebrate specialists): • Marine Benthic invertebrate surveys • Water Beetle surveys • Non-marine molluscan surveys NPWS also suggested brackish Lepidoptera should be surveyed as part of the ecological surveys.	JE/SC
NPWS noted: • Impacts and mitigation for amphibians should be addressed in EIS. • In-combination/cumulative effects may be significant and need to be addressed in the EIS; including assessment of loss of wetland habitat due to existing road in addition to this scheme (Harper's Island compensation may be relevant here) and import/export impacts (e.g. AA of source for aggregates?) • Examples of Little Egret sites next to roads were given; R666 Rosslare to Kilmurry road at Kimurry (3-5 pairs nesting in Norway Spruce within 10m of road); Fota Island (24 pairs recorded in 2005 adjacent to railway station) • Planting trees on road verge and in-between Pfizer woodland and road may help mitigation for Little Egret/Heron fledgling mortalities • NPWS did not feel that presence of little egret is a major consideration for the scheme but felt concerned about a walkway/cycleway near the high tide roost in the north west corner of the SPA were a bigger issue and suggested that any pedestrian/cycle route should be routed to the north of the railway line/scheme • Consider 'train' system for design of surface water drainage system, for treatment of road run-off i.e. interceptor, attenuation and reedbeds/wetlands. NPWS gave various references for publications on the issue. • Liason with Port of Cork is needed regarding potentially significant cumulative impacts (particularly via roads through or infilling of Jack Lynch tunnel tidal 'lagoon') • Liase with Sharon Casey of Cork Co Co regarding Dunkettle House EIS • Confirm aggregate source for road surfaces is from licensed quarry free from invasive material • NPWS stressed the sensitivity of the Jack Lynch tunnel tidal 'lagoon' on SPA features Impacts on the nearby SAC could be screened out due to distance from the scheme NPWS are planning on submitting formal comments on Cork Harbour Study	JE/SC

Appendix 5.3 Additional Consultation

Consultee	Date of Response	Comments
Inland Fisheries Ireland (IFI) (Southwestern Regional Fisheries Board)	14/01/2010	IFI provided SWRFB Cork Harbour Survey Report which includes a link to the online resource at http://corkharbourbirds.ucc.ie/. The report contains summarised results of a suite of marine surveys in the wider Cork Harbour area including fish species lists (Twaite Shad noted), seal haul-out area survey data (dates unspecified), Cormorant/Little Egret/Grey Heron/Little Grebe/Tern fishing and breeding survey data (2006), reared Salmon survey data (2005-2006), and phyoplantkton data (2006). A range of freshwater and marine species are present in the Glashaboy and Harbour (Sea Trout, Brown Trout, Lamprey, Mullet).
Inland Fisheries Ireland (IFI) Michael McPartland	08/05/2012	IFI confirmed that within the exception of the Glashaboy, the intertidal areas affected are not considered to be a fishery, and have little or no fisheries potential. Notwithstanding this, sediment control and release/suspended solids must be controlled during construction and the construction phasing should be such that it minimises the potential for an increase in suspended solids.
National Parks & Wildlife Service – Mid Southern District Conservation Officer (Cyril Saich)	14/01/2010 and 1/02/2010	NPWS's main concern is likely to be the Cork Harbour SPA and the high tide waterfowl roost near the Jack Lynch Tunnel. Little Egret are breeding in the Dunkettle shore pNHA in woodland on lands belonging to the Pfizer facility. The Local Ranger for Dunkettle area is now retired and has not been replaced. There is no known formal monitoring or management of the Dunkettle pNHA. The Environmental Impact Statement (EIS) for the Dunkettle House & Balinglanna Lands development (O'Flynn, 2007) is a key reference source for ecological data. Bats are likely in mature plantations. There are anecdotal Otter deaths on N8 from January 2011.
Pat Smiddy (Retired NPWS Local Conservation Ranger)	1/11/2010	Little Egrets and Grey Heron are breeding in the Pfizer Factory woodland (Total of 20 pairs in 2010). Bee Orchids occur on the woodland fringe here and elsewhere in the locality. Several similarly-sized Little Egret colonies occur in the wider area (Fota Wildlife Park, Atlantic Pond and Middleton). There are no Kingfisher breeding sites likely in brackish riparian estuarine stretches or backwaters, but a nest is known on the Glashaboy River 2km to the north of the existing Dunkettle Interchange.
John Lusby (BirdWatch Ireland	24/03/2011	BWI is not aware of any active Barn Owl within the Dunkettle area - however BWI
Raptor Project Officer)		have recorded sightings over the past 5 years within reasonable proximity to this area, both within and outside of the breeding season. The N8 & M8 are particularly devastating for Barn Owl fatalities – BWI has records of nearly 30 road casualties on the M8 since the road opened.
Dr. Geoff Oliver (Comharchumann Chléire Teo, Cape Clear Island)	6/4/2011	The Jack Lynch tunnel tidal polder was not included in the formal NPWS survey of Irish coastal lagoons. The feature may not qualify as a lagoon if it does not retain significant water at low tide.
National Parks & Wildlife Service (Jervis Good Divisional Ecologist; Cyril Saich District Conservation Officer)	0/04/2011	The NIS and EcIA will cover the following items: Undertake bird counts in the Cork Harbour SPA in the winter during medium to low tide; Contact Tom Gittings (Chairman of Cork Branch of Irish Wildlife Trust) for SPA bird counts; Check the Appropriate Assessment for Dunkettle House & Balinglanna Lands development ; This project will aim for no net loss of bird foraging habitat plus a disturbance buffer zone; Cork Harbour Study 2010 (out for Public Consultation) Contact Cork County Council in relation to this study Include cumulative impacts & check the draft Carrigaline and Middleton Local Area Plans Look out for Short-Eared Owl in September and October frequenting the Cork Harbour SPA If there needs to be a choice, minimise the impact on the SPA over the pNHA
Connor Kelleher (Bat Specialist)t Ecologist & Member of Cork Bat Group)	19/7/11	Provided bat data from survey reports from 2004 and 2005 for the Environmental Impact Statement for Dunkettle House and Balinglanna Lands in addition to a survey report for the Glanmire Road Re-alignment (2008). Had no knowledge of bats using North Esk folly buildings.
Sean Runnane (MSc Student, University College Cork)	7/4/2011	Never surveyed Egret colony at Pfizer woodland During field work for Master's Thesis on Egrets in Cork due to access restrictions.
Dr. Tom Kelly (Mammal ecologist, UCC)	7/4/2011	Otter kill known from N8 east of interchange, near slip road to North Esk Industrial Estate. Single Heron nest at distillery fields. The Egret/Grey Heron Colony at Atlantic Pond is protected from human disturbance by water, and this or another barrier to human presence near the colony is likely to make a colony more favourable. Lighting of the colony may be important, as several species of roosting birds use

		woodland sites in darkness.
Dr. Paddy Sleeman (Mammal ecologist, UCC)	6-9/4/2011,	No knowledge of stoat in area. Major Otter breeding holt known from Dunkettle roundabout at western edge of scheme. This is one of most important holts in Cork city, which has total of 4-5 known holts (see publication on Otters of Cork City). Barn Owls feed on Daubenton's bats in Cork (remains found in 1/15 pellets).
Dr. Tom Gittings (Entomologist, UCC and organizer of IWeBS counts at Dunkettle)	19/4/2011	Recorded 100 Black-tailed Godwit in large intertidal mudflat to east of interchange. These areas used to be grassland fields, but were converted to intertidal areas by construction of road. Has not studied invertebrates in the area, but recommended talking to Dr. Ken Bound on butterflies. Examined Dunkettle House Barn Owl nest box in 2006/7 but no signs of occupancy.
National Parks & Wildlife Service (Jervis Good Divisional Ecologist; Cyril Saich District Conservation Officer)	15/7/2011	NPWS Highlighted the requirement for marine benthic surveys, and survey of brackish and saltmarsh specialist invertebrates including Lepidoptera, coleoptera, benthos and non-marine molluscs. There is risk of fledgling bird mortality if the proposed development is located below the Egret/heronry colony at Pfizer. Otter morality is high on secondary roads in Cork.
Dr. Fidelma Butler (Mammal ecologist, UCC)	19/7/2011	Holds no ecological records for locality. No known bat fatalities on N8, but bats may be knocked into roadside vegetation and could be overlooked. Mitigation will focus on commuting routes radiating from known roosts.
Cork County Council Planning Department	17/04/2012	Blarney Local Area Plan contains an Appropriate Assessment and Environmental Report. The Dunkettle and Balinglanna Lands housing development is still an objective of the Blarney LAP. A Park & Ride proposal for the nearby Train Station was refused, but the site is still zoned for a Park & Ride within Little Island. The Port of Cork proposal to move the Tivoli container terminal to Ringaskddy was refused. The Cork Harbour Study is a broad, indicative proposal only. The proposal for an access route to the Tivoli terminal, to run adjacent to the SPA (& high tide bird roost) is indicative only, and there is no certainty it would be built.

Aquatic And Terrestrial Beetles From Intertidal Mudflats And Shorelines And Saltmarsh At Dunkettle/Inchera.

Stephen McCormack – Independent Consultant

Methodology

Waterbeetles were collected by pond netting, treading on or splashing marginal vegetation or bare substrates to dislodge animals then scooping them out of the water with a net or sieve (mesh size 0.5mm). Terrestrial beetles were collected by manual searching, sieving vegetable debris on shorelines and sweeping emergent vegetation with a large sweep net. Collected beetles were stored in ethanol and identified. Voucher specimens of uncommon species have been retained.

