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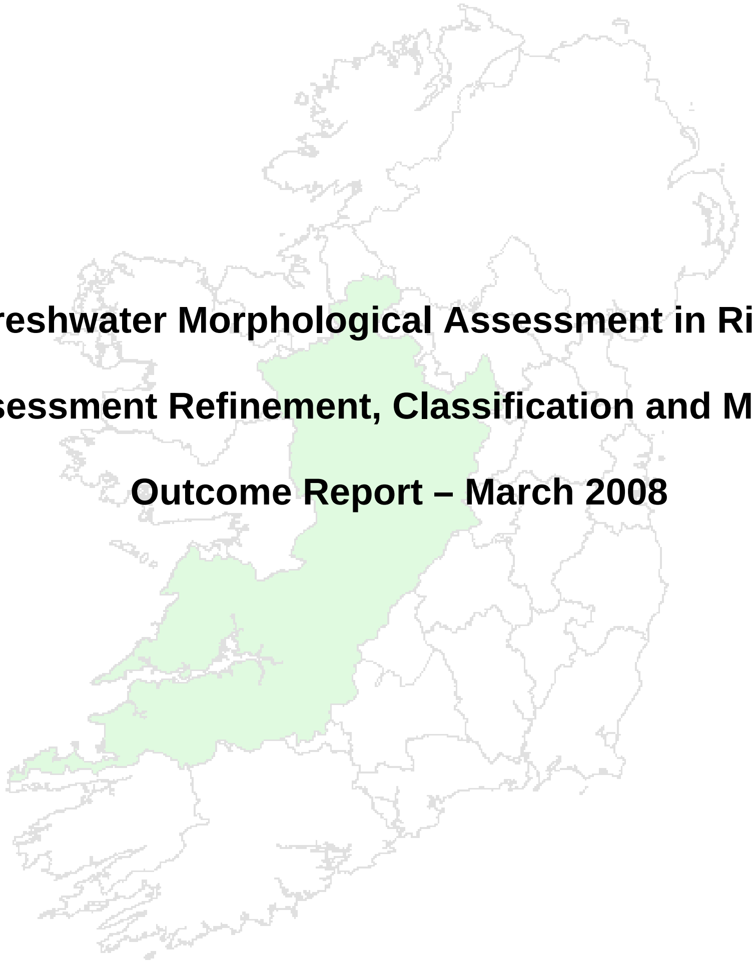
# Freshwater Morphological Assessment in Rivers

## Risk Assessment Refinement, Classification and Management

## Outcome Report – March 2008



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**Date: 26.3.08**

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**REVISION CONTROL TABLE**

| Rev. | Description of Changes | Prepared by | Checked by | Approved by | Date |
|---|---|---|---|---|---|
| 0 | Issued for initial comment | LH | SD | GG | 26.3.08 |
| 1 | Steering Group initial comments addressed and Workshop Follow Up incorporated | LH/SD | GG | AGB | 26.05.08 |
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**The User is Responsible for Checking the Revision Status of this Document**

shannon
international
river basin district

**Report No. DC094**

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**GLOSSARY OF TERMS:**

| | |
|---|---|
| **CFB** | Central Fisheries Board |
| **DARD** | Department of Agriculture and Rural Development (NI) |
| **EHS** | Environment and Heritage Service (NI) |
| **EPA** | Environmental Protection Agency (RoI) |
| **ERBD** | Eastern River Basin District |
| **EU** | European Union |
| **HMWB** | Heavily Modified Water Body (pHMWB indicates provisional HMWB) |
| **ILU** | Intensive Land Use |
| **MImAS** | Morphological Impact Assessment System |
| **NI** | Northern Ireland |
| **NS SHARE** | North- South Shared Aquatic Resource Project |
| **NWIRBD** | North Western International River Basin District |
| **OPW** | Office of Public Works |
| **PoMS** | Programmes of Measures and Standards |
| **R.A.T** | Rapid Assessment Technique |
| **RBD** | River Basin District |
| **RBMP** | River Basin Management Plan |

| | |
|---|---|
| **RoI** | Republic of Ireland |
| **SEPA** | Scottish Environmental Protection Agency |
| **SERBD** | South Eastern River Basin District |
| **SHIRBD** | Shannon International River Basin District |
| **SWRBD** | South Western River Basin District |
| **WFD** | Water Framework Directive |

# 1.0 Introduction

This report is a follow up report to the *"Comparative Studies of Morphological Fieldwork Techniques Interim Outcome Report"* completed through the Shannon IRBD Freshwater Morphology Programmes of Measures and Standards (PoMS) Study (April 2007). The Interim Outcome report made several recommendations for further investigation so that the objectives of morphological assessment of rivers in Ireland are fully met. These have been implemented in the past year. This report documents the findings of these investigations and presents final recommendations.

The Shannon IRBD Freshwater Morphology PoMS study has two overarching aims:

1. To refine risk assessment thresholds with respect to 2 key morphological pressures; intensive land use and channelisation so that the uncertainties identified in the Article 5 risk assessment process can be resolved

2. To develop a management response framework for regulators - so that morphological change to rivers can be monitored for classification and/or regulatory purposes.

In meeting these aims a morphological assessment methodology must be established that can meet the following objectives:

1. ***Refine morphological thresholds applied to rivers so that the uncertainties with the Article 5 risk assessment can be resolved***

2. ***Enable NI and RoI agencies to classify rivers in terms of morphology supporting the biological elements so that ecological status can be defined***

3. ***Manage and tracking morphological status so that waterbody status can be improved where necessary or deterioration prevented***

The Freshwater Morphology PoMS Study began meeting these objectives by firstly identifying possible morphological assessment field techniques and conducting trials on a subset of pilot waterbodies that were identified throughout Ireland and Northern Ireland. The outcome of the trials and subsequent expert judgement was that the Rapid Assessment Technique (R.A.T) was suitable for classification purposes by recording observed morphological impact in the field and largely met Objective 2 as listed above. However, it was also found that the Morphological Impact Assessment System (MImAS) as used in Scotland is a tool aimed at recording pressures that can cause morphological impact and is a regulatory tool. To build on these findings, fieldwork was planned for summer 2007 on the complete list of pilot waterbodies, mainly with a focus on risk assessment refinement (Objective 1), and to supplement tool development work being undertaken to meet Objective 3.

The complete findings of the fieldwork trials and associated expert judgement workshop are documented in the Interim Outcome report of April 2007. Table 1 summarises these interim findings and the outstanding issues that are now addressed in this final Outcome report.

*Note: Further work items identified as completed under Work Package 6 "Tool Development" are reported on separately.*

**Table 1: Interim Outcome Report Findings and Further Investigation with respect to Morphological Assessment Objectives**

<table>
<tr><td colspan="3"><i>Objective 1:<br>Refine morphological thresholds applied to rivers so that the uncertainties with the Article 5 risk assessment can be resolved</i></td></tr>
<tr><td><b>Interim Outcome Report 2007 Findings</b></td><td><b>Further Investigation</b></td><td><b>Final Outcome Report 2008 - Findings</b></td></tr>
<tr><td>Assessment of the relationship between morphological score (using R.A.T or MImAS) and biological quality using the Biological Quality (Q Rating) system did not yield definitive conclusions in terms of sustainable levels of morphological pressures on a river.<br>There were uncertainties with respect to channelisation pressures (i.e. arterial drainage) and intensive land use pressures (forestry, overgrazing, arable, urban) post Article 5.</td><td>Further biological fieldwork on pilot waterbodies to include macrophyte surveys as well as Q surveys<br>Further morphological fieldwork on pilot waterbodies using R.A.T to observe impact and MImAS to record pressure data</td><td><b>Refer to Chapter 2.0</b></td></tr>
<tr><td colspan="3"><i>Objective 2:<br>Enable NI and RoI agencies to classify rivers in terms of morphology supporting the biological elements so that ecological status can be defined</i></td></tr>
<tr><td><b>Interim Outcome Report 2007 Findings</b></td><td><b>Further Investigation</b></td><td><b>Final Outcome Report 2008 - Findings</b></td></tr>
<tr><td>R.A.T, MImAS and RHS were trialled<br>R.A.T emerged as the preferred technique for classification by EPA in Ireland and EHS in Northern Ireland</td><td>Undertake R.A.T surveys of "likely high status" sites in Ireland in conjunction with EPA to determine if morphological condition supports a "high status" classification</td><td>Refer to Chapter 3.0</td></tr>
<tr><td colspan="3"><i>Objective 3:<br>Manage and track morphological status so that waterbody status deterioration can be prevented</i></td></tr>
<tr><td><b>Interim Outcome Report 2007 Findings</b></td><td><b>Further Investigation</b></td><td><b>Final Outcome Report 2008 - Findings</b></td></tr>
<tr><td>R.A.T is more suitable for classification than regulation. The MImAS technique which records and quantifies an engineering footprint that contributes to the overall score by assessing how much capacity to accept morphological change has been taken up by the presence of such features. This is known as a "top-down" approach which starts with</td><td>Assess the applicability of MImAS as a tool to track morphological change</td><td>Completed under Work Package 6 of the PoMS Study and reported on separately.</td></tr>
</table>

| | | |
|---|---|---|
| the human activities (i.e. pressures) in the river and derives what impact this will have on the morphological condition, and subsequently the expected impact on ecological status.<br>In contrast, the R.A.T technique uses the "bottom–up" approach, which starts with identifying the impacts in a river such as loss of substrate diversity, siltation, changes to vegetation structure, lack of floodplain connectivity and bank stability, which are considered to be the impacts caused by morphological pressures, and assesses these impacts as a measure of morphological status. | Compare MImAS field data with pressure data to assess the applicability of the thresholds used in the context of regulation. | Refer to Chapter 4.0 |
| An automated GIS based tool using the metrics, slope, valley confinement, geology and sinuosity is required so that channel typologies can be assigned before undertaking field surveys. | Develop an Automated GIS methodology for assigning channel typology | Completed under Work Package 6 of the PoMS Study and reported on separately. |
| Appropriate thresholds relating these metrics to channel typology descriptions such as pool-riffle or active meandering must be developed. | Assess the role of channel typology in morphological assessment | Refer to Chapter 2.0 |
| The issue of waterbody scale was identified by comparing R.A.T and MImAS results with the criteria with which pilot waterbodies were selected. Land Use pressures such as overgrazing cannot be detected by monitoring a single site within a waterbody. Sampling strategies must be devised so that surveys are representative at a waterbody scale. | Fieldwork planned for 2007 should select test sites at the upstream and downstream end of waterbodies where possible. | Refer to Chapter 4.0 |
| The role of remote sensing, in particular, detailed aerial imagery should be explored so that waterbody scale assessments can be made. | Assess the role of remote sensing by comparing with morphological assessment data obtained using R.A.T and MImAS Surveys | Completed under Work Package 6 of the PoMS Study and reported on separately. |

The remainder of this report focuses on the findings of the investigative fieldwork undertaken through the PoMS Study during 2007 in the context of Table 1.

Most of the recommendations made are in relation to the refined risk assessment thresholds under Objective 1 in relation to channelisation and intensive land use.

## 1.1 Freshwater Morphology Workshop, 4th April 2008

The recommendations were presented to the Technical Steering Group and their colleagues at a Freshwater Morphology Workshop held on 4th April 2008. The aim of the workshop was to gain feedback on the recommendations, undertake further analysis where required and derive final recommendations.

Workshop Follow Up sections are highlighted throughout the report as appropriate. These sections outline the feedback from the delegates and how this was addressed. Final recommendations are then made. The final recommendations are summarised in Chapter 5.0.

# 2.0 OBJECTIVE 1 – RISK ASSESSMENT REFINEMENT

## 2.1 Background

Under Article 5, Pressures and Impacts Analysis (Risk Assessment) - the WFD originally required reporting of waterbodies under two categories; **at risk** or **not at risk**. In December 2004 the EU Commission's Reporting Sheets changed the reporting categories to at least one of the three following categories, namely **at risk**, **risk uncertain** or **not at risk**. This recognised that further characterisation was necessary for some waterbodies to determine risk with certainty, which was due to pressure information and data gaps throughout Europe. The methodology used in Ireland to define morphological risk was developed using UK TAG and European guidance so that the requirements of the EU Commission's Reporting Sheets for Article 5 could be met. (The full methodology is described in "*Guidance on Thresholds and Methodology to be Applied in Ireland's River Basin Districts,* Paper by the Working Group on Characterisation and Risk Assessment 2004").[1]

In Ireland's case for freshwater morphology, the two pressures with the most uncertainty were also identified as most significant in placing waterbodies at risk – Channelisation and Intensive Land Use as indicated by Figure 1.

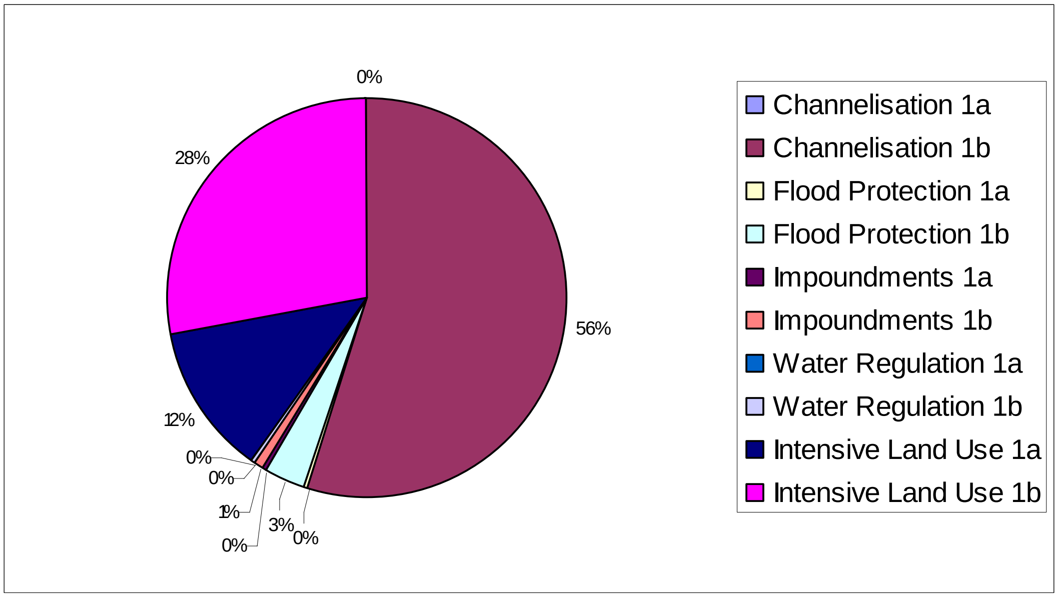

**Figure 1: Most Significant Morphology Pressures in Ireland (Article 5 Risk Assessment) (Freshwater Morphology PoMS Study, 2005)**

Specifically with regard to historical channelisation and dredging works and ongoing maintenance dredging there is uncertainty as to the long term impacts of these activities.

