
**Aquatic macro-invertebrate monitoring at
Paul Holme Strays, East Yorkshire
May 2007**

A report for the Environment Agency

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Summary

The creation of new inter-tidal habitat at Paull Holme Strays (East Yorkshire) necessitated the loss of an established borrow pit with a rich invertebrate fauna but resulted in the creation of a new pond along with extensive new dykes behind the re-aligned Humber Bank in 2003. The macro-invertebrates of these new water bodies have been monitored during spring visits since 2004. The usual four sampling points were re-visited in May 2007.

Sampling in May 2005 confirmed that the car park pond (SP1) has become highly saline with the loss of the pioneer freshwater invertebrate community recorded in 2004. Indeed by May 2006, the only 'core' species¹ of macro-invertebrate found was the brackish water amphipod *Gammarus zaddachi*. By May 2007, there had been a marked recovery with seven core taxa present, four of which are obligately brackish water species and three of which are freshwater species which tolerate some salinity.

In May 2006, the car park dyke (SP2) also appeared to have become increasingly saline though not to the same extreme as the pond. This water body was by then dominated by *Gammarus zaddachi* and the lesser water-boatman *Sigara stagnalis* with additional brackish water indicators including the amphipod *Corophium volutator*. By May 2007, the dyke showed some amelioration in salinity but remained markedly brackish. Its continuing and consistent brackishness is indicated by the presence of new indicator species such as a marine polychaete (*Nereis* sp) and the Lagoon Slater *Idotea chelipes*, a characteristic invertebrate of saline lagoons. *Corophium volutator* was recorded again and other brackish indicators included the water beetles *Enochrus bicolor* and *Ochthebius marinus*.

A water sample collected from the car park dyke on 21st August 2006 produced an electrical conductivity reading of 24.4 mS/cm⁻¹ with a pH of 8.7. A sample collected on 8th May 2007 produced an electrical conductivity reading of 12.68 mS/cm⁻¹ with a pH of 8.4. Conductivity (a measure of ionic content) had almost halved between these two readings but this probably masks marked seasonal fluctuations in salinity.

As in previous years, by far the richest location was Sampling Point 3, the western soke dyke. This is a section of dyke with complex vegetation structure including a mosaic of shallow pools and patches of tall emergents. This sampling point yielded 43 core taxa including four scarce beetles, as well as the Nationally Scarce soldier fly *Stratiomys singularior*. This compares to 44 taxa the previous year and 45 in 2005². The water bug assemblage is now that of a mature, well-vegetated habitat, lacking pioneer Corixidae.

¹ Core taxa are here defined as aquatic and semi-aquatic Coleoptera, aquatic Heteroptera, larval Odonata, Trichoptera and Ephemeroptera, aquatic Isopoda, Amphipoda and Decapoda, aquatic Molluscs, leeches and polychaetes. A few other taxa are listed in Appendix 1 (e.g. spiders, soldier fly larvae) for the sake of completeness.

² Due to the unreliability of keys to the larvae of 'blue' damselflies (Coenagriidae), these should now be treated as a single taxon for monitoring purposes, resulting in a very minor re-adjustments of the figures given in previous reports.

Recruitment of mollusc species appears to be slow with the same species present since 2005.

The most easterly dyke section (Sampling Point 4) has a species-poor brackish water invertebrate fauna with a few tolerant freshwater taxa still present. This ‘simple’ community is characterised by the lesser water boatman *Sigara stagnalis*, the snail *Potamopyrgus antipodarum*, *Gammarus zaddachi* and large numbers of the prawn *Palaeomonetes varians*.

In April 2004, five brackish water indicator species were recorded from the new water bodies: the water beetles *Haliphus apicalis*, *Agabus conspersus* and *Enochrus bicolor*, the caddis fly *Limnephilus affinis / incisus* and the amphipod *Gammarus zaddachi*. In May 2005, four indicator species were recorded including the lesser water boatman *Sigara stagnalis*. In May 2006, all the previously recorded brackish indicators were present plus *Palaeomonetes varians*, *Corophium volutator* and the water beetles *Enochrus halophilus* and *Ochthebius marinus*. In May 2007, additional brackish water/marine taxa included the Lagoon Slater *Idotea chelipes* and the ragworm *Nereis* sp (see Table 1).