Results

The sites were surveyed on May 17th 2012. The mudflats and saltmarsh at Dunkettle/Inchera contain some species that are confined to saline habitats. None were found that have an IUCN threat status and only one, *Ochthebius marinus*, is considered Near Threatened (Foster et al., 2009). Most of the aquatic habitats were tidal and subject to more or less complete inundation by sea water and therefore were unlikely to be suitable for the majority of brackish waterbeetle species. The range and type of habitats present are not considered to support an especially rich brackish water fauna. There were however, some species of terrestial beetles found in the waterside habitats and saltmarshes that are of note. The ground beetle *Bembidion varium* is quite uncommon in Ireland (Anderson and McFerran, 2001) although this group of insects has not been assessed to IUCN critera. *Bembidion varium* inhabits areas where there is bare mud or fairly sparse vegetation and there are less that 10 records for the species in Ireland since 1970 (Anderson and McFerran, 2001). It is confined to saltmarshes in the southern half of Ireland.

Ochthebius marinus was found to be fairly abundant at WF4, WF7 and WF14 where it occurs in very shallow water or crawling in mud at water margins.

Overall the sites surveyed that supported uncommon species confined to saltmarshes were the sparsely vegetated areas at the margins of mud flats on the Iarnrod Eireann Intertidal Mudflat (WF7) and Eastgate Saltmarch (WF14).

Jack Lynch Tunnel Intertidal Mudflat (WF2)

No beetles found and habitat deemed to be unsuitable.

North Esk Intertidal Mudflat West (WF3)

No beetles found and habitat deemed to be unsuitable.

North Esk Intertidal Mudflat East (WF4)

Suitable habitat was found here in strandline debris, and around high water mark. Species of note here were *Bembidion varium* and *Ochthebius marinus*.

Pfizer Intertidal Mudflats West (WF5) and East (WF6)

Small amounts of habitat for beetles were found on vegetated margins. Species found here are generally common species associated with wetlands, shorelines and riparian habitats.

Iarnrod Eireann Intertidal Mudflat Small (WF7)

Suitable habitat for riparian and wetland beetles was found here and several brackish water species including *Enochrus bicolor*, *Ochthebius marinus*, *Saldula cf. palustris* and *Bembidion varium*.

Photo: habitat of *Enochrus bicolor, Ochthebius marinus* and *Bembidion varium* (WF7)

Eastgate Saltmarsh (WF14)

Shallow saline ponds here supported Bembidion varium and Ochthebius marinus.

References

Foster , G.N., Nelson, B.H. and O Connor, A. (2009) Irish Red List No. 1 Water beetles. National Parks and Wildlife Service, Dublin.

Anderson, R. and McFerran, D., 2001. *[In] The Ground Beetles of Ireland* - http://www.habitas.org.uk/groundbeetles/

List Of Species Recorded At Dunkettle And Inchera Intertidal Wetlands 17 May 2012.

Scientific name	Description	Comment	WF14	WF 5	WF4	WF6	WF7
			W742724	W738722	W737725	W736723	W740724
Silpha tristis	A carrion beetle	Local and usually coastal		X			
Coccidula rufa	A coccinellid beetle	Common near water	X		X		
Agabus bipustulatus	A diving beetle	Very common in freshwater				X	
Agabus sturmi	A diving beetle	Very common in freshwater				X	
Hydroporus planus	A diving beetle	Very common in freshwater				X	
Hydroporus tessellatus	A diving beetle	Very common in fresh and brackish water				X	
Ilybius montanus	A diving beetle	Common in freshwater				X	
Acupalpus dubius	A ground beetle	Local in moss and leaf letter near freshwater	X				
Agonum marginatum	A ground beetle	Common on bare ground	X	X			X
Bembidion aeneum	A ground beetle	Common on bare ground		X	X		
Bembidion assimile	A ground beetle	Local in marshes	X	X	X		
Bembidion lampros	A ground beetle	Very common on bare ground		X			
Bembidion tetracolum	A ground beetle	Common everywhere	X				
Bembidion varium	A ground beetle	Very local in saltmarshes in S and E Ireland	X	X	X		X
Demetrias atricapillus	A ground beetle	Common on tall vegetation near water	X				
Dromius linearis	A ground beetle	Common on tall vegetation	X				
Elaphrus cupreus	A ground beetle	Common on damp soils					X
Notiophilus substriatus	A ground beetle	Common on dry soils					X
Paranchus albipes	A ground beetle	Very common on riverbanks and strandlines	X				
Philorhizus melanocephalus	A ground beetle	Common on tall vegetation near water	X				
Pterostichus strenuus	A ground beetle	Very common in damp soils		X			
Acrotona laticollis	A rove beetle	Local in decaying vegetable matter	X				
Anotylus tetracarinatus	A rove beetle	Local in decaying vegetable matter			X		
Brachygluta helferi	A rove beetle	Local in saltmarshes	X				
Carpelimus rivularis	A rove beetle	Common in wetlands and riparian habitats	X				X
Drusilla canaliculata	A rove beetle	Common in association with ants nests	X				
Gnypeta carbonaria	A rove beetle	Local on sandy and silty shorelines					X
Lesteva sicula	A rove beetle	Common in wetlands and riparian habitats	X		X		
Metopsia clypeata	A rove beetle	Local in rotting vegetation	X				
Paederus riparius	A rove beetle	Common in wetlands and riparian habitats			X		
Quedius maurorufus	A rove beetle	Common in marshes	X				
Stenus bimaculatus	A rove beetle	Common on emergent vegetation			X		
Stenus impressus	A rove beetle	Common in variety of habitats	X				
Stenus juno	A rove beetle	Very common in variety of habitats			X		
Tachyporus pusillus	A rove beetle	Common in shoreline debris	X				
Thinobaena vestita	A rove beetle	Common in strandline debris		X	X		
Trissemus impressus	A rove beetle	Common in moss and leaf litter in wetlands			X		
Chartosirta cincta	A shore bug	Common on wetland and riparian habitats			X		

Saldula cf. *palustris*	A shore bug	S. palustris is local and confined to saltmarshes					X
Ovatella mysotis	A snail	Local and confined to saltmarshes	X				
Anacaena lutescens	A water beetle	Common in wetlands with decaying vegetation				X	
Cercyon sternalis	A water beetle	Common in wetlands with decaying vegetation			X		
Enochrus bicolor	A water beetle	Local but common in brackish water					X
Helophorus aequalis	A water beetle	Common in variety of wetland habitats				X	
Helophorus brevipalpis	A water beetle	Very common in freshwater				X	
Helophorus grandis	A water beetle	Very common in freshwater					X
Helophorus obscurus	A water beetle	Very common in freshwater				X	
Megasternum concinnum	A water beetle	Very common in decaying vegetation		X			
Ochthebius dilatatus	A water beetle	Local but not uncommon in brackish water habitats		X			
Ochthebius marinus	A water beetle	IUCN Near Threatened. Found in brackish water and saline mud in E and S Ireland	X		X		X

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A MOLLUSCAN SURVEY OF SALT MARSH HABITATS IN THE VICINITY OF DUNKETTLE, COUNTY CORK

April 2012

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1.0 Background

A molluscan survey was undertaken in the vicinity of the Dunkettle Interchange, County Cork, where there is an upgrade proposed. The purpose of the survey was to use molluscan saltmarsh indicators to assess the level of habitat development for invertebrates in the environs of Dunkettle.

Some saltmarsh and saltmarsh transition habitat are present on both the southern and northern sides of the existing N25 road and on the western side of the Jack Lynch Tunnel.

A survey has been carried out to determine the molluscan fauna of these habitats, to establish if any Red Listed or rare species are present, and the value of the habitat compared with well developed salt marshes in the Atlantic bioregion.

2.0 Methodology

The survey included hand searches in the field and collection of litter samples for processing in the laboratory.

The hand searches for molluscs focused on three main areas of habitat:

1) The upper limit of the tidal mudflats and the saltmarsh vegetation community. This included examination of algae such as *Vaucheria* growing on the mud and at the base of plants for species such as *Hydrobia ulvae* and sacoglossan sea slugs such as *Limapontia depressa* and *Alderia modesta*. The air-breathing pulmonate snail *Myxotella myosotis* was sought on mud under flood rubbish (flotsam, dead plant stems etc), and at the base of saltmarsh plants, as was the prosobranch snail *Assiminea grayana*. Another pulmonate snail *Leucophytia bidentata* was searched for in crevices in semi-embedded rocks on the very upper part of the shore.

2) Transitional habitats for terrestrial and transitional species (i.e those that do have an obligatory requirement for salt water) were searched for by hand and by shaking handfuls of vegetation onto a white tray from the maritime grassland transition zone which lies immediately above the saltmarsh. In particular, the survey focused on searching for the narrow-mouthed whorl snail *Vertigo angustior* (an Annex II species) which is a typical component of maritime grassland especially saltmarsh to grassland transition (see Killeen & Moorkens 2011).

3) The habitat (grassland , scrub, woodland) on the lower slopes immediately above the transition zone were also searched by hand and shaking litter onto a white tray.

Fully estuarine/marine and fully aquatic habitat was excluded from this survey.