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[1] http://www.wfdireland.ie/Documents/Characterisation%20Report/Background%20Information/Review%20of%20Env%20Impacts/Surface%20Water%20Risk%20Ass/morphology_Risk_Assessment_Guidance.pdf

The channelisation pressure thresholds that were used are outlined in Table 2.

**Table 2: Channelisation Risk Assessment Thresholds applied under Article 5**

| Measures Attribute | Threshold | EU Risk Category |
|---|---|---|
| Proportion of water body stretch length affected by channelisation work within 500m of the stretch | < 5% | 2b – not at risk |
| | 5 – 15% | 2a – probably not at risk |
| | > 15% | 1b – probably at risk |
| | Not defined | - |

Given the uncertainty as to the impacts of channelisation activities, and the possibility that recovery can occur post-dredging, the level of risk associated with this pressure was capped at 1b "probably at risk".

The intensive land use pressure thresholds that were used are outlined in Table 3:

**Table 3: Intensive Land Use Risk Assessment Thresholds applied under Article 5**

| Measures Attribute | Threshold | EU Risk Category |
|---|---|---|
| Proportion of water body stretch length with intensive land use cover (within 50 m of the reach) | < 10% | 2b – not at risk |
| | 10 – 30% | 2a – probably not at risk |
| | 30 – 70% | 1b – probably at risk |
| | < 70% | 1a – at risk |

The uncertainty with the intensive land use assessment related to the thresholds but also the intensive land use types that should be included. The land use categories that were included were forestry, arable, urban and peat lands, but it was considered that the inclusion of improved grassland should be investigated under Further Characterisation as the approaches to this differed between UK and Ireland.

These issues form the basis of Objective 1 and defined the main focus of the fieldwork requirements through the Freshwater Morphology PoMS Study in 2007.

## 2.2 Fieldwork 2007

Following the findings of the Interim Outcome report (Table 1) and the fieldwork trials, a full programme of investigative fieldwork was commissioned during 2007 on a range of Pilot Waterbodies throughout Ireland. This fieldwork was aimed at acquiring enough morphological and biological data principally to refine the pressure thresholds (Tables 2 and 3) to meet Objective 1, but also to facilitate further work required under Objectives 2 and 3, and to provide field based verification data for the GIS tool development work undertaken through Work Package 6 (separate report).

### 2.2.1 Site Selection

The priority in site selection was pilot waterbodies where channelisation and intensive land use pressures were identified as the only pressure, morphological or otherwise posing risk of failure to meet WFD Good Ecological Status objectives by 2015. This would allow attribution of observed impact to these pressures since no other pressures are acting on the waterbodies. In contrast, sites which are deemed to be of high status were also selected so that a range of pressure thresholds could be observed in the field. Table 4 outlines the pilot sites categories, and their site selection criteria. The risk assessment categories used in the Article 5 Pressures and Impact Assessment are also included.

**Table 4: Pilot Waterbodies – Site Selection Criteria**

| CATEGORY | SITE SELECTION CRITERIA | WATERBODY ARTICLE 5 RISK DESCRIPTION |
|---|---|---|
| A | Intensive Land Use – 1a | Intensive Land Use – At Risk<br>Other Morphology Pressures – Not At Risk<br>Other Pollution/Abstraction Pressures – Not At Risk |
| B | Intensive Land Use – 1b | Intensive Land Use – Probably At Risk<br>Other Morphology Pressures – Not At Risk<br>Other Pollution/Abstraction Pressures – Not At Risk |
| C | Channelisation – 1b | Channelisation – Probably At Risk<br>Other Morphology Pressures – Not At Risk<br>Other Pollution/Abstraction Pressures – Not At Risk |
| D | Unique Sites from NPWS report – The Vegetation of Irish Rivers. | High Status Sites as identified by NPWS (NPWS, Heuff,1987) |
| E | Sites from ERTDI report – Characterisation of Reference Conditions and Testing Typology of Rivers | Reference Sites with morphological impact identified through research project (Kelly-Quinn et al, 2005) |
| F | Site Proposal By South Western Regional Fisheries Board | Pilot Waterbodies added as an example of sites where fisheries improvements have been made |
| G | Sites within Catchments Proposed for Overgrazing Impact Assessments | Sites impacted by overgrazing and forestry as advised by expert Steering Group |
| H | Provisional Heavily Modified | Sites provisionally identified as Heavily |

| | | |
|---|---|---|
| | Water Bodies (Rivers) in RoI | Modified (for input to HMWB Further Characterisation) |
| J | Morphologically Impacted Sites | EPA Q sites where morphological impact was observed by field staff |
| EPA | EPA Likely High Status Sites | Sites selected by EPA for R.A.T surveys to assist in classification (Objective 2) |

In addition, sites in Northern Ireland were added to the dataset. A total of 123 sites were surveyed by the Environment and Heritage Service (EHS) during 2006 and 2007. These were provided to the Shannon IRBD project for use in site data analysis where appropriate.

### 2.2.2 Fieldwork Methodologies

Morphological fieldwork was undertaken by University of Southampton, GeoData Ltd on Irish sites through the PoMS Study. The surveys conducted were R.A.T and MImAS. The surveys were completed during September and October 2007.

The corresponding R.A.T Scores with WFD Class are shown below:

WFD Class: > 0.8 = high status

>0.6 – 0.8 = good status

>0.4 – 0.6 = moderate status

>0.2 - 0.4 = poor status

< 0.2 = bad status

The MImAS scoring system is based on capacity of a river to accept morphological change. If more than 15% capacity is lost, the morphological status reduces from good to less than good.

Biology surveys were undertaken by Shannon IRBD Project staff and Aquatic Services Unit, University College Cork. The surveys conducted were Biological Q Assessments and CBAS Surveys during September 2007. Definition of Biological Q ratings are given below.

| **Quality Ratings** | **Category of River Water Quality** |
|---|---|
| Q5, Q4-5, Q4 | unpolluted |
| Q3-4 | slightly polluted |
| Q3, Q2-3 | moderately polluted |
| Q2, Q1-2, Q1 | seriously polluted |

CBAS is a macrophyte based survey, the details of which are outlined in Section 2.3.2.

### 2.2.3 Sites Surveyed

The sites surveyed using R.A.T and MImAS (along a 500m reach) are tabulated in Appendix A1 under categories A to J (refer to Table 1). There are 56 sites in total within 32 pilot waterbodies. Biological Q Surveys and CBAS surveys were also undertaken at these sites.

In addition 42 sites were surveyed using R.A.T only for classification purposes. These have also been used in risk assessment refinement where appropriate (refer to Appendix A2). Biological Surveys were not undertaken at these sites through the PoMS Study, however by the nature of their "likely high" status, it can be taken that these sites have high quality biology and are not subject to pollution pressures.

The Environment and Heritage Service (EHS) in Northern Ireland have also conducted R.A.T surveys during 2006 and 2007 on a range of sites. 63 sites were surveyed in 2006 and 60 sites were surveyed in 2007. The site selection criteria in Northern Ireland were not the same as those used in the PoMS Study (refer to Table 4). Sites were selected based on internal requirements within EHS including designation of Heavily Modified Water Bodies (HMWB), and to address gaps where previous morphology data was not available.

However, NI site data was included in the analysis where appropriate (Appendix A3).

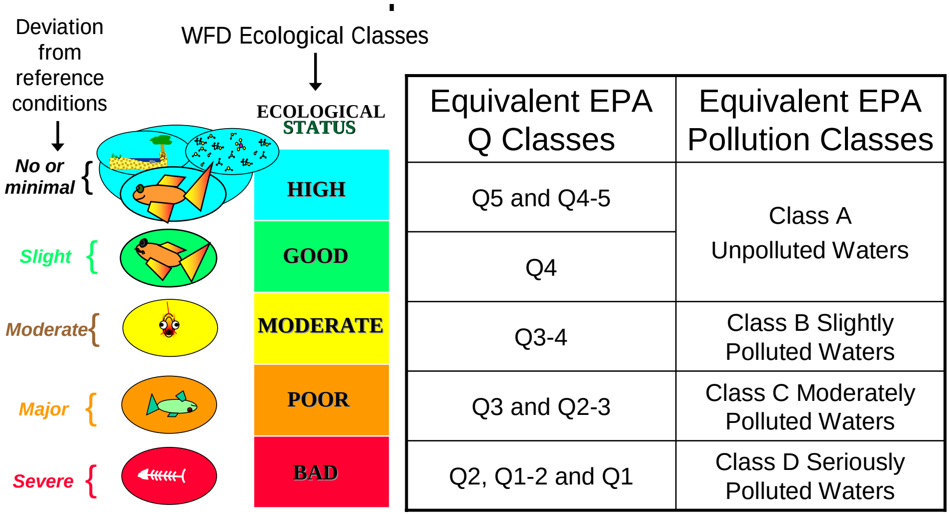
## 2.3 Indication of Biological Impact due to Channelisation and Intensive Land Use

The fundamental uncertainty with morphological pressures on river waterbodies is the impact they have on the biological condition. This uncertainty is reflected in all Member States and has been identified as a research gap which must be addressed during the first WFD cycle.

Within the Freshwater Morphology PoMS Study, biological surveys of macroinvertebrates (Q Rating) and macrophytes (CBAS) were undertaken at the pilot sites. It was not expected that the uncertainty surrounding the links between morphology and ecology could be resolved in the site data analysis given the relatively small sample size, but it was considered that the level of morphological pressure that may cause a drop in biological status could be identified.

### 2.3.1 Macroinvertebrates (Q Rating) – Comparison with R.A.T scores

The existing Biological Quality Classification Scheme (Q System) has been aligned by EPA to the equivalent WFD status class as illustrated by Figure 2.



| Equivalent EPA Q Classes | Equivalent EPA Pollution Classes |
|---|---|
| Q5 and Q4-5 | Class A Unpolluted Waters |
| Q4 | |
| Q3-4 | Class B Slightly Polluted Waters |
| Q3 and Q2-3 | Class C Moderately Polluted Waters |
| Q2, Q1-2 and Q1 | Class D Seriously Polluted Waters |

**Figure 2: EPA Biological Q Score and Equivalent WFD Ecological Status (EPA National Water Conference, 2006)**

Sites with a Q score less than Q4 are deemed “less than good” in terms of WFD ecological status.

Figure 3 shows the corresponding Q Score (1 – 5) against R.A.T score for each of the Pilot Waterbodies surveyed in Ireland.

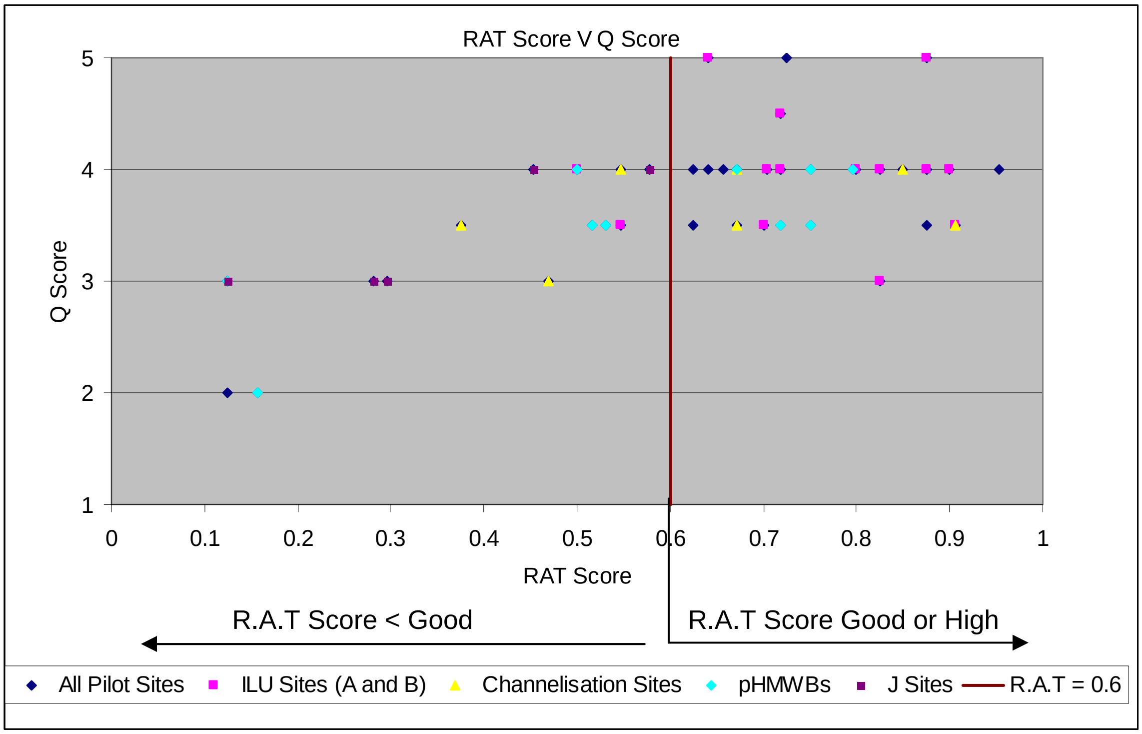


**Figure 3: R.A.T Scores and Corresponding Q Scores – All Pilot Waterbodies (Ireland) (Refer to Table 4 for Waterbody Categories)**

In general, an upward trend of increasing Q Score with R.A.T score is evident. Sites with R.A.T scores less than 0.6 (i.e. less than good status) generally have biological Q scores less than 4 (less than good status in terms of macroinvertebrates) as per Figure 1. Whilst there is a low correlation, it can be demonstrated that a R.A.T score lower than 0.6 is more likely to impact Q score.