Six core species listed as Nationally Scarce were recorded in April 2004, two in May 2005, seven in May 2006 and six in May 2007. All of these have been water beetles, though larvae of a Nationally Scarce soldier fly were also found in 2006 and 2007 (Diptera larvae have not been counted as core taxa).

Table 1: Brackish water indicator taxa and scarce species (core taxa) recorded from the new water bodies at Paull Holme Strays.

Survey	Brackish water species	Scarce species
April 2004	5	6
May 2005	4	2
May 2006	10	7
May 2007	10	6

Species newly recorded from the water bodies in May 2007 included the isopod *Idotea chelipes*, the ragworm *Nereis* sp., the diving beetle *Hydroporus angustatus* and the marsh beetle *Cyphon laevipennis*. This compares with nine new species recorded in May 2006, perhaps suggesting that the freshwater component of the fauna is now relatively stable.

1. Introduction

This report refers to new water bodies formed as part of the Paull Holme Strays managed realignment scheme in 2003. This scheme necessitated the loss of a large borrow pit behind the old Humber bank which had supported a rich aquatic insect fauna including several scarce water beetles associated with low-end brackish conditions. The new scheme created a pond and extensive new dykes immediately inland of the new flood bank.

A macro-invertebrate survey of the new water bodies was undertaken in mid April 2004 to provide baseline data on the colonising fauna. Collectively, the pond and dykes were found to support several brackish water specialists including the amphipod *Gammarus zaddachi*, the caddis *Limnephilus affinis / incisus* and the water beetles *Haliphus apicalis*, *Agabus conspersus* and *Enochrus bicolor*. Most other taxa were freshwater or ecologically wide-ranging species. The pond supported a notable suite of small diving beetles characteristic of raw, early-successional standing waters including the scarce *Hygrotus nigrolineatus* and *Scarodytes halensis*.

The survey was repeated on 4th May 2005 to assess subsequent changes, using the same four sampling points. The pond had become much more saline with a corresponding loss of invertebrate diversity but the dyke at Sampling Point (SP) 3 was species-rich and productive.

A further monitoring visit on 3rd May 2006 confirmed that the pond had become highly saline with *Gammarus zaddachi* being the only 'core' taxon detected; no beetles, water bugs, Odonata or molluscs could be found. The car park dyke also had a markedly brackish fauna dominated by *G. zaddachi* and the lesser water-boatman *Sigara stagnalis*. Increased salinity was also indicated in the eastern soke dyke (SP4) but the western soke dyke again produced a species-rich fauna dominated by water beetles.

On 8th May 2007, each sampling point was surveyed using the same methodology as in previous years. At each sampling point, all meso-habitats present (e.g. open water, submerged vegetation, trailing grasses) were worked vigorously with the pond net until no further taxa could be found. Fieldwork was undertaken by R. Merritt and M. Hammond. Material was identified either in the field or by RM in the laboratory. Species lists for each sampling point are provided at Appendix 1. An aggregated species list for core taxa recorded in May 2007 is provided at Appendix 2. Appendix 3 is a list of all core taxa recorded from April 2004 onwards.

2. Sampling sites

SP1: Car Park Pond. A steep-sided pond near the visitors' car park (TA 1800 2512), created in 2003. As in 2006, the water had a marked salty tang and contained little submerged vegetation. There were fragments of spiked water milfoil (*Myriophyllum spicatum*), fennel pondweed (*Potamogeton pectinatus*) and horned pondweed (*Zannichellia palustris*) around the margins but these may have been uprooted from the adjacent dyke. There is a small patch of emergent grey club rush (*Schoenoplectus tabernaemontani*).

SP2: Car Park Dyke (TA 1798 2515). This dyke is now dominated by fennel pondweed with smaller amounts of horned pondweed (mainly in the shallow water at the edges of the channel) and occasional spiked water-milfoil. There are also stands of grey club-rush. Stonewort vegetation has completely disappeared. The western end of the dyke becomes muddy 'saltpan' habitat with small, very shallow trickles running through. There are small amounts of saltmarsh vegetation such as sea aster (*Aster tripolium*) and common

saltmarsh grass (*Puccinellia maritima*). A water sample from mid-way along the ditch produced a pH of 8.4 with electrical conductivity of 12,680 $\mu\text{S}/\text{cm}^{-1}$. Although this represents markedly brackish conditions, it is only around half the electrical conductivity recorded in August 2006.