As well as observing snails in the field, salt marsh molluscs were sampled by collecting litter samples. Approximately 2-3 litres of litter was taken from each representative sampling site, air dried in the laboratory and then sieved through two mesh sizes, 3mm and 0.5mm. The contents of each sieve were examined for snails. An Olympus 40X binocular microscope was used to examine the smaller species. The numbers of samples collected was dependent on the heterogeneity of habitat in the field.

3.0 Results

A total of 9 study areas were sampled during the survey. The study area locations are shown in Table 1 and Figure 1. Photographs of the sites surveyed are provided in Annex 1. A total of 25 species were found in the study and the species are recorded in Table 2. All nomenclature follows Anderson (2005). Photographs and requirements of the indicator species are given in Annex 2.

Table 1 Study area locations.

Water Feature	General grid reference	Description
5	W73700 72256 to W 73877 72227	Tidal inlet to the north of Pfizer works. The northern margin comprises a steep rocky slope beneath the dual carriageway. The south side has a narrow grassy transition shoreline which then goes into a steep, heavily disturbed scrub-covered slope. Piles of flotsam have accumulated at the eastern end and where there are small patches of a more gentle transition zone.
6	W73923 72200	Tidal inlet to the north-east of Pfizer works and with culvert link to WF5 Better developed saltmarsh habitat but the transition is very shallow sloping and the grassland is subject to inundation on all spring tides. Walls and steep slopes do not offer opportunity for a more gradual transition zone.
11	W73271 72407	Tidal lagoon on west side of Jack Lynch Tunnel formed by rocky barrage on south side. High rocky shore on east side with grassland and wooded habitat above. NE corner with large accumulations of flotsam and transition into rocky habitat and grassland.
14	W74345 72408	Small triangle of saltmarsh with dual carriageway to the north, industrial estate to the south and freshwater ponds to the east. Area of stable saltmarsh surrounded by well developed grassland transition, a muddy tidal rill runs along the northern margin.
3	W73599 72493	Deep tidal inlet with steep rocky sides at southern end of old industrial estate. Too steep for any grassland transition zone.
4 (West)	W73613 72480	Eastern end of large area of tidal mudflats with good sized areas of saltmarsh and saltmarsh grassland transition.
4 (East)	W73865 72459	On north side of dual carriageway, eastern end of tidal inlet. Area of saltmarsh and transition grassland
Grassland	W74006 72532	On east side of slip road adjacent to works area. Wet grassland with some tidal

North of WF7		influence, bare muddy pools (dry at time of survey), regularly inundated
12	W74145 72458	Small tidal muddy rill with connection through culvert to WF4 (Eastern Part). Patches of saltmarsh and saltmarsh grassland transition

Table 2. Species found in the survey

Area	1	2	3	4	5	6	7	8	9
Saltmarsh (saline) species									
Peringia ulvae	X	X	X	X	X	X	X		X
Mysotella myosotis	X	X	X	X		X	X		X
Leucophytia bidentata			X		X	X			
Limaponta depressa				X			X		
Terrestrial snails									
Aegopinela nitidula			X	X					
Candidula intersecta			X						
Carychium minimum				X					
Cepaea nemoralis	X		X		X			X	
Clausilia bidentata	X		X		X				
Cochlicopa lubrica				X	X				
Cornu aspersum			X						
Lauria cylindracea	X								
Nesovitrea hammonis				X					
Oxychilus cellarius			X	X	X				
Trochulus hispidus			X		X				
Trochulus hispidus			X		X				
Vitrina pellucida							X		
Terrestrial slugs									
Arion circumscriptus			X						
Arion distinctus			X	X					
Arion flagellus	X	X	X						
Arion rufus			X						
Deroceras panormitanum	X	X	X						
Deroceras reticulatum	X	X	X	X				X	
Lehmannia valentiana			X					X	
Limacus maculatus			X						
Total (25 species)	8	5	20	10	8	3	4	3	2

4.0 Discussion

The ambitious molluscan database of habitat preferences and life history traits was published in 2001 (Falkner *et al.*, 2001), providing opportunities for malacologists to predict species lists from accurate habitat assessment, and which may be used to provide information on the level of function of habitats. The molluscan database is based on a fuzzy coding system, which assigns a 0 (no association), 1 (minor association), 2 (Moderate association) or 3 (maximum association) category with each variable assessed. The non-shelled slugs and bivalve molluscs were not included in the original database but these were later added (Moorkens & Killeen 2009).

Table 3 shows the molluscan species given in the database as having associations with saltmarsh habitat.

Of this list, *Bithynia leachii* and *B. tentaculata* are completely freshwater species in Ireland and would not be expected in the Dunkettle survey. *Hydrobia ventrosa* and *Obrovia neglecta* occur in brackish water lagoons (and are also rare in Ireland). The pulmonate *Myxotella denticulata* is more typically associated with more marine habitats such as caves and the upper shore crevice fauna. The database also includes *Heleobia stagnorum, Mercuria zarahae, Obrovia glyca, Oxyloma dunkeri,* and *Paludinella littorina* none of which are recorded from Ireland.

This leaves 13 species listed as having an association with saltmarsh habitat. Three more should be added. The database does not include the narrow-mouthed whorl snail *Vertigo angustior* as being associated with saltmarsh but it has since been shown to be a frequent component of a saltmarsh transition zone where there is a transition with maritime grassland habitats, and is strongly associated with saltmarsh habitat in estuaries and on old sea wall habitats (Killeen & Moorkens 2011). The other species that should be listed are the sacoglossan sea slugs *Limapontia depressa* and *Alderia modesta*. Slugs were excluded from the original molluscan database, and these are the two true exclusively saltmarsh species.

In the Dunkettle survey a total of 25 mollusc species were recorded including 5 of those listed in the Molluscan Database (six when *Limapontia depressa* is added). These were *Myxotella myosotis*, *Leucophytia bidentata* and *Hydrobia ulvae* (all species with a strong association – code 3), and 2 terrestrial snails *Cochlicopa lubrica* and *Vitrina pellucida*, both listed as having minor association. *Assiminea grayana* and *Truncatella subcylindrica* were the only species listed as having a strong association with saltmarsh but were not found during the Dunkettle survey. *Assiminea* is uncommon in Ireland as in known mainly from the Shannon estuary although the habitat at Dunkettle was considered suitable for the species. *Truncatella* is extremely rare in Ireland (listed as Endangered in the Red Data Book – Byrne *et al.* 2009), and is only known from two sites on the west coast. *Vertigo angustior* was not found.

All of the other snails and slugs recorded during the survey are considered to be truly terrestrial species.

Table 3. Molluscan species listed by Falkner *et al.*, 2001 as having saltmarsh associations (species given as stated in the database, the equivalent nomenclature by Anderson 2005 is in brackets where different). 1 (minor association), 2 (Moderate association) or 3 (maximum association).

Species	Estuarine	Tidal rivers	Tidal flats	Lagoons	Salt marsh general	Pioneer swards	*Spartina* beds	Atlantic salt meadows	Continental salt meadows
Assiminea grayana				2	3			3	1
Bithynia leachii				1					
Bithynia tentaculata				1					
Cochlicopa lubrica									1
Hydrobia ventrosa (Ventrosia ventrosa)	1	1	1	3	3	2	3		1
Leucophytia bidentata	3	3	3		3				
Mercuria anatina (M. similis)	1	1		1					
Myxotella denticulata	3		3	2					
Myxotella myosotis					3			3	
Obrovia neglecta (Hydrobia acuta)	2	2	2	2	3	3	1		
Oxyloma elegans				1				1	1
Hydrobia ulvae (Peringia ulvae)	3	3	3	2	2	2	2		
Potamopyrgus antipodarum				2					
Succinia putris					1				1
Truncatella subcylindrica	2		2		3		1	3	
Vallonia pulchella					1				1
Vitrina pellucida					1				1
Zonitoides nitidus					1				1
Additions since 2000									
Vertigo angustior					2			2	
Limapontia depressa					3	3			
Alderia modesta					3	3			

5.0 Conclusions

Of the 9 habitat areas surveyed, the most important areas were sites 3, 4 and 7.

The Jack Lynch "lagoon" at WF11 has good transition from mud shore to rocky edge to saline grassland, but although it has a good range of species, it has not got a well developed salt marsh due to the steep nature of the rocky edges.

The small triangle of saltmarsh at WF14 was the best developed salt marsh area found in the survey, and had good numbers of *Peringia ulvae, Myxotella myosotis* and *Limnaponta deprssa.* The absence of *Leucophytia bidentata* was due to the gentle sloping of the salt marsh, which retained a good rate of saturation at low tide, and *L. Bidentata* requires air to breathe under rocks. The salt marsh transition rose to a well developed grassland, but *V. angustior* was absent from the transition, most likely due to the very gentle slope which leads to regular salt water inundation of a wide area.

WF4 (Eastern Part) on the north side of the dual carriageway had a good salt marsh to grassland transition, and also had the three species in the salt marsh as in WF14 *Peringia ulvae, Myxotella myosotis* and *Limnaponta deprssa*. The grassland transition was not as gently sloping as in WF14, and looked to have good potential for *V. angustior*. However, there were very few snails at all found in the grassland, and these were of *Vitrina pellucida*, a terrestrial species with salt marsh tolerance. Although there was quite a big area of salt marsh/grass transition, the terrestrial edge is bunded by the slip road to the east and south, and by old garden/sea defence walls to the north, thus retaining spring tide water, which, in spite of the slope it appears to completely inundate.