The sites with specific pressures acting in isolation are highlighted in pink (ILU) and yellow (Channelisation).

The sites with Channelisation pressure in isolation have Q scores ranging from Q3 to Q4.

The sites with ILU pressures in isolation have Q scores ranging from Q 3 to Q5. In many cases, sites with ILU pressures in isolation achieved Q5 scores. The sites at the lower end of the Q scale and R.A.T scale are HMWBs. Several morphology and pollution pressures acting within these waterbodies are contributing to the low scores.

Sites where immediate morphological impact was observed by EPA during Q surveys (J Sites) such as dredging or siltation due to nearby road or bridge construction also have low R.A.T and Q scores. It is considered that this drop in biological condition may be short term with the possibility of recovery following the completion of such activities (Freshwater Morphology PoMS Study, WP2, 2007).

### 2.3.2 Macrophytes (CBAS) – Comparison with R.A.T Scores

The river CBAS survey method (Dodkins *et al.* 2007) was developed through the North South Share Project as a system to assign ecological status based on presence or absence of in-channel macrophyte species. A score is calculated based on impact metrics associated with nutrient loading (Soluble Reactive Phosphate, Nitrates, and Ammonia) and hydromorphology (Substrate, dissolved oxygen and pH). A high impact metric indicates a deviation from reference condition (defined based on slope, geology and alkalinity). The impact metrics are generated based on the type of macrophytes that are present in the river as an indicator of the nutrient and morphological condition. These impact metrics generate an overall CBAS score related to WFD status classes. An override exists based on presence of alien species, which automatically reduces status to “bad” if present over 50% of the survey reach.

Figure 4 is an example of the graphical representation of CBAS impact metrics showing deviation from reference condition.

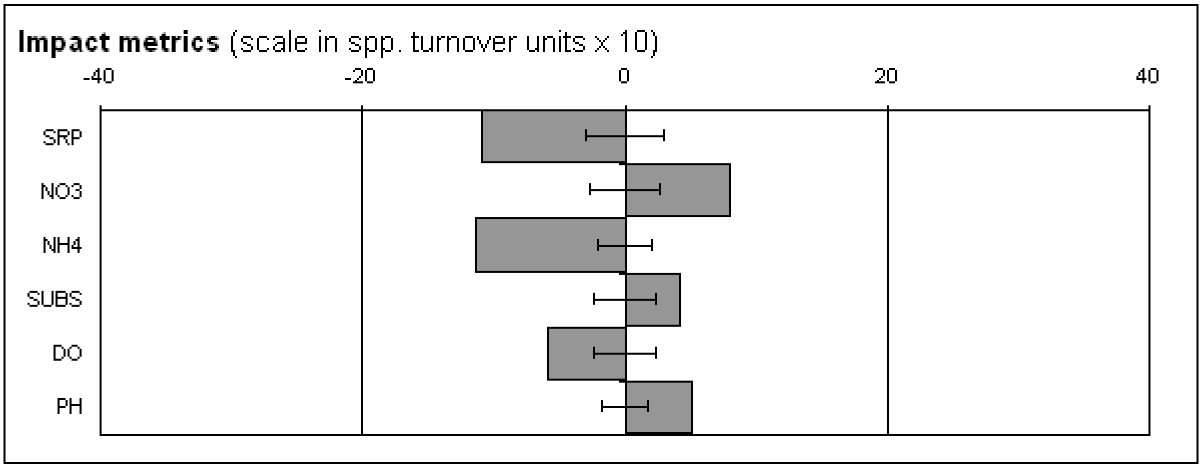


**Figure 4: Graphical representation of CBAS Impact Metrics in relation to Reference Condition**

The method itself has not been deemed sensitive enough as an overall indicator of ecological status. It is not yet known if it will be adopted as an ecological classification tool in Ireland and Northern Ireland. This was reflected in this Study as the majority of sites had high overall CBAS scores regardless of the impact metrics. However, for the purposes of analysis in terms of morphology, the SUBSTRATE impact metric has been looked at in relation to R.A.T score. Whilst it cannot be directly related to WFD ecological status, a high substrate impact metric indicates a higher level of siltation due to morphological impact in the channel than there would be at reference condition (I Dodkins *pers. comm.*. 2007).

Figure 5 shows the R.A.T score and corresponding Substrate Impact Metric for each site that was surveyed with both the R.A.T and CBAS method in Ireland.

In general, sites with high Substrate Impact metrics have low R.A.T scores. The majority of sites with Substrate Impact Metrics greater than 5 have R.A.T scores less than 0.6 (less than good morphology status).

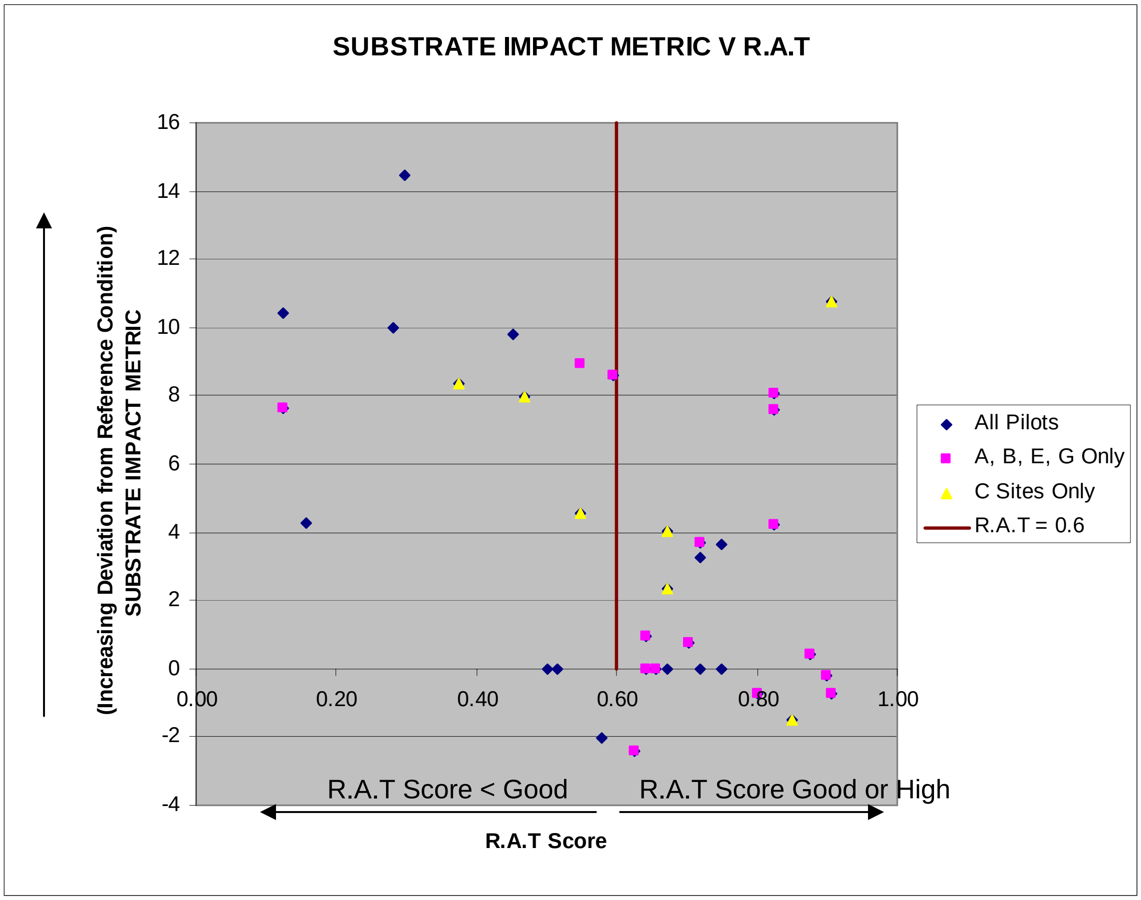


**Figure 5: R.A.T Score Against Substrate Impact Metric**

A subset of the relevant Pilot Waterbodies (Categories A, B, E and G, refer to Table 4) sites are highlighted in pink. These sites are subject to intensive land use pressures in isolation or were found to deviate from reference condition due to these pressures under separate research. The R.A.T score for these sites drops below 0.6 when the substrate impact metric is greater than 8.0.

Sites subject to channelisation pressures in isolation are highlighted in yellow (Category C). With the exception of one, sites with Substrate impact metrics greater than 4 have R.A.T scores less than 0.6. However, since the Substrate impact metric is an indicator of in-channel siltation, and not bank siltation, it is considered that it is not a strong indicator of macrophyte impact due to channelisation. It is likely that bank side macrophytes would be impacted more significantly but impact metric scores for bank species have not yet been developed (Dodkins, *pers comm.,* 2007).

The remaining pilot waterbodies are HMWBs and as such have several pressures contributing to both low R.A.T score and high in-channel siltation.

### 2.3.3 Biology - Findings

The observed relationship between biological data and R.A.T score in Section 2.3 has confirmed that morphological pressure can impact biology and therefore ecological status, albeit the impact is more significant when a combination of pressures are acting on a waterbody. In general, sites with R.A.T scores less than 0.6 also have less than good Q scores. Similarly high levels of siltation affecting macrophyte populations are reflected by less than good R.A.T scores. Whilst this may be the result of a combination of pressures, the associated sustainable level of channelisation and ILU (that ensures a waterbody is not at risk of failing WFD objectives) must now be identified to refine the Article 5 risk assessment.

In addition, since the substrate impact metric denoted by presence or absence of particular macrophyte species provides an indication of morphological condition, it is recommended that this could be a useful supplementary field technique to R.A.T in morphology monitoring for WFD classification.

## 2.4 CHANNELISATION – REFINEMENT OF RISK ASSESSMENT

The Article 5 methodology used to define risk of channelisation pressures causing failure to meet good status by 2015 is summarised below.

Threshold between ‘at risk’ and ‘not at risk’ = 15%

All rivers with >15% channelisation were identified as “probably at risk” of failing to meet Good Status by 2015

The uncertainties associated with the Article 5 channelisation risk assessment and the steps taken to address these within this Study are outlined in Table 5.

**Table 5: Channelisation – Issues to be Addressed**

| Section | Uncertainty / Issue | Analysis | Data Used |
|---|---|---|---|
| **2.4.1** | Is 15% a good reflection of how channelisation can impact the status of a river waterbody? | Comparison of<br>% Channelisation along a river waterbody<br>With<br>R.A.T Score | % Channelisation along a river waterbody as calculated for Article 5 risk assessment<br>R.A.T. scores:<br>**RoI Sites -** Sites in Category:<br>C<br>E<br>J<br>(refer to Table 4)<br>E and J sites with other morphological pressures removed<br>**NI Sites** – Sites with no other morphology pressures and low intensive land use (<10%)<br>Sites with no Article 5 risk assessment data removed<br>Sites with other pressures acting removed |

| **Section** | **Uncertainty / Issue** | **Analysis** | **Data Used** |
|---|---|---|---|
| **2.4.2** | Does the response of a river to channelisation vary according to channel type? | Comparison of:<br>% Channelisation along a river waterbody<br>With<br>R.A.T Score<br>***According to Channel Type*** | As above |
| **2.4.2.1** | **WORKSHOP FOLLOW UP**<br>***Do the channel slopes within the R.A.T Typology Classes adequately represent Irish lowland rivers?*** | % Channelisation along a river waterbody<br>With<br>R.A.T Score<br>***According to Channel Slope*** | As above |
| **2.4.3** | Does watercourse maintenance of drained rivers have an impact by impeding the ability to recover morphologically and as a subsequence ecologically? | Comparison of "Maintained Rivers"<br>Against<br>R.A.T Score<br>And Comparison of:<br>"Not Maintained Rivers"<br>Against R.A.T Score | As above |

### 2.4.1 Is 15% a good reflection of how channelisation can impact the status of a river waterbody?

Figure 6a shows the percentage channelisation in each waterbody and the corresponding R.A.T score at the survey site. The sites used in the analysis were taken from both RoI and NI datasets and were screened as outlined in Table 5.

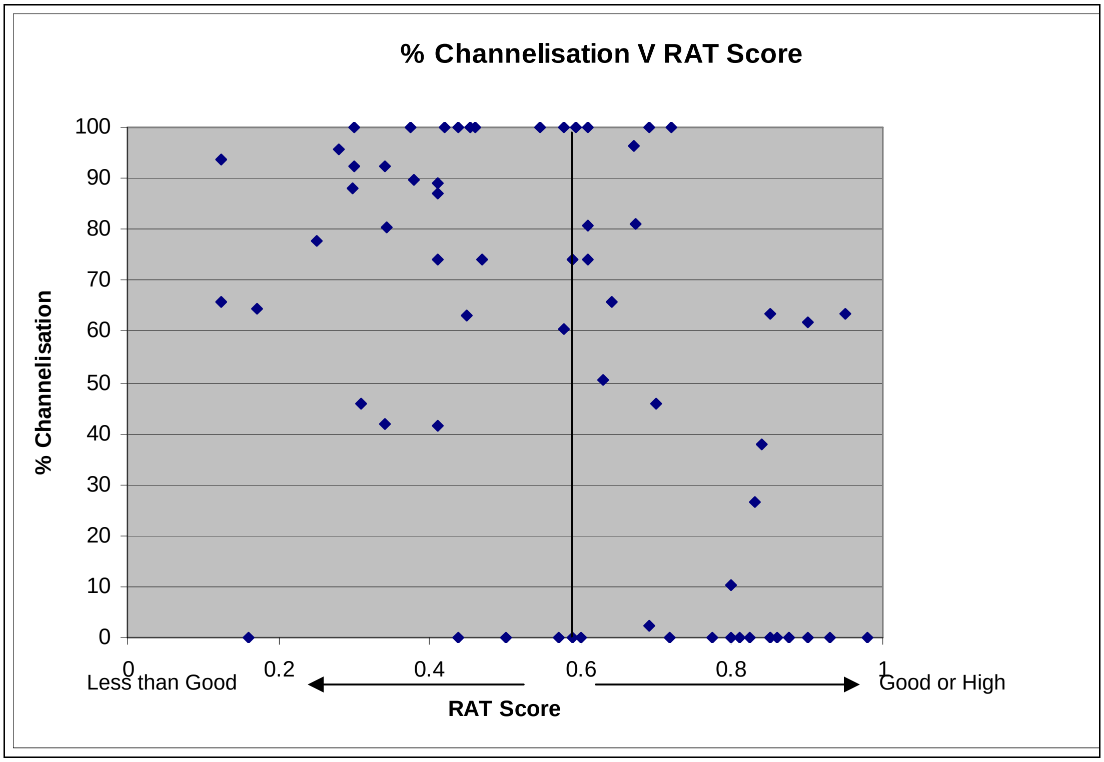


Figure 6a: Channelisation against R.A.T Score per Survey Site

Figure 6a indicates a large degree of scatter however a general trend of increasing R.A.T score with decreasing percentage channelisation in the waterbody is evident.