SP3: Western Soke Dyke. This covers about 100 metres of new dyke to the east of South Pasture Drain (TA 1819 2477). This section of dyke continues to support diverse and structurally-complex vegetation including *Chara*, stands of brackish water-crowfoot (*Ranunculus baudotii*), spiked water-milfoil, trailing grasses and emergent swamp comprising common reed (*Phragmites australis*), sea club-rush (*Bolboschoenus maritimus*) and grey club-rush.

A water sample from mid-way along the ditch produced a pH of 7.3 with electrical conductivity of 2,090 $\mu\text{S}/\text{cm}^{-1}$; previous samples have produced pH readings of 8.6 (May 2005) and 8.4 (May 2006). This represents a significant drop in pH but there is no obvious environmental cause for this, and no indication of any change in vegetation structure.

SP4: Eastern Soke Dyke. This is a section of the same dyke east of a sluice which receives inflow from agricultural drains (TA 1890 2411). This is a steep-sided trapezoidal channel with a simple vegetation structure: submerged weed beds are dominated by horned pondweed with patches of emergent swamp dominated by common reed.

3. Results

3.1 Invertebrate assemblages

Aquatic Coleoptera (beetles)

28 species of aquatic or semi-aquatic beetle were recorded in May 2007 compared to 33 in May 2006, 30 in May 2005 and 38 in April 2004. Of 51 species recorded from April 2004 onwards, 55% were recorded during the most recent survey. Newly-recorded species in May 2006 included the diving beetle *Hydroporus angustatus* and the marsh beetle *Cyphon laevipennis*. The apparent reduction in water beetle diversity does reflect the loss of some pioneer species which were found in the car park pond before it became saline; changes since have probably not been significant. As usual, by far the richest sampling point was SP3, with 26 species.

The pond and car park dyke produced only *Enochrus bicolor*, *Ochthebius marinus* and, in the dyke, the aquatic weevil *Phytobius leucogaster*. The first two species can tolerate quite saline conditions; *P. leucogaster* appears to be capable of surviving so long as its host plant (spiked water-milfoil) does. SP4 was almost bereft of water beetles.

Four indicators of brackish conditions were recorded from the new water bodies in May 2007 (*Haliphus apicalis*, *Agabus conspersus*, *Enochrus bicolor* and *Ochthebius marinus*), compared to five in 2006, three in spring 2004 and two in May 2005.

Six water beetles recorded in May 2007 are currently listed as Nationally Scarce³ (*Haliplus apicalis*, *Agabus conspersus*, *Enochrus bicolor*, *Enochrus melanocephalus*, *Ochthebius marinus*, *Phytobius leucogaster*). In previous surveys the equivalent number was six in April 2004, two in May 2005 and seven in May 2006. The regional (Yorkshire and Humber) status of these species can be updated as follows:

Haliplus apicalis: A small algivorous water beetle found in mildly brackish (or otherwise very solute-rich) water. *H. apicalis* is now recorded annually from the western soke dyke (SP3). There are modern records from ten hectads (10x10 km squares) in the region, mainly on the north bank of the Humber (from Broomfleet to Welwick) or around Teesmouth. It is only known from one site on the Lincolnshire side of the Humber and one on the east coast (Barmston), with two inland sites in North Yorkshire.

Agabus conspersus: A medium-sized, mottled diving beetle found in brackish water. There are modern records from nine hectads in the region, predominantly on the Humber where it occurs on both banks. It also occurs at Teesmouth but much more scarcely. This species is recorded annually from the new water bodies at Paull Holme Strays.