From the most recent database list, one species is critically endangered in Ireland (Truncatella subcylindrica), two are listed as endangered (*Hydrobia acuta, Mercuria similis*), and three are listed as vulnerable (*Vallonia pulchella, Ventrosia ventrosa, Vertigo angustior*). None of these species was found in the survey (Byrne *et al.*, 2009).

To put the results in context, there are good examples of salt marsh habitat with indicator mollusc species present, but some are absent, mainly due to the fact that the habitat has not been able to develop more specific habitat niches through restraint caused by hard edges and artificial walls in a highly developed environment. There are many examples of this, and better developed salt marsh habitats in county Cork. However, on a local level, the areas surveyed provide an excellent addition to biodiversity. These sites should therefore be rated as High Value, Locally

Important (Category C of NRA guidelines), as they are semi-natural habitat types with high biodiversity in a local context, with significant populations of locally rare species.

6.0 References

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Moorkens, E. A. & Killeen, I. J. (2009). Database of association with habitat and environmental variables for non-shelled slugs and bivalves of Britain and Ireland. Irish Wildlife Manuals, No. 41. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

Annex 1. Water Feature Photographs

Photo 1: WF5 view from west to east

Photo 2: WF5 south-east corner

Photo 3: WF5 south-east corner looking north

Photo 4: WF6 western end

Photo 5: WF6 view looking east from west end

Photo 6: WF6 southern shore

Photo 7: WF11 view looking N along E margin

Photo 8: WF11 north-east corner

Photo 9: WF14 view from east side

Photo 10: WF14 saltmarsh grassland transition

Photo 11: WF14 saltmarsh

Photo 12: WF14 muddy tidal rill

Photo 13: WF3 tidal pond

Photo 14: WF4 (Western Part) south-west corner

Photo 15: WF4 (Eastern Part) saltmarsh grassland transition

Photo 16: "Grassland North of WF7" wet grassland

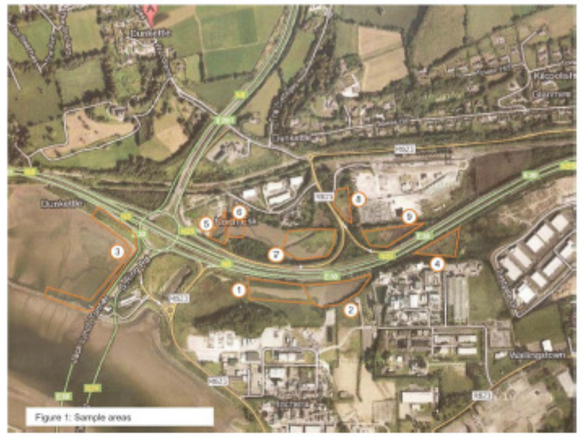
Annex 2. Selected indicator mollusc species

Myxotella myosotis (syn. *Ovatella myosotis*)
This air-breathing pulmonate snail is one of the most typical snails of stable saltmarsh habitats, where it is found most often on mud under flood rubbish (flotsam, dead plant stems etc), and at the base of saltmarsh plants such sea purslane (*Halimione portulacoides*). It is widely but locally distributed around Irish coasts.

Leucophyta bidentata
This species is also an air-breathing pulmonate but unlike *M. myosotis*, it is in muddy crevices, often under wall-embedded rocks at the upper zones of tidal shores and estuaries. It is widely but locally distributed around Irish coasts.

Hydrobia ulvae
This is the most abundant snail in estuaries, mudflats and saltmarshes where it is often found in enormous numbers. It occurs all around the coast of Ireland.

Limapontia depressa
This very small (usually under 5mm) species of sacoglossan sea slug is found only on sheltered saltmarshes and estuaries where it lives on the veneers of algae such as *Vaucheria* growing on the mud. Its small size, greenish colour and cryptic habitat mean that it can be extremely difficult to find. It is widely but locally distributed around Irish coasts.



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Intertidal Benthic Survey
at
Dunkettle, Co. Cork.

Commissioned by: Scott Cawley Environmental
Carried out by: Aquatic Service Unit
May 2012

Introduction and Brief

The Aquatic Services Unit (ASU) was commissioned by Scott Cawley Environmental Consultancy to undertake an assessment of the intertidal benthic ecology at the location of a proposed roadway at Dunkettle, Co. Cork. The following report outlines the results of baseline surveys within the study area carried out in March and April 2012.

SURVEY METHODS

Soft Sediment Field Sampling

Fieldwork was carried out on the 21st and 26th of March 2012 with a further days survey work undertaken on 18th April 2012. All sampling stations were positioned using a Trimble Geo XM GPS system. A complete list of stations sampled and the stations are displayed on a map (Figure 1) and are presented in Table I.

Table I: Positions of sampling positions. All positions are given in Irish National Grid

	Co-ordinates Irish National Grid				
	Easting	Northing		Easting	Northing
WF1-1	178280	72427	WF5-1	173710	72268
WF1-2	172970	72554	WF6-1	173911	72254
WF1-3	173210	72359	WF6-2	174025	72260
WF2-1	173382	72292	WF7-1	174160	72462
WF3-1	173592	72492	WF8-1	174527	72660
WF4-1	173648	72467	WF8-2	174635	72700
WF4-2	173744	72477	Lee-1	173112	72163
WF4-3	173853	72399	Lee-2	173307	72089

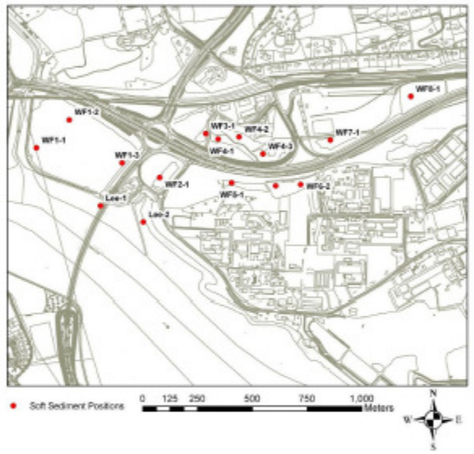


Figure 1: Map of sampling locations taken across the water features in the Dunkettle survey area.

A total of 16 intertidal stations were sampled for benthic faunal analysis, granulometric analysis and organic carbon analysis. Sampling methodology was based on the methods employed by the JNCC (JNCC, 2001) for Habitat Assessment Surveys.

At each station:

- 3 x 0.01m^2 cores were taken to a depth of 20cm for benthic faunal analysis (16 Stations).
- 1 x 1m^2 quadrat was marked out and all physical and biological characteristics were recorded for that area.
- 1 x 0.25m^2 (0.5m x 0.5m) quadrat was marked out and excavated to a depth of 20cm. Sediment was sieved in situ through a 5mm mesh sieve. Samples were processed as per sediment cores.
- 1 x surface scrape of sediment was taken and stored in a labelled, plastic bag for granulometric and organic carbon analysis.

Sample Processing

All faunal cores (0.01m^2) were sieved through a 0.5mm mesh sieve within 12 hours of collection and fixed using 10% buffered formalin. Samples were sorted by eye and subsequently preserved using 70% Ethanol. All faunal dig sample (0.25m^2) samples were visually dug through and all large fauna were collected and fixed using 10% buffered formalin. Samples were subsequently sorted by eye and preserved using 70% Ethanol. All faunal samples were enumerated and identified to the lowest taxonomic level possible using standard keys for European fauna.

Granulometric analysis was carried out on oven dried sediment samples from each station. The sediment was passed through a series of nested brass test sieves with the aid of a mechanical shaker. The sediments were then divided into various fractions: % Fine Gravel (>4mm), % Very Fine Gravel (>2mm), % Very Coarse Sand (<2.0mm >1.0mm), % Coarse Sand (<1.0mm >500Bm), % Medium Sand (<500Bm >250Bm), % Fine Sand (<250Bm >125Bm), % Very Fine Sand (<125Bm >63Bm) and % Silt-Clay (<63Bm).

Organic matter was estimated using the Loss on Ignition (LOI) method. One gram of dried sediment was ashed at 450°C for 6 hours and organic carbon was calculated as % sediment weight lost.

Intertidal Hard Benthos Survey

A walk-over survey of the hard benthos intertidal areas of the eight water features WF1-WF8 was carried out on April 9th, 10th, 26th and 29th. Where suitable substrate was present, transects were undertaken. General searches for fauna were also conducted and all habitats were classified using (Fossit, 2000 and Connor *et al*, 2004)

Mysid Survey

Ponds net sweeps and plankton net twos were undertaken in water features WF1, WF4, WF6 and WF8 for mysids on April 14th 26th and 29th. The resultant samples were identified to species level by a crustacean taxonomist.

SURVEY RESULTS

The detailed findings of the hard and soft benthos field surveys of are presented below for each of eight water features examined (FW1-FW8). The findings of the mysid survey are presented at the end. Full species lists are presented in Appendix 1A & 1B and detailed granulometry and organic matter (Loss on Ignition) are given in Appendix 2.

