Appendix H

Aquatic Ecology
Conservation Services Ltd.

BASELINE AQUATIC SURVEY OF SECTIONS OF THE WHITE RIVER (OWVANE), AS PART OF THE EIS FOR A PROPOSED EXTENSION TO THE LANDFILL FACILITY AT GORTADROMA, COUNTY LIMERICK

15 December 2003

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1 INTRODUCTION

Limerick County Council have appointed RPS-MCOS Ltd., to undertake the preparation of an Environmental Impact Statement for an extension to the landfill facility at Gortadroma, County Limerick. As part of the Environmental Impact Statement, Conservation Services, Ecological & Environmental Consultants have been commissioned by RPS-MCOS Ltd. to carry out a baseline aquatic survey of the potentially affected sections of the White River (Owvane), in the catchment of which the Gortadroma landfill is located.

The objectives of the survey are:

- To assess the present water quality and general ecological condition of the White River upstream and downstream of the landfill.
- To assess the present status of salmonid fish stocks and the quality of salmonid habitat in the White River upstream and downstream of the landfill.
- To assess the importance of the White River from an ecological and angling amenity view point.
- To provide baseline data on the biological condition of the White River against which any future changes can be assessed.
- To assess the present impact of the existing landfill on the water quality, ecology and salmonid fish stock of the White River.
- To assess the potential environmental impact of the proposed landfill extension on the ecology of the White River.

The following bodies were invited to submit information and/or comments for this report:

i. Shannon Regional Fisheries Board
ii. Central Fisheries Board
iii. Dúchas
iv. Marine Institute
v. Abha Bhan Fishing Club

However, except where otherwise stated, the findings and conclusions of the report are those of Conservation Services.

2 METHODOLOGY

A detailed baseline assessment of the White River was carried out by Conservation Services in 1997 as part of the EIS for the existing Gortadroma landfill (Conservation Services 1997). The present report incorporates the results of the 1997 survey and brings the results of that survey up to date.

2.1 HABITAT ASSESSMENT

Habitat quality for in-stream invertebrate and plant communities, and for fish, and riparian birds and mammals, is primarily a function of 'naturalness' and diversity. The more diverse the stream habitat in terms of substrate, flow rate, depth, riparian vegetation, light conditions etc., the richer the biological community is likely to be, and the more suitable it is likely to be for salmonid fish (trout and salmon). Habitat assessment was carried out at each of the biological sampling sites. Biological sampling sites were assessed in terms of:

- Stream width and depth
- Substrate type, listing substrate fractions in order of dominance, i.e. large rocks, cobble, gravel, sand, mud etc.
- Flow type, listing percentage of riffle, glide and pool in the sampling area
- Dominant bankside vegetation, listing the main species overhanging the stream
- Estimated degree of shade of the sampling site by bankside vegetation.
- Rating of the site as habitat for salmonid adult, nursery and spawning on a scale of None/ Poor/ Fair/ Good/ Very Good/ Excellent broadly based on a qualitative procedure described by Kennedy (1984). This rating assesses

the physical suitability of the habitat; the presence/absence/density of salmonids at the site will also depend on present and historical water quality and accessibility of the site to fish. A rating of "none" indicates that the ecologist carrying out the assessment regards it as impossible that the stream could support salmonid fish in the relevant life stage. A rating of "None - Poor" indicates that it is regarded as possible but extremely unlikely that the stream could support salmonid fish in the relevant life stage.

A general assessment of salmonid habitat quality was carried out from c.500m upstream of the proposed development to the Shannon Estuary at Loghill, c. 10km downstream of the landfill, and of the main watercourses (c.2km) in the area of the proposed landfill extension, which enter the White River at Grid Reference R224 431. This assessment consisted of walking/wading the stream channel. Salmonid habitat quality was assessed, taking into account width, depth, type of flow (riffle/glide/pool), bottom material, bankside vegetation, etc. Based on these observations, the value of each stream section for spawning, as a nursery area for juveniles, and as an area for adult salmonids, was estimated. Locations for identification of habitat sections were recorded as Irish Grid References using a Garmin GPS 38. To illustrate the habitat quality photographs were taken using a Rollei LED 35 and a FUJIFILM MX-1700 digital camera. Habitat assessment of watercourses on the proposed landfill extension area was carried out on 22 April 2002. The habitat assessment of the main White River channel was carried out in August 1997.

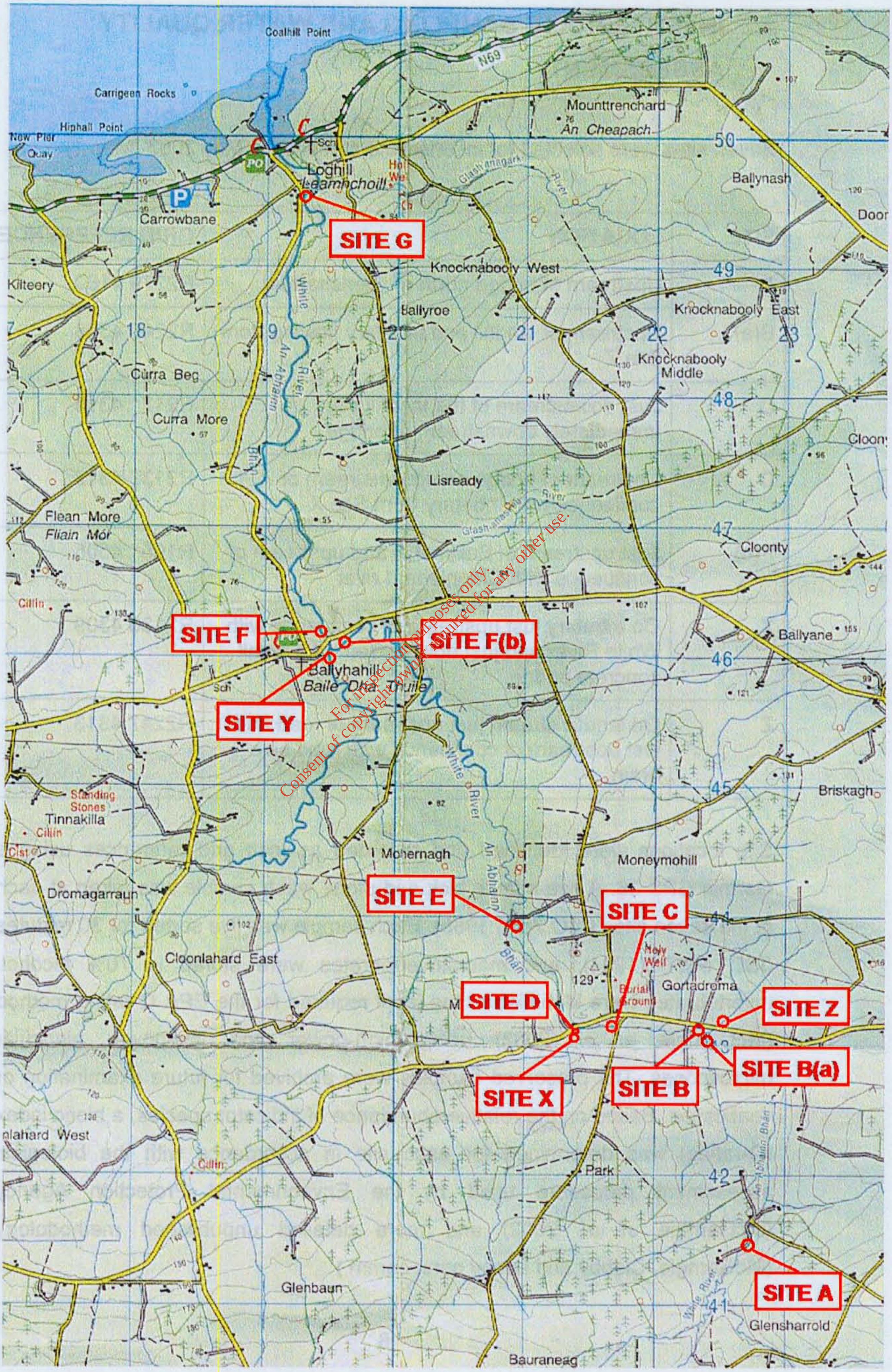
2.2 INVERTEBRATE SAMPLING AND WATER QUALITY ASSESSMENT

Seven sites were selected for invertebrate sampling in May 2003 (Map 1):

SITE	LOCATION	GRID REFERENCE
A	Upstream of bridge north of Glensharrold	R2279 4160
B(a)	Upstream of landfill and tributary flowing from Site Z	R2240 4308
C	Just downstream of the landfill site. Immediately downstream of bridge.	R2171 4315
D	Upstream of bridge and downstream of confluence with tributary from Site X	R2137 4312
F(b)	Just upstream of Ballyhahill and upstream of confluence with Cloonlahard river	R1951 4605
X	On tributary just upstream of confluence with White River and just downstream of a small concrete bridge	R2138 4309
Z	On landfill stream just upstream of road and just upstream of confluence with road side drain.	R2247 4313

Site locations were identified and recorded as Irish grid references using a Garmin GPS 38. A five-minute kick and stone wash sample was taken at each of the seven sites (ISO 7828:1985). Each sample was live sorted for 30 minutes (ISO 5667-3:1994), and macroinvertebrates were stored in 70% alcohol. Invertebrates were identified to the level required for the EPA Q-rating method (McGarrigle *et al,* 2002) using high-power and low-power binocular microscopes. The preserved samples were archived for future examination or verification. Based on the relative abundance of indicator species, a biotic index (Q-rating) was determined for each site in accordance with the biological assessment procedure used by the Environmental Protection Agency (McGarrigle *et al*, 2002) and more detailed unpublished methodology (McGarrigle, Clabby and Lucey pers. comm.)

MAP 1 INVERTEBRATE SAMPLING SITES 1997 AND 2003



In the 1997 survey invertebrate samples were taken at nine sites (Sites A, B, C, D, E, F, G, X & Y; see Map 1) and invertebrates were identified to the lowest practicable taxonomic level for the calculation of EPA Q-values and to determine the invertebrate biodiversity of the river. Chironomids and oligochaetes were identified using a high-power microscope; other macroinvertebrates were identified using a low-power binocular microscope. A list of the taxonomic keys used for identification is given (see References).

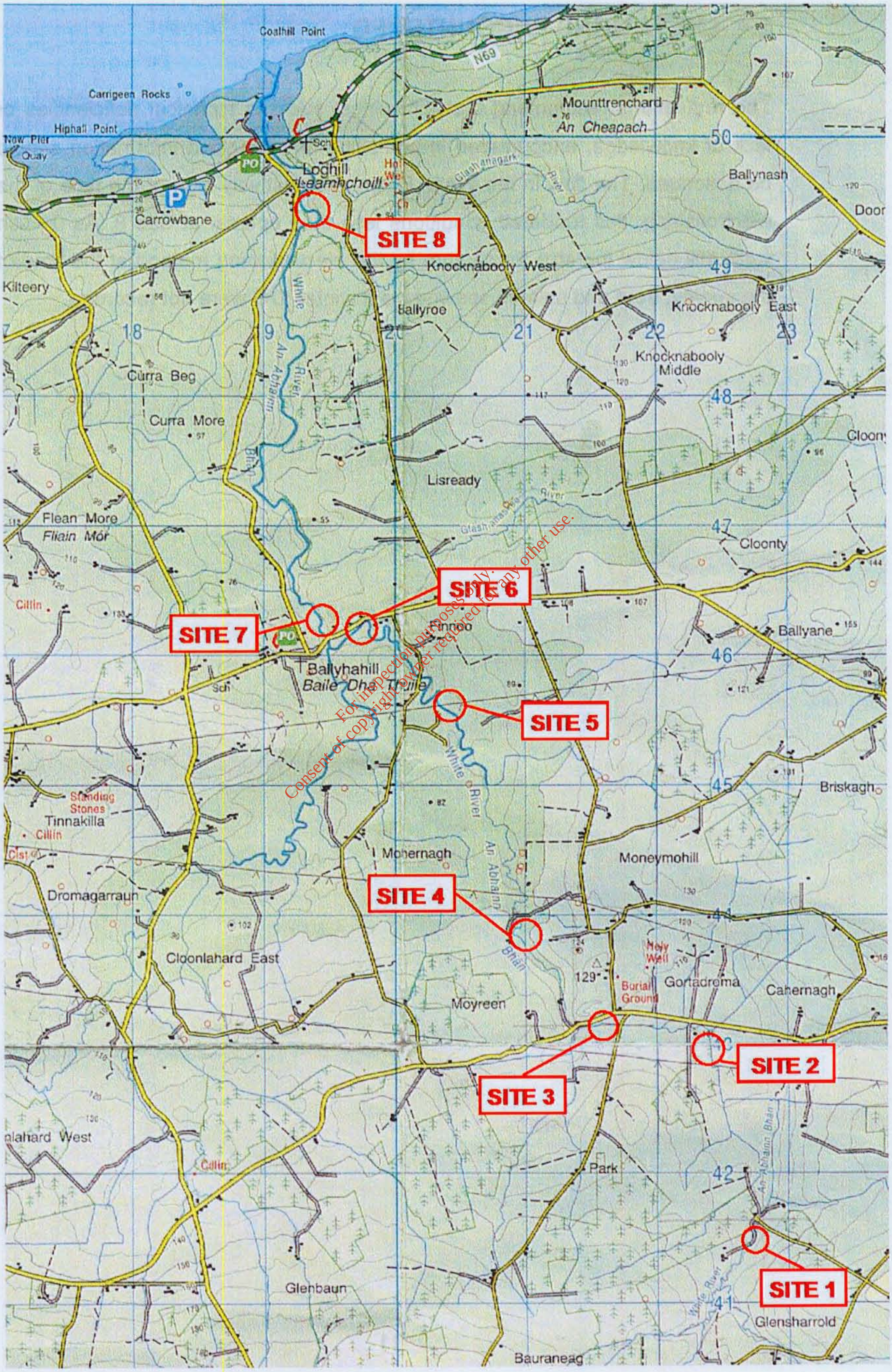
2.3 ASSESSMENT OF FISH STOCK

Five sites were selected for fish assessment in May 2003 (Map 2):

SITE	LOCATION	GRID REFERENCE
1	Upstream of bridge north of Glensharrold	R2279 4160
2	Upstream of landfill and tributary flowing from Site Z	R2240 4308
3	Just downstream of the landfill site. Immediately downstream of bridge.	R2171 4315
6	Just upstream of Ballyhahill and upstream of confluence with Cloonlahard river.	R1951 4605
8	Upstream of bridge upstream of Loghill.	R1933 4958

Site locations were identified and recorded as Irish grid references using a Garmin GPS 38. Timed electrofishing was carried out at each site to provide a Catch Per Unit Effort (CPUE) index of the fish population density. Fish were captured using a Safari Research Surveyor pulsed direct current backpack electrofisher. Fish captured were held in the river in a perforated bin. Prior to handling, fish were anaesthetised in a benzocaine solution to reduce handling stress. Fish were then identified, and fork length of salmonids was measured to the nearest mm. Salmonid age was determined by length frequency distribution combined with scale reading using a high power binocular microscope. Salmonids were classified according to age as fish spawned last winter (0+), 1 year old (1+), 2 years old (2+), etc. The electrofishing was carried out from 13th - 15th May 2003.

MAP 2 FISH SURVEY SITES 1997 AND 2003



2.4 LIMITATIONS ENCOUNTERED

The regulations recommend that difficulties, such as technical deficiencies or lack of knowledge, encountered in compiling any specified information should be described. The flow in the White River was relatively high at the time of the electrofishing; this rendered conditions less than optimal at Site 8. As 0+ fish were still below the size for capture by the electrofishing method at the time of the survey, trout and salmon spawned last winter (0+) were not recorded.