Enochrus bicolor: A scavenger water beetle found in brackish water, tolerating more saline conditions than many aquatic Coleoptera. There are modern records from seven hectads in the region, concentrated on the north bank of the Humber from Paull Holme Strays to Spurn. It has also been recorded from one site on the south bank of the estuary, at two brackish sites inland and one location on Teesmouth. Although it can sometimes be encountered in numbers, or as a wanderer, there are probably only a handful of regular breeding populations in the region. *E. bicolor* may now be established in the car park dyke.

Enochrus melanocephalus is a species of early successional habitats such as recently-created or cleaned-out ponds and ditches. It is sporadic rather than genuinely scarce and has recently expanded its range northwards into North-east England (Eyre et al, 2005)⁴. There are modern records from 18 hectads in the Yorkshire and Humber region. As in May 2006, a single specimen was collected from SP3.

Ochthebius marinus: A very small water beetle found in very shallow brackish pools or on exposed mud in coastal locations. There are modern records from seven hectads in the region: on the north bank of the Humber from Paull Holme Strays to Spurn, two sites on the Lincolnshire bank of the estuary and several around Teesmouth. *O. marinus* is well-established in the salt-pan at the western end of the car park dyke with small numbers occasionally found elsewhere.

Phytobius leucogaster: An aquatic weevil feeding on spiked water-milfoil. Known from two inland sites in South-west Yorkshire, Cowpen Marsh at Teesmouth and Paull Holme Strays, where it was first found in the old borrow pit in 2000. This species was recorded from three locations in 2006 and two in 2007.

³ Based on Foster (2000) or, for aquatic weevils, Hyman & Parsons (1992).

⁴ This species clearly no longer merits Nationally Scarce status but is listed here for the sake of consistency with previous reports.

Water bugs (Hemiptera – Heteroptera)

11 water bug species were recorded in May 2007, compared to the same number in May 2006, 13 in May 2005 and 16 in April 2004. A total of 21 water bugs have been recorded from April 2004 onwards, so just over half were detected during the most recent two surveys. This decline in diversity is due to the reduced number of lesser water-boatmen (Corixidae) associated with early successional freshwater habitats, resulting from elevated salinity and/or more mature vegetation cover. The only brackish water specialist recorded to date is *Sigara stagnalis*.

Trichoptera (caddis flies) and Ephemeroptera (mayflies)

The only caddis larvae recorded were all *Limnephilus marmoratus*, at SP3. Larvae of the *L. affinis* / *incisus* species-pair were found at three locations in May 2006 but none in 2007; this is probably not significant.

No mayfly larvae were collected in May 2007.

Odonata (damselflies and dragonflies)

Due to known problems with the published keys for British damselfly larvae, Coenagriidae were only recorded to family level in the present survey. Larvae of Four-spotted Chaser (*Libellula quadrimaculata*) were found in the western soke dyke (SP3). Set against the poor diversity of Odonata recorded in May 2007, ‘blue’ damselflies (Coenagriidae) have recolonised the pond and their larvae were plentiful in the car park dyke, presumably reflecting a reduction in the salinity of these water bodies.

Mollusca

Jenkin’s Spire Snail (*Potamopyrgus antipodarum*) has colonised the site since spring 2004, and was recorded from each sampling point in May 2007. Recruitment of mollusc species is slow with only four species recorded to date, all of which were present in the western soke dyke (SP3) in May 2007.

Isopoda and amphipoda

Of the ‘macro’ crustaceans, the amphipod *Gammarus zaddachi* remains abundant at all four sampling points. In the car park dyke (SP2), *Corophium volutator* was recorded for the second year, along with the newly-recorded isopod *Idotea chelipes*. The latter, known as the Lagoon Slater, is listed as a specialist of saline lagoons by Bamber et al (2001). No Yorkshire records are given by Fryer (1993), though his treatment of brackish habitats is cursory; *I. chelipes* is also known to occur at Easington Lagoons (SSSI citation).

The translucent brackish-water prawn *Palaeomonetes varians* is well-established in the eastern soke-dyke (SP4), where it is now abundant. It was first recorded at this location in May 2006, when several individuals were noted.

Other taxa

A ragworm (a marine Polychaete) belonging to the genus *Nereis* was collected from the car park dyke (SP2). Only a single specimen was found but benthic sampling (e.g. using a dredge) would give a better indication of the status of this species (and perhaps other marine polychaetes).