Water Feature 1

This is by far the largest water feature with its roughly square outline bounded by steep rock-armour embankments (Plate 1). The majority of its area comprises intertidal sandy mud (Plate 1A), with the exception of the north eastern corner where a smaller square of ground comprises a low cobble rubble perimeter and scattered cobble and pebble within this smaller area where brown seaweed (fucoids) have become locally dominant (Plate 1B); this area covers about 3-4% of the overall area of WF1. Elsewhere, apart from very occasional clusters of scattered cobbles or small boulder (e.g. toward the NW corner), only the rock armour embankments provide stable anchorage for brown seaweeds (Plate 1 C, 1D, 1E) where density is locally very heavy along all sides except the northern side (Plate 1F) where the line of the base of the rock armour is at a higher elevation than the other three sides and mainly above the intertidal. Also in the NW corner, there is a small patch of degraded saltmarsh meadow. A feature of the southern embankment in particular is the fact that water flushes through the rock armour which is associated with local concentrations of filter feeders, barnacles (*Elminius modestus*) and mussels (*Mytilus edulis*). These areas tend also to be the only ones where fine red algae are present epiphytic on brown seaweeds (especially *Fucus serratus*) or epilithic on rock armour.

The rubble area in the NE corner was dominated at its fringes by *Ascophyllum* and in its centre by *Fucus spiralis* and *F. vesiculosus*, even though it was difficult at times to distinguish between the latter two species. Here also, gammarid amphipods were common beneath seaweed, with *Lekanesphaera* isopods frequent under stones over lying dry muddy sand, as well as occasional small shore crabs (*Carcinus maenas*) in similar locations; the barnacle *E. modestus*, was present on scattered boulders.

A transect down the east embankment and was topped by a faint cover of yellow lichen (0-0.6m), followed down the shore successively by bare boulders with a very light cover of *Enteromorpha* (green alga) (0.6-1.3m), *Fucus vesiculosus*, 40-60% cover, (1.3-3.5m), and *Ascophyllum* , 100% cover, (3.5-5.8m). Along the transect amphipods were very common under *Ascophyllum*, with occasional juvenile shore crabs beneath cobbles and *Elminius modestus* frequent on larger cobble/boulder.

A transect down the inside of the southern embankment had the following sequence of zones from the top to the base: 0-0.6m - yellow and white lichens; 0.6-2.5m - bare rock; 2.5-3.7m – *F. vesiculosus;* 3.7-4.5m - *Ascophyllum*; 4.5-6.0m – *F. serratus*. Along the transect *E. modestus* were common, small shore crabs frequent, and mussels common between cobbles. Epiphytic fine red algae and bryozoa were noted also on *F. serratus* fronds at the base of the transect.

The western shore is similar to the southern shore, although with a diminishing cover of seaweed moving north, as the elevation of the base of the embankment gradually rises. Along the northern embankment the large rock armour elements have scattered yellow lichens above and fine *Enteromorpha* cover below and a very narrow zone of *F. vesiculosus* at their base. Extending out from the base over mud is a narrow, (~1m) *Ascophyllum* zone. *Elminius* barnacles are also present at the base of the boulders.

A total of three infaunal sampling stations were surveyed in the open soft sediment area of WF1, where soft sediment communities typical of upper estuarine habitats were identified. Overall species diversity is low in the area, with the fauna present dominated by the polychaete worms, *Hediste diversicolor* and *Streblospio sp.*, which are characteristic of the upper estuarine biotope LS.LMu.UEst.Hed.Str (*Hediste diversicolor* and *Streblospio shrubsolii* in littoral sandy mud). These species are present in significant numbers at each of the three survey sites in this area. The sediment present consists of sandy muds across all three sites (ranging from 37% muds to 70% muds), with anoxia present at a depth of 1cm at each sample location. Loss on ignition (LOI) values for the water feature range from 4% - 5%. This is typical for this biotope type.

Based on Fossitt 2000, the habitats present in WF1 would fall under three headings: Coastal Construction, CC1 - sea wall, piers and jetties and the related LR3 – sheltered rocky shores, and LS4 – mud shores. Under the JNCC Marine Habitat classification the hard benthos areas are best described by LR.LLR.FVS.AscVS (*Ascophyllum nodosum* and *Fucus vesiculosus* on variable salinity mid eulittoral rock) with the soft benthos biotopes identified as LS.LMu.UEst.Hed.Str (*Hediste diversicolor* and *Streblospio shrubsolii* in littoral sandy mud).

Plate1 WF1-A (muddy sand area); B (NE corner of hard substrate); C, D, E (eastern, southern and western rock-armour embankment with heavy brown seaweed cover; F (northern embankment with narrow basal fringe of brown seaweeds).

Water Feature 2

WF2 is roughly rectangular in shape and is typified by having steep rock-armour shores (on 3 sides) with smaller and more sloped areas of exposed soft sediment than most of the other water features (Plate 2A-2D). Water enters and exits at the northern and southern ends via single large culverts; the southern culvert exiting directly to Lough Mahon.

The eastern rock armour shore has the best developed seaweed cover and hard substrate zonation patterns. The top of the shore, below the heavy terrestrial scrub, has a fairly well defined yellow lichen zone (~1.8m) followed in turn down the shore by a zone of fine *Enteromorpha* cover on bare boulders (~1m), a narrow *Fucus vesiculosus* zone (~0.6m), the main *Ascophyllum nodosum* zone (~3.3.) leading on to the sandy, mud lower shore (Plate 2E & 2F). The mid to lower rock armour elements, beneath their *Ascophyllum* cover, were coated in a fine adherent layer of mud with scattered, locally common numbers of the barnacle *Elminius modestus* on vertical rock faces and very occasional mussels (*Mytilus edulis*) between boulders within the heavy seaweed cover zone. The western shore mainly lacked the hard substrate.

The soft sediment areas of WF2 are narrow intertidal areas principally along the eastern shoreline of the feature. The fauna present is typical of upper estuarine systems, being dominated by Oligochaetes. Anoxia was present at a depth of 1-2cm in this area and a layer of gravel was present at a depth of 10cm. This is characteristic of the LS.LMu.UEst.Hed.OI (*Hediste diversicolor* and oligochaetes in littoral mud) biotope identified here. Sediments consisted primarily of gravelly muds (reflecting the gravel layer present in the area) with LOI values of 5% recorded in the area.

It may be noteworthy to point out that WF2 and WF3 both had the lowest % mud content in the sediments samples taken i.e. 31% and 22% respectively, which is thought to relate to the more dynamic water movements through these, the narrowest of the water features in the study area.

Based on Fossitt 2000, the habitats present in WF2 would fall under three headings: Coastal Construction, CC1 - sea wall, piers and jetties and the related LR3 – sheltered rocky shores, and LS4 – mud shores. Under the JNCC Marine Habitat classification the hard benthos areas are best described by LR.LLR.FVS.AscVS (*Ascophyllum nodosum* and *Fucus vesiculosus* on variable salinity mid eulittoral rock) with the soft benthos biotopes identified as LS.LMu.UEst.Hed.OI (*Hediste diversicolor* and *oligochaetes* in littoral mud).

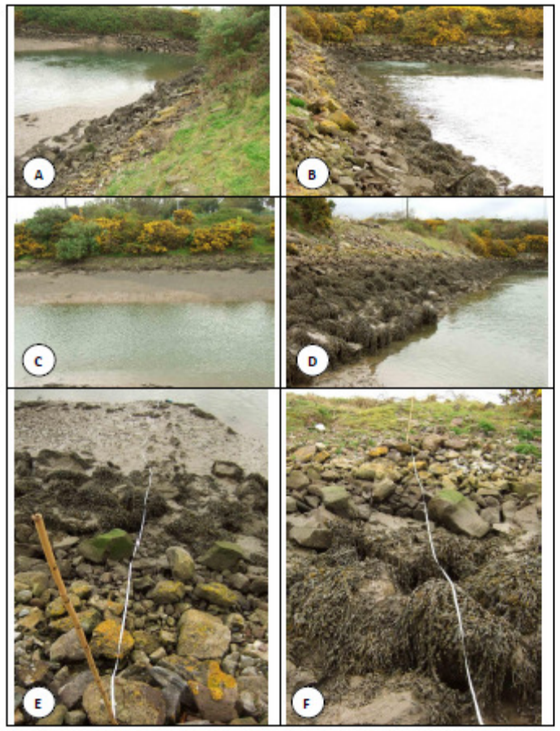


Plate2 WF2-A (view to southern outlet); B (view to northern inlet); C, (eastern shore without rock armour); (D) (western rock armour shore dominated by brown seaweed); E and F (view of eastern shore transect down-shore and up-shore views)

Water Feature 3

Water Feature 3 is very similar in general form to WF2, with which it is directly connected by a large culvert at its southern end. The western boundary embankment of WF3 comprises large rock armour elements dominated by a heavy growth of *Ascophyllum* and sloping steeply down to a sandy mud, narrow, low water base (Plate 3A). The eastern boundary with WF4 has a more gently sloping embankment with smaller rock-armour components; it also is dominated by *Ascophyllum* (Plate 2B). A few features of WF4 distinguish it from WF2 the first of which is a small narrow stream valley joining it from the north which is overwhelmingly dominated by *Fucus ceranoides*, a brown seaweed associated generally with sheltered low salinity areas at the head of estuaries (Plate 3C). Another is the presence of four large culverts connecting with WF4 at the site of the old Inchera Bridge (Plate 3D & 3F). The most northerly of these culverts in particular is associated with high tidal velocities at certain stages in each tidal cycle. These currents have the effect of increasing the local density of filter feeding species (hydroids, barnacles and mussels) and reducing the presence of silt and being associated with more fine red algae, including *Rhodothamniella floridula* on current swept rocks. This was also a feature noted in WF1 along the southern embankment where water flushed tidally through crevices in the rock armour. On the rock armour on the west side of WF3, immediately opposite the most northerly culvert, *Fucus serratus* is present at the base of the rock-armour (Plate 3E), the only water feature where it was noted other than in WF1, presumably because of the combination of sufficiently stable substrate and lower shore depth. In the other water features to the east, there may be no lower shore *per se* because their floor levels are too much above chart datum. The zonation pattern noted along the main rock armour section in WF3 saw an upper band of *Enteromorpha*, followed by a narrow band of *F. vesiculosus* and then the main band of *Ascophyllum* with high cover values. In the northern inlet to the site, the entire intertidal below the top *Enteromorpha* zone comprises *F. ceranoides*. The small low tide freshwater stream entering at this point was dominated by high densities of *Gammarus* amphipods.