3 EXISTING ENVIRONMENT

3.1 HABITAT ASSESSMENT

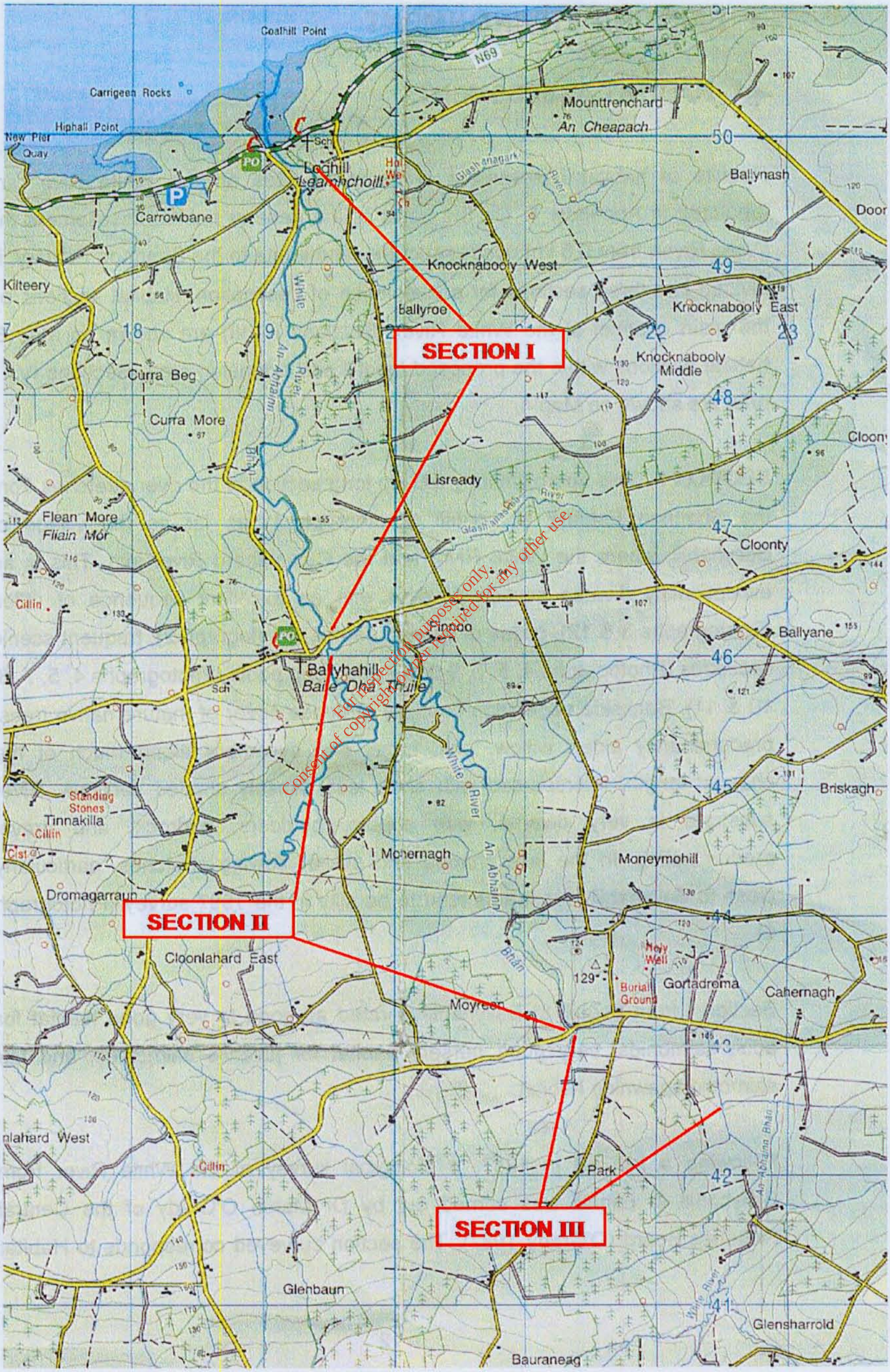
Results of habitat assessment at sampling sites on the White River are tabulated in Appendix 1. On the basis of the general habitat assessment the White River, from 0.5 km upstream of the landfill site to the Shannon Estuary, is divided into three sections for convenience of description. Habitat sections on the main channel of the White River (Sections I - III) are shown on Map 3; habitat sections within the proposed landfill site extension area (Sections IVA - IVD) are shown on Map 4.

SECTION I This approximately 5.5 km long section of the river stretches from the Shannon Estuary at Loghill (Photograph 1) as far as the village of Ballyhahill, where the White River and the Cloonlahard River join. This is an exceptionally diverse section of river with an excellent sequence of riffles (Photographs 3 & 12), glides of varying depths (Photograph 2), frequent scenic cascades (Photographs 4, 5, 7, 9 & 10) and deep pools (Photographs 4, 5, 7, 8, 10 & 11). Bankside vegetation consists of dense cover of mature native trees, predominantly alder, willow, oak, hazel and sycamore along much of the channel length, interspersed with short less densely shaded sections. River substrate is very diverse, with cobble, boulders, bedrock, and gravel predominating. In the less shaded and slower flowing stretches, particularly close to Ballyhahill, substrates tend to be silty in the 1997 survey (Photograph 6).

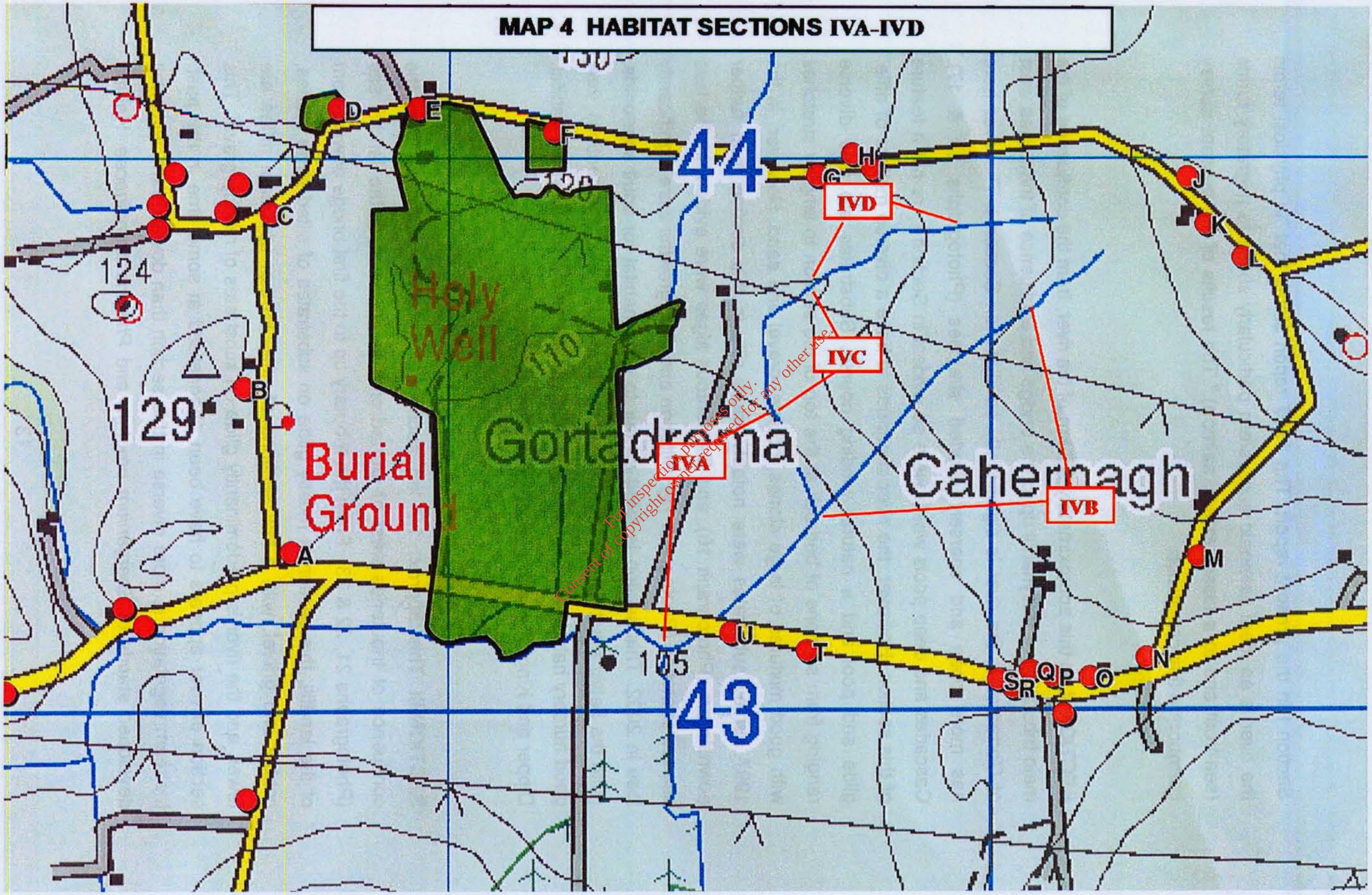
Section I from Loghill to Ballyhahill is rated as good to very good habitat for adult salmonids, very good nursery habitat for juvenile salmonids, and fair salmonid spawning habitat.

Following a fish kill in 1987, a biological survey of the White River from Ballyhahill to Loghill was carried out by Dr Martin O'Grady of the Central Fisheries Board (O'Grady 1987). The section surveyed corresponds to Habitat

MAP 3 HABITAT SECTIONS I-III ON WHITE RIVER MAIN CHANNEL



MAP 4 HABITAT SECTIONS IVA-IVD



Section I in the present report. The 1987 report states that "in physical terms the river is an ideal salmonid ecosystem particularly suited to migratory forms (sea-trout and to a lesser extent, salmon)." The results of the present survey corroborate this conclusion.

SECTION II In this approximately 5.5 km of the river, from the confluence of the main tributaries at Ballyhahill up to the bridge and confluence of tributaries west of Gortadroma, the river is significantly smaller than Section I. The river here has more open and sparsely shaded stretches (Photographs 14 & 17). Cascades and deep pools which were so evident in Section I are not a feature of this section. However, the river continues to have a diverse mixture of riffle, glide and pool and a natural winding course. Substrates are also diverse ranging from sections of bedrock at the top of the section to lengthy stretches with good mixtures of large stones, cobble, gravel and sand. However, in the 1997 survey substrates were notably more silty in this section than further downstream (Photograph 16), and filamentous algae were evident in the less shaded stretches (Photograph 15). Siltation and algal growths were significantly less in 2002. This section is rated as fair to good habitat for adult salmonids, (with the better adult habitat being found in the lowest part of the section), very good nursery habitat for juvenile salmonids and fair salmonid spawning habitat. Dipper and Kingfisher were observed on this section of the river.

SECTION III This approx. 1.7 km section of the river stretches from the confluence of tributaries west of Gortadroma to upstream of the landfill site (Photographs 21, 22 & 23). From the tributary up to the first bridge downstream of the landfill, this section is mostly glide on substrates of silted large stones, cobble and gravel, with a few sections of riffle. Further upstream riffles are fewer, and the river is predominantly glide on substrates of muddy gravel. This section of river appears to have been channelised at some time in the past. Instream vegetation is more diverse in this section than downstream, with well developed stands of *Sparganium erectum* and *Phalaris arundinacea*. Habitat

Section III is rated as fair habitat for adult salmonids, fair to good nursery habitat for juvenile salmonids, and fair habitat for salmonid spawning.

SECTION IV This consists of c. 2km of very small stream/drains within the area of the proposed landfill extensions. It is divided into the following subsections.

Section IVA Slow flowing muddy drain with growths of *Callitriche* sp., *Apium nodiflorum*, *Rorripa nasturtium aquaticum, Glyceria* and *Veronica anagalis catenata* (Photo. 25 - 27). Short section of cobble & gravel substrate on mud with water depth of 2-3 cm and width of less than 1m (Photo. 28 & 29). Habitat section IVA is rated as poor to none for salmonid spawning and nursery habitat, and none for salmonid adult habitat.

Section IVB Very small trickle sometimes just damp mud in deep sided drain heavily overgrown with hawthorn. Habitat section IVB is rated as poor - none for salmonid spawning, none for nursery habitat, and none for salmonid adult habitat.

Section IVC Very small muddy stream, mostly trickle flow over substrates of muddy cobble and gravel (Photos 30 & 31). Habitat section IVC is rated as poor for salmonid spawning and nursery habitat, and none for salmonid adult habitat.

Section IVD Wet muddy drain heavily overgrown with bramble and rushes. *Veronica beccabunga*, *Callitriche*, *Glyceria* and *Apium nodiflorum* growing in less shaded sections (Photos 32 & 33). Habitat section IVD is rated as none for all salmonid life stages.

3.2 INVERTEBRATE ANALYSIS AND WATER QUALITY ASSESSMENT

3.2.1 CURRENT WATER QUALITY

Sampling site locations, including grid references, are given in report section 2.2. Site locations are shown on Map 1.

SITE A (Photo. 34) The river at this site is small, rocky and fast flowing with no instream vegetation recorded. Description of habitat at the sampling site is given in Appendix 1. The invertebrate community tabulated below is characterised by very high densities of Group A indicators and five different Group A indicator taxa. This would usually merit a Q5 rating; however, because of the high density of the Group C species *Gammarus duebeni* and significant numbers of Erpobdellidae, the rating is reduced to Q4-5, indicating unpolluted conditions.

INDICATOR GROUP	POLLUTION SENSITIVITY/TOLERANCE	TAXON	NUMBER
A	Very Pollution Sensitive	*Rhithrogena* sp.	313
		Ecdyonurus sp.	26
		Chloroperla sp.	2
		Isoperla sp.	1
		Amphinemura sp.	1
B	Moderately Pollution Sensitive	Goeridae	77
		Limnephilidae	1
		Glossosomatidae	6
		Baetis muticus	1
C	Moderately Pollution Tolerant	*Gammarus duebeni*	178
		Hydropsychidae	62
		Baetis rhodani	25
		Ancylus sp.	6
		Elminthidae	5
		Simuliidae	8
		Chironomidae	3
		Caenidae	1
D	Very Pollution Tolerant	Erpobdellidae	6

INDICATOR GROUP	POLLUTION SENSITIVITY/TOLERANCE	TAXON	NUMBER
E	Most Pollution Tolerant	Tubificidae	1
Taxa not assigned to any Indicator Group		Nematomorpha	1
		Ceratopogonidae	2
		Lumbriculidae	1
		Nematoda	1

SITE B(a) (Photo. 35) The river at this site is predominantly fast shallow glide over mud and gravel substrate. Description of habitat at the sampling site is given in Appendix 1. The invertebrates recorded at Site B are tabulated below. Given the nature of the substrate, this site has a very high density of Group A invertebrates, with four Group A taxa recorded. Combined with the moderate densities of tolerant groups the site merits a Q-value of Q4-5 indicating unpolluted conditions.

INDICATOR GROUP	POLLUTION SENSITIVITY/TOLERANCE	TAXON	NUMBER
A	Very Pollution Sensitive	*Rhithrogena* sp.	53
		Ecdyonurus sp.	2
		Chloroperla sp.	1
		Isoperla sp.	2
B	Moderately Pollution Sensitive	Goeridae	26
		Sericostomatidae	2
		Glossosomatidae	17
		Baetis muticus	1
C	Moderately Pollution Tolerant	*Gammarus duebeni*	53
		Polycentropidae	5
		Baetis rhodani	1
		Potamopyrgus jenkinsi	1
		Elminthidae	86
		Hydracarina	1
		Chironomidae	1
		Caenidae	4
D	Very Pollution Tolerant	Erpobdellidae	9

INDICATOR GROUP	POLLUTION SENSITIVITY/TOLERANCE	TAXON	NUMBER
E	Most Pollution Tolerant	None recorded	
Taxa not assigned to any Indicator Group		*Stylodrilus heringianus*	3
		Stratiomyidae	1

SITE C (Photo. 36) The river at this site is predominantly riffle and fast shallow glide over muddy, cobble and gravel substrate. Description of habitat at the sampling site is given in Appendix 1. The invertebrates recorded at Site C are tabulated below. Given the nature of the substrate, this site has a good density of Group A invertebrates with three Group A taxa recorded; however, too many (34) of the very pollution tolerant Erpobdellidae were recorded to merit a Q-value of Q4-5. The site is given a Q-value of Q4, with the *caveat* that the high densities of Erpodellidae may indicate a deteriorating invertebrate community.

INDICATOR GROUP	POLLUTION SENSITIVITY/TOLERANCE	TAXON	NUMBER
A	Very Pollution Sensitive	*Rhithrogena* sp.	34
		Ecdyonurus sp.	10
		Isoperla sp.	3
B	Moderately Pollution Sensitive	Goeridae	9
		Limnephilidae	9
		Baetis muticus	1
C	Moderately Pollution Tolerant	*Gammarus duebeni*	14
		Ancylus sp.	5
		Hydropsychidae	3
		Polycentropidae	1
		Glossosomatidae	1
		Baetis rhodani	32
		Elminthidae	27
		Chironomidae	3
D	Very Pollution Tolerant	Erpobdellidae	34

INDICATOR GROUP	POLLUTION SENSITIVITY/TOLERANCE	TAXON	NUMBER
E	Most Pollution Tolerant	Tubificidae	2
Taxa not assigned to any Indicator Group		None Recorded	

SITE D (Photo. 42) The river at this site is predominantly riffle over substrates of cobble and large rocks with some gravel and sand. Description of habitat at the sampling site is given in Appendix 1. The invertebrates recorded at Site D are tabulated below and merit a Q-value of Q4-5 indicating unpolluted conditions.

INDICATOR GROUP	POLLUTION SENSITIVITY/TOLERANCE	TAXON	NUMBER
A	Very Pollution Sensitive	*Rhithrogena* sp.	216
		Ecdyonurus sp.	93
		Isoperla sp.	3
B	Moderately Pollution Sensitive	Goeridae	2
		Limnephilidae	1
		Glossosomatidae	9
		Baetis muticus	13
C	Moderately Pollution Tolerant	*Gammarus duebeni*	139
		Ancylus sp.	4
		Ephemerellidae	5
		Simuliidae	17
		Hydropsychidae	5
		Polycentropidae	3
		Rhyacophilidae	3
		Baetis rhodani	44
		Potamopyrgus jenkinsi	1
		Elminthidae	15
		Chironomidae	14
		Caenidae	2

INDICATOR GROUP	POLLUTION SENSITIVITY/TOLERANCE	TAXON	NUMBER
D	Very Pollution Tolerant	Erpobdellidae	9
E	Most Pollution Tolerant	Tubificidae	1
Taxa not assigned to any Indicator Group		*Stylodrilus heringianus*	1
		Ceratopogonidae	1

SITE F (b) (Photo. 37) The river at this site is predominantly fast riffle over substrates of cobble, large rocks and gravel. Description of habitat at the sampling site is given in Appendix 1. The invertebrates recorded at Site F(b) are tabulated below. This site has a very high density of Group A invertebrates, with four Group A taxa recorded. The invertebrate community merits a Q-value no higher than Q4 because of high densities (81) of the tolerant Simuliidae.