Figure 6a shows five sites that have no channelisation pressures yet have a R.A.T score less than 0.6. These are:

- BLK 10 (NI)
- OWY02A (NI)
- FIN 02 (NI)
- SWA 02 (NI)
- EPA 6 (RoI)

The screening process implemented means that these sites were not at risk from other morphological pressures or pollution pressures under Article 5 risk assessment.

However, on inspection of the R.A.T field sheets, cattle poaching, over deepening, culverting and flood banks are recorded; this combination of other morphology pressures resulted in poor R.A.T scores. The field sheets are included in Appendix B. This demonstrates the need for follow up investigative monitoring on the basis of risk assessment.

For the purposes of further analysis these sites have been removed from Figure 5 as indicated by Figure 6b below.

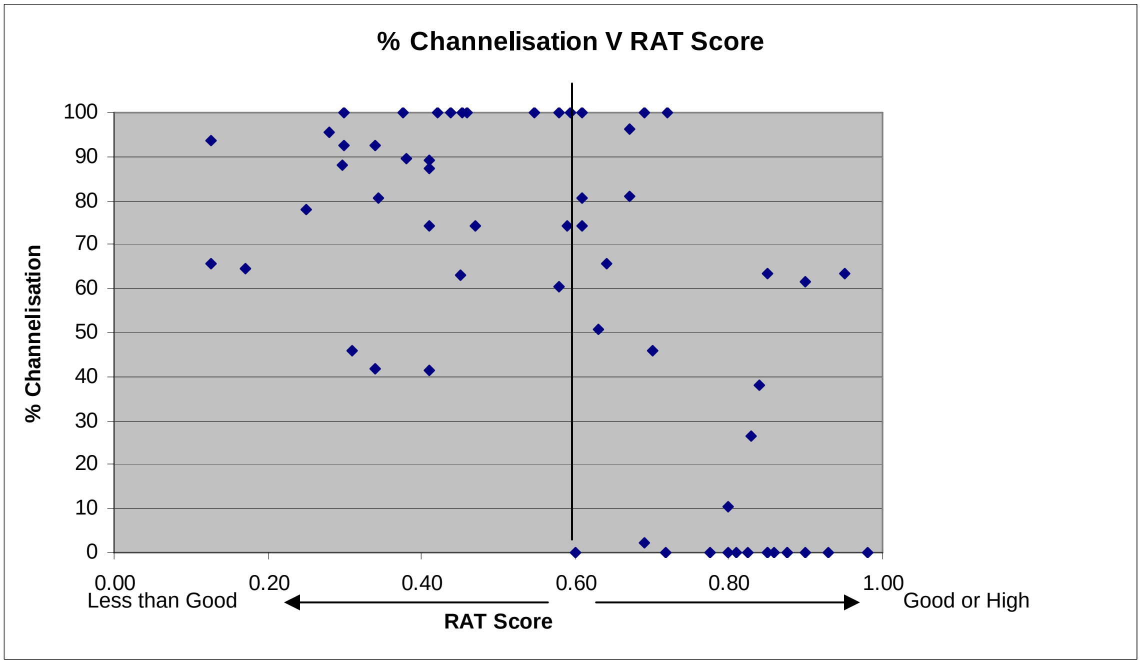


**Figure 6b: % Channelisation V R.A.T Score (Outliers Removed)**

Figure 6b has been used to optimise the risk assessment percentage channelisation thresholds as outlined below.

### 2.4.1.1 Threshold Optimisation Matrix

Figure 6c illustrates the matrix between assigning risk to a waterbody remotely using risk assessment and verifying the result in the field using a R.A.T survey.

The risk assessment threshold applied is highlighted in red.

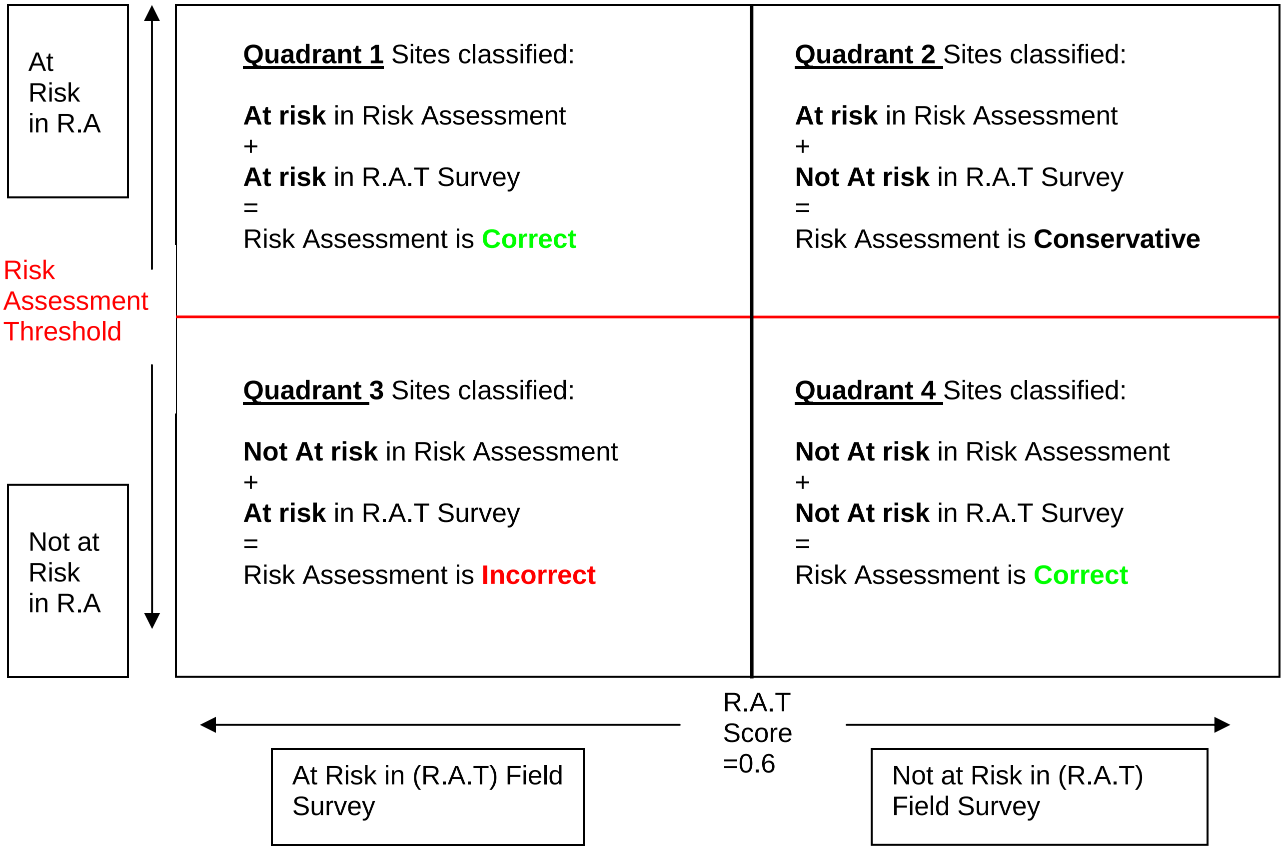


**Figure 6c: Risk Assessment (R.A) Threshold Optimisation Matrix**

When comparing % channelisation against R.A.T score, sites which are within Quadrants 1 and 4 are classified correctly i.e. the risk assessment matches the morphological status classification in the field.

Sites within Quadrant 2 are identified as “at risk” in the risk assessment but has good or high morphological status in the field. Whilst this is not a match, it is a conservative approach.

Sites within Quadrant 3 are identified as “not at risk” in the risk assessment but have less than good morphological status is the field. In this case the risk assessment places the waterbody at less risk than what is observed in the field. This is incorrect.

In optimising where the % channelisation risk assessment threshold line lies, the number of sites falling into Quadrant 3 should be minimised whilst optimising the number of sites assigned risk correctly (Quadrants 1 and 4); and the number of sites conservatively assigned “at risk” whilst not classified at risk in the field.

Figure 6d applies the 15% threshold used for the Article 5 risk assessment to this matrix.

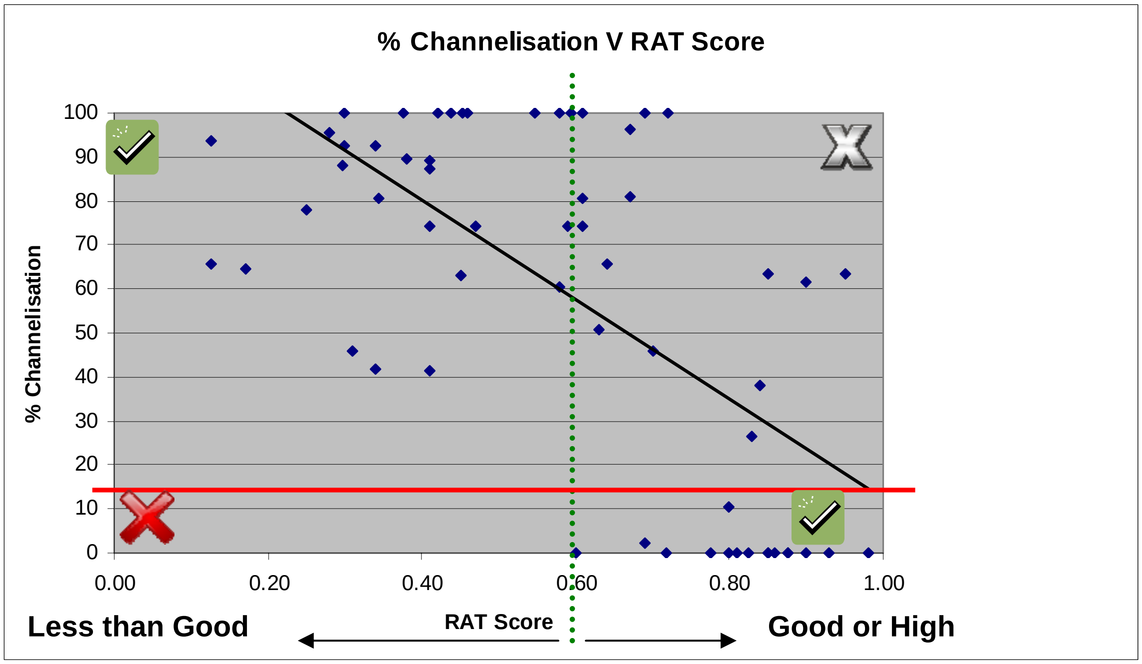


**Figure 6d: 15% threshold applied at Article 5.**

Figure 6d indicates that this threshold is too conservative. There are too many sites in Quadrant 2, that is identified as “at risk”, but actually have good or high R.A.T scores when ground-truthed. Using this threshold within the risk assessment would not be a cost-effective screening tool that enables focus on a manageable number of waterbodies when identifying Programmes of Measures. Too many waterbodies would be unnecessarily identified as “at risk”.

Figure 6e applies a 50% threshold to the matrix.

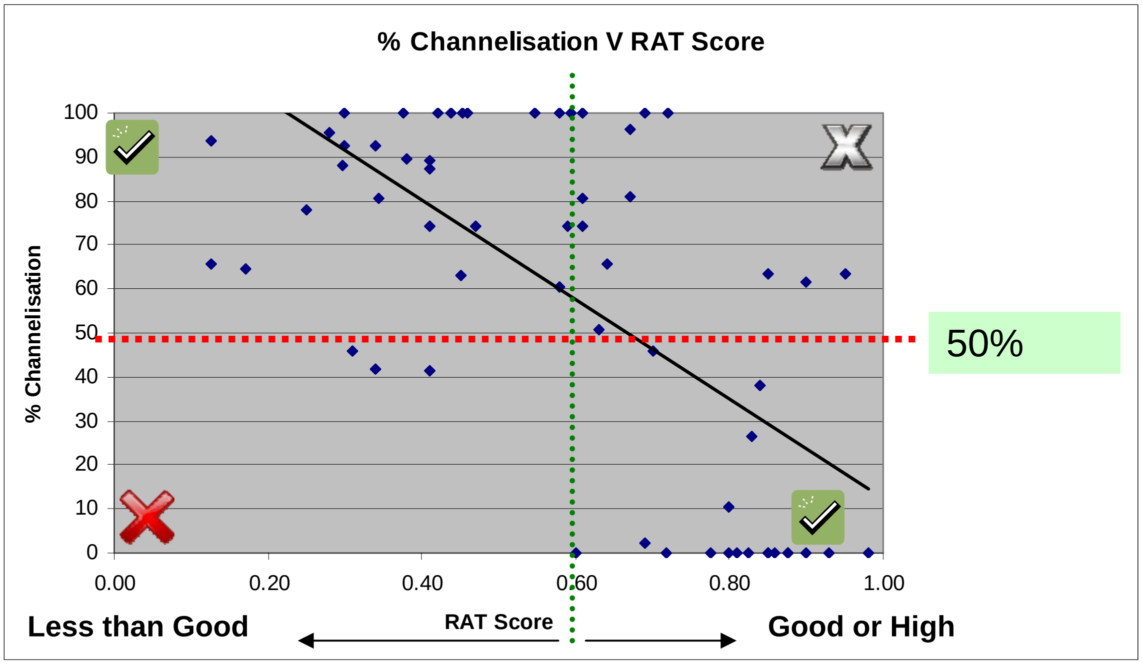


Figure 6e: 50% ILU threshold

42% of sites with greater than 50% channelisation have a R.A.T score of less than 0.6 (i.e. less than good). 29% of sites with less than 50% channelisation have R.A.T scores greater than 0.6. Therefore in total 71% of sites are classified correctly using the 50% threshold for channelisation.