The soft sediment areas of WF3 consist of narrow intertidal stretches of running parallel and adjacent to the rock armour shoreline. The infauna present is typical of upper estuarine systems, being dominated by Oligochaetes. Anoxia was present at a depth of 1-2cm in this area and a layer of gravel was present at a depth of 10cm, such as that identified in WF2. This is characteristic of the LS.LMu.UEst.Hed.Ol (*Hediste diversicolor* and oligochaetes in littoral mud) biotope identified here. Sediments consisted primarily of gravelly muds (reflecting the gravel layer present in the area) with LOI values of nearly 8% recorded in the area.

Based on Fossitt 2000, the WF3 habitats would fall under three headings: Coastal Construction, CC1 - sea wall, piers and jetties and the related LR3 – sheltered rocky shores and LS4 – mud shores. Under the JNCC Marine Habitat classification the hard benthos areas are best described by LR.LLR.FVS.AscVS (*Ascophyllum nodosum* and *Fucus vesiculosus* on variable salinity mid eulittoral rock) and LR.LLR.FVS.Fcer *Fucus ceranoides* on reduced salinity eulittoral rock in the northern narrow valley of the freshwater stream. Soft benthos biotopes were identified as LS.LMu.UEst.Hed.Ol (*Hediste diversicolor* and *oligochaetes* in littoral mud).

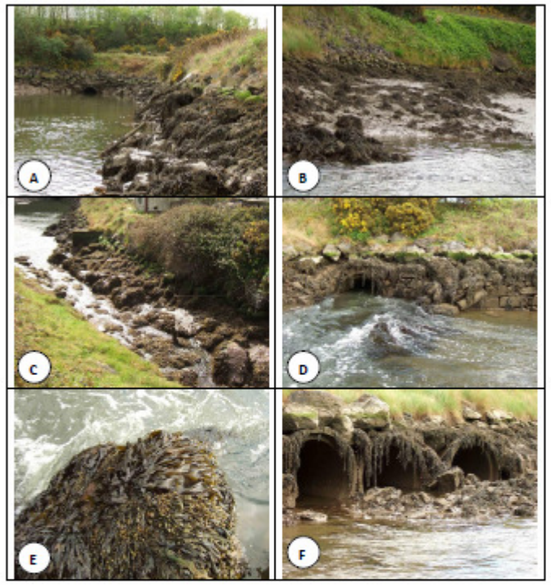


Plate 3 WF3-A (view to southern outlet from western shore); B (view to SE along eastern shore); C, (northern inlet stream valley with *Fucus ceranoides* – view to south); (D) (inlet culvert from WF4 showing strong flow); E (silt-free *F. serratus* and *Ascophyllum* on current swept boulders); F (three inlet culverts from WF4)

Water Feature 4

WF4 immediately east of WF3 is dominated by a sandy mud floor for about 60-75% of its area (Plate 4A & 4B) with the balance covered by saltmarsh situated in the eastern and north eastern portions of the feature. A culvert in the north eastern sector connects with WF7 and WF8 farther to the east (Plate 4C), while another in the south east connects with WF5 and WF6 just to the south (Plate 4D). The hard substrate intertidal areas on the perimeter of the site are generally narrow, usually no more than 3-4 m in width, although stretching to about 7m at the western end of the southern shore. The substrate comprises large angular cobble and small boulder along the western embankment (adjoining WF3), along a short portion of the northern shore toward its western end (Plate 4E), along both sides of the finger-like causeway which flanks the inlet channel from WF7 and WF8 (Plate 4c), and along the southern shore around the inlet of the culvert from WF5 and WF6 and for a further 150-200m west along the southern shore where an old wall has a lower fringe of angular cobble and small boulder (Plate 4G). Elsewhere, the intertidal comprises mainly gravel and pebble over sandy or gravelly mud e.g. along the northern shore as far as the inlet from WF7 and WF8, and along the eastern and westerns ends respectively of the southern shore (Plate 4H). These hard intertidal substrates allow macroalgae (seaweeds) to become established, whereas outside these areas saltmarsh or sandy mud predominate and in fact provide the overwhelming area of habitat within WF4.

The western half of the northern shore is shallow and gravelly with some flat cobble toward the top of the shore. A transect here recorded the red alga *Bostrychia scorpioides* at the head of the shore (0-0.8m), followed by a narrow zone of *Fucus vesiculosus* (0.8-1.0m), followed by *Ascophyllum* (1.0-3.0m) which was by far the dominant species in terms of biomass. *Enteromorpha* was sporadically present at the top of the shore on angular cobble. All long the rock armour embankment fringing the inlet channel from WF7 and WF8 (Plate 4C), *Ascophyllum* cover dominates the intertidal with narrow fringes of *Enteromorpha* and *Fucus vesiculosus* at the top of the shore. Along the southern shore, east of the inlet from WF5 and WF6, the narrow hard substrate intertidal comprises angular cobble at the top of the shore, with gravel merging into gravelly mud below. The top (0-1.2m) is dominated by *Enteromorpha* with scattered *Fucus spiralis/F. vesiculosus*, with the balance (1.2-3.3m) dominated by *Ascophyllum*. Farther west a stone wall with more or less the same zonation pattern just described continues to the west and is replaced again by another low-gradient gravel intertidal of up to 6-7m in width, with the same three species dominating (*Enteromorpha*, *Fucus vesiculosus* and in particular *Ascophyllum*) (Plate 4H) as far as the western embankment which separates WF4 from W3. The most frequently encountered fauna were amphipods beneath the seaweed cover and occasional small shore crab. The barnacle *Elminius modestus* was common on all the inlet-outlet culverts. Mussels (*Mytilus edulis*) were also concentrated in areas of strong tidal currents by the outlet/inlet culverts to WF3.

The soft sediment present in WF4 consists of sandy muds across the whole feature (values ranging from 43% Mud to 58% Mud), with anoxia present at a depth of 1-2cm and LOI values of approximately 8% were recorded in the area. Bird tracks were present in large parts of the area. The fauna present in WF4 are dominated by the polychaetes *Hediste diversicolor* and *Streblospio sp.*, as well as the arthropod *Cyathura carinata* which are typical of upper estuarine systems. The soft sediment in WF4 has been classified as LS.LMu.UEst.Hed.Str (*Hediste diversicolor* and *Streblospio shrubsolii* in littoral sandy mud).

Based on Fossitt 2000, the WF4 habitats would fall under three headings: Coastal Construction, CC1 - sea wall, piers and jetties and the related LR3 – sheltered rocky shores and LS4 – mud shores. Under the JNCC Marine Habitat classification the hard benthos areas are best described by LR.LLR.FVS.AscVS (*Ascophyllum nodosum* and *Fucus vesiculosus* on variable salinity mid eulittoral rock) with the soft benthos biotopes identified as LS.LMu.UEst.Hed.Str (*Hediste diversicolor* and *Streblospio shrubsolii* in littoral sandy mud).

Plate 4 WF4-A (mud and saltmarsh – view to NNW from SE shore); B (view west from mid way along southern shore); C. (inlet channel from WF7 & WF7 and flanking embankment – NE shore); (D) (hard intertidal adjoining inlet culvert from WF5 &WF6 on southern shore); E (rock-armour base of wall on western end of northern shore); F (*Bostrychia* on cobble on upper shore); G (hard substrate base of old stone wall – mid way on southern shore; H (gravel intertidal with brown macroalgae on western end of northern shore)

WF5

This water feature was almost entirely dominated by sandy muds with small saltmarsh areas toward the western end (Plate 5A) and scattered hard substrate, comprising cobble and pebble over the mud at the eastern end, mainly along the southern shore (Plate 5B & 5C). The latter were dominated by *Ascophyllum* and scattered *F. vesiculosus* (Plate 5D). Scattered pieces of *Ulva* were in evidence across the main soft sediment area of WF5 (Plate 5E). At the outlet to WF6, *Elminius modestus* were common on the wall of the culvert (Plate 5G); a small shore crab was noted among gravel in the low water creek near the culvert.

The soft sediment areas of WF5 consist of sandy muds (with mud values of 48% recorded). Anoxia is present at a depth of 1-2cm and a layer of standing water covered 70% of the sediment surface. LOI values of 5.86% have been recorded in the area. The fauna identified in the area are low in diversity and are dominated by the polychaete *Hediste diversicolor* and the crustacean *Corophium sp.* And the site is typical of an upper estuarine system.

Based on Fossitt 2000, the WF5 habitats habitat would mainly be classified as LS4 – mud shores with a little LR3 – sheltered rocky shores, while under the JNCC Marine Habitat classification it can be best described by LR.LLR.FVS.AscVS (*Ascophyllum nodosum* and *Fucus vesiculosus* on variable salinity mid eulittoral rock) although this only refers to a very small portion of the water feature at its north eastern end. The soft sediment in the area is classified as LS.LMu.UEst.Hed.Cvol (*Hediste diversicolor* and *Corophium volutator* in littoral mud).