INDICATOR GROUP	POLLUTION SENSITIVITY/TOLERANCE	TAXON	NUMBER
A	Very Pollution Sensitive	*Rhithrogena* sp.	169
		Ecdyonurus sp.	27
		Chloroperla sp.	1
		Amphinemura sp.	1
B	Moderately Pollution Sensitive	Glossosomatidae	1
		Baetis muticus	15
C	Moderately Pollution Tolerant	*Gammarus duebeni*	14
		Simuliidae	81
		Hydropsychidae	12
		Rhyacophilidae	2
		Polycentropidae	2
		Ephemerellidae	2
		Baetis rhodani	50
		Hydrophilidae	1
		Chironomidae	2

INDICATOR GROUP	POLLUTION SENSITIVITY/TOLERANCE	TAXON	NUMBER
D	Very Pollution Tolerant	None Recorded	
E	Most Pollution Tolerant	None Recorded	
Taxa not assigned to any Indicator Group		None Recorded	

SITE X (Photo. 39) This site is situated on the tributary which joins the White River west of Gortadroma, just upstream of the confluence. The stream at the site is predominantly riffle on substrates of cobble and large rocks with some gravel sand and mud. Description of habitat at the sampling site is given in Appendix 1. The invertebrates recorded at Site X tabulated below merit a Q-value of Q4 indicating unpolluted conditions.

INDICATOR GROUP	POLLUTION SENSITIVITY/TOLERANCE	TAXON	NUMBER
A	Very Pollution Sensitive	*Rhithrogena* sp.	74
		Ecdyonurus sp.	3
		Isoperla sp.	1
		Amphinemura sp.	1
B	Moderately Pollution Sensitive	Goeridae	1
		Limnephilidae	1
		Glossosomatidae	19
		Baetis muticus	7
		Leuctra sp.	1
C	Moderately Pollution Tolerant	*Gammarus duebeni*	223
		Ancylus sp.	17
		Hydropsychidae	18
		Polycentropidae	12
		Baetis rhodani	61
		Elminthidae	8
		Chironomidae	5
D	Very Pollution Tolerant	Erpobdellidae	5

INDICATOR GROUP	POLLUTION SENSITIVITY/TOLERANCE	TAXON	NUMBER
E	Most Pollution Tolerant	None Recorded	
Taxa not assigned to any Indicator Group		*Eiseniella tetraedra*	1
		Tabanidae	1
		Enchytraeidae	1
		Ceratopogonidae	2

SITE Z (Photo. 40) this is a very slow flowing muddy channel which is too small to be optimal for the Q-rating method. Description of habitat at the sampling site is given in Appendix 1. No group A taxa were recorded at this site; however, the substrate and flow are not suitable for group A, and as none of the more tolerant taxa are present at high densities, the invertebrate community recorded merits a tentative Q-rating of Q4 indicating unpolluted conditions.

INDICATOR GROUP	POLLUTION SENSITIVITY/TOLERANCE	TAXON	NUMBER
A	Very Pollution Sensitive	None Recorded	
B	Moderately Pollution Sensitive	Limnephilidae	7
C	Moderately Pollution Tolerant	*Gammarus duebeni*	16
		Dytiscidae	3
		Chrysomelidae	2
		Polycentropidae	9
		Chironomidae	18
D	Very Pollution Tolerant	Erpobdellidae	9
		Glossiphonia sp.	2
		Lymnaea stagnalis	1
		Sphaeriidae	3
E	Most Pollution Tolerant	Tubificidae	12

INDICATOR GROUP	POLLUTION SENSITIVITY/TOLERANCE	TAXON	NUMBER
Taxa not assigned to any Indicator Group		Lepidoptera	1
		Diptera	4

3.2.2 WATER QUALITY 1971 - 2003

The Environmental Protection Agency and its predecessors, the Environmental Research Unit and An Foras Forbartha, have monitored the water quality of the White River periodically since 1971. The results of this monitoring and the results of the 1997 and the present survey are tabulated (Table 1).

Despite fish kills such as that investigated by O'Grady (1987), which was attributed to an agricultural source, Q-ratings less than 3-4, indicating slight pollution, have not been recorded on the White River. It therefore seems likely that these fish kills have been caused by short term serious pollution incidents, rather than long term problems of chronic serious pollution. By the time of the 1988 ERU survey, the condition of the river at Ballyhahill and Loghill had recovered to a slightly polluted condition from the serious incident in 1987. By 1994 the river had recovered to an unpolluted Q-rating of Q4 at all sites monitored, with the exception of Site 0075 just downstream of the landfill where a slightly polluted rating of Q3-4 was recorded. The landfill had commenced operation in September 1990. In 1996 the slightly polluted rating of Q3-4 downstream of the landfill was repeated. The river had a Q4 at Ballyhahill, however downstream of Ballyhahill and at Loghill the river was slightly polluted. As the river was unpolluted at Ballyhahill, the pollution of the lower sections of the river was clearly due to pollution sources other than the landfill.

The 1997 Conservation Services survey recorded a recovery of the river just downstream of the landfill to an unpolluted Q4 rating in 1997. This recovery was probably due to the fact for some months prior to the survey the leachate from the landfill was collected and pumped to a newly constructed leachate holding lagoon, from where it was tankered off site (RPS-MCOS pers. comm.)

Local anglers stated in 1997 that measures taken at the landfill site at that time resulted in an improvement in the water quality of the river. They also stated that fish, which they believe were excluded from the river immediately downstream of the landfill returned to these sections of the river at that time. Pollution of the river sufficient to have a seriously detrimental impact on trout had not been recorded by EPA. However, as the EPA surveys were carried out with a minimum interval of two years, and as the invertebrate community assessed in the EPA surveys would reflect the condition in the previous months rather than years, the possibility of incidents of more serious pollution emanating from the landfill, such as described by local residents and anglers, cannot be ruled out. In the 1997 survey, while juvenile trout were plentiful at the sites in the 4 km section of river downstream of the landfill, adult trout were virtually absent. This cannot be explained in terms of habitat quality, as significant numbers of adult trout would be expected in such habitat. The virtual absence of adult trout, and the relative abundance of juveniles, would be in keeping with a recent improvement in water quality, as trout occupying new territories are usually young fish. In 1999 and 2002 EPA recorded Q4 unpolluted conditions at all sites monitored except for Site 0120 downstream of Ballyhahill were a Q3-4 was recorded in 2002, as an unpolluted Q4 was recorded at Ballyhahill Bridge the slightly polluted conditions at Site 0120 was clearly due to inputs in the vicinity of Ballyhahill and was not due to any landfill effects. Improving conditions upstream of the landfill were indicated by the Q4-5 recorded at Site 0070 in 1999. During most of this period leachate from the landfill was collected and tankered off site.

In the present survey (May 2003) unpolluted conditions were recorded at all sites assessed (though Q-values were not measured downstream of Ballyhahill). A very good Q4-5 rating was again given at the site immediately upstream of the landfill and at the site c. 2km upstream. It is notable that while the downstream site retained its unpolluted rating (Q4), there was a small decline (½ a Q-rating point) between the sites immediately upstream (Site B) and downstream (Site C) of the landfill. At Site D, c.600m downstream of the landfill, the river had returned to a Q4-5 rating. The rating at Site C may be indicative of some low level of contamination possibly from landfill or agricultural sources.

Limerick County Council quarterly water chemical monitoring 2000–2002 indicates generally satisfactory conditions in the White River downstream of the landfill. Some low level influence possibly from the landfill is however indicated by the fact that the average ammonia concentration at the downstream site (Site S1) is more than twice the average concentration at the upstream site (Site S6). This difference is statistically significant (one-tailed Student's t-test: $p=0.0127$; i.e. the probability of this result occurring by chance alone is less than 1.3%). The Salmonid Waters Regulations set a limit of 1.0 mg/l total ammonia as N. The concentration of ammonia at Site 1 was higher than this limit on 25/1/02 (1.07 mg/l) and on 18/9/02 (1.57 mg/l).

TABLE 1. Q-RATINGS RECORDED ON WHITE RIVER 1971- 2003

EPA Site No.	CS Site Code	Site location	EPA 1971	EPA 1975	EPA 1979	EPA 1986	EPA 1988	EPA 1994	EPA 1996	CS 1997	EPA 1999	EPA 2002	CS 2003
		West Branch (Cloonlahard River)											
0040		Bridge upstream of Cloonlahard Bridge	-	-	-	-	-	4	4	-	4	4	-
0050	Y	0.1 km upstream of confluence with main channel	-	-	-	-	-	4	-	3-4	-	-	-
		Tributary drain/stream on proposed landfill extension area											
	Z	Upstream of road	-	-	-	-	-	-	-	-	-	-	4*
		Tributary d/s of landfill											
	X	On tributary just upstream of the confluence with the white river	-	-	-	-	-	-	-	3-4	-	-	4
		Main Channel											
	A	Bridge north of Glensharrold	-	-	-	-	-	-	-	4	-	-	4-5
	B(a)	Upstream of landfill and stream from proposed extension area	-	-	-	-	-	-	-	-	-	-	4-5
0070	B	Upstream of landfill	-	-	-	-	-	-	-	4	4-5	4	-
0075	C	(West) Bridge South of Gortadroma just downstream of landfill	-	-	-	-	-	3-4	3-4	4	4	4	4
	D	Second Bridge downstream of landfill. Downstream of confluence with small tributary	-	-	-	-	-	-	-	4	-	-	4-5
	E	Bridge on private Cul de Sac	-	-	-	-	-	-	-	4	-	-	-
0090		Bridge upstream of Ballyhahill Bridge	-	-	-	-	4	4	4	-	4	4	-
	F(b)	Ballyhahill upstream of Cloonlahard confluence	-	-	-	-	-	-	-	-	-	-	4

EPA Site No.	CS Site Code	Site location	EPA 1971	EPA 1975	EPA 1979	EPA 1986	EPA 1988	EPA 1994	EPA 1996	CS 1997	EPA 1999	EPA 2002	CS 2003
0100	F	Ballyhahill Bridge	5	4-5	4-5	4-5	3-4	-	-	4	-	-	-
0120		0.5 km downstream of Ballyhahill Bridge	-	-	-	-	-	4	3-4	-	4	3-4	-
0200	G	Bridge upstream of Loghill	5	4-5	4-5	4	3-4	4	3-4	3-4	4	4	-

*Tentative

3.3 FISH ASSESSMENT

Fish were assessed at eight sites in August 1997 (Conservation Services 1997); five of these sites were resurveyed in May 2003. Complete 2003 fish survey data are given in Appendix 2. Sites electrofished are shown on Map 2. Summary of fish catch at each site is given in Table 2, and the catch per unit effort (CPUE) of salmonids is given in Table 3. The length frequency distributions of trout and salmon captured at each site are illustrated in Figs. 1 and 2. CPUE of salmon and trout at each site is illustrated in Fig. 3; CPUE of trout age groups at each site is illustrated in Fig. 4.

3.3.1 FINDINGS OF THE 1997 FISH SURVEY

Juvenile Brown Trout: Present at all sites surveyed, most sites having high densities.

Adult Brown Trout: Recorded in low numbers at sites upstream of the landfill, and in good numbers in the lowest 5km of the river. However, while juvenile trout were plentiful at the sites in the 4km section of river downstream of the landfill, adult trout were virtually absent. This could not be explained in terms of habitat quality, as significant numbers of adult trout would be expected in such habitat. The virtual absence of adult trout, and the relative abundance of juveniles in 1997, would be in keeping with trout having recolonised these waters after improvement in water quality, as trout occupying new territories are usually young fish.

Sea Trout: Small numbers of sea trout (post-smolts and one-sea-winter fish) were recorded in the lower 8 km of the river. The size of the sea trout run could not be determined from the survey, which may not have corresponded with the main period of upstream migration.

Juvenile Salmon: Recorded only in the lowest section of the river at low density. The 1997 survey indicated a small run of salmon into the lowest section of the White River. Whereas it is possible that salmon ran and spawned further upstream, no juvenile salmon were recorded except at the lowest site.

3.3.2 FINDINGS OF THE 2003 SURVEY

Brown Trout: A good population of juvenile and adult brown trout was recorded at all sites surveyed. Notably, at Site 3 which is just downstream of the landfill, a CPUE of 46 adult trout per hour equivalent was recorded, indicating that the population structure of the trout downstream of the landfill has recovered to a healthy condition as compared with 1997.

Sea-Trout: A single sea-trout smolt was recorded at Site 8. Because of high water levels, conditions were poor for electrofishing at this site, and it is likely that a larger number of sea trout would have been recorded under more suitable conditions.

Juvenile Salmon: In 1997 juvenile salmon were only recorded at Site 8. No salmon were recorded at this site in 2003; however, it cannot be concluded from this that salmon are no longer present at the site, as water conditions were unsuitable for the capture of juvenile salmon at the time of the survey. The May 2003 survey recorded good densities (CPUE of 76 fish per hour equivalent) of juvenile salmon at Site 1, where no salmon were recorded in 1997. These were all 1+ fish, i.e. fish spawned in the winter of 2001/2002. The Abha Bhan Fishing Club with the assistance of the Shannon Regional Fisheries Board has stocked this section of river with c. 6,000 unfed salmon fry over the last 4 years (M. Walsh, Abha Bhan Fishing Club pers. comm.). The fact that a good density of 1+ salmon were recorded at this site indicates that the stocked fish have successfully colonised this section of stream, and it seems probable that some of the stocked fish may already have migrated to sea.

TABLE 2. SUMMARY OF FISH CATCH AT EACH SITE

Numbers caught are given for salmonids; where non-salmonid species were taken, their presence is recorded.

Site	1+ trout	2+ trout	3+ trout	Sea trout smolts (2+)	1+ salmon	Eels	Stone loach	Three-spined stickleback	Flounder
1	11	3			33	+	+		
2	14	2							
3	16	15	1					+	
6	26	18	2			+	+	+	
8	1	10	1	1		+			+

TABLE 3. SUMMARY OF FISH CATCH PER UNIT EFFORT

To calculate catch per unit effort, the catch figures and fishing time are combined to calculate the theoretical catch per hour fishing.