Several sites with 10% channelisation or less have R.A.T scores greater than 8.0 (high status).

It is recommended that the 15% threshold between good and less than good status is increased to 50%.

However, there are cases where waterbodies with high percentage channelisation have high R.A.T scores. There are also cases where sites with low percentage channelisation have less than good R.A.T scores. This raises the questions:

1. Does channel type affect morphological response to channelisation?
2. Does watercourse maintenance affect morphological recovery?

as outlined in Table 5.

### 2.4.2 Does the response of a river to channelisation vary according to channel type?

Figure 6f categorises percentage channelisation and associated R.A.T score according to channel type. The typology classes are those specified in the R.A.T method:

- Lowland Meandering
- Pool Riffle
- Step Pool Cascade
- Bedrock

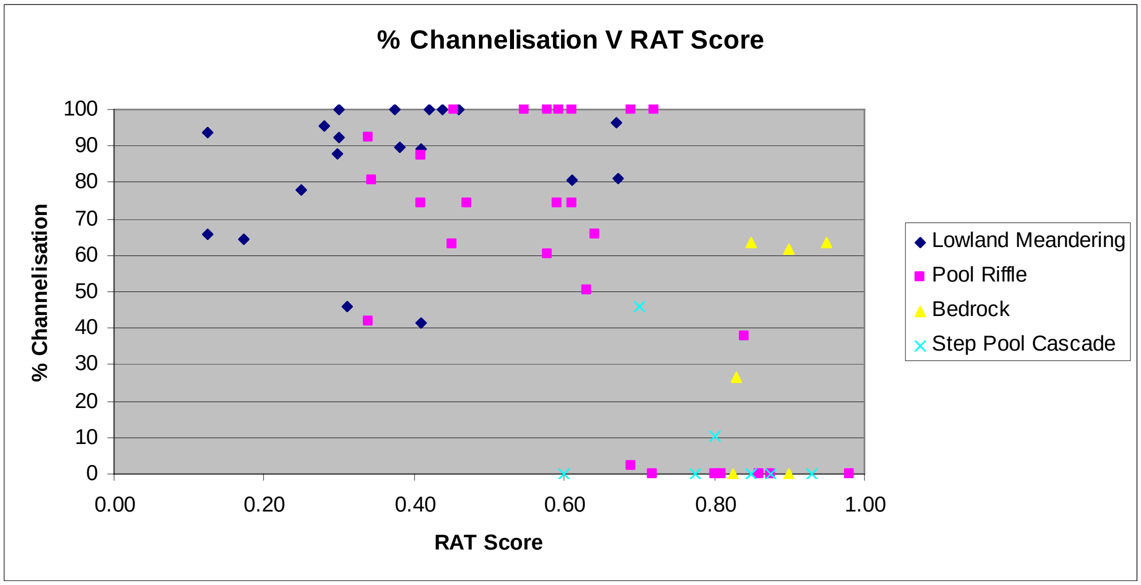


**Figure 6f: % Channelisation against R.A.T Score According to Channel Type**

Figure 6c indicates that upland rivers (i.e. bedrock and step-pool cascade) are less susceptible to channelisation pressures and tend to have high R.A.T scores (greater than 0.8).

The majority of rivers with high percentages of channelisation and R.A.T scores below 0.6 are lowland meandering and pool riffle. These rivers are more susceptible to the pressure, in particular lowland meandering. Whilst it could be argued that a higher threshold between good status and less than good status could be applied to upland rivers it is recommended that 50% is applied throughout since the majority of rivers subjected to drainage are lowland meandering and pool riffle.

**Workshop Follow Up**

### 2.4.2.1 Do the channel slopes within the R.A.T Typology Classes adequately represent Irish lowland rivers?

The findings outlined above were presented to the PoMS Study Steering Committee and their colleagues at a workshop held on 4th April 2008 (Insert link to workshop proceedings).

The channel slope ranges assigned to each typology class in the R.A.T method are:

- Lowland Meandering - < 0.5%
- Pool Riffle – 0.5 – 2%
- Step Pool Cascade 2 – 4%
- Bedrock > 4%

Feedback from the Office of Public Works (OPW) and Central Fisheries Board (CFB) in relation to channel slope prompted further analysis of the pilot sites. The comments made were as follows:

| **OPW Feedback** | **PoMS Study Follow Up** |
|---|---|
| • OPW expect 90% of drained channels to be deemed “at risk” of failing WFD status objectives<br>• The need for an initial GIS based screening process is recognized<br>• Integrating channel gradient to risk assessment may help more accurately reflect on-site results<br>• Sub division of drained waterbodies into the following slope categories will screen out those unsuitable for enhancement measures:<br>i. >0.5%, likely to have good R.A.T score or close to good and suitable for enhancement if needed<br>ii. 0.2 – 0.5%, likely to have slightly less than Good R.A.T score and possible suitable for enhancement<br>**iii.** <0.2% , likely to have lower R.A.T scores and not suitable for enhancement | Further analysis on the Pilot Sites has been undertaken.<br>Slope values for the reaches surveyed have been calculated.<br>Pilot sites have been categorized according to the slope categories suggested by OPW |
| **Central Fisheries Board Feedback** | |
| • Lowland meandering rivers have several different ecologies at a range of slopes < 0.5% therefore it is not enough to have one slop category for lowland Irish rivers | As above |

Figure 6g categorises percentage channelisation and associated R.A.T score according to channel slope using the suggested slope categories for lowland rivers as suggested at the Workshop. The actual slope values for each pilot site (500m reach) were calculated using a Digital Terrain Model and the WFD River Network GIS layer.

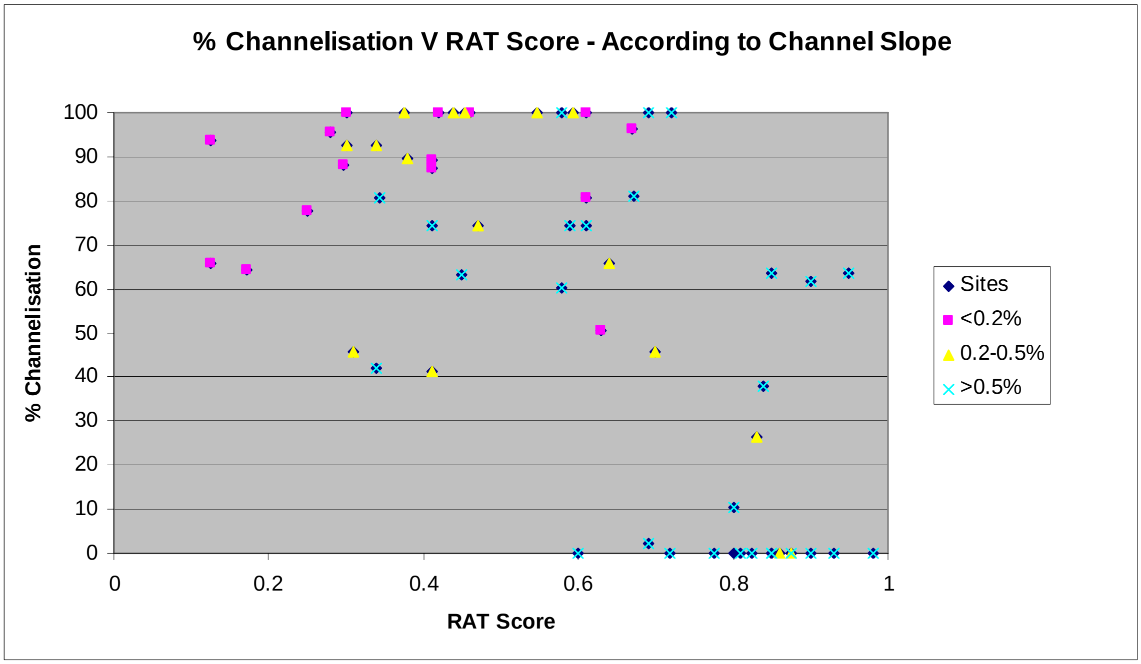


**Figure 6g: % Channelisation against R.A.T Score According to Channel Slope**

Figure 6d indicates that the lowest slope rivers (<0.2%) are those that have the highest percentage of channelisation, and also the lower R.A.T scores.

OPW advised that since the R.A.T system scores morphology based on deviation from reference condition, then it must be recognized that very low gradient rivers have should have lower expectations in terms of the morphological attributes and their reference condition. This is further illustrated by plotting channel slope against R.A.T score as per Figure 6h.

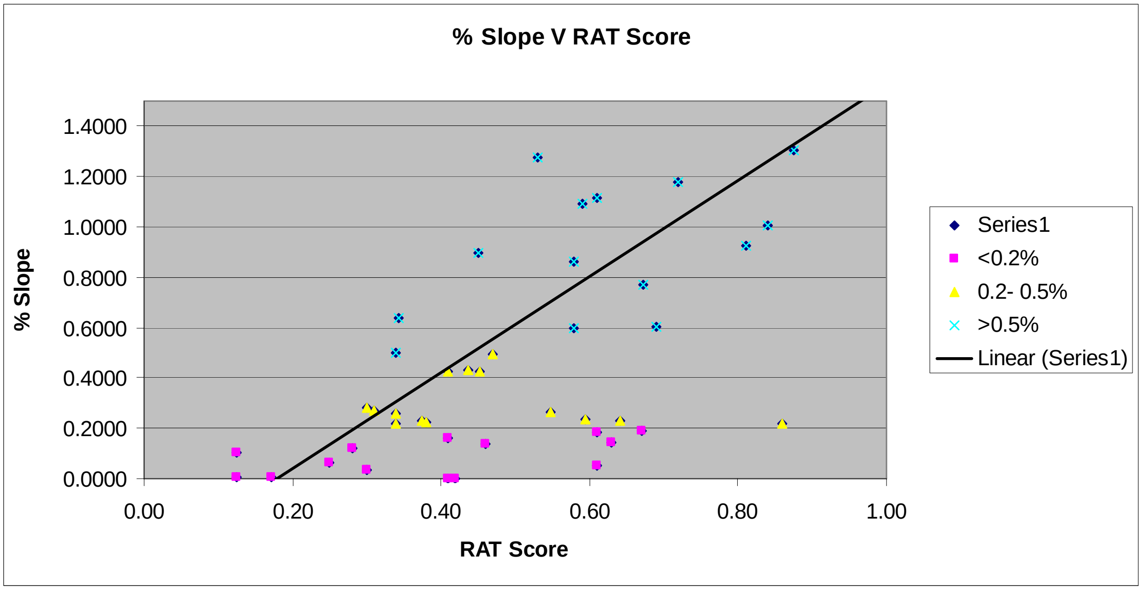


**Figure 6h: % Slope against R.A.T Score per Site**

Again, it is clear that the lowest gradient rivers (<0.2%) generally score a WFD class (Hydromorph score of 0.2) behind lowland meandering rivers within the 0.2-0.5% slope category.

Since R.A.T is the chosen surveillance monitoring method for EPA and EHS it is recommended that this is accounted for in the survey i.e. very low gradient rivers should be scored accordingly, by noting that the reference condition for these rivers is naturally less that higher slope rivers.

However, in terms of the GIS based risk assessment, the 50% channelisation threshold is still considered a more appropriate assessment of risk, based on the observed impact at the sites used in this Pilot Study.

### 2.4.3 Does watercourse maintenance of drained rivers have an impact by impeding the ability to recover morphologically and as a consequence ecologically?

Under Work Package 2 of the Freshwater Morphology PoMS Study a literature review was undertaken in relation to the recovery of rivers post channelisation. Research in Ireland and in the United States indicates that continual watercourse maintenance to maintain flood conveyance in drained rivers impedes the recovery process.

Maintenance records for the survey sites subject to channelisation were sought from the Office of Public Works (OPW) in Ireland and DARD Rivers Agency in NI. Figures 7 and 8 illustrate the percentages of sites *(for which records were available)* that had good or less than good R.A.T scores.

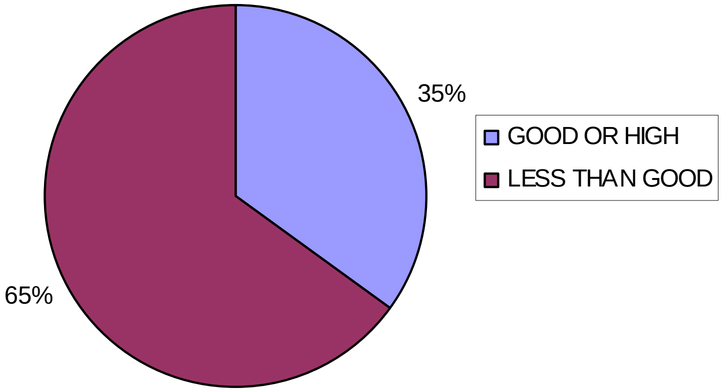


**Figure 7: Percentage of Maintained Rivers with Good or Less than Good R.A.T Scores**

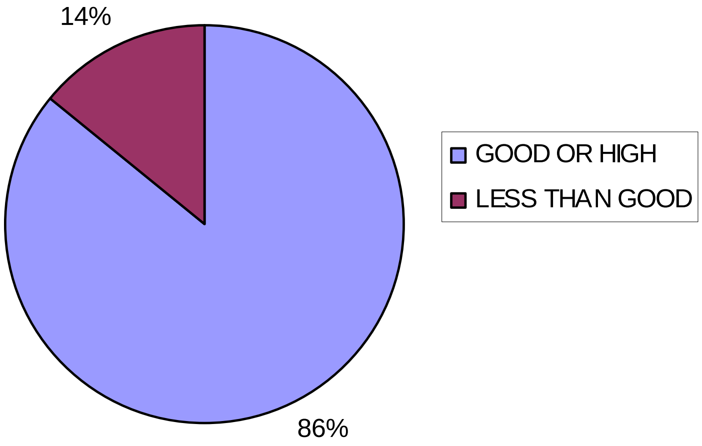


**Figure 8: Percentage of Non Maintained Rivers with Good or Less than Good R.A.T Scores**

65% of maintained rivers surveyed in RoI and NI have a R.A.T score lower than 0.6 (i.e. less than good).