Several larvae of the Nationally Scarce soldierfly *Stratiomys singularior* were found in the western soke dyke (SP3), where this species was first found in 2006 (see previous report). This species is associated with mildly brackish conditions, often in high quality coastal grazing marsh ditches.

Terrestrial invertebrates recorded incidentally included a flat-backed millipede of the genus *Polydesmus* (exoskeletons on exposed mud in the car park dyke); and a specimen of the ground beetle *Notiophilus biguttatus* from the edge of the car park pond. A single Greenshank was feeding at the edge of the car park dyke. Three-spined Stickleback was found at each location. A few adult Smooth Newts and both Common Frog and Common Toad tadpoles were present in the western soke dyke (SP3).

3.2 Ecological trends

Over the site as a whole there was a doubling in the number of brackish water indicator species recorded between 2004 and 2006 (from five to ten), with the same number of indicators recorded in 2007 (Table 2). This trend is emphasized by the increased occurrence of crustaceans associated with markedly brackish or saline conditions (*Corophium volutator*, *Gammarus zaddachi*, *Palaeomonetes varians*, *Idotea chelipes*) and the presence of the estuarine ragworm *Nereis* sp. in the car park dyke. The western soke dyke (SP3) retains a species-rich, predominantly freshwater fauna including a few water beetles characteristic of mildly brackish habitats whereas the other sampling points show a tendency to develop a fauna dominated by brackish water specialists (Table 3).

Table 2: Brackish water indicator species

Species	2004	2005	2006	2007
<i>Corophium volutator</i>			●	●
<i>Gammarus zaddachi</i>	●	●	●	●
<i>Palaeomonetes varians</i>			●	●
<i>Idotea chelipes</i>				●
<i>Limnephilus affinis / incisus</i>	●		●	
<i>Sigara stagnalis</i>		●	●	●
<i>Haliplus apicalis</i>	●	●	●	●
<i>Agabus conspersus</i>	●	●	●	●
<i>Enochrus bicolor</i>	●		●	●
<i>Enochrus halophilus</i>			●	
<i>Ochthebius marinus</i>			●	●
<i>Nereis</i> sp.				●

Table 3: Brackish water indicator species by Sampling Point (number of indicators and percentage of all taxa recorded per sample)

Species	2005	2006	2007
SP1 (car park pond)	1 (13%)	1 (100%)	4 (57%)
SP2 (car park dyke)	2 (14%)	7 (64%)	6 (67%)
SP3 (soke dyke west)	3 (7%)	5 (11%)	4 (10%)
SP3 (soke dyke east)	3 (23%)	6 (33%)	3 (33%)

In addition, the soldier fly *Stratiomys singularior* (not a core taxon) can be considered an indicator of mildly brackish water. This was recorded as a larva at SP3 in 2006 and was evidently well-established there in 2007.

As in previous years, SP3 (western soke dyke) produced by far the greatest species-richness: 43 core taxa as compared to single figures for the other sampling points. The low salinity of SP3 and the presence of complex and varied aquatic and emergent vegetation is clearly associated with high diversity of aquatic macroinvertebrates.

Table 4: Comparison of species-richness between sampling points*

Sampling Point	2005					2006					2007				
	No. of core taxa	Co	He	Mo	Cr	No. of core taxa	Co	He	Mo	Cr	No. of core taxa	Co	He	Mo	Cr
1	8	0	4	2	1	1	0	0	0	1	7	2	2	1	1
2	14	5	6	1	1	16	8	2	2	2	9	3	0	1	3
3	48	25	10	4	2	44	28	6	3	2	42	26	8	4	1
4	13	2	7	2	1	18	9	5	1	2	9	1	4	1	2

*Co – aquatic Coleoptera, He – aquatic Hemiptera-Heteroptera, Mo– aquatic molluscs; aquatic macrocrustacea (Amphipoda, Isopoda, Decapoda)

4. Comments on conservation issues

Elevated salinity in the car park dyke and pond is presumably due to seepage below the new embankment as well as aerial deposition. There appears to have been considerable amelioration of salinity in these water bodies between August 2006 and May 2007 but the car park dyke nonetheless seems to be developing a saline lagoon type fauna. Since saline lagoons are a UK Biodiversity Action Plan Priority Habitat, this should be seen as a positive – if unintended – conservation gain.