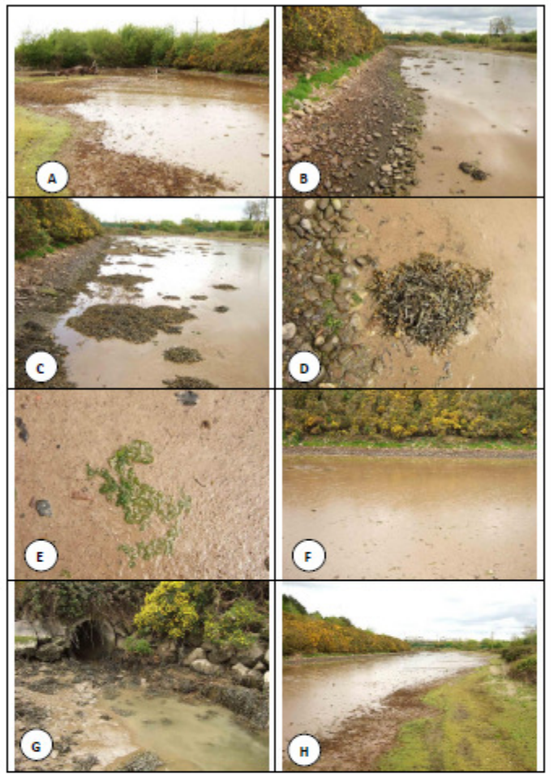


Plate 5 WF5-A (view to western end; note brown, decayed drift algae in foreground); B (view to east along eastern end of southern shore); C, (farther east along the shore from B); D (close-up of *Ascophyllum* and *F. vesiculosus* on mud); E (*Ulva* on mud); F (view toward northern shore mid-way along southern shore); G (outlet culvert to WF6 viewed from WF6); H (view east along northern shore).

WF6

Like WF5, WF6 was also dominated by soft sediment intertidal substrates. However, it also has greater amounts of fringing saltmarsh vegetation, along the south west and the south eastern sections. In addition, the entire northern shore comprised a low rock-armour embankment where the main biomass of brown seaweed within WF6 occurred. The separating wall between WF6 and WF5 at the western end also had heavy growths of brown macroalgae. At the south eastern corner of the southern shore a pipe conveyed surface water from industrial hardstand areas immediately to the south (Plate 6A) while farther west along the same shore two further culverts conveyed freshwater flows from the southern side into the water feature (Plate 6C). These inputs may explain the prominence of *Fucus ceranoides* along the eastern end of WF4 over intertidal gravel, among the bases of sea club-rush (Plate 6B) at the outer fringes of the saltmarsh vegetation, and along parts of the southern wall. Most of the northern embankment was not accessible (Plate 6E) but it is suggested that the eastern end of this was dominated by *F. ceranoides*, which was replaced closer to the north western corner and the outlet culvert to WF4 by *Ascophyllum* which was the dominant intertidal alga in the western and north western areas of the water feature (Plate 6F & 6G).

The extensive soft sediment areas of WF6 consist of soft muds and sandy muds (mud values ranging from 46% to 69%), with anoxia present at a depth of 1cm. Faunal diversity in the area is low, with infauna dominated by the polychaete worms *Hediste diversicolor* and *Streblospio* sp. as well as the crustacean *Cyathura carinata*. The water feature is typical of an upper estuarine system.

Based on Fossitt 2000, the WF6 habitats would fall under three headings: Coastal Construction, CC1 - sea wall, piers and jetties and the related LR3 – sheltered rocky shores and LS4 – mud shores. Under the JNCC Marine Habitat classification it can be best described by LR.LLR.FVS.AscVS (*Ascophyllum nodosum* and *Fucus vesiculosus* on variable salinity mid eulittoral rock) and LR.LLR.FVS.Fcer *Fucus ceranoides* on reduced salinity eulittoral rock. The expanse of soft sediment in the area is classified as LS.LMu.UEst.Hed.Str (*Hediste diversicolor* and *Streblospio shrubsolii* in littoral sandy mud).

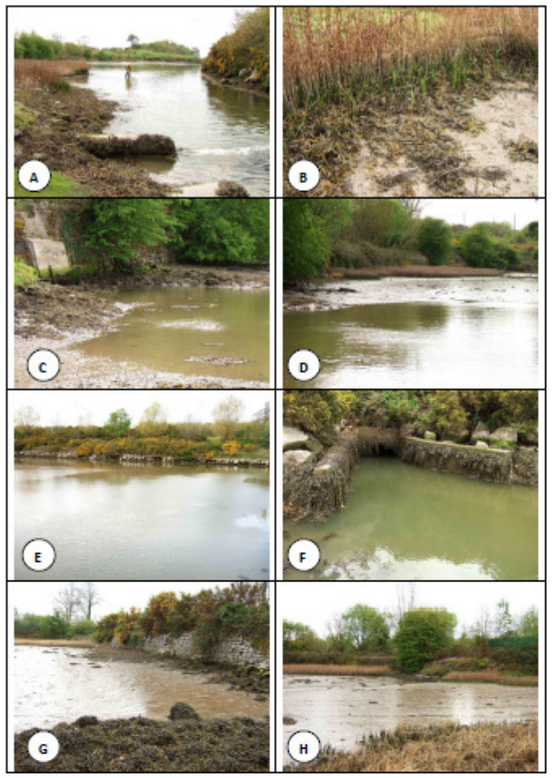


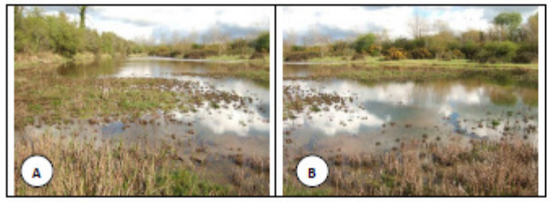
Plate 6 WF6-A (view to west from NE end, note surface water outlet pipe in foreground); B (*F. ceranoides* at margins of sea club-rush stand); C, (stream inlet non-return valve southern shore, eastern end); D (southern shore showing sea club-rush stands); E (northern shore with low rock armour embankment); F (outlet culvert to WF4 – SW corner); G (old boundary wall-western end); H (NW shore viewed from WNW corner)

WF7

This water feature was devoid of hard intertidal substrate and no macroalgae other than scattered floating sections of *Ulva* were in evidence as well as a shallow monoculture of the blue-green alga *Oscillatoria cf. limosa* at the western end of the feature (Plate 7C & 7D). Scattered saltmarsh / marshy vegetation was also present along the eastern shore (Plate 7A & 7B).

The soft sediment in the area was under a thin layer of standing water, approximately 2-3cm deep. The sediment consisted of firm muds, with a lot of plant material present within the sediment matrix. This is reflected in the high LOI values recorded at this WF – 15%. The dominant species were the polychaete *Hediste diversicolor* and the crustacean *Corophium volutator*. As with other features in this system, diversity was low - only 3 species were recorded.

Based on Fossitt 2000, the WF7 habitats would best be described as LS4 – mud shores. Under the JNCC Marine Habitat classification the soft sediment is classified as LS.LMu.UEst.Hed.Cvol (*Hediste diversicolor* and *Corophium volutator* in littoral mud).



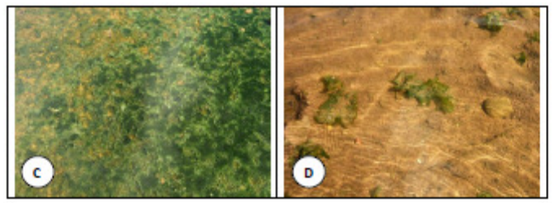


Plate 7 WF7-A (view to east from western); B (view to the SSE from NW shore); C, (close-up of blue-green algal, *Oscillatoria*, cover at western end of WF7; D (*Ulva* over sandy mud)

WF8

This, the most easterly water feature was dominated with open shallow mud (Plates 8A & 8B) fringed by saltmarsh (sea club-rush) vegetation mainly along the southern, eastern and western areas. There were virtually no hard intertidal areas *per se*, with *Fucus ceranoides*, either attached to submerged dead tree branches (Plate 8C), especially along the northern and north eastern margins, or in marginal drift, especially around the edges of club-rush stands. The salinity at low tide at the eastern side of the water feature was measured as 21.3‰ on April 10th Along the western end of the northern shore *F. ceranoides* as a mixture of drift and loosely attached formed a 4m wide band. *Enteromorpha* was occasionally noted along the northern shore in a shallow tidal channel. The western end of WF8 is partly separated from the main waterbody by a north-south running embankment lined with trees and scrub (Plate 8E). This western site is a little deeper. It is also dominated by *Fucus ceranoides* attached to submerged branches in marginal drifts among the saltmarsh vegetation or attached to marginal cobbles at the base of the far western boundary of the site (Plate 8F); some *Enteromorpha* was also present here just above the *F. ceranoides*. Saltmarsh vegetation is dominant in this portion of WF8 (Plate 8D).

The soft sediment areas of WF8 consist of soft muds (mud values ranging from 37% to 47%). Anoxia was present at a depth of 3-4cm across the site and a layer of vegetation was present at a depth of 10cm in the area, which is reflected by LOI values of 10%. The fauna identified in the area are low in diversity and are dominated by the polychaete *Hediste diversicolor* and the crustacean *Corophium sp.* which are typical of this upper estuarine biotope.