14% of non maintained rivers surveyed in RoI and NI have a R.A.T score lower than 0.6 (i.e. less than good).

This suggests that watercourse maintenance does have an impact on a river's ability to recover after channelisation and justifies the capping of risk identification at Article 5 to "probably at risk" which reflected Ireland's expert opinion that channelised rivers can recover depending on the degree of maintenance undertaken. Measures to mitigate against this impact should be included in the Programmes of Measures within River Basin Management Plans.

Whether a channel is maintained or not should be accounted for in the risk assessment. A higher (less stringent) threshold should be applied to rivers that are not maintained. However, maintenance records are not readily available at present. This datset should be improved and stored within a morphological alterations database during the first River Basin Management Plan (RBMP) cycle with a view to refining the risk assessment further in the second RBMP cycle.

### 2.4.4 Recommendations for Refinement of Channelisation Risk Assessment

In summary, the list of recommendations for refinement of the Channelisation Risk Assessment is as follows:

- Increase threshold between at risk and not at risk from 15% to 50%. This optimises the number of sites assigned risk correctly.

- Lowland meandering and pool-riffle rivers are more sensitive to channelisation pressures. Whilst it could be argued that a higher threshold between good status and less than good status could be applied to upland rivers it is recommended that 50% is applied throughout since the majority of rivers subjected to drainage are lowland meandering and pool riffle. Furthermore, the GIS based tool for depicting channel typology at frequent intervals is not yet available. This should be revisited for the second RBMP cycle.

- Whether a channel is maintained or not should be accounted for in the risk assessment. A higher (less conservative) threshold should be applied to rivers that are not maintained. However, maintenance records are not readily available at present. Data on this should be provided and stored within a morphological alterations database during the first RBMP with a view to refining the risk assessment further in the second RBMP.

## Further Recommendations Following Workshop

- The lowest gradient rivers (<0.2%) generally score a WFD class (Hydromorph score of 0.2) behind lowland meandering rivers within the 0.2-0.5% slope category.

- Since R.A.T is the chosen surveillance monitoring method for EPA and EHS it is recommended that it is modified to account for this in the survey i.e. very low gradient rivers should be scored accordingly, by noting that the reference condition for these rivers is different to higher slope rivers.

- Research into the reference condition of low gradient rivers should be undertaken with a view to refining the R.A.T scoring system further

*Note:*
*It should be noted that these recommendations were made to EHS and EPA who have advised that the issue of channel slope is being accounted for in the modified version of R.A.T that will be used for surveillance monitoring purposes in 2008.*

## 2.5 INTENSIVE LAND USE –REFINEMENT OF RISK ASSESSMENT

The Article 5 methodology used to define risk of Intensive Land Use (ILU) pressures causing failure to meet good status by 2015 is summarised below.

Threshold between ‘at risk’ and ‘not at risk’ = 30%

All rivers with 30 – 70% intensive land use were identified as “probably at risk” of failing to meet Good Status by 2015

All rivers with > 70% intensive land use were identified as “at risk” of failing to meet Good Status by 2015

The % ILU was calculated on GIS as the length of river (within 50m of the river banks) flanked by ILU zones as a proportion of the total river length

The ILU zones included:
Forestry
Arable Land
Urban Fabric
Exploited Peat Land

As depicted by the Corine 2000 GIS Dataset.

Whilst Channelisation can have a direct impact on a river and its riparian zone, Intensive Land Use (ILU) causes indirect impact which can occur due to catchment wide pressures or more directly along the river itself. This makes it more difficult to characterise in terms of morphological risk assessment and as such there was more uncertainty with the ILU risk assessment than the channelisation risk assessment at Article 5. The uncertainties associated with the Article 5 risk assessment and the issues arising from the Freshwater Morphology Interim Outcome Report are outlined in Table 6.

**Table 6: Intensive Land Use – Issues to be Addressed**

| **Section** | **Uncertainty / Issue** | **Analysis** | **Data Used** |
|---|---|---|---|
| **2.5.1** | Is 30% a good reflection of how ILU can impact the status of a river waterbody? | Comparison of:<br>% ILU<br>With<br>R.A.T Score | % ILU along river as calculated for Article 5 risk assessment<br>R.A.T. scores:<br>**RoI Sites** - Sites in Category:<br>A<br>B<br>E<br>J<br>(refer to Table 4)<br>E and J sites with other morphological pressures removed<br>**NI Sites** – Sites with no ILU pressures only<br>Sites with no Article 5 risk assessment data removed<br>Sites with other pressures acting removed |
| **2.5.2** | Should Improved Grassland be included as an ILU type? | Comparison of:<br>% ILU (Incl. Improved Grassland)<br>With<br>R.A.T Score | AS ABOVE except:<br>% ILU calculated including Improved Grassland as a land use category |
| **2.5.3** | Does a river's response to ILU pressures vary according to channel type | As per 2.5.2 | As per 2.5.2 |

| Section | Uncertainty / Issue | Analysis | Data Used |
|---|---|---|---|
| **2.5.4** | Should calculation of percentage ILU be based on a catchment scale or along the river itself? | Comparison of:<br>% ILU (Calculated based on area of ILU upstream)<br>With<br>R.A.T Score | As per 2.5.2<br>Excluding NI Sites |
| **2.5.5** | What is the optimum risk assessment threshold between "at risk" and "not at risk"? | Risk Assessment Threshold Optimisation Matrix used to maximise number of sites assigned risk correctly or conservatively whilst minimising number of sites assigned risk incorrectly. | As per 2.5.2 |
| **2.6** | **WORKSHOP FOLLOW UP**<br>Is the risk assessment effective in identifying risk from ILU?<br>Should it be omitted from the Morphological Risk Assessment ? | Discussion | - |

### 2.5.1 Is 30% Intensive Land Use a Good Reflection of how River Waterbody Status can be impacted?

Figure 9 is a graphical representation of percentage ILU as calculated in the Article 5 risk assessment against R.A.T score for selected pilot waterbodies.

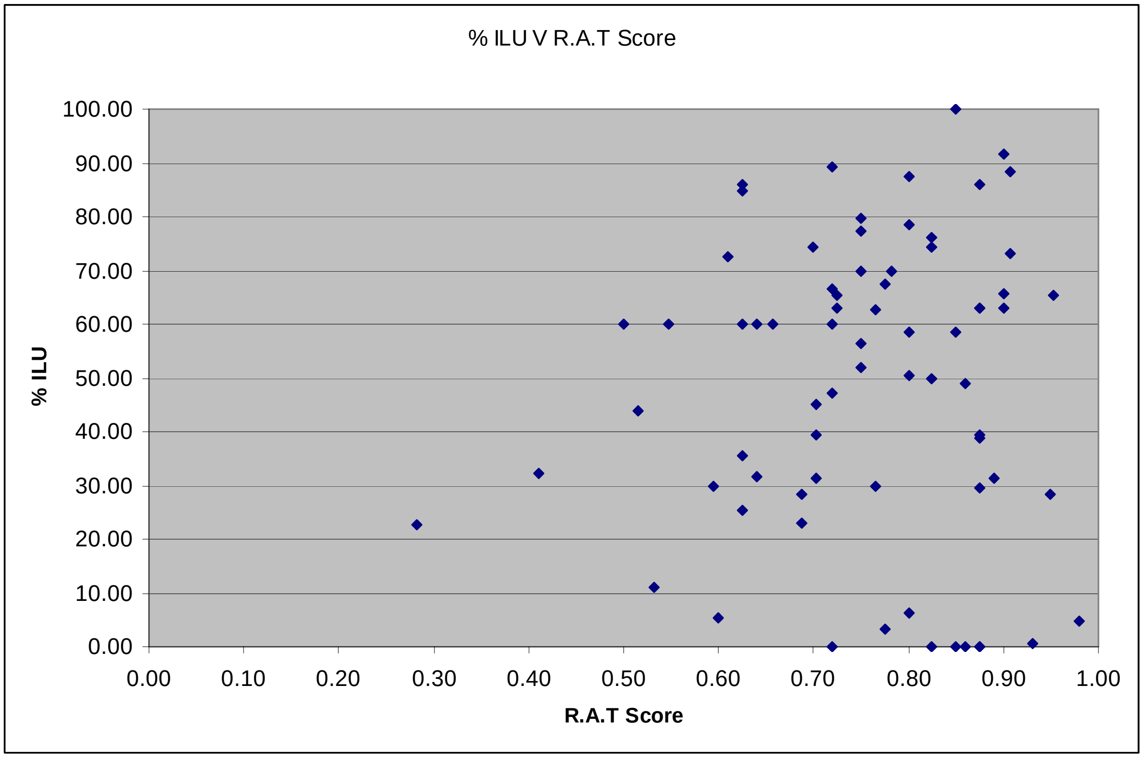


**Figure 9: % ILU against R.A.T Score**

The sites included in the analysis have no other pressures acting on them except ILU or are considered likely high status since no pressures, morphological or otherwise have been identified (refer to Tables 4 & 6 for Site Categories). The outliers as listed in Section 2.4.2 have also been screened out.

Figure 9 indicates that a general trend is not evident.  Of those sites that have good or high R.A.T scores, the range of % ILU is 0 to 100%.

It is clear that the majority of sites have R.A.T scores greater than 0.6 (good or high morphological status) indicating that ILU alone is not enough to cause a drop in status. This was also evident in the biological analysis (Section 2.3).

The data would suggest that in many cases, sites should not be identified as at risk regardless of the % ILU along its river length.

This raises the following questions in reaching a conclusion on how the % ILU threshold should be refined, if at all:

1. Would inclusion of Improved Grassland as an ILU type improve the relationship between ILU and R.A.T score?

2. Does a river's response to ILU pressures vary according to channel type?

3. Would calculation of percentage ILU on a catchment scale provide a more realistic reflection of impact?

These issues require investigation before refinement of the risk assessment threshold can be undertaken, and are documented in the following sections of this report.

### 2.5.2 Should Improved Grassland be included as an ILU type?

Improved grassland can impact river morphology at a local scale in the form of cattle poaching and removal of riparian zones. It can also impact more indirectly e.g. overgrazing which increases soil run-off to rivers and increases sediment movement within the system.

The impact of cattle poaching on a local scale is evident as indicated by sites BLK 10, OWY02A, FIN 02 and SWA 02 (refer to Section 2.4.2). This would suggest that areas of Improved Grassland should be included in the risk assessment so that it can be accounted for in investigative monitoring.

Figure 10 overleaf is a graphical comparison of pilot sites indicating % ILU against R.A.T score excluding and including improved grassland. The top graph represents % ILU as per Figure 9 (excluding improved grassland), the bottom graph represents % ILU including Improved Grassland as a land use category.

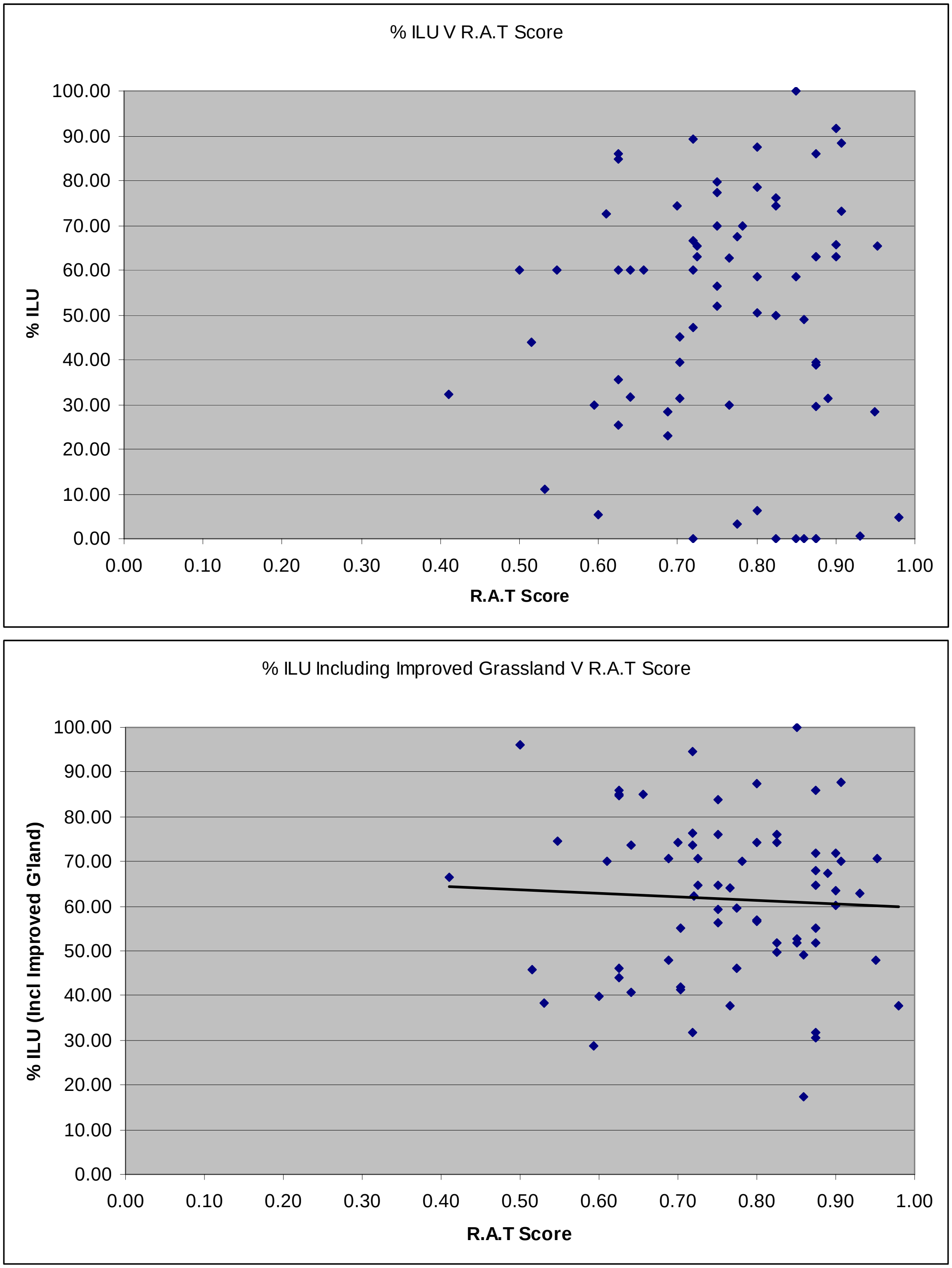


**Figure 10: Comparison of Graphical Relationships when Improved Grassland is included as an ILU Category (Top graph excluding Improved Grassland, bottom graph including Improved Grassland).**

Whilst a weak correlation, there is an improved relationship between % ILU and R.A.T score when improved grassland is included as an ILU category. Table 7 highlights the improved relationship by outlining the difference in range of % ILU above and below a R.A.T score of 0.6.