As mentioned in the previous report, the saltmarsh/saltpan habitat which is developing at the western end of the car park dyke could prove to be very interesting since saline mud not exposed to tidal flooding is a rare habitat on the Humber. Further investigation of its invertebrate fauna is again recommended.

The western soke dyke, SP3, is already amongst the most valuable ‘low-end brackish’ water bodies on the north bank of the Humber for invertebrates. At present vegetation structure can be considered optimal for maintaining the existing, species-rich invertebrate community. However, small-scale, rotational management will be needed eventually to maintain structural heterogeneity. This could include removing vegetation and sediment from short, discontinuous sections so that no more than 25% of the ditch was cleared in any one year.

5. References

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Appendix 1: Sample data, May 2007

(L) – larvae; *n* – not a core taxon

SP1 (pond by car park)		
Coleoptera	Hydrophilidae	<i>Enochrus bicolor</i> (1)
	Hydraenidae	<i>Ochthebius marinus</i> (1)
Hemiptera-Heteroptera	Corixidae	<i>Paracorixa concinna</i> (1♂)
		<i>Sigara stagnalis</i> (several)
Odonata	Coenagriidae	several larvae
Mollusca	Hygrobiiidae	<i>Potamopyrgus antipodarum</i>
Amphipoda	Gammaridae	<i>Gammarus zaddachi</i>
SP2 (dyke nr car park)		
Coleoptera	Hydrophilidae	<i>Enochrus bicolor</i> (2)
	Hydraenidae	<i>Ochthebius marinus</i> (2)
	Curculionidae	<i>Phytobius leucogaster</i> (1)
Odonata	Coenagriidae	several larvae
Amphipoda	Gammaridae	<i>Gammarus zaddachi</i> (abundant)
	Corophiidae	<i>Corophium volutator</i> (1)
Isopoda	Idoteidae	<i>Idotea chelipes</i> (1)
Mollusca	Hygrobiiidae	<i>Potamopyrgus antipodarum</i>
Polychaeta	Nereidae	<i>Nereis</i> sp. (1)

SP3 (soke dyke, W end)		
Coleoptera	Haliplidae	<i>Haliphus apicalis</i> (1♂) <i>H. confinis</i> (1) <i>H. lineatocollis</i> (several) <i>H. obliquus</i> (several) <i>H. ruficollis</i> (5♂)
	Noteridae	<i>Noterus clavicornis</i>
	Dytiscidae	<i>Hygrotus impressopunctatus</i> <i>H. inaequalis</i> <i>Hydroporus angustatus</i> <i>H. palustris</i> <i>H. planus</i> <i>Liopterus haemorrhoidalis</i> <i>Agabus conspersus</i> (1) <i>A. nebulosus</i> <i>Laccophilus minutus</i>
	Helophoridae	<i>Helophorus aequalis</i> <i>H. minutus</i> group (♀)
	Hydrophilidae	<i>Hydrobius fuscipes</i> <i>Anacaena limbata</i> <i>Laccobius bipunctatus</i> <i>Helochares lividus</i> (many) <i>Enochrus melanocephalus</i> (1) <i>Cymbiodyta marginellus</i>
	Hydraenidae	<i>Ochthebius minimus</i>

	Scirtidae	<i>Cyphon laevipennis</i> (2)
	Coccinelidae	<i>Coccidula rufa</i> (n)
	Curculionidae	<i>Phytobius leucogaster</i> (1)
Hemiptera – Heteroptera	Veliidae	<i>Microvelia reticulata</i>
	Hydrometridae	<i>Hydrometra stagnorum</i>
	Gerridae	<i>Gerris odontogaster</i>
	Nepidae	<i>Nepa cinerea</i>
	Naucoridae	<i>Ilyocoris cimicoides</i>
	Pleidae	<i>Plea minutissima</i>
	Corixidae	<i>Sigara dorsalis</i>
		<i>Sigara stagnalis</i> (5)
Odonata	Coenagriidae	Copenagriidae larvae <i>Ischnura elegans</i> adults
	Libellulidae	<i>Libellula quadrimaculata</i> , 2 larvae
Trichoptera	Limnephilidae	<i>Limnephilus marmoratus</i>
Diptera	Stratiomyidae	<i>Stratiomys singularior</i> several L (n)
Mollusca	Hydrobiidae	<i>Potamopyrgus antipodarum</i>
	Lymnaeidae	<i>Lymnaea stagnalis</i> <i>Radix balthica</i> ⁵
	Planorbidae	<i>Gyraulus crista</i> (10+)
Amphipoda	Gammaridae	<i>Gammarus zaddachi</i> (common)