Site	1+ trout	2+ trout	3+ trout	Sea trout smolts (2+)	1+ salmon	Eels	Stone loach	Three-spined stickleback	Flounder
1	25	7			76	+	+		
2	42	6							
3	46	43	3					+	
6	65	45	5			+	+	+	
8	3	26	3	3		+			+

Fig. 1 Trout Length-Frequency

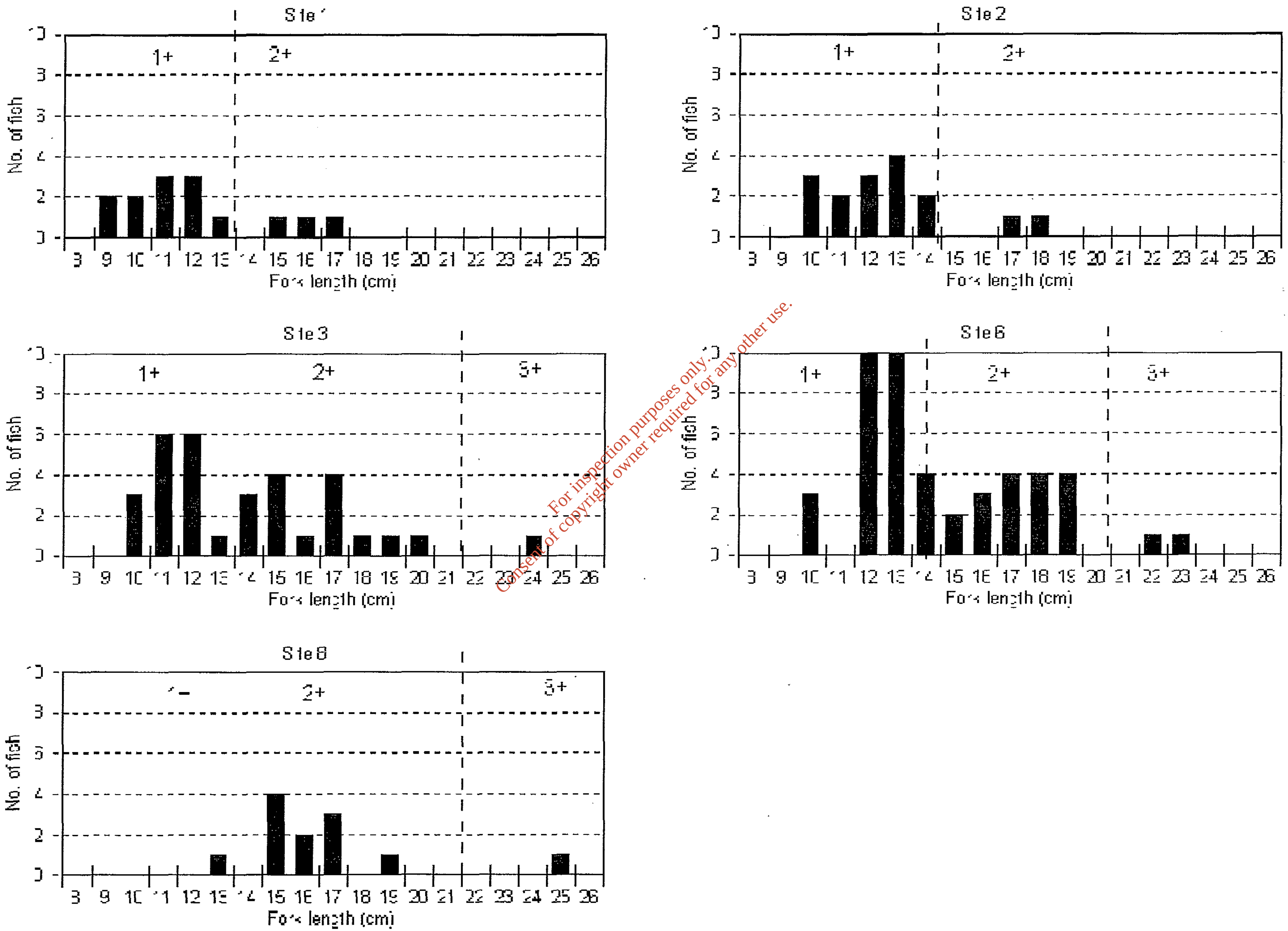


Fig. 2 Salmon Length-Frequency

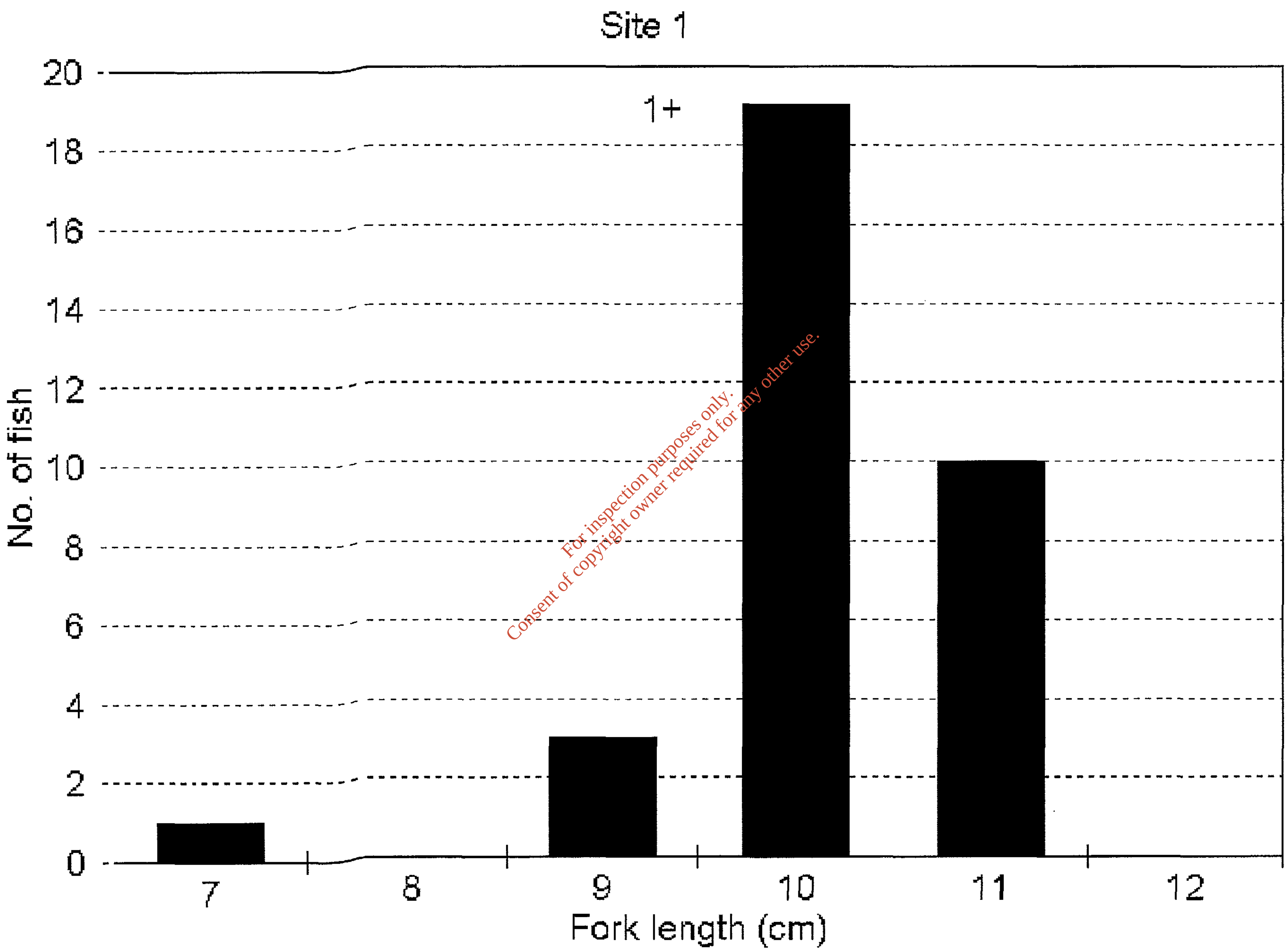


Fig. 3 Salmonid Catch Per Unit Effort

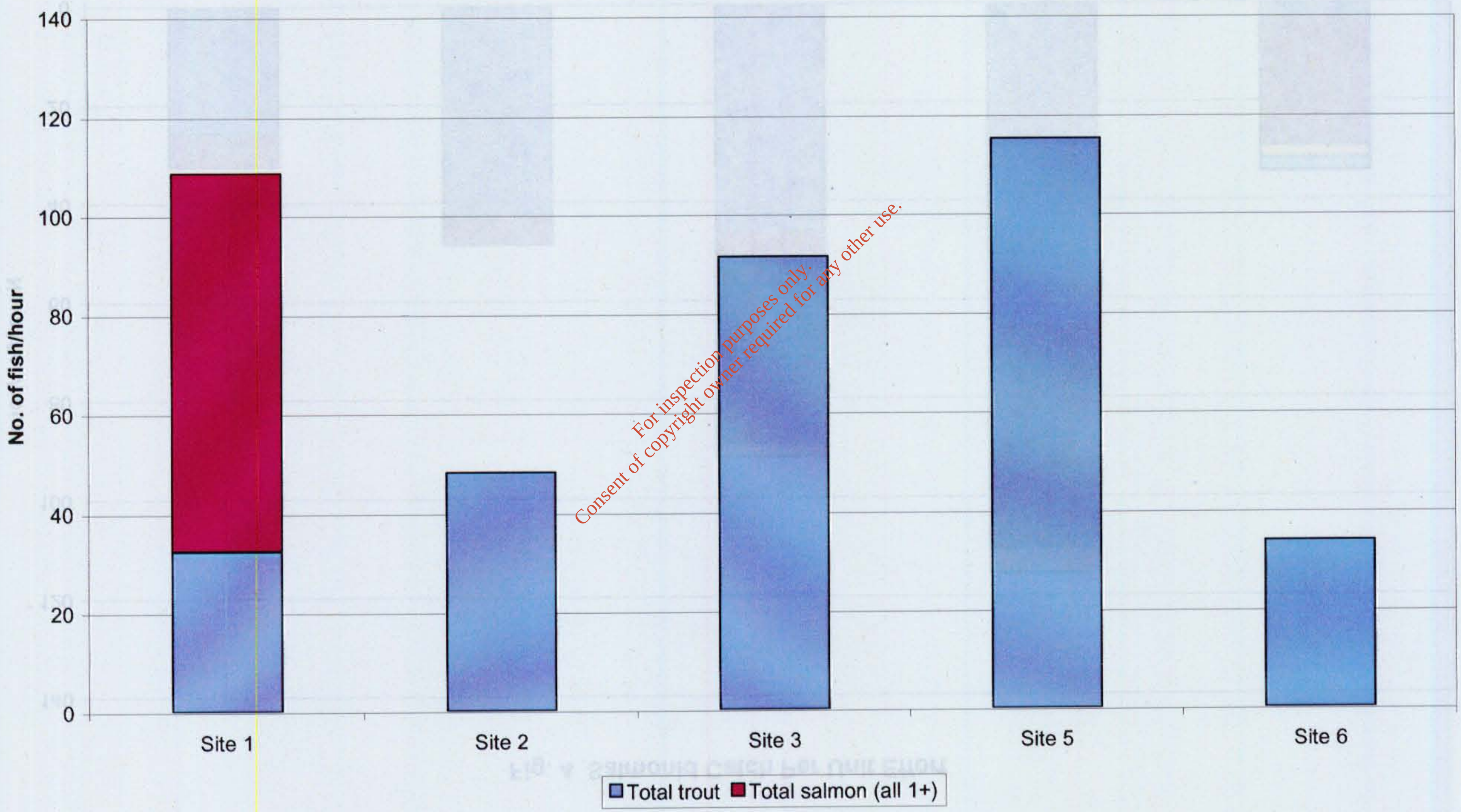
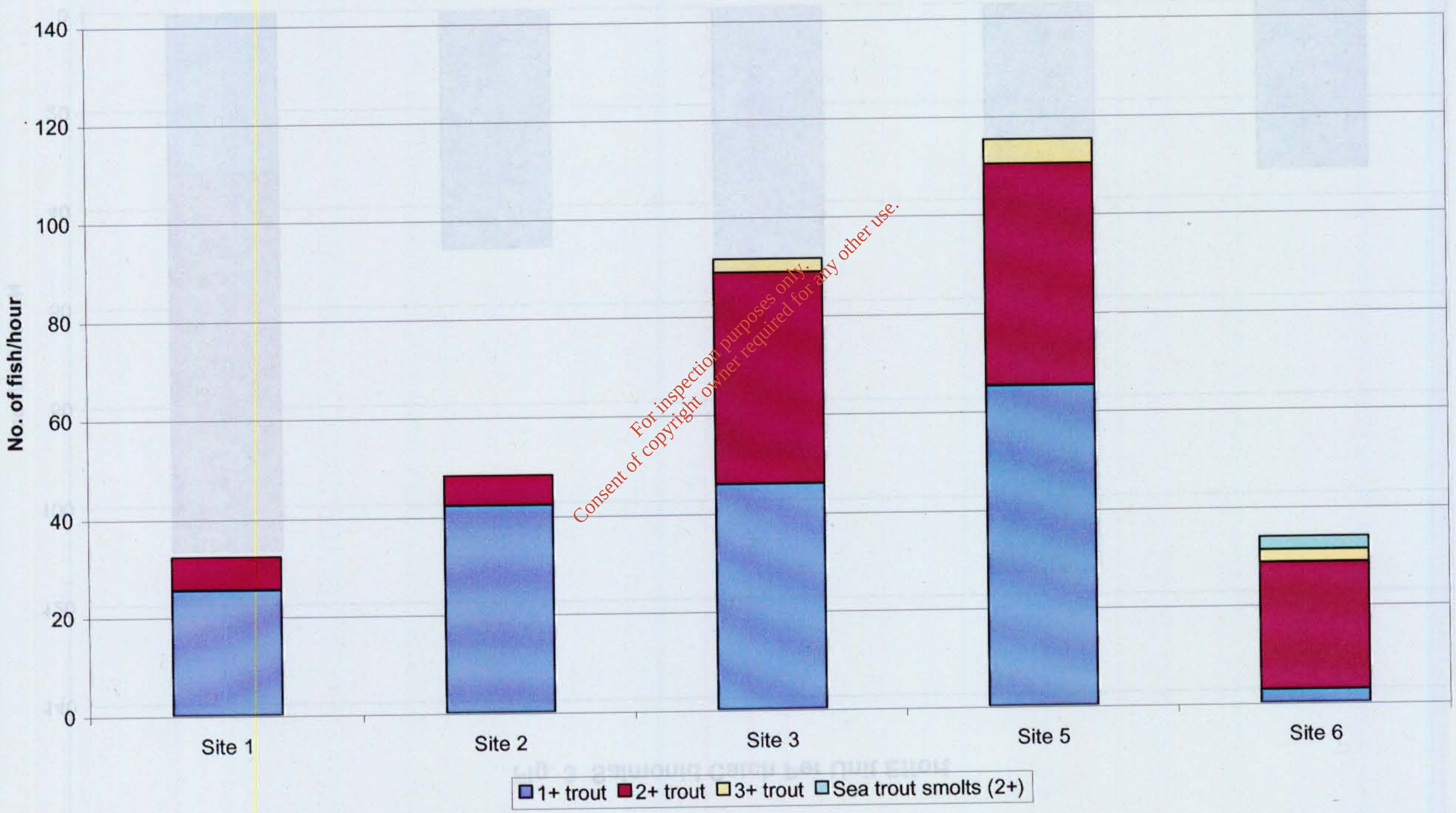


Fig. 4 Salmonid Catch Per Unit Effort



3.4 ANGLING AMENITY VALUE OF THE WHITE RIVER

On the basis of the 1997 survey it appears that there is a small run of salmon into the lowest section of the White River. The 2003 survey further indicates that recent stocking of the river with salmon fry has been successful in at least one location. The 1997 and 2003 surveys establish the fact that the river has a run of sea trout, though the size of this run cannot be determined from these surveys, which may not have corresponded with the main periods of sea trout migration. The 1997 & 2003 surveys establish that the White River has a very good population of brown trout. At present the White River is a significant leisure resource for a local anglers; the Abha Bhan Fishing Club now has up to 100 members (Eileen O'Connell, Abha Bhan Fishing Club, letter of 25/5/03, see Appendix 5). It seems that at present few anglers visit the river from outside the area. However, O'Grady (1987) states that "*there is a long history of angling for sea trout, salmon and brown trout in the White River. As far back as 1958 a Fishing Club was formed. Over the next two years the Club spent almost £1,000 on improving access for migratory fish, in particular sea trout. Substantial stocking of all three species mentioned was carried out at that time, and development works were carried out by the club members. The White River system, which includes the Cloonlahard, is the only complete river system in Co. Limerick which is recognised as a sea trout fishery. This fact makes the river unique. Overseas anglers, mainly German and British have fished the river over the years, thus contributing to tourism income.*" Fish kills such as that investigated in the 1987 study (O'Grady 1987) seem to have resulted in the decline of the river as an angling resource. The section of the river from Ballyhahill to Loghill is notably picturesque, with numerous attractive cascades and pools in a setting of mature deciduous woodland composed largely of native species. This, combined with the facilities of the adjacent villages of Ballyhahill and Loghill, makes the river a potentially significant local resource and amenity.

The results of the 1997 & 2003 surveys indicate a very substantial recovery of the fish stocks and the possibility of developing the river as a local and tourism amenity. An ongoing program of stocking with salmon fry and improvements to the access infrastructure for anglers is described in the letter from the Abha Bhan Fishing Club in Appendix 3. Works already completed include the release of 57,000 salmon fry, construction of three access bridges (see Photo. 41), and construction of wheelchair and disabled persons access to the river.

3.5 ECOLOGICAL INTEREST OF THE WHITE RIVER

The Dúchas national map of SPAs and cSACs (15/2/01) shows no cSACs or SPAs in the vicinity of the White River, other than the Shannon Estuary (cSAC 002165) into which the river flows. The site synopsis for this site is contained in Appendix 5. No information has been received from the National Parks & Wildlife Service (formerly Dúchas); however, a search for the river name in a computer archive of Dúchas site synopses for NHAs, cSACs and SPAs produced no results, indicating that there are no NHAs in the vicinity of the river. Salmon (*Salmo salar*) which occur in the river are listed in Annex II of the Habitats Directive. The three Irish species of lamprey, Sea Lamprey (*Petromyzon marinus*), Brook Lamprey (*Lampetra planeri*), River Lamprey (*L. fluviatilis*), are also listed in Annex II of the Habitats Directive. Lampreys have been recorded in the River Maigue, another tributary of the Shannon Estuary (Kurtz & Costello 1998), and could therefore occur in the White River. However, no lampreys were recorded in the present survey, in the 1997 Conservation Services survey, or in the 1987 Central Fisheries Board survey (O'Grady 1987).

Crayfish (*Austropotamobius pallipes*) are a protected species under the Wildlife Act (1976), and are also listed in Annex II of the EU Habitats Directive. Crayfish could occur in the White River, but the author of this report is not aware of any Crayfish records for the White River, and no Crayfish were recorded in the present or the 1997 Conservation Services surveys.