**Table 7: Difference in Range of ILU percentages when excluding and including Improved Grassland**

| | **R.A.T > 0.6 (Good or High)** | **R.A.T < 0.6 (Less than Good)** |
|---|---|---|
| | **% ILU RANGE** | **% ILU RANGE** |
| **Excluding Improved Grassland** | 0 – 100 | 15 - 85 |
| **Including Improved Grassland** | 15 – 100 | 30 - 95 |

The range of % ILU for which sites have R.A.T scores greater than 0.6 is reduced from (0 to 100%) to (15 to 100%) when Improved Grassland is included as an ILU type.

Similarly, the range of % ILU for which sites have R.A.T scores less than 0.6 is reduced from (15 to 85%) to (30 to 95%) when Improved Grassland is included as an intensive land use type.

There is an improved relationship between % ILU and R.A.T score when Improved Grassland is included. It is recommended that Improved Grassland is included in the refined ILU risk assessment.

However the nature of ILU, as an indirect pressure, means that it is more difficult to quantify impact than direct pressures. This has been proven by the lack of a strong correlation between percentage ILU and R.A.T scores. Nonetheless, for the purposes of risk assessment, it is necessary to assign appropriate thresholds and to observe the relationships according to channel type.

## 2.5.2 Does a river's response to ILU pressures vary according to channel type?

Figure 11 categorises the sites according to channel type based on % ILU (Including Improved Grassland)

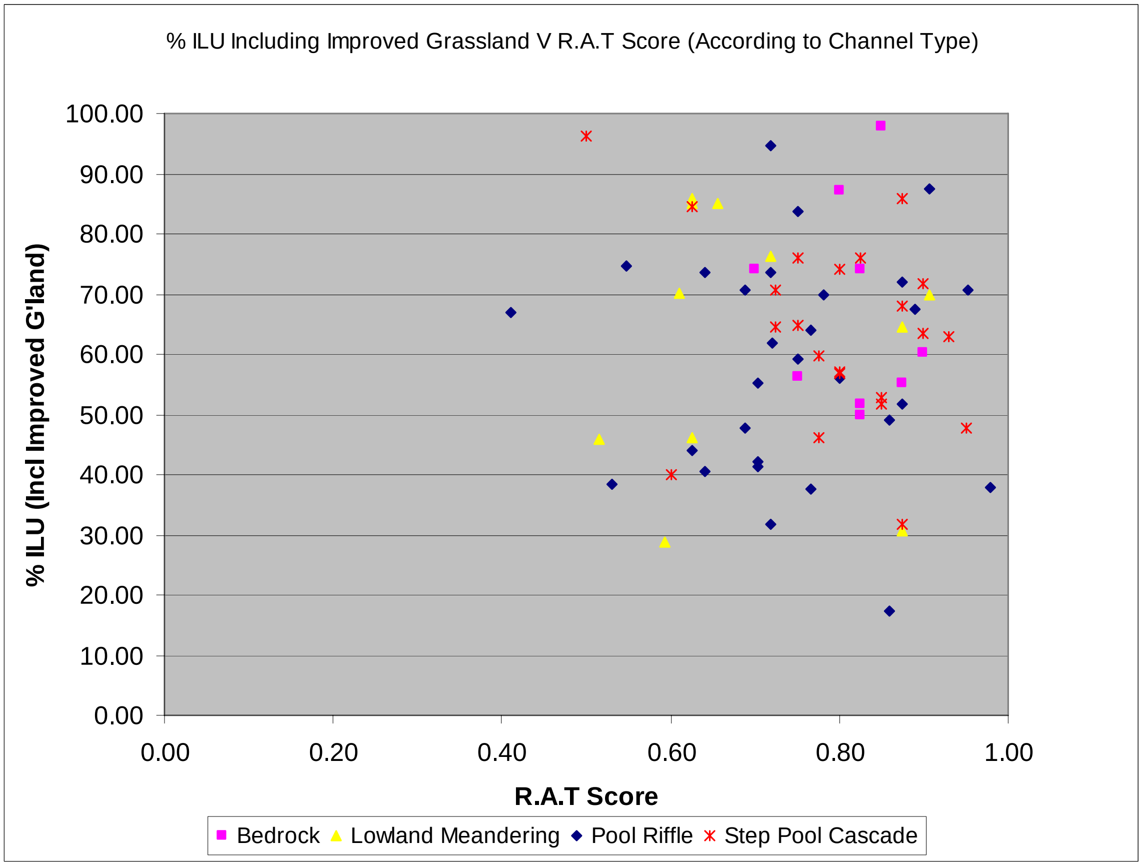


**Figure 11: % ILU (Including Improved Grassland) against R.A.T Score (According to Channel Type)**

The majority of sites with R.A.T scores less than 0.6 are lowland meandering and pool riffle indicating that these channel types are more sensitive to ILU pressures. This is likely to be caused by indirect pressures upstream such as forestry and peat exploitation causing increased sediment transport in the system, but also on a more local level due to cattle poaching and loss of riparian zones in improved grassland areas.

Figure 11 has been split according to channel type for clarity as follows:

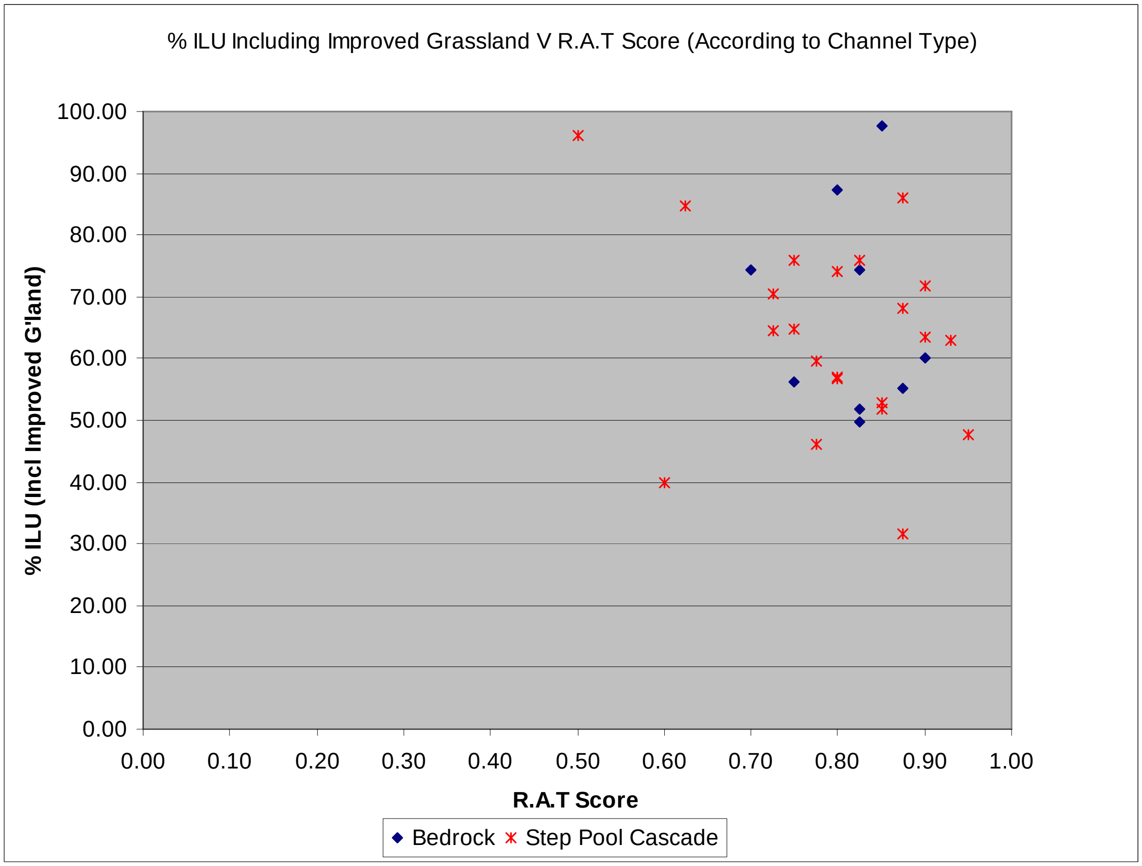


**Figure 11a – % ILU V R.A.T Score – Bedrock and Step Pool Cascade Channels**

**Bedrock and Step Pool Cascade** – An inverse correlation between % ILU and R.A.T score is evident but only 2 sites have a R.A.T score of 0.6 or less. Upland rivers tend to have good R.A.T scores regardless of % ILU. This suggests that upland rivers are less sensitive to ILU pressures or that ILU within a catchment causes impact further downstream in the system.

In comparing Figure 11a to Figure 10 bedrock and step-pool-cascade rivers remain largely unchanged in terms of % ILU when improved grassland is included as an ILU type. This is because improved grassland is more prevalent in lowland rivers. As a consequence, it is more likely to cause direct morphological impact (e.g. cattle poaching and removal of riparian zones to maximize the extent of available pasture).

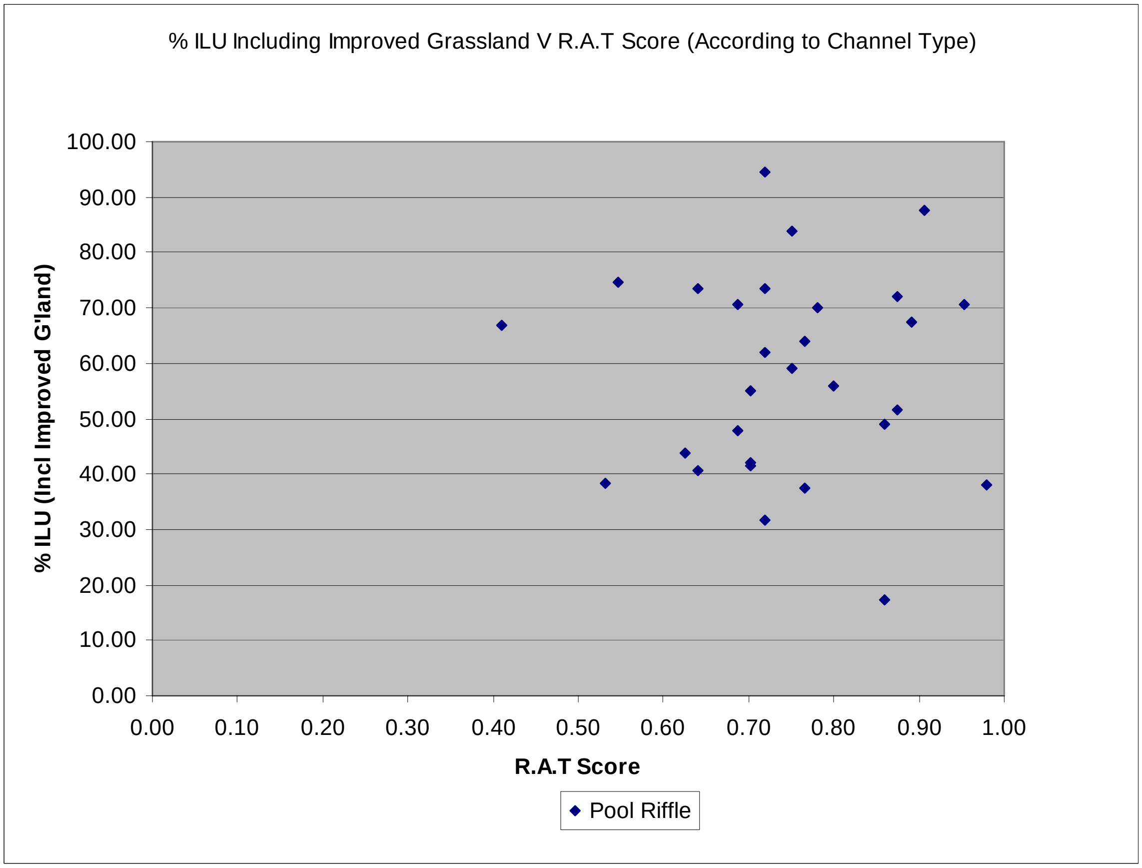


**Figure 11b – % ILU V R.A.T Score – Pool Riffle Channels**

**Pool Riffle -** The range of % ILU at sites with R.A.T < 0.6 is 38% to 75%.

However, the range at sites with R.A.T > 0.6 is 18% to 95%.

A relationship for pool riffle channels is not evident. A risk assessment threshold must be applied that optimises the number of sites assigned correctly in terms of risk (refer to Section 2.5.5).