SP4 (soke dyke)		
Coleoptera	Hydrophilidae	<i>Hydrobius fuscipes</i>
Hemiptera-Heteroptera	Gerridae	<i>Gerris thoracicus</i>
	Corixidae	<i>Sigara dorsalis</i>
		<i>S. stagnalis</i> (abundant)
	Notonectidae	<i>Notonecta viridis</i>
Odonata	Coenagriidae	several larvae
Mollusca	Hydrobiidae	<i>Potamopyrgus antipodarum</i>
Amphipoda	Gammaridae	<i>Gammarus zaddachi</i> (common)
Decapoda	Palaemonidae	<i>Palaemonetes varians</i> (abundant)

⁵ Formerly known as *Lymnaea peregra*; mollusc names have been revised following Anderson (2005)

Appendix 2: Core taxa recorded in May 2007 (all records)

Coleoptera	Haliplidae	<i>Haliplus apicalis</i> <i>H. confinis</i> <i>H. lineatocollis</i> <i>H. obliquus</i> <i>H. ruficollis</i>
	Noteridae	<i>Noterus clavicornis</i>
	Dytiscidae	<i>Hygrotus impressopunctatus</i> <i>H. inaequalis</i> <i>Hydroporus angustatus</i> <i>H. palustris</i> <i>H. planus</i> <i>Agabus conspersus</i> <i>A. nebulosus</i> <i>Liopterus haemorrhoidalis</i> <i>Laccophilus minutus</i>
	Helophoridae	<i>Helophorus aequalis</i> <i>H. minutus</i> group
	Hydrophilidae	<i>Hydrobius fuscipes</i> <i>Anacaena limbata</i> <i>Laccobius bipunctatus</i> <i>Helochares lividus</i> <i>Enochrus bicolor</i> <i>Enochrus melanocephalus</i> <i>Cymbiodyta marginellus</i>
	Hydraenidae	<i>Ochthebius minimus</i> <i>O. marinus</i>
Hemiptera – Heteroptera	Gerridae	<i>Gerris odontogaster</i> <i>G. thoracicus</i>
	Veliidae	<i>Microvelia reticulata</i>
	Naucoridae	<i>Ilyocoris cimicoides</i>
	Nepidae	<i>Nepa cinerea</i>
	Notonectidae	<i>Notonecta viridis</i>
	Corixidae	<i>Paracorixa concinna</i> <i>Sigara dorsalis</i> <i>S. stagnalis</i>
Odonata	Coenagriidae	<i>Ischnura elegans</i> adults Indet Coenagriidae larvae
	Libellulidae	<i>Libellula quadrimaculata</i> , L
Trichoptera	Limnephilidae	<i>Limnephilus marmoratus</i> L
Mollusca	Hydrobiidae	<i>Potamopyrgus antipodarum</i>
	Lymnaeidae	<i>Lymnaea stagnalis</i> <i>Radix balthica</i>
	Planorbidae	<i>Gyraulus crista</i>
Amphipoda	Gammaridae	<i>Gammarus zaddachi</i>
	Corophiidae	<i>Corophium volutator</i>
Isopoda	Idoteidae	<i>Idotea chelipes</i>
Decapoda	Palaemoniidae	<i>Palaemonetes varians</i>
Polychaeta	Nereidae	<i>Nereis</i> sp.