The 1997 survey of the White River (Conservation Services 1997) sampled aquatic macroinvertebrates at nine sites on the White River and carried out identification to the lowest practicable taxonomic level. Sixty nine taxa were recorded, indicating a moderate to good invertebrate biodiversity in the river. Taxa recorded are listed with notes on their ecology and distribution in Appendix 3.

4 AN ASSESSMENT OF POTENTIAL IMPACTS IN THE ABSENCE OF ADEQUATE MITIGATION

4.1 LEACHATE POLLUTION

The future impact of the proposed landfill extension on the White River will depend on the quantity and quality of treated or untreated leachate (if any), which enters the river in future years. The dry weather flow of the White River of Gortadroma is estimated as 0.003 cubic metres per second (RPS-MCOS Ltd pers. comm.) This constitutes a low flow volume offering limited dilution.

4.1.1 COMPOSITION OF LEACHATE

One of the consequences of the disposal of wastes in landfills is the generation of leachate, which is the noxious liquid that is produced as a result of the interactions in the waste as water passes through it.

The concentration of various potentially polluting substances in leachate varies depending on a variety of factors such as water content of the waste, rainfall, design and operation of the site, the age of the waste and the type of waste being disposed. The EPA Waste Licence for Gortadroma landfill allows for a maximum waste disposal of 130,000 tonnes per annum, comprised of household waste 55.4%, commercial waste 30%, sewage sludge 3.7%, industrial non-hazardous sludge 0.9%, industrial non-hazardous solids 8.5% (Hazardous as defined in Waste Management Act 1996) and water treatment sludge 1.6%. The licence also allows for a once off disposal of 3,000 tonnes of calcium phosphate/ sand mixture or bonedust.

Some typical components of untreated leachates from domestic wastes at various stages of decomposition are tabulated below, with recent leachate analysis data from Gortadroma landfill.

	Range of concentrations (mg/l) recorded at Gortadroma 2001 & 2002 (untreated leachate)	Typical Composition (mg/l) of untreated leachates from domestic wastes in Britain D.O.E. data reproduced in Daly (1987)		
Parameter		**Untreated Leachate Recent Waste**	**Untreated Leachate Aged Waste**	**EU Maximum Admissible Concentration in receiving waters**
pH		6.2	7.5	6.0 - 9.0 (Salmonid Waters Regulations)
C.O.D.	392 (mean)	23,800	1,160	
B.O.D.	48 (mean)	11,900	260	<5 (Salmonid Waters Regulations)
T.O.C. (Total Organic Carbon)		8,000	465	
Fatty Acids (as C)		5,688	5	
Ammon-iacal N	110 (mean)	790	370	1.0 mg/l total ammonium subject to complying with standard of 0.02 mg/l for non-ionised ammonia NH_3 (Salmonid Waters Regulations)

	Range of concentrations (mg/l) recorded at Gortadroma 2001 & 2002 (untreated leachate)	Typical Composition (mg/l) of untreated leachates from domestic wastes in Britain D.O.E. data reproduced in Daly (1987)		
Parameter		**Untreated Leachate Recent Waste**	**Untreated Leachate Aged Waste**	**EU Maximum Admissible Concentration in receiving waters**
Ortho-phosphate	<0.02 - 7.10	0.73	1.4	0.03 mg/l (Phosphorus Regulations)
Chloride		1,315	2,080	250 (Surface Water Regulations)
Sodium		960	1,300	150 (Drinking Water Regulations)
Magnesium	43 - 201	252	185	50 (Drinking Water Regulations)
Potassium		780	590	12
Calcium	33 - 193	1,820	250	200 (Drinking Water Regulations)
Manganese	0.150 – 62.634	27	2.1	0.05 (Surface Waters Regulations)
Iron		540	23	0.2 (Surface Waters Regulations)
Nickel		0.6	0.1	0.05 (Drinking Water Regulations)

	Range of concentrations (mg/l) recorded at Gortadroma 2001 & 2002 (untreated leachate)	Typical Composition (mg/l) of untreated leachates from domestic wastes in Britain D.O.E. data reproduced in Daly (1987)		
Parameter		**Untreated Leachate Recent Waste**	**Untreated Leachate Aged Waste**	**EU Maximum Admissible Concentration in receiving waters**
Copper	<0.01 – 0.05	0.12	0.03	<0.005 at hardness of 10 mg/l $CaCO_3$. <0.112 at hardness of 300 mg/l $CaCO_3$. (Salmonid Waters Regulations)
Zinc		21.5	0.4	<0.03 at hardness of 10 mg/l $CaCO_3$. <0.5 at hardness of 500 mg/l $CaCO_3$. (Salmonid Waters Regulations)
Lead	<0.049 – 0.359	0.40	0.14	0.05 (Surface Waters Regulations)

(Sources for leachate concentrations: Daly (1987), & Annual leachate monitoring data for Gortadroma provided by RPS-MCOS Ltd.)

Many organic compounds which may be found in landfill leachate are of environmental significance in very low concentrations - parts per billion (ppb) or parts per trillion (ppt) quantities. Consequently very small amounts can cause severe pollution (Daly 1991). Of particular concern are compounds which are fat-soluble and biologically stable so that they accumulate in body fats. Such compounds may biomagnify along food chains and in some ecosystems concentration factors from water to top predators may be as high as 10 to the power of 7 (Mason 1996).

4.1.1.1 Waste Electrical & Electronic Equipment (WEEE)

According to the Commission of the European Communities (2000) the most environmentally problematic substances contained in WEEE include heavy metals, such as mercury, lead, cadmium and chromium, halogenated substances, such as chloroflourocarbons (CFCs), polychlorinated biphenols (PCBs), polyvinyl chloride (PVC) and brominated flame retardants as well as asbestos and arsenic.

A significant reduction in quantities of WEEE reaching landfill can be anticipated as a result of EU Directive 2002/96/EC (on waste electrical and electronic equipment). The directive requires member states to minimise the disposal of WEEE to landfill, and to achieve by the end of 2006 separate collection of at least 4kg on average per inhabitant per year of WEEE from private households. The Directive will require producers of electrical and electronic equipment to finance the collection from collection facilities and the treatment, recovery and disposal of WEEE. In the case of WEEE other than WEEE from private households, producers will be obliged to provide for collection of such waste. Irish legislation to enact the Directive (which must be in place by August 2004) will not include a prohibition on the disposal of WEEE to landfill by private householders (Sean O'Suilleabháin, Dept. of Environment pers. comm.). For at least the first five years after the entry into force of Directive 2002/96/EC the onus will be on the householder to take the waste equipment back to its original producer/distributor or recycling collection facility. The quantities of these products entering the landfill in future will therefore depend on a range of factors including education of the public and the ease with which these products can be correctly disposed of by the public. At present there are facilities at Gortadroma landfill for accepting "white" goods such as fridges, freezers etc. for recycling and in accordance with the WEEE Directive Limerick County Council will be providing WEEE collection points at their Civic Amenity Sites by August 2005.

EU Directive 2002/95/EC (on the restriction of the use of certain hazardous substances in electrical and electronic equipment) will result in a reduction in toxic compounds used in the manufacture of electrical and electronic equipment. From 1 January 2008, with certain exceptions, lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ether (PBDE) must be replaced by other substances. As this requirement does not come into force until 2008, and equipment manufactured until that year can be expected to enter the waste stream over the following ten years or more, the benefits of this Directive will be largely felt in ten to twenty years time.

4.1.1.2 Endocrine Disrupting Chemicals (EDCs)

Endocrine disrupters, also known as oestrogen mimicking chemicals, are substances which interfere with the hormonal systems of animals and humans. "*A range of chemical substances, designed for use in industry, agriculture and consumer products, are suspected of interfering with endocrine (hormonal) systems of humans and wildlife*". (European Union Commission Communication COM (2001) 262). Landfill leachate has been identified as a potential source of EDC pollution, in Ireland (Dempsey & Costello 1998) and abroad (Daughton et al 1999).

In October 2000 the European Parliament adopted a resolution on endocrine disrupters emphasising the application of the precautionary principle and calling on the Commission to identify substances for immediate action.

Research is now underway in many countries to clarify the scale and scope of the problem. Significant endocrine disruption effects from environmental contaminants have been recorded both in laboratory tests and in the wild. (Jobling *et al* 1998).

A research team at Cork Institute of Technology has drawn a list of endocrine disruptors most likely to be present in surface and waste waters in the Irish aquatic environment. Included in the list are the following phthalates (Dr H. Tarrant, Cork Institute of Technology, pers. comm.):

Dimethyl Phthalate	Plasticiser
Diethyl Phthalate	Plasticiser
Di-n-butyl Phthalate	Plasticiser
Butyl Benzyl Phthalate	Plasticiser
Bis 2-(ethylhexyl) Phthalate	Plasticiser
Di-n-octyl phthalate	Plasticiser

Phthalates are probably the most important group of endocrine disrupting chemicals which may be present in landfill leachate. Phthalates are a major component in PVC, of which they form up to 60% of the total volume (European Commission 2000). About 50% of the total consumption of phthalates is bis(2-ethylhexyl) phthalate DEHP (Cadogen *et al* 1993 quoted in European Commission 2000). PVC forms approx. 2.5% of landfilled municipal waste in Europe (European Commission 2000).

The Final Report to the European Commission: *The Behaviour of PVC in Landfill* (European Commission 2000) indicates that a significant proportion of phthalates are degraded within landfills and are therefore not released to the environment. However, the report also states: "*Essential information is still lacking for an assessment of quantitative phthalate emission from landfills. … Emissions of phthalates to landfill leachates and to the aquatic environment cannot be excluded, DEHP in particular is considered to be persistent and to accumulate in sediments. …. According to the findings from the literature survey and from our own analysis with regard to emissions resulting from the disposal of PVC in landfills, a contribution to the contamination of leachate … occurs. … As there is evidence that phthalates, DEHP mainly, are not fully eliminated through current leachate treatment .. emission to aquatic ecosystems cannot be* *excluded. ...Technical solutions for leachate treatment are feasible.*" (European Commission 2000).

In Ireland an ongoing EPA funded project to detect any signs of endocrine disruption in Irish freshwater fish is scheduled to be completed by Cork Institute of Technology in December 2003 (Dr Heloise Tarrant, Cork Institute of Technology pers. comm.) Research into Endocrine Disrupters is also ongoing at Athlone Institute of Technology (Dr A. Fogarty pers. comm.), and at Sligo RTC and the University of Ulster. Until these studies are completed the scope and scale of endocrine disruption in Irish freshwaters remains unknown, and specifically the contribution (if any) of landfill leachate to the problem also remains unknown.

It is notable that analysis of leachate from Gortadroma in 2001 included six phthalates including DEHP; all of these compounds were below the detection limit in the leachate analysed (Euro Environmental Services Report 28/11/01).

4.1.1.3 Risks from other chemicals and products which are permitted in the landfill

All biodegradable organic wastes which enter the landfill such as food waste, garden waste, paper and cardboard products, animal products, and a range of commercial and industrial wastes will ultimately decompose; leachate produced during this decomposition process typically has levels of B.O.D. and ammonia which are potentially lethal (in the absence of adequate treatment) to most aquatic animals and plants. Likewise decomposition of organic material frequently results in the production of phosphorus containing compounds, which if released to the aquatic environment may result in eutrophication of the receiving waters. Non organic phosphorus containing compounds disposed at the landfill may also result in phosphorus in the leachate, which if not removed by leachate treatment could result in eutrophication of receiving waters.

In addition to such well documented pollutants in landfills, a wide range of compounds enter landfill, the environmental effects of which are not known. The number of chemicals now on the market is very large and growing (Royal Commission on Environmental Pollution 2003; EU MEMO 03/213). "*Extensive national, EU and international legislation and agreements prescribe requirements for testing and assessing chemicals for their potential to cause harm in the environment, but only a small proportion of chemicals on the market have been the subject of risk assessment.*"(Royal Commission on Environmental Pollution 2003). To redress this situation the European Commission on 29/10/03 proposed a new EU regulatory framework for chemicals called REACH (Registration, Evaluation and Authorisation of Chemicals). The proposed regulation would replace over 40 existing Directives and Regulations. REACH would require companies that produce and import chemicals to assess the risks arising from their use and to take necessary measures to manage any risks they identify. (EU document IP/03/1477) The Commission estimates that it will take 11 years from the year the legislation enters into force to complete the REACH registration process (EU MEMO 03/213).

Given the large and increasing number of compounds which are on the market and which have not been tested for potential adverse environmental impacts, there is a significant likelihood that some of these compounds which are entering landfill will have significant potential for adverse environmental impact. If the EU Commission's REACH proposal is written into EU law this potential for adverse environmental impact could be expected to decrease over the next 10 – 15 years.

4.1.1.4 Risks from chemicals and products which are prohibited in the landfill

Disposal of waste classified as hazardous in the Waste Management Act 1996 is prohibited at Gortadroma landfill (EPA Waste Licence 17-2). In 2001 leachate from Gortadroma was tested for a range of 52 Volatile Organic Compounds, 17 Organochlorine Pesticides and 60 Semivolatile Organic Compounds. All of these compounds were below the detection limit in the leachate analysed (Euro Environmental Services Report 28/11/01).

Evidence from Britain (Royal Commission on Environmental Pollution Report 2003) indicates that significant quantities of domestic pesticides may still be disposed of illegally to landfill in Britain. Whether these products will be reduced to an insignificant level in non-hazardous waste landfills will depend on a range of factors including education of the public, the ease with which these products can correctly disposed of by the public, the level and thoroughness of checking of incoming wastes at landfills, and the penalties imposed on persons found to be attempting to dispose of these wastes to landfill.

4.1.2 TIMESCALE FOR LEACHATE GENERATION

The sequence of microbiological breakdown processes which occurs in landfills is now well established, in that the landfill progresses through the aerobic, acetogenic, methanogenic and finally semi-aerobic phases. Whilst these phases will ensure that organic matter is eventually completely broken down and the carbon is released in the form of methane and carbon dioxide gases, some of the end products of these degradation processes remain as soluble components of leachate. Thus, waste components which constitute pollutants in the solid phase are gradually transposed into a liquid phase and can only be eliminated from a landfill providing waste encapsulation by the removal and treatment of the leachate. Robinson and Gronow (1993) state that a large, deep, high-density domestic waste landfill, operated in a typical manner as at present in the UK, will continue to produce strong and polluting leachates well in excess of values considered acceptable for discharge to surface or ground water for a large number of decades, and possibly over timescales in excess of a century.

One of the most difficult components of leachate to eliminate is ammonia, since this is the soluble end product of the anaerobic breakdown of nitrogenous components of wastes. Typically the ammonia content of leachates is 1000 mg/l, and for direct discharge to controlled waters a limit of say perhaps 1 mg/l would be required. Thus a dilution ratio of 1000:1 would be required for all leachate contained within a site. Walker (1993) calculates that if an engineered landfill site were capped over a depth of refuse of 10m with an average drained moisture content of 40%, then the hydraulic retention time (HRT) for the infiltration rate of 50mm per annum is given by: 10m x 0.4 ÷ 0.05m/a = 80 years. Knox (1990) calculates that for a hydraulic retention time of 80 years, the time to reduce the concentration of ammonia from 1000 mg/l to 1 mg/l is 552 years. Krumpelbeck and Ehrig (1999) report that in a study of 50 German landfills, ammonia concentrations did not show a significant decrease thirty years after closure. Thus extremely protracted time scales may be involved for the operation of leachate control measures at fully engineered sites. This conclusion is supported by Freeze and Cherry (1979) who state that "in some cases leachate production may continue for many decades or even hundreds of years". The concept of very protracted time scales for leachate control is discussed in more detail by Belvi and Baccini (1989).

4.1.3 WORST CASE SCENARIO

If leachate containment, collection and treatment measures were to fail or not be implemented, very significant quantities of leachate entering the White River would result in contamination of the entire aquatic food chain with a variety of pollutants, a general impoverishment of aquatic flora and fauna, and the depletion or elimination of salmonid fish from some or all of the White River downstream of the landfill.

4.2 OTHER POTENTIAL IMPACTS

4.2.1 POLLUTION WITH SUSPENDED SOLIDS DURING CONSTRUCTION AND OPERATION OF THE LANDFILL

Research in North America indicates that the equivalent of many decades of natural or even agricultural erosion may take place during a single year from areas cleared for construction (Wolman and Schick 1967). In the absence of adequate mitigation measures, suspended sediment due to runoff of soil from construction, excavation and landscaping areas can have severe negative impacts on invertebrate and plant life and on all life stages of salmonid fish.