Based on Fossitt 2000, the WF8 habitats would fall under LS4 – mud shores, while under the JNCC Marine Habitat classification they can be best described by LR.LLR.FVS.Fcer *Fucus ceranoides* on reduced salinity eulittoral rock, although in the case of WF8, hard substrate was very restricted. The soft sediment in the area is classified as LS.LMu.UEst.Hed.Cvol (*Hediste diversicolor* and *Corophium volutator* in littoral mud).

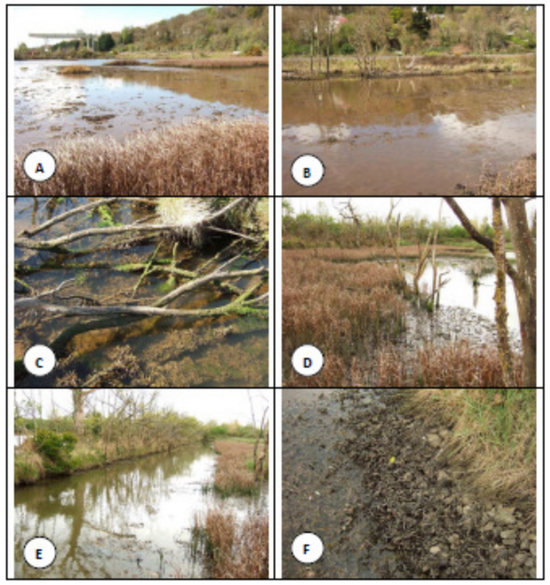


Plate 8 WF8-A (view to west from SE end); B (View of north eastern shore from south eastern shore); C, (submerged branches in northern boundary low-tide channel with attached *F. caranoides* and *Enteromorpha*); D (far western part of WF8 with sea-club-rush stands and areas of drifting *F. caranoides*); E (view of scrub & tree covered embankment separating main body of WF8 from western portion – view from north to SSE); F (*F. caranoides* on small inter-tidal angular cobble on far western embankment boundary of WF8)

Mysid Survey

Mysids were caught in low densities in each of the water features where they were searched for. Table II gives the species and numbers encountered. Only two species were recorded *Praunus flexuosus* and *Neomysis integer*, both very widespread and common species. *P. flexuosus* was only noted in WF1 and WF4 whereas *Neomysis integer* occurred in the farthest easterly water feature. *N. integer* is known to be more euryhaline than *Praunus flexuosus* which may partly explain why the former dominated in the water features farthest from Lough Mahon.

Table II: Species/Abundance table for Mysid survey undertaken at selected Water Features in the survey area.

	WF1	WF4	WF6	WF8	WF8 West section
Praunus flexuosus	5	5	-	-	-
Neomysis integer	-	16	20	12	8

Appendix 1A: Faunal taxa/Abundance table. Data is presented as per 0.01m^2 (for reps A, B & C) or 0.25m^2 (for dig samples).

	WF1-1 A	WF1-1 B	WF1-1 C	WF1-1 Dig	WF1-2 A	WF1-2 B	WF1-2 C	WF1-2 Dig	WF1-3 A	WF1-3 B	WF1-3 C	WF1-3 Dig	WF2-1 A	WF2-1 B	WF2-1 C	WF2-1 Dig
Hediste diversicolor	16	11	11	7	18	16	11	19	11	9	10	24	2	-	1	-
Corophium sp.	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Streblospio sp.	25	33	23	-	30	7	18	-	13	19	6	-	-	6	8	-
Oligochaeta spp.	7	7	7	-	17	6	11	-	25	29	23	-	87	52	243	-
Cyathura carinata	5	7	3	-	7	6	9	-	-	-	-	-	-	-	-	-
Scrobicularia plana	2	-	1	5	1	-	1	1	-	-	-	2	-	1	1	-
Hydrobia ulvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tharyx sp.	-	-	-	-	-	-	-	-	-	-	-	-	2	3	1	-
Spionidae indet.	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polydora sp.	-	1	-	-	-	-	-	-	-	2	-	-	-	1	-	-
Nephtys hombergii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	WF3-1 A	WF3-1 B	WF3-1 C	WF3-1 Dig	WF4-1 A	WF4-1 B	WF4-1 C	WF4-1 Dig	WF4-2 A	WF4-2 B	WF4-2 C	WF4-2 Dig	WF4-3 A	WF4-3 B	WF4-3 C	WF4-3 Dig
Hediste diversicolor	9	6	5	15	4	3	3	-	13	10	8	15	2	4	1	15
Corophium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Streblospio sp.	7	7	19	-	34	25	39	-	11	9	6	-	23	18	19	-
Oligochaeta spp.	168	196	243	-	47	90	62	-	-	6	4	-	1	9	2	-
Cyathura carinata	1	-	-	-	8	1	1	-	4	6	5	-	3	11	1	-
Scrobicularia plana	1	-	1	1	-	-	-	1	-	-	-	-	-	-	-	1
Hydrobia ulvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tharyx sp.	-	-	-	-	6	13	5	-	2	6	-	-	-	-	-	-
Spionidae indet.	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Polydora sp.	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nephtys hombergii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix 1A contd.: Faunal taxa/Abundance table. Data is presented as per 0.01m^2 (for reps A, B & C) or 0.25m^2 (for dig samples).

	WF5-1 A	WF5-1 B	WF5-1 C	WF5-1 Dig	WF6-1 A	WF6-1 B	WF6-1 C	WF6-1 Dig	WF6-2 A	WF6-2 B	WF6-2 C	WF6-2 Dig	WF7-1 A	WF7-1 B	WF7-1 C	WF7-1 Dig
Hediste diversicolor	14	13	16	-	3	10	6	2	15	16	8	11	12	8	14	-
Corophium sp.	37	33	25	-	-	-	-	-	-	-	-	-	8	14	25	-
Streblospio sp.	3	8	4	-	24	43	18	-	12	5	21	-	-	5	3	-
Oligochaeta spp.	1	2	-	-	13	37	9	-	2	1	5	-	-	-	-	-
Cyathura carinata	-	-	-	-	9	10	6	-	3	2	6	1	-	-	-	-
Scrobicularia plana	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Hydrobia ulvae	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tharyx sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spionidae indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polydora sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nephtys hombergii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	WF8-1 A	WF8-1 B	WF8-1 C	WF8-1 Dig	WF8-2 A	WF8-2 B	WF8-2 C	WF8-2 Dig	Lee 1 A	Lee 1 B	Lee 1 C	Lee 1 Dig	Lee 2 A	Lee 2 B	Lee 2 C	Lee 2 Dig
Hediste diversicolor	33	29	20	-	30	29	22	-	1	1	-	-	-	-	-	-
Corophium sp.	17	22	15	-	22	22	27	-	-	-	-	-	-	-	-	-
Streblospio sp.	-	-	1	-	-	-	1	-	2	4	7	-	3	6	4	-
Oligochaeta spp.	-	3	2	-	1	-	-	-	1	-	1	-	-	4	2	-
Cyathura carinata	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scrobicularia plana	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-
Hydrobia ulvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tharyx sp.	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Spionidae indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polydora sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nephtys hombergii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-

Appendix 1B: Intertidal flora and fauna taxa reordered in intertidal hard substrate areas

	WF1	WF2	WF3	WF4	WF5	WF6	WF7	WF8
Enteromorpha sp.	x	x	x	x	x	x	x	x
Ulva	x	-	-	-	x	-	x	-
Oscillatoria c.f. limosa	-	-	-	-	-	-	x	-
Fucus spiralis	x	x	x	-	-	-	1	-
Fucus vesiculosus	x	x	x	x	-	x	-	-
Fucus ceranoides	-	-	x	-	-	x	-	x
Fucus serratus	x	-	x	-	-	-	-	-
Ascophyllum nodosum	x	x	x	x	x	x	-	-
Polysiphonia lanosa	x	x	x	-	-	-	-	-
Ceramium sp.	x	x	x	x	-	-	-	-
Bostrychia scorpioides	-	-	-	-	-	-	-	-
Gammarus sp	x	x	x	x	x	x	x	x
Lekanesphaera sp.	x	-	-	-	-	-	-	-
Neomysis integer	x	-	x	x	-	x	-	x
Praunus flexuosus	x	-	-	-	-	-	-	-
Elminius modestus	x	x	x	x	x	x	-	-
Mytilus edulis	x	x	x	x	-	-	-	-

Appendix 2: Granulometry and Loss on Ignition results for all soft sediment sites surveyed.

Site	% Gravel	% Sand	% Mud	% LOI
WF1-1	0.00	62.99	37.01	3.92
WF1-2	1.93	49.47	48.60	4.58
WF1-3	0.00	29.00	71.00	5.25
WF2-1	38.73	30.06	31.21	5.34
WF3-1	42.12	35.84	22.04	7.90
WF4-1	0.00	41.74	58.26	8.73
WF4-2	0.85	55.75	43.40	7.68
WF4-3	0.38	51.71	47.91	7.60
WF5-1	0.00	52.04	47.96	5.86
WF6-1	6.58	47.85	45.57	5.91
WF6-2	0.24	30.68	69.08	8.88
WF7-1	0.00	59.25	40.75	15.29
WF8-1	0.00	52.76	47.24	9.81
WF8-2	0.76	62.71	36.54	11.66
Lee 1	0.00	34.29	65.71	7.24
Lee 2	0.00	55.39	44.61	9.50