Appendix 3: cumulative list of core taxa, April 2004 – May 2007

Coleoptera	Haliplidae	<i>Haliplus apicalis</i> <i>H. confinis</i> <i>H. flavicollis</i> <i>H. fluviatilis</i> <i>H. immaculatus</i> <i>H. lineatocollis</i> <i>H. obliquus</i> <i>H. ruficollis</i>
	Noteridae	<i>Noterus clavicornis</i>
	Dytiscidae	<i>Laccophilus minutus</i> <i>Hydroglyphus geminus</i> <i>Hygrotus confluens</i> <i>H. impressopunctatus</i> <i>H. inaequalis</i> <i>H. nigrolineatus</i> <i>Hydroporus angustatus</i> <i>H. memnonius</i> <i>H. palustris</i> <i>H. planus</i> <i>H. tessellatus</i> <i>Scarodytes halensis</i> <i>Liopterus haemorrhoidalis</i> <i>Agabus bipustulatus</i> <i>A. conspersus</i> <i>Rhantus suturalis</i> <i>Colymbetes fuscus</i> <i>Dytiscus circumflexus</i> <i>D. marginalis</i>
	Helophoridae	<i>Helophorus aequalis</i> <i>H. grandis</i> <i>H. griseus</i> <i>H. minutus</i> <i>H. obscurus</i>
	Hydrophilidae	<i>Cercyon marinus</i> <i>Megasternum concinnum</i> <i>Hydrobius fuscipes</i> <i>Anacaena limbata</i> <i>Laccobius bipunctatus</i> <i>L. colon</i> <i>Helochares lividus</i> <i>Enochrus bicolor</i> <i>E. halophilus</i> <i>E. melanocephalus</i> <i>E. testaceus</i> <i>Cymbiodyta marginellus</i>
	Hydraenidae	<i>Ochthebius dilatatus</i> <i>O. marinus</i> <i>O. minimus</i>

	Scirtidae	<i>Cyphon laevipennis</i>
	Heteroceridae	<i>Heterocerus fenestratus</i>
	Curculionidae	<i>Phytobius leucogaster</i>
Hemiptera – Heteroptera	Gerridae	<i>Gerris lacustris</i> <i>G. odontogaster</i> <i>G. thoracicus</i>
	Hydrometridae	<i>Hydrometra stagnorum</i>
	Veliidae	<i>Microvelia reticulata</i>
	Naucoridae	<i>Ilyocoris cimicoides</i>
	Nepidae	<i>Nepa cinerea</i>
	Notonectidae	<i>Notonecta viridis</i>
	Pleidae	<i>Plea minutissima</i>
	Corixidae	<i>Corixa panzeri</i> <i>C. punctata</i> <i>Callicorixa praeusta</i> <i>Arctocorisa germari</i> <i>Hesperocorixa linnaei</i> <i>Sigara concinna</i> <i>S. distincta</i> <i>S. dorsalis</i> <i>S. falleni</i> <i>S. lateralis</i> <i>S. nigrolineata</i> <i>S. stagnalis</i>
Odonata	Coenagriidae	<i>Coenagrion puella</i> <i>/pulchellum, L</i> <i>Ischnura elegans, L</i>
	Libellulidae	<i>Libellula quadrimaculata, L</i> <i>Sympetrum sp., imm L</i>
	Aeshnidae	<i>Anax imperator L</i>
Ephemeroptera	Baetidae	<i>Cleon dipterum L</i>
Trichoptera	Limnephilidae	<i>Limnephilus marmoratus, L</i> <i>L. affinis / incisus</i>
Mollusca	Hydrobiidae	<i>Potamopyrgus antipodarum</i>
	Lymnaeidae	<i>Lymnaea stagnalis</i> <i>Radix balthica</i>
	Planorbidae	<i>Gyraulus crista</i>
Amphipoda	Gammaridae	<i>Gammarus zaddachi</i>
	Corophiidae	<i>Corophium volutator</i>
Isopoda	Asellidae	<i>Asellus aquaticus</i>
	Idoteidae	<i>Idotea chelipes</i>
Decapoda	Palaemonidae	<i>Palaemonetes varians</i>
Annelida	Glossiphoniidae	<i>Glossiphonia complanata</i>
Polychaeta	Nereidae	<i>Nereis sp.</i>