- Suspended sediment can settle on spawning areas, infill the intragravel voids and smother the eggs and alevins (newly hatched fish) in the gravel.
- Bed Load (coarse material transported along the bottom of the stream) and settled sediments can infill pools and riffles, reducing the availability and quality of rearing habitat for fish.
- Suspended sediment can reduce water clarity and visibility in the stream, impairing the ability of fish to find food items.
- Settled sediments can smother and displace aquatic organisms such as macroinvertebrates, reducing the amount of food items available to fish.
- Increased levels of sediment can displace fish out of prime habitat into less suitable areas. (Chilibeck *et al* 1992)
- Suspended solids can abrade or clog the gills of salmonid fish. It takes a high concentration of solid wastes to clog a fish gill and cause asphyxiation, but only a little to cause abrasions and thus permit the possibility of infections. (Solbe 1988)

4.2.2 POLLUTION OF RIVER WITH OTHER SUBSTANCES ASSOCIATED WITH THE CONSTRUCTION PROCESS.

In the absence of adequate mitigation measures the potential exists for a range of serious pollutants to enter watercourses during the construction and operation of the landfill extension. For example any of the following will have deleterious effects on fish, plants and invertebrates if allowed to enter watercourses.

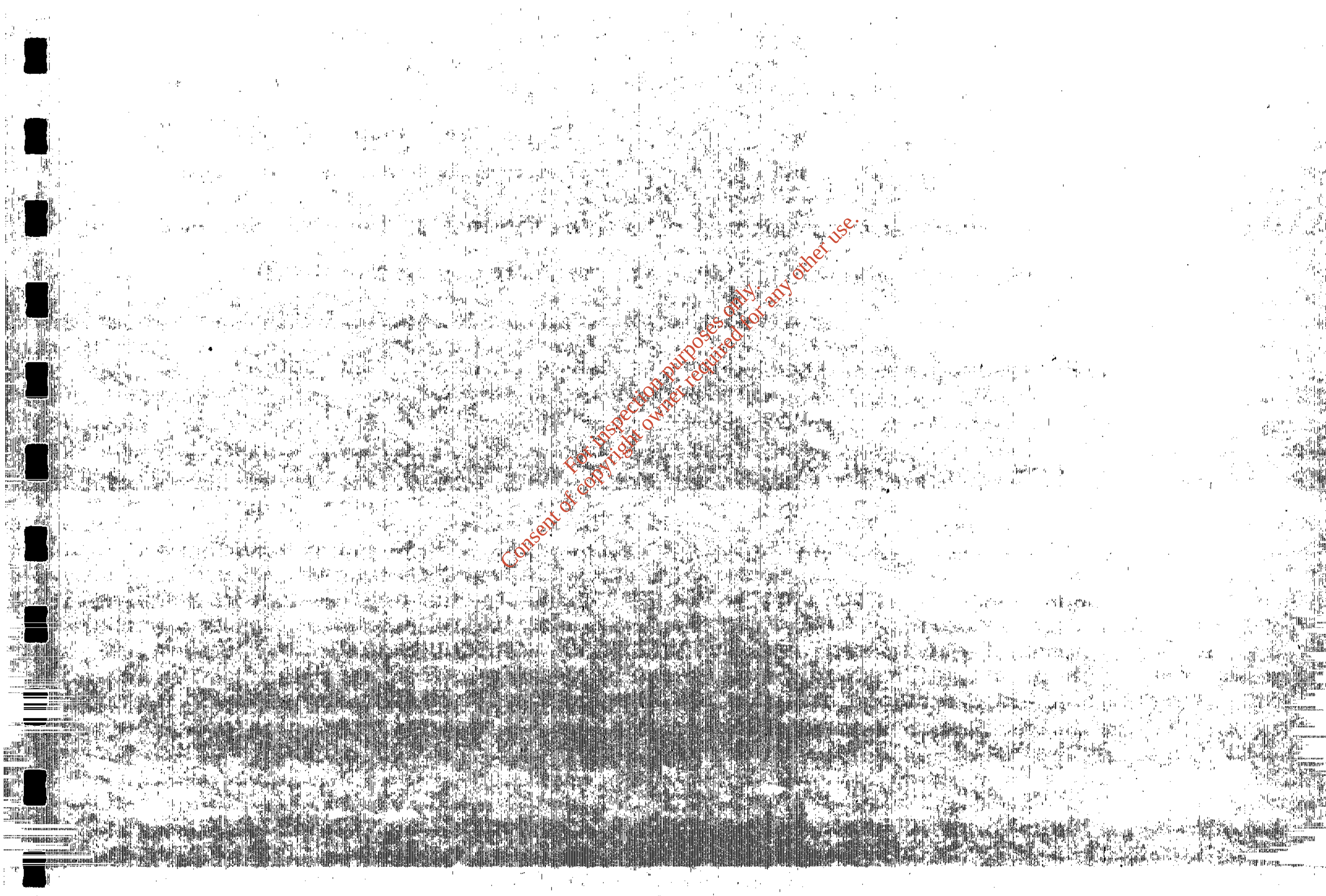
- Raw or uncured concrete and grouts
- Wash down water from exposed aggregate surfaces, cast-in-place concrete and from concrete trucks
- Fuels, lubricants and hydraulic fluids for equipment used on the development site
- Waste from on site toilet and wash facilities

4.2.3 POLLUTION OF RIVER WITH CONTAMINATED WATER DRAINING FROM PARKING AND DELIVERY AREAS AND OTHER PAVED AREAS

The most serious risk posed would be from accidental spillages of transported materials with high B.O.D. or other polluting potential.

4.2.4 LOSS OF HABITAT

The proposed landfill extension would result in the loss of up to 2km of watercourse within the landfill extension area. This consists of habitat sections IVA – IVD (see report section 3.1). Most of this watercourse would be most accurately described as a drain and would be rated as having no potential salmonid habitat value. No section is rated higher than poor as potential salmonid nursery habitat. Overall this watercourse would rate as of low ecological value and the potential impact on the watercourse would rate as either minor or not significant.



5 MITIGATION MEASURES

5.1 MITIGATION OF LEACHATE POLLUTION

5.1.1 STANDARDS FOR EFFLUENT AND RECEIVING WATERS

The protection of the White River is currently accomplished by collecting, treating and removing leachate for disposal elsewhere. However, there are potential impacts on the environment due to the haulage of leachate by road tanker and subsequent treatment and release of treated effluent. If adverse impacts on the ecology, fish populations and amenity value of the White River are to be avoided, it will be necessary to prevent biologically significant quantities of leachate pollutants from reaching the White River over a prolonged period of time, i.e. for as long as pollutants are present in the leachate at a concentration hazardous to the aquatic environment (see Section 4.1.2).

With present levels of knowledge, establishing environmentally safe levels of contaminants is not always a simple matter (see sections 4.1.1.2 & 4.1.1.3). However, for many potential contaminants maximum acceptable levels have been established in EU regulations such as the Salmonid Waters Regulations. Environmental quality standards for a wide range of compounds have been recommended by EPA (1997). The EPA waste licence requires that treated leachate be monitored annually for List I/II compounds from EU Directive 76/464/EEC & 80/68/EEC. List I compounds are to be replaced by listed priority substances as specified in the Water Framework Directive and the amending Decision No. 2455/2001/EC. The 2001 decision aims for "*review and adaptation of the first list of priority substances at the latest four years after the entry into force of the Water Framework Directive (2000/60/EC) and at least every four years thereafter. … In accordance with Article (1)c of Directive 2000/60/EC the future reviews of the list of priority substances under Article 16(4) of that Directive will contribute to the cessation of emissions, discharges and losses of all hazardous substances by 2020 by progressively adding further substances to the list.*" It is recommended that the treated leachate monitoring at

Gortadroma include relevant substances on this updated list. If significant concentrations of any priority substances are recorded in the treated effluent, measures would be required to reduce or eliminate them from the discharge. If concentrations are found of other pollutants in the effluent which could result in river concentrations above EPA Proposed Environmental Quality Standards (EPA 1997) additional treatment would be required. If research at present being conducted in Ireland concludes that biologically significant concentrations of endocrine disrupting chemicals are present in leachate from Irish landfills, the compounds, if not already monitored, should be added to the list of compounds to be monitored in the treated leachate, and measures should be taken to ensure that biologically significant concentrations of these compounds are not allowed to enter the White River.

The existing EPA waste licence sets emission limits for treated leachate discharged to the river at BOD 25mg/l, Total Suspended Solids 35mg/l, Ammonium 3mg/l, Total-P 2mg/ and pH 6-8. The minimum river flow in the White River must be 50 l/s and must be greater than 40 dilutions of effluent at all times. Dilution (1:40) of effluent with maximum permitted levels of contaminants would elevate the levels of these contaminants in the river as follows:

	Effluent Concentration	Elevation in River	EU Maximum Admissible Concentration in receiving waters
BOD	25 mg/l	0.625 mg/l	<5 (Salmonid Waters Regulations)
Suspended Solids	35 mg/l	0.875 mg/l	25 mg/l (Salmonid Waters Regulations)
Total Ammonia	3 mg/l	0.075 mg/l	1.0 mg/l total ammonium subject to complying with standard of 0.02 mg/l for non-ionised ammonia NH_3 (Salmonid Waters Regulations)
Total-P (as P)	2 mg/l	0.05 mg/l	0.015 - 0.03 mg/l Molybdate Reactive P (Phosphorus regulations)[1]

The proposed maximum licensed discharge concentrations at the minimum permitted dilution would be unlikely to elevate BOD, Suspended Solids and Ammonium in the White River above the limits set by the Salmonid Regulations. An elevation of 0.05mg/l Total-P in the White River would however, be likely to elevate molybdate reactive phosphorus (MRP) in the river to levels above those permitted in the Phosphorus Regulations, and could result in significant nutrient enrichment of the river downstream of the effluent point. It will be necessary that phosphorus concentrations and volumes of treated leachate released to the river be compatible with the requirements of the Phosphorus Regulations, i.e. median MRP should not exceed 0.03mg/l or the EPA Q-rating should not fall below Q4 as a result of the effluent released to the river. The allowable amounts of effluent phosphorus will therefore be a function of river flow volume, and the background concentration of phosphorus in the White River. Reduction in phosphorus concentrations in the river upstream of the landfill would result in an increase in the allowable quantities of phosphorus in the effluent.

[1] Under the 1998 Phosphorus Regs threshold limits are set at a median MRP concentration of 0.03 mgP/l or a biological Q value of Q4 for this section of the White River.

EC Directive 1999/31/EC on the landfill of waste requires that after landfill closure "*the operator shall be responsible for its maintenance, monitoring and control in the after-care phase for as long as may be required by the competent authority, taking into account the time during which the landfill could present a hazard*".

The 'top carnivore' in the White River food chain will on occasions be anglers and their families, as well as otters, kingfishers and other valued wildlife. Therefore, the biological impact, if any, of treated leachate discharges should be carefully monitored, and water, sediments and fish from the river should be periodically tested for a broad spectrum of contaminants.

5.1.2 PROPOSED COLLECTION AND TREATMENT OF LEACHATE

Recommendations of specific engineering methods by which the effluent and water quality standards outlined in the previous section should be achieved (i.e. methods of leachate containment and treatment) do not fall within the brief of this report or within the expertise of the report's authors. The following is a brief description of the proposed methodologies provided by RPS-MCOS Ltd. A more detailed description of proposed containment and treatment methods is contained elsewhere in the EIS.

It is proposed that all leachate will be collected and treated to a standard which will preclude adverse biological impacts before being discharged to the White River. Collected leachate will be pumped to a treatment plant. The Leachate Treatment Plant (LTP) at the Gortadroma Landfill provides biological treatment, secondary clarification and tertiary polishing. The biological treatment is comprised of de-nitrification (anoxic tank) and activated sludge processes. The liquid from these processes is clarified and the settled sludge returned into the activated sludge lagoon. The tertiary processes in the plant include a polishing pond, sand filter and a peat filter. The existing Gortadroma LTP processes a combination of fresh and old leachate. Discharge from the leachate treatment plant is piped to the White River.

The effluent quality and treatment efficiency based on analysis of about 40 grab samples from the inlet and outlet between March to December 2000 are given below:

	Influent[(1)] mg/l	Effluent[(1)] mg/l	Reduction %
BOD_5	48	2.8	94
COD	392	135	66
SS	602	46	92
NH_4^+-N	110	0.89[(2)]	99
NH_4^+-N, summer[(2)]	87	0.7	99
$(NO_2^- + NO_3^-)$-N	112	172	-54[(3)]
$(NH_4^+ + NO_2^- + NO_3^-)$-N	219	176	20
Total P	1.4	0.28	81

(1) Average of results in the period 7th March to 29th December 2000.
(2) Summer: 1st April to 31st October. 2000
(3) Negative reduction due to the oxidation of NH_4^+-N
Data provided by M.C. O'Sullivan Ltd.

It is proposed that any leachate produced in low water conditions will not be released to the river, but be returned and stored in the treated leachate lagoon until suitable conditions prevail. Should any deterioration occur in the effluent quality or if the treated leachate lagoon has reached capacity, leachate would be removed by road tanker (RPS-MCOS Ltd, pers. comm.)

5.2 MITIGATION OF NON LEACHATE POLLUTION GENERATED DURING CONSTRUCTION AND OPERATION OF THE LANDFILL

i. Release of suspended solids to surface waters should be kept to a minimum. The key factors in erosion and sediment control are to intercept and manage off- and on-site runoff. This limits the potential for soils to be eroded and enter streams in runoff. Both runoff and surface erosion control are used in Gortadroma together with settlement lagoons to prevent sediment contamination of receiving surface waters.

ii. Raw or uncured waste concrete should be disposed of by removal from the site or by burial on the site in a location and in a manner that will not impact on the watercourse.

iii. Wash down water from exposed aggregate surfaces, cast-in-place concrete and from concrete trucks should be trapped on-site to allow sediment to settle out and reach neutral pH before clarified water is released to the stream or drain system or allowed to percolate into the ground.

iv. Fuels, lubricants and hydraulic fluids for equipment used on the site should be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, and provided with spill containment according to codes of practice.

v. Fuelling and lubrication of equipment should not be carried out close to water courses.

vi. Any spillage of fuels, lubricants or hydraulic oils should be immediately contained and the contaminated soil properly disposed of.

vii. Waste oils and hydraulic fluids should be collected in leak-proof containers and properly disposed of.

5.3 MITIGATION OF POLLUTION FROM RUNOFF FROM PAVED AREAS

A spill response action plan should be put in place, and spill response materials kept on site, to ensure that any spills of potentially polluting materials are prevented from entering surface waters.

Extensive surface water control infrastructure has been put in place under the recent contracts including interceptor drains to divert surface water streams around the extension area. Additionally a sedimentation tank has been constructed at the site to provide settlement of surface water runoff before discharge to the White River, and containment and storage of surface water run-off in the event of contamination.

6 NON TECHNICAL SUMMARY

6.1 EXISTING ENVIRONMENT

- By the criteria of naturalness and diversity, the aquatic habitat of the White River is of high quality. The physical habitat is exceptionally diverse with an excellent mixture of shallow riffles, glides, cascades and pools. The river substrate is equally diverse. Bankside habitat quality is also good, particularly in the section between Ballyhahill and Loghill where the river flows through a linear woodland composed mostly of mature native trees.

- Of the approx. 13km of river channel adjacent to and downstream of the landfill site, 5.5km constitutes good or very good adult salmonid habitat, and 11km constitutes very good juvenile salmonid habitat.

- A 1987 report by the Central Fisheries Board states that "in physical terms the river is an ideal salmonid ecosystem particularly suited to migratory forms (sea-trout and to a lesser extent, salmon)." The results of the present survey corroborate this conclusion.

- Invertebrate community analysis indicates high invertebrate biodiversity at most sites examined. A Q-rating of 4 or higher, indicating unpolluted conditions, was obtained in all sections of the river assessed upstream and downstream of the landfill site. Assessment was not carried out downstream of Ballyhahill in this survey (2003); however, EPA recorded a slightly polluted Q-rating of Q3-4 at this site in 2002.

- A good population of juvenile and adult brown trout was recorded at all sites surveyed.

- A single sea-trout smolt was recorded in the lowest section of the river. Because of high water levels conditions were poor for electrofishing at this site, and it is likely that a larger number of sea trout would have been recorded under more suitable conditions. Small numbers of sea trout (post-smolts and one-sea-winter fish) were recorded in the lower 8 km of the river in 1997. The size of the sea trout run cannot be determined from the 1997 or the present survey, which may not have corresponded with the main period of sea-trout migration. The White River is the only river in County Limerick with a run of sea trout (Eamonn Cusack, Shannon Regional Fisheries Board, pers. comm.)

- In 1997 juvenile salmon were only recorded in the lowest section of the river, just upstream of the estuary. No salmon were recorded at this site in 2003; however, it cannot be concluded from this that salmon are no longer present at the site, as water conditions were unsuitable for the capture of juvenile salmon at the time of the survey. The May 2003 survey recorded good densities of juvenile salmon at Glensharrold c.2km upstream of the landfill, where no salmon were recorded in 1997. These were all fish spawned in the winter of 2001/2002. This section of river was stocked with unfed salmon fry over the last 4 years. The fact that a good density of one year old salmon were recorded at this site indicates that the stocked fish have successfully colonised this section of stream, and it seems probable that some of the stocked fish may already have migrated to sea.

- This survey establishes that the White River has a very good population of brown trout. At present the White River is a significant leisure resource for local anglers. Overseas anglers formerly visited the river in significant numbers. It seems that few anglers now visit the river from outside the area, perhaps due to fish kills in recent decades.

- The section of the river from Ballyhahill to Loghill is notably picturesque, with numerous attractive cascades and pools in a setting of mature deciduous woodland composed predominantly of native tree species. This, combined with the facilities of the adjacent villages of Ballyhahill and Loghill, makes the river a potentially significant attraction for angling tourists. Significant expenditure has taken place in the last four years to improve the angling amenity value of the river and to restock the river with salmon.

- Landfill leachate contains a large variety of potentially serious pollutants. The future impact of the landfill on the White River will depend on the quantity and quality of treated or untreated leachate (if any) which enters the river in future years. The White River at Gortadroma is a relatively small river, offering limited dilution.

6.2 POTENTIAL IMPACTS IN AND PROPOSED MITIGATION MEASURES

- Landfill leachate contains a large variety of potentially serious pollutants. The future impact of the landfill on the White River will depend on the quantity and quality of treated or untreated leachate (if any) which enters the river in future years. It is noteworthy that the biological survey carried out for this report recorded a good population of brown trout and an invertebrate community indicative of unpolluted conditions (Q4) immediately downstream of the existing landfill.

- If adverse impacts from the proposed landfill extension on the ecology, fish populations and amenity value of the White River are to be avoided, it will be necessary to prevent biologically significant quantities of leachate pollutants from reaching the river over a prolonged period of time, i.e. for as long as pollutants are present in the leachate at a concentration hazardous to the aquatic environment. This could be accomplished, as is currently the case, by collecting, treating and removing all leachate for disposal elsewhere. However, there are potential impacts on the environment due to the haulage of leachate by road tanker and subsequent treatment and release of treated effluent elsewhere. It is proposed that all leachate will be collected and treated to a standard which will preclude adverse biological impacts, before being discharged to the White River (RPS-MCOS Ltd pers. comm.) It is proposed that this mitigation will be applied for as long as pollutants are present in the leachate at a concentration hazardous to the aquatic environment. This proposed mitigation, if implemented in full, will ensure that the impacts of the proposed landfill extension on the flora, fauna and habitats of the White River are minor or insignificant.

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APPENDIX 1

HABITAT AT INVERTEBRATE SITES

SITE CODE	A	B(a)	C	D	F(b)	X	Z
DATE OF ASSESSMENT	15/05/2003	13/05/2003	13/05/2003	15/05/2003	15/05/2003	15/05/2003	15/05/2003
SITE LOCATION	Upstream of bridge north of Glensharrold	Upstream of landfill and tributary flowing from Site Z	Just downstream of landfill site. Immediately downstream of bridge	Upstream of bridge, downstream of confluence with tributary	Just upstream of Ballyhahill and upstream of confluence with Cloonlahard river	On tributary just upstream of confluence with White River and just downstream of a small concrete bridge	On landfill stream just upstream of road and just upstream of confluence with road side drain
River System	White River	White River	White River	White River			
EPA Code (Main Channel)	25/O/02	25/O/02	25/O/02	25/O/02			
Irish Grid Square Identification	R	R	R	R	R	R	R
Irish Grid Reference Eastings	2279	2240	2171	2137	1951	2137	2247
Irish Grid Reference Northings	4160	4308	4315	4312	4605	4309	4313
Photograph	34	35	36	42	37	39	40
Width (m)	4-5	5	5	5-8	5	3-4	0.75
Depth (cm)	10-20	10-30	10-20	12-30	10-30	10-20	10-15
Conductivity(μS/cm)	200	160					380
Substrate (components numbered in order of dominance)							
Bed Rock							
Large rocks	2			2	2	2	
Cobble	1		3	1	1	1	
Gravel/pebble	3	2	2	3	3	3	
Sand				4		4	
Mud		1	1			5	1
Flow type							
% cascade							
% riffle	60	5	75	70	100	75	
% glide	40	95	25	30		25	100
% pool							
Bankside Vegetation							
Dominant bankside vegetation	Hawthorn	Bramble	Conifer, Hawthorn	Ash, Sycamore, Gorse, Hawthorn	Grass	Gorse, Hawthorn, Flag Iris	Grass, Meadowsweet
Estimated summer cover of stream by bankside vegetation (High, Medium, Low, None)		L	L	L	L	L	M
Fish Habitat Assessment							
Salmonid adult habitat at site	Poor	Good-Fair	Fair	Fair	Good	Poor	None
Salmonid nursery habitat at site	Very Good	Good-Fair	Fair-Good	Good-Very Good	Good	Fair-Good	None
Salmonid spawning habitat at site	Poor	Fair-Poor	Poor-Fair	Poor	Fair	Poor	None
Instream vegetation (% cover)		None	None visible		None visible	None	
Filamentous algae	<5%			<5			
Fontinalis antipyretica				10			
Sparganium erectum							50
Comments			Substrate poorly visible as water turbid				

APPENDIX 2

FISH SURVEY DATA

Owvane River Site 1

Location of section electrofished	R2279 4160; length c.180m	
Salmonid habitat quality	Spawning	Fair
	Nursery	Good - V.Good
	Adult	Poor - Fair
Fishing time	26 minutes	
Conductivity (µS/cm)	200	
Photograph	34	
Site description	Shallow fast flowing stream. Width 3-5 metres, depth 12 - 50 cm. Riffle 60%, glide 40%. Shade <5% by hawthorn. Substrate in order of dominance cobble, large rocks, gravel.	
Fish species found	Stone Loach, Brown Trout, Eels, Salmon	

Details of salmonids captured

Brown trout	
Fork length (cm)	**Age**
9.0	
9.6	
10.0	
10.9	
11.0	
11.8	1+
11.8	
12.0	
12.0	
12.8	
13.6	
15.5	
16.0	2+
17.0	

Salmon	
Fork length (cm)	Age
7.9	
9.0	
9.2	
9.9	
10.0	
10.2	
10.3	
10.3	
10.3	
10.4	
10.4	
10.5	
10.5	
10.6	
10.6	
10.6	
10.6	1+
10.6	
10.6	
10.7	
10.7	
10.7	
10.7	
11.0	
11.0	
11.1	
11.2	
11.2	
11.2	
11.3	
11.3	
11.6	
11.8	

Owvane River Site 2

Location of section electrofished	R2240 4308; length c.200m	
Salmonid habitat quality	Spawning	Fair - Good
	Nursery	Fair - Good
	Adult	Fair – Good
Fishing time	20 minutes	
Conductivity (µS/cm)	160	
Photographs	35	
Site description	Mostly fast shallow muddy glide with some muddy riffle on cobble & gravel	
Fish species found	Stone Loach, Brown Trout	

Details of salmonids captured

Brown trout	
Fork length (cm)	**Age**
10.0	
10.2	
10.9	
11.0	
11.3	
12.0	
12.2	1+
12.7	
13.3	
13.4	
13.7	
13.9	
14.1	
14.4	
17.1	2+
18.5	

Owvane River Site 3

Location of section electrofished	R2171 4315; length c.175m	
Salmonid habitat quality	Spawning	Fair
	Nursery	Fair-Good
	Adult	Fair-Good
Fishing time	21 minutes	
Conductivity (µS/cm)	200	
Photograph	36	
Site description	Small silty stream with little bankside shade. Riffle 30%, Glide 70%. Width 5 metres; depth 10 - 50 cm. Water turbid; substrate not visible	
Fish species found	Three Spined Stickleback, Brown Trout	

Details of salmonids captured

Brown trout	
Fork length (cm)	**Age**
10.0	
10.4	
10.6	
11.0	
11.0	
11.1	
11.2	
11.5	1+
11.9	
12.1	
12.3	
12.4	
12.5	
12.6	
12.6	
13.8	
14.4	2+
14.7	
14.8	
15.4	

Brown trout	
Fork length (cm)	**Age**
15.4	
15.5	
15.8	
16.5	2+
17.0	
17.0	
17.5	
17.8	
18.3	
19.3	
20.8	
24.0	3+

Owvane River Site 6

Location of section electrofished	R1951 4605	
Salmonid habitat quality	Spawning	Good
	Nursery	V. Good
	Adult	Good
Fishing time	24 minutes	
Conductivity (µS/cm)	210	
Photograph	37	
Site description	Mixture of stony riffle 70% and shallow glide 30%. Depth 30-50 cm. Width 3-6 metres. Substrate not visible in 2003 due to turbid water; in 1997 was in order of dominance large rocks, cobble, gravel, boulders. Bankside shade sparse.	
Fish species found	Stone Loach, Eels, Three Spined Stickleback, Brown Trout	

Details of salmonids captured

Brown trout	
Fork length (cm)	**Age**
10.2	
10.5	
10.6	
12.0	
12.0	
12.0	
12.0	
12.0	
12.1	1+
12.5	
12.5	
12.5	
12.8	
13.0	
13.0	
13.0	

Brown trout	
Fork length (cm)	Age
13.0	
13.2	
13.5	
13.5	
13.5	1+
13.6	
13.8	
14.0	
14.0	
14.0	
14.8	
15.2	
15.8	
16.0	
16.0	
16.2	
17.0	
17.0	
17.5	2+
17.7	
18.0	
18.0	
18.0	
18.4	
19.0	
19.3	
19.4	
19.7	
22.3	3+
23.8	

Owvane River Site 8

Location of section electrofished	R1933 4958; length c.100m	
Salmonid habitat quality	Spawning	Good
	Nursery	V. Good
	Adult	Good - V. Good
Fishing time	23 minutes	
Conductivity (µS/cm)	220	
Photograph	38	
Site description	Excellent mixture of riffle 40%, glide 40% and pool 20%. Depth 20cm to 75cm. Width 10-15 metres. Substrate in order of dominance consists of cobble, large rocks, boulders and gravel.	
Fish species found	Flounder, Eels, Brown Trout, Sea Trout	

Details of salmonids captured

Sea trout smolt	
Fork length (cm)	**Age**
14.8	2+

Brown trout	
Fork length (cm)	**Age**
13.0	1+
15.0	
15.4	
15.6	
15.9	2+
16.0	
16.0	
17.0	
17.3	
17.5	2+
19.5	
25.0	3+

APPENDIX 3

INVERTEBRATE SPECIES LIST WITH NOTES ON ECOLOGY AND DISTRIBUTION

TAXON	Ecology and Distribution in Freshwater
Oligochaeta (Segmented worms)	
Enchytraeidae	Found in detritus and mud
Limnodrilus sp.	Common and abundant in many habitats.
Hirudinea (Leeches)	
Erpobdella octoculata/testacea	Common in many habitats
Glossiphonia complanata	Common in many habitats
Helobdella stagnalis	Common in many habitats
Gastropoda (Snails and limpets)	
Ancylus fluviatilis	Common in rivers and still waters, usually on hard substrates - stones etc.
Lymnaea peregra	Probably the commonest water snail in Europe, occurring in a wide variety of habitats
Potamopyrgus jenkinsi	Common, often very abundant in many habitats
Bivalvia (Freshwater Mussels)	
Pisidium sp.	Common in many habitats
Hydracarina (Water mites)	Common in many habitats

TAXON	Ecology and Distribution in Freshwater
Amphipoda (Freshwater shrimps)	
Gammarus duebeni	Common in Ireland in a wide range of habitats
Ephemeroptera (Mayflies)	
Baetis rhodani	Common and abundant in small streams; extending into rivers
Baetis muticus	Common, typical of small stony streams.
Baetis fuscatus/scambus	Common in rivers with fairly swift flow
Caenis luctuosa	Common in rivers, lakes and ponds, expecially amongst silt trapped between gravel and stones.
Ecdyonurus dispar	Found in stony rivers and lake shores
Ephemerella ignita	Common, occurring mostly in running waters amongst vegetation
Plecoptera (Stoneflies)	
Isoperla grammatica	Very common in stony rivers and streams.
Leuctra fusca	Common and widespread, occurring mostly in stony streams
Leuctra hippopus	Common and abundant in rivers and streams with a stony substrate
Hemiptera (Water Bugs)	
Velia sp.	Common and widely distributed, typically occrring on slacks in flowing waters, but occasionally in ponds.
Trichoptera (Caddis flies)	
Agapetus fuscipes	Common on stony substrates.
Athripsodes cinereus	Widespread and common in rivers, streams, lakes and canals on stony and sandy substrata

TAXON	Ecology and Distribution in Freshwater
Glossosoma boltoni	Common in Ireland on stony substratum in large streams and rivers
Halesus radiatus	Common in streams, rivers and lake shores.
Hydropsyche angustipennis	Common in lower reaches of large rivers but also occurs in small streams
Hydropsyche contubernalis	Found in lower reaches of large rivers
Hydropsyche pellucidula	Common, usually in fast-running waters.
Hydropsyche siltalai	Common, usually found in fast-running waters.
Polycentropus flavomaculatus/kingii	Common in slower-flowing or still waters. (Larvae of the two species cannot be distinguished with certainty.)
Potamophylax cingulatus	Common in streams and rivers on stony substrates
Potamophylax latipennis	Common in streams, rivers and lake shores on stony substrates
Psychomyia pusilla	Common in large streams and rivers.
Rhyacophila dorsalis	Common in fast-running waters.
Rhyacophila munda	Found under stones in running waters. Localised distribution.
Sericostoma personatum	Common on stony substrates.
Tipulidae (Crane flies)	Common in a variety of habitats.
Culicidae (Mosquitoes & Gnats)	Usually found in still and stagnant water
Ceratopogonidae (Biting midges)	Common in a variety of habitats.
Psychodidae (Owl-midges)	Common, typically in foul habitats, but also among decaying vegetation.

TAXON	Ecology and Distribution in Freshwater
Simuliidae (Black-flies)	Common and often abundant in all types of flowing waters.
Muscidae (House-fly types)	
Chironomidae (Non-biting midges)	
Brillia sp.	Found in a wide variety of still and flowing water habitats
Cricotopus/Orthocladius sp.	Common in all types of freshwater, frequently associated with aquatic plants. (*Orthocladius* larvae cannot be distinguished from some *Cricotopus* larvae with certainty.)
Cryptochironomus sp.	Found in lakes, small streams and larger rivers in various substrata
Eukiefferiella sp.	Found in flowing water.
Micropsectra sp.	Found in a wide variety of still and flowing water habitats
Microtendipes sp.	Found in sediments and submerged mosses.
Parametriocnemius sp.	Found in springs and relatively fast flowing streams and rivers
Paratanytarsus sp.	Found in a wide variety of still and flowing water habitats
Paratendipes sp.	Found in soft sediments and sandy bottoms in standing and running water
Pentaneurini	Common in a variety of habitats.
Polypedilum sp.	Common in a variety of habitats.
Potthastia longimana	Found in still or flowing water, usually associated with sandy substrates.
Potthastia gaedii	Found in flowing water, usually associated with sandy substrates.
Procladius sp.	Common in muddy substrata of standing or slow-flowing waters.
Psectrocladius sp.	Common in a variety of habitats.
Tanytarsus sp.	Common in all types of freshwater.
Thienemaniella sp.	Found in a variety of flowing water habitats
Tvetenia sp.	Found in flowing water.

TAXON	Ecology and Distribution in Freshwater
Coleoptera (Beetles)	
Brychius elevatus	Common in running water and wave-washed lakeshores.
Elmis aenea	Common in running water in riffles.
Helodes sp.	Common in streams.
Laccobius sp.	Several species, of which two are common, are found in still and slow-flowing water.
Limnius volckmari	Common in running water and upland lakes.
Oreodytes sanmarkii	Occasional in Ireland in running water and lakes.
Oreodytes septentrionalis	Common in running water and lakes.
Oulimnius sp.	Common in running water and lakes.
Potamonectes depressus	Common in lakes and rivers.

APPENDIX 4

DUCHAS SITE SYNOPSIS

SITE NAME : LOWER RIVER SHANNON

SITE CODE : 002165

This very large site stretches along the Shannon valley from Killaloe to Loop Head/ Kerry Head, a distance of some 120 km. The site thus encompasses the Shannon and Fergus Estuaries, the freshwater lower reaches of the River Shannon (between Killaloe and Limerick) and the marine area between Loop Head and Kerry Head. The Shannon and Fergus flow through Carboniferous limestone as far as Foynes, but west of Foynes Namurian shales and flagstones predominate (except at Kerry Head, which is formed from Old Red Sandstone).

The site is of high ecological interest, containing a number of habitats listed on Annex I of the EU Habitats Directive. Of these, one is a priority habitat: Lagoons. The site also supports a range of mammals, fish and invertebrates listed on Annex II of the EU Habitats Directive. Most of the estuarine part of the site has been designated a Special Protection Area (SPA), under the EU Birds Directive, primarily to protect the large numbers of migratory birds present in winter.

The Shannon and Fergus Estuaries form the largest estuarine complex in Ireland. They form a unit stretching from the upper tidal limits of the Shannon and Fergus Rivers to the mouth of the Shannon estuary (considered to be a line across the narrow strait between Kilcredaun Point and Kilconly Point). Within this main unit there are several tributaries with their own 'sub-estuaries' e.g. the Deel River and Maigue River. To the west of Foynes, a number of small estuaries form indentations in the predominantly hard coastline, namely Poulnasherry Bay, Ballylongford Bay, Clonderalaw Bay and the Feale or Cashen River Estuary.

Both the Fergus and inner Shannon estuaries feature vast expanses of intertidal mudflats, often fringed with saltmarsh vegetation. The smaller estuaries also feature mudflats, but have their own unique characteristics, e.g. Poulnasherry Bay is stony and unusually rich in species and biotopes. Plant species are typically scarce on the mudflats, although there are some Eel-grass beds (*Zostera* spp.) and patches of green algae (e.g. *Ulva* sp. and *Enteromorpha* sp.). The main macro-invertebrate community, which has been noted from the inner Shannon and Fergus estuaries, is a *Macoma-Scrobicularia-Nereis* community.

In the transition zone between mudflats and saltmarsh, specialised colonisers of mud predominate: swards of Common Cord-grass (*Spartina anglica*) frequently occur in the upper parts of the estuaries. Less common are swards of Glasswort (*Salicornia europaea* agg.). In the innermost parts of the estuaries, the tidal channels or creeks are fringed with species such as Common Reed (*Phragmites australis*) and Club-rushes (*Scirpus maritimus, S. tabernaemontani* and *S. triqueter*). In addition to the nationally rare Triangular Club-rush (*Scirpus triqueter*), two scarce species are found in some of these creeks (e.g.

Ballinacurra Creek): Lesser Bulrush (*Typha angustifolia*) and Summer Snowflake (*Leucojum aestivum*).

Saltmarsh vegetation frequently fringes the mudflats. Over twenty areas of estuarine saltmarsh have been identified within the site, the most important of which are around the Fergus Estuary and at Ringmoylan Quay. The dominant type of saltmarsh present is Atlantic salt meadow occurring over mud. Characteristic species occurring include Common Saltmarsh Grass (*Puccinellia maritima*), Sea Aster (*Aster tripolium*), Thrift (*Armeria maritima*), Sea-milkwort (*Glaux maritima*), Sea Plantain (*Plantago maritima*), Red Fescue (*Festuca rubra*), Creeping Bent (*Agrostis stolonifera*), Saltmarsh Rush (*Juncus gerardi*), Long-bracted Sedge (*Carex extensa*), Lesser Sea-spurrey (*Spergularia marina*) and Sea Arrowgrass (*Triglochin maritima*). Areas of Mediterranean salt meadows, characterised by clumps of Sea Rush (*Juncus maritimus*) occur occasionally. Two scarce species are found on saltmarshes in the vicinity of the Fergus Estuary: a type of robust Saltmarsh-grass (*Puccinellia foucaudii*), sometimes placed within the compass of Common Saltmarsh-grass (*Puccinellia maritima*) and Hard-grass (*Parapholis strigosa*).

Saltmarsh vegetation also occurs around a number of lagoons within the site. The two which have been surveyed as part of a National Inventory of Lagoons are Shannon Airport Lagoon and Cloonconeen Pool. Cloonconeen Pool (4-5 ha) is a natural sedimentary lagoon impounded by a low cobble barrier. Seawater enters by percolation through the barrier and by overwash. This lagoon represents a type which may be unique to Ireland since the substrate is composed almost entirely of peat, the adjacent shore features one of the best examples of a drowned forest in Ireland. Aquatic vegetation in the lagoon includes typical species such as Beaked Tasselweed (*Ruppia maritima*) and green algae (*Cladophora* sp.). The fauna is not diverse, but is typical of a high salinity lagoon and includes six lagoon specialists (*Hydrobia ventrosa, Cerastoderma glaucum, Lekanesphaera hookeri, Palaemonetes varians, Sigara stagnalis* and *Enochrus bicolor*). In contrast, Shannon Airport Lagoon (2 ha) is an artificial saline lake with an artificial barrier and sluiced outlet. However, it supports two Red Data Book species of Stonewort (*Chara canescens* and *Chara cf. connivens*).

Most of the site west of Kilcredaun Point/Kilconly Point is bounded by high rocky sea cliffs. The cliffs in the outer part of the site are sparsely vegetated with lichens, Red Fescue, Sea Beet (*Beta vulgaris*), Sea Campion (*Silene maritima*), Thrift and Plantains (*Plantago* spp.). A rare endemic Sea Lavender (*Limonium recurvum* subsp. *pseudotranswallinum*) occurs on cliffs near Loop Head. Cliff-top vegetation usually consists of either grassland or maritime heath. The boulder clay cliffs further up the estuary tend to be more densely vegetated, with swards of Red Fescue and species such as Kidney Vetch (*Anthyllis vulneraria*) and Bird's-foot Trefoil (*Lotus corniculatus*).

Other coastal habitats that occur within the site include the following:

- stony beaches and bedrock shores - these shores support a typical zonation of seaweeds (*Fucus* spp., *Ascophyllum nodosum* and kelps).

- shingle beaches - the more stable areas of shingle support characteristic species such as Sea Beet, Sea Mayweed (*Matricaria maritima*), Sea Campion and Curled Dock (*Rumex crispus*).
- sand dunes - a small area of sand dunes occurs at Beal Point. The dominant species is Marram Grass (*Ammophila arenaria*).

Flowing into the estuaries are a number of tidal rivers. In some cases non-tidal portions of the rivers have been included in the site, most notably the Shannon from Killaloe to Limerick (along with some of its tributaries, such as the Mulkear River and the Kilmastulla River), the Fergus up as far as Ennis, and the Cloon River. The three rivers are very different in character: the Shannon being broad, generally slow-flowing and naturally eutrophic; the Fergus being smaller and alkaline; while the narrow, fast-flowing Cloon is acid in nature. Semi-natural habitats, such as wet grassland, wet woodland and marsh occur by the rivers, however, improved grassland is most common.

Woodland is infrequent within the site, however Cahiracon Wood contains a strip of old Oak woodland. Sessile Oak (*Quercus petraea*) forms the canopy, with an understorey of Hazel (*Corylus avellana*) and Holly (*Ilex aquifolium*). Great Wood-rush (*Luzula sylvatica*) dominates the ground flora. Less common species present include Great Horsetail (*Equisetum telmeteia*) and Pendulous Sedge (*Carex pendula*).

A number of plant species that are Irish Red Data Book species occur within the site - several are protected under the Flora (Protection) Order, 1999:

- Triangular Club-rush (*Scirpus triqueter*) - in Ireland this protected species is only found in the Shannon Estuary, where it borders creeks in the inner estuary.
- Opposite-leaved Pondweed (*Groenlandia densa*) - this protected pondweed is found in the Shannon where it passes through Limerick City.
- Meadow Barley (*Hordeum secalinum*) - this protected species is abundant in saltmarshes at Ringmoylan and Mantlehill.
- Hairy Violet (*Viola hirta*) - this protected violet occurs in the Askeaton/Foynes area.
- Golden Dock (*Rumex maritimus*) - noted as occurring in the River Fergus Estuary.
- Bearded Stonewort (*Chara canescens*) - a brackish water specialist found in Shannon Airport lagoon.
- Convergent Stonewort (*Chara connivens*) - presence in Shannon Airport Lagoon to be confirmed.

Overall, the Shannon and Fergus Estuaries support the largest numbers of wintering waterfowl in Ireland. The highest count in 1995-96 was 51,423 while in 1994-95 it was 62,701. Species listed on Annex I of the EU Birds Directive which contributed to these totals include: Great Northern Diver (3; 1994/95), Whooper Swan (201; 1995/96), Pale-bellied Brent Goose (246; 1995/96), Golden Plover (11,067; 1994/95) and Bar-tailed Godwit (476; 1995/96). In the past, three separate flocks of Greenland White-fronted Goose were regularly found but none were seen in 1993/94.

Other wintering waders and wildfowl present include Greylag Goose (216; 1995/96), Shelduck (1,060; 1995/96), Wigeon (5,976; 1995/96); Teal (2,319; 1995-96); Mallard (528; 1995/96), Pintail (45; 1995/96), Shoveler (84; 1995/96), Tufted Duck (272; 1995/96), Scaup (121; 1995/96), Ringed Plover (240; 1995/96), Grey Plover (750; 1995/96), Lapwing (24,581; 1995/96), Knot (800; 1995/96), Dunlin (20,100; 1995/96), Snipe (719, 1995/96), Black-tailed Godwit (1062; 1995/96), Curlew (1504; 1995/96), Redshank (3228; 1995/96), Greenshank (36; 1995/96) and Turnstone (107; 1995/96). A number of wintering gulls are also present, including Black-headed Gull (2,216; 1995/96), Common Gull (366; 1995/96) and Lesser Black-backed Gull (100; 1994/95). This is the most important coastal site in Ireland for a number of the waders including Lapwing, Dunlin, Snipe and Redshank. It also provides an important staging ground for species such as Black-tailed Godwit and Greenshank.

A number of species listed on Annex I of the EU Birds Directive breed within the site. These include Peregine Falcon (2-3 pairs), Sandwich Tern (34 pairs on Rat Island, 1995), Common Tern (15 pairs: 2 on Sturamus Island and 13 on Rat Island, 1995), Chough (14-41 pairs, 1992) and Kingfisher. Other breeding birds of note include Kittiwake (690 pairs at Loop Head, 1987) and Guillemot (4010 individuals at Loop Head, 1987)

There is a resident population of Bottle-nosed Dolphin in the Shannon Estuary consisting of at least 56-68 animals (1996). This is the only known resident population of this EU Habitats Directive Annex II species in Ireland. Otter, a species also listed on Annex II of this directive, is commonly found on the site.

Five species of fish listed on Annex II of the EU Habitats Directive are found within the site. These are Sea Lamprey (*Petromyzon marinus*), Brook Lamprey (*Lampetra planeri*), River Lamprey (*Lampetra fluviatilis*), Twaite Shad (*Allosa fallax fallax*) and Salmon (*Salmo salar*). The three lampreys and Salmon have all been observed spawning in the lower Shannon or its tributaries. Twaite Shad is not thought to spawn within the site. There are few other river systems in Ireland which contain all three species of Lamprey.

Two additional fish of note, listed in the Irish Red Data Book, also occur, namely Smelt (*Osmerus eperlanus*) and Pollan (*Coregonus autumnalis pollan*). Only the former has been observed spawning in the Shannon.

Freshwater Pearl-mussel (*Margaritifera margaritifera*), a species listed on Annex II of the EU Habitats Directive, occurs abundantly in parts of the Cloon River.

There are a wide range of landuses within the site. The most common use of the terrestrial parts is grazing by cattle and some areas have been damaged through over-grazing and poaching. Much of the land adjacent to the rivers and estuaries has been improved or reclaimed and is protected by embankments (especially along the Fergus Estuary). Further, reclamation continues to pose a threat as do flood relief works (e.g. dredging of rivers).

In the past, Cord-grass (*Spartina* sp.) was planted to assist in land reclamation. This has spread widely, and may oust less vigorous colonisers of mud and may also reduce the area of mudflat available to feeding birds.

Domestic and industrial wastes are discharged into the Shannon, but water quality is generally satisfactory - except in the upper estuary, reflecting the sewage load from Limerick City. Analyses for trace metals suggest a relatively clean estuary with no influences by industrial discharges apparent. Further industrial development along the Shannon and water polluting operations are potential threats.

Other uses of the site include commercial and recreational angling, oyster farming, boating (including dolphin-watching trips) and shooting. Some of these may pose threats to the birds and dolphins through disturbance. Specific threats to the dolphins include underwater acoustic disturbance, entanglement in fishing gear and collisions with fast moving craft.

This site is of great ecological interest as it contains a high number of habitats and species listed on Annexes I and II of the EU Habitats Directive, including the priority habitat lagoon, the only known resident population of Bottle-nosed Dolphin in Ireland and all three Irish lamprey species. A good number of Red Data Book species are also present, perhaps most notably the thriving populations of Triangular Club-rush. A number of species listed on Annex I of the EU Birds Directive are also present, either wintering or breeding. Indeed, the Shannon and Fergus Estuaries form the largest estuarine complex in Ireland and support more wintering wildfowl and waders than any other site in the country.

20.5.1999

APPENDIX 5

SUBMISSIONS

Dr Bill Quirke,
Conservation Services,
Tullaha,
Glenflesk,
Killarney,
Co. Kerry.

Marine Institute
Furnace
Newport
Co. Mayo

telephone 353 98 42300
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Marine
Foras na Mara

16 April 2003

Re: Gortadroma Landfill Extension EIS

Dear Bill,

Thank you for your letter regarding the above. While I don't have any specific comments to make about this particular dump the Marine Institute would be concerned about any additional pollutants entering freshwaters.

Dump leachate contains a full suite of both biological and chemical toxic wastes which have to be properly treated in order to 'minimise to acceptable levels'. This would imply some deterioration in water quality.

The Marine Institute would be particularly concerned about the possible inclusion of toxins, heavy metals, silver, cadmium, mercury, endocrine disrupters, PCBs, dioxins, phenols and other solvents, organophosphates and oil and fuel residues to name but a few. Endocrine disrupters, for example, originate from many sources such as cleaning products, paints, pesticides, paper and textile pulp. These are known to have detrimental effects on salmonid smoltification and survival and on the maturation cycles in shellfish. PCBs may be emitting from discarded fridges, and freezers dumped historically and these compounds will continue to be discharged. As the majority of these toxins and compounds are either accumulated in the sediments and and/or bio-accumulated in flora and fauna, many of which are harvested as food sources, any increases of these compounds into the environment should be avoided at all costs.

Many of these compounds also affect salmonid smoltification and survival. Endocrine disrupters, for example, can have a significant impact on salmonids at quite low doses. The synergistic effects of more than one of these compounds should also be borne in mind.

The Shannon Estuary is likely to be included as a designated transitional water under the Waterframework Directive and the NASCO Habitats

Agreement also requires the application of the precautionary principle for the protection of salmon habitat and migration routes. The estuary may also be the focus of a glass eel harvesting programme over the next five to ten years as part of a national eel management plan which is currently being drawn up. Other Directives, such as the EU Quality of Shellfish Waters Directive 1994, should also be borne in mind should they apply to the receiving waters in question.

It is therefore, the disposal of dump leachate that is the main concern and the type and level of treatment that this would receive before release. It is not acceptable to include leachate in sewage treatment plants as that treatment is not appropriate. Sludges from sewage plants, which have accumulated many of the toxic elements of the leachate, may ultimately end up being as fertiliser on the land. The impact of increased winter rainfall patterns over the next 30 years on volumes of leachate should also be included in the EIS.

For the full evaluation of the proposal, the following information should be examined:

* details of the previous dumping history (i.e. types of waste dumped, quantities etc)

* details of license for future dumping, waste types etc.

* full analysis of composition of leachate (not the routine EPA analysis)

* details of the future plans for the site (types of lining for individual cells, guaranteed lifetime of cell linings, projected volumes of leachate).

I hope this is of help to you.

Yours sincerely,

Dr. Russell Poole
Section Manager
Aquaculture & Catchment Management Services
Marine Institute
Newport

ABHA BHÁN FISHING CLUB

Finnoe, Ballyhahill, Co. Limerick. (069) 82229

Finnoe,
Ballyhahill,
Co. Limerick.
25/05/03

Dear Sir/Madam,

The Abha Bhán Fishing Club is only delighted to report to you their hard and dedicated work over the past few years and their plans for the future. The club was revived in 1995 and has up to 100 members and carry out many fundraising events to fund their work.

The Abha Bhán River, which is about fifteen miles long in total, has been cleaned manually and freed of all plastic and debris.

The club endeavoured to cut back the scrub and bushes along eight miles of the river but this work proved heavy and escavators had to be employed to do this.

Major and worthwhile fishing holes have been opened up and made assessable and where necessary styles have been erected.

One fifty foot steel bridge, a twenty eight foot and a thirty two foot steel bridge have been assembled and erected at different points along the river making it safe and easily assessable.

One of the club's latest projects was to build a wheelchair and disablement pathway complete with handrails along a section of the river (near Ballyhahill village) for those who would find walking the river bank difficult.

A restocking programme with the help of The Shannon Fisheries Board and The E.S.B. is also part of the plan with 57,000 salmon fry released into the river so far and this year anglers are looking forward to the return of the fully grown salmon to their spawning beds.

Future plans include the building of one to two more wheelchair and disablement pathways with a site already secured for one near Loughill village.

Up to sixty more styles are scheduled at various points along the river. Continuos restocking is proposed. The revival and renewal of fishing as a sport is the ultimate aim.

Included is a plan that shows a map of the river and the work scheduled in the future.

The club have been disappointed with their various requests for help from Limerick County Council but hope that in the future that they may be in a position to help in some way.

Finally I would like to invite any one who would be interested in our project to come and visit us at any time they would be more than welcome.

I on behalf of the club would like to thank you for your interest in the work being carried out and our plans for the future.

Kind regards,

(Secretary) Eileen O'Connell

APPENDIX 6

PHOTOGRAPHS

Photo 01

Photo 02

Photo 03

Photo 04

Photo 05

Photo 06

Photo 07

Photo 08

Photo 09

Photo 10

Photo 11

Photo 12

Photo 13

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Photo 15

Photo 16

Photo 17

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Photo 41


Photo 42