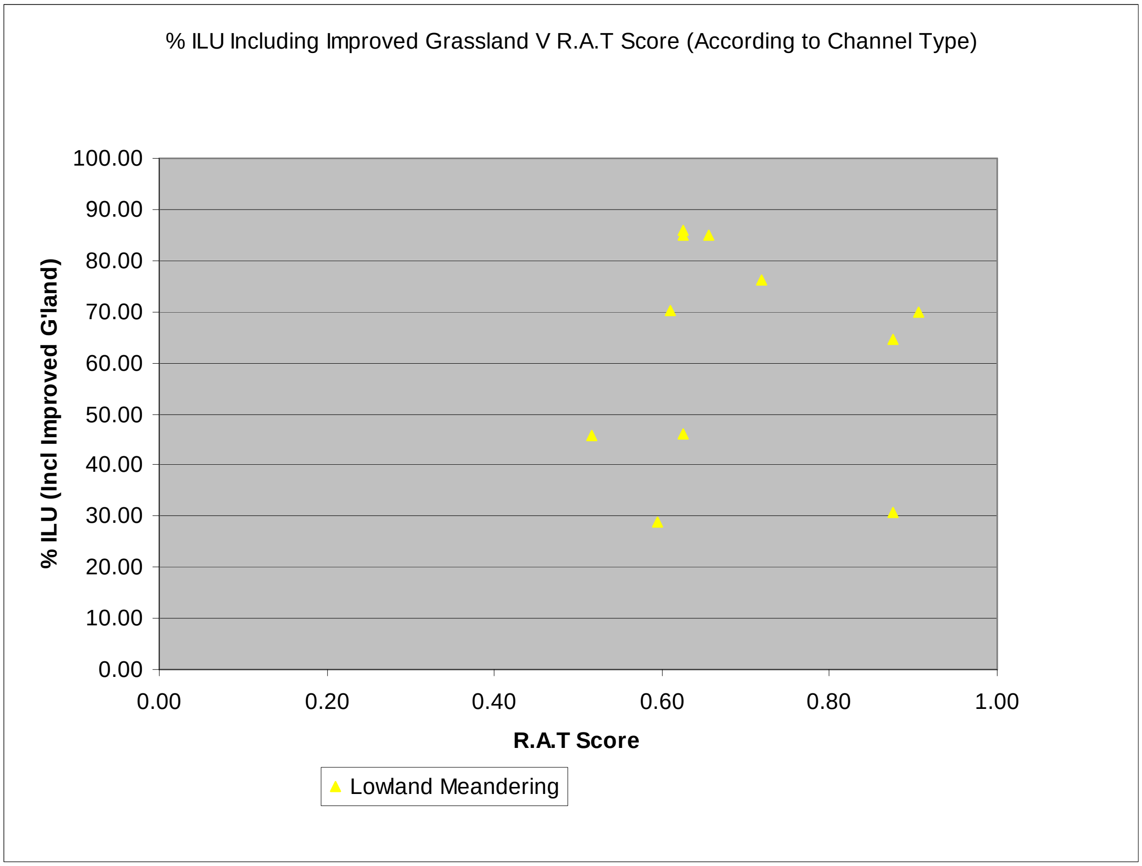


**Figure 11c – % ILU V R.A.T Score – Lowland Meandering**

**Lowland Meandering -** Lowland Meandering – Whilst a weak correlation, a trend of increasing R.A.T score with decreasing % ILU is evident. However, similar to pool riffle channels, a risk assessment threshold must be applied that optimises the number of sites assigned correctly in terms of risk (refer to Section 2.5.5).

### 2.5.4 Should Percentage of ILU be calculated along the river length or based on the area of ILU Zones within the overall Upstream Catchment?

Since low lying rivers have been identified as more sensitive to ILU pressures than upland rivers, the question of how the percentage of ILU affecting a river is calculated (to which a threshold between "at risk" and "not at risk" is applied) in the risk assessment methodology must be addressed.

Past research has shown that catchment wide forestry and peat exploitation, impact river morphology by increasing soil run-off and disturbing river sediment regimes as the system moves downstream. Therefore it may be more realistic to base the percentage of ILU on the area of intensive land use zones upstream in a waterbody as opposed to along the river length itself as per the Article 5 risk assessment approach.

To test this, the pilot waterbodies within categories A, B, E, D, G (refer to Table 4) and the EPA Surveillance Sites (candidate high status) were subjected to a revised risk assessment methodology using ArcGIS. Table 8 highlights the change in approach from the Article 5 method in calculating percentage of ILU affecting a river waterbody.

(This analysis has been conducted including Improved Grassland as an ILU type).

**Table 8: Revised Calculation of Percentage ILU Trialled on Pilot Waterbodies.**

| **STEP** | **ARTICLE 5 GIS BASED CALCULATION (Linear Method)** | **TRIAL REVISED GIS BASED CALCULATION (Area Method)** |
|---|---|---|
| 1 | A 50m buffer was applied to each river stretch in order to select Intensive Land Use adjacent to river stretches on GIS | The catchment area upstream of a river stretch was delineated on GIS. |
| 2 | % ILU = The river length flanked by intensive land use cover as a percentage of the total river length within a waterbody | % ILU = The area of ILU zones upstream of the river as a percentage of the river's total upstream catchment area |

Figure 12 illustrates the difference in approach from the Article 5 linear method for calculating percentage of ILU affecting a river waterbody on GIS to the trialled revised Area method.

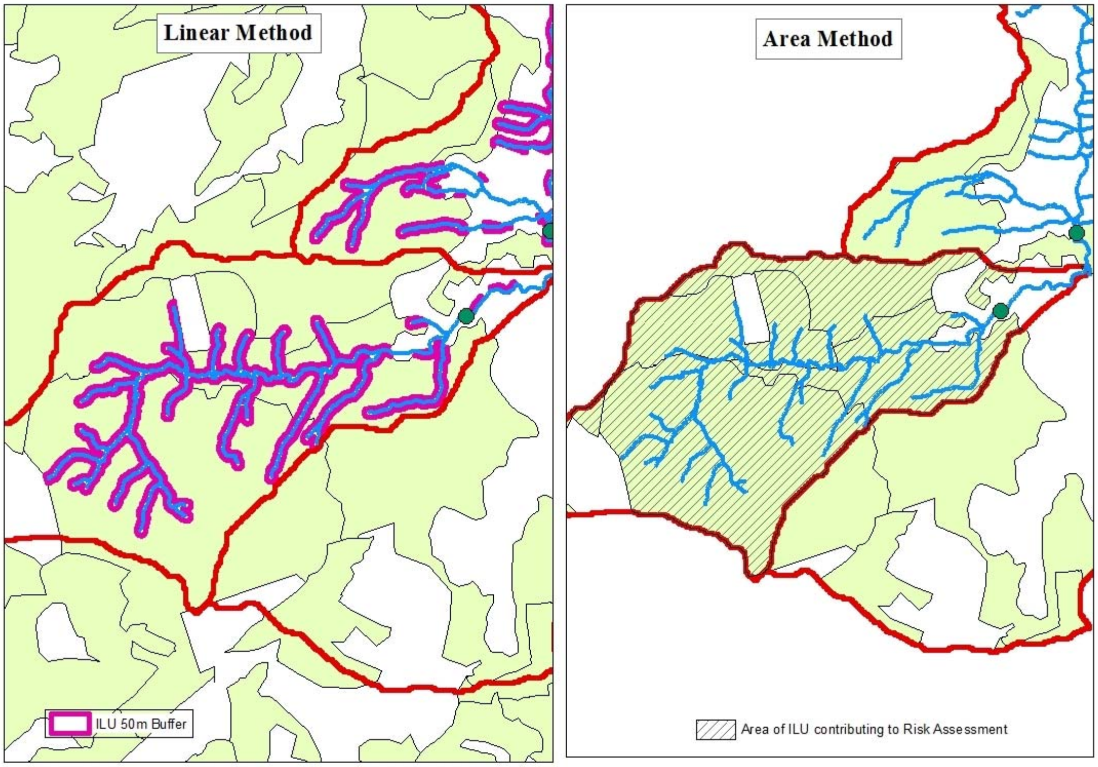
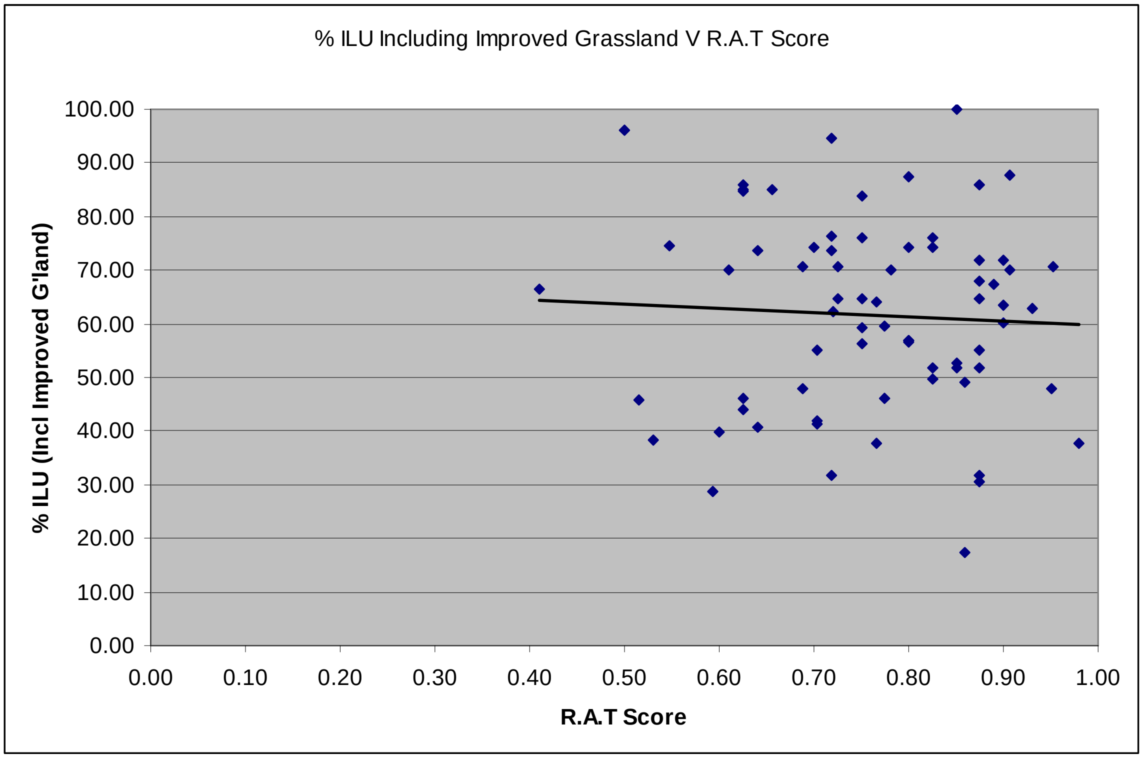


**Figure 12: Area Method and Linear Method for calculating % ILU affecting a river waterbody on GIS**

Figure 13 overleaf is a graphical comparison of the pilot sites indicating % ILU against R.A.T score. The top graph represents % ILU as per Figure 11, the bottom graph represents % ILU based on the area of intensive land use zones upstream of the test site.

*Note: the sites in Northern Ireland are not included in the bottom graph as the revised calculation method was only trialled on pilot waterbodies within Ireland.*



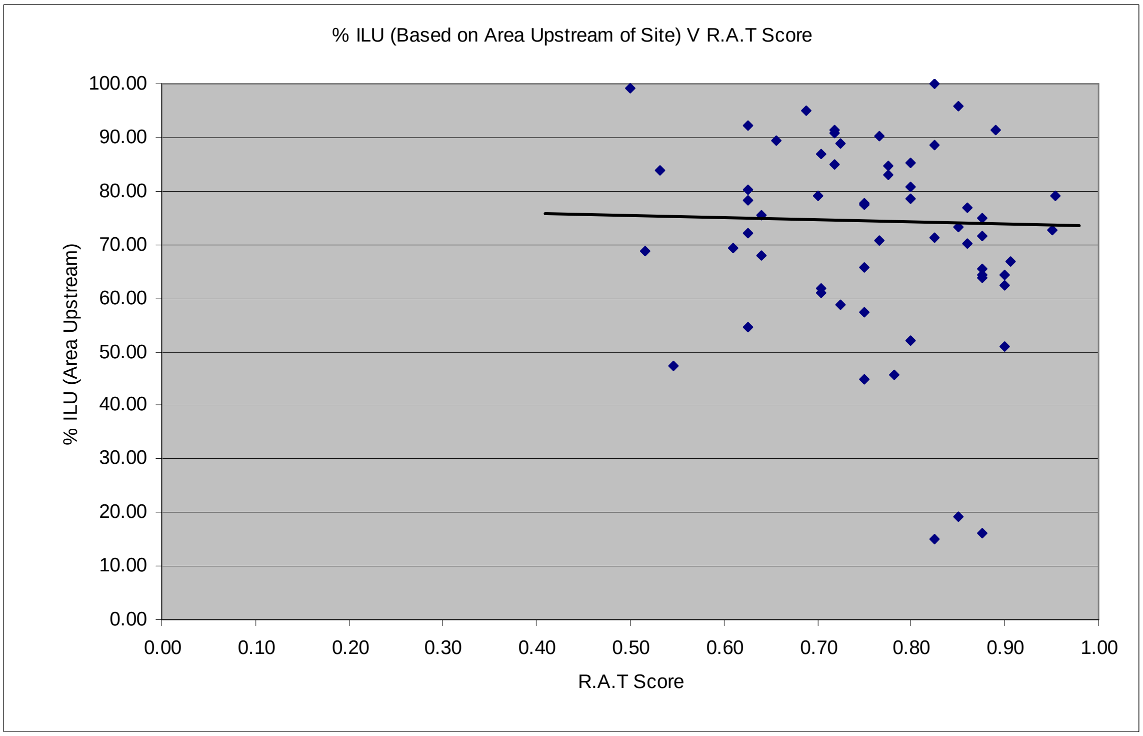


**Figure 13: Comparison of % ILU and R.A.T Score Relationships using different methods to calculate % ILU (Top graph – linear method; bottom graph – area method)**

Based on the trial % ILU calculation conducted on pilot waterbodies, the revised method does not produce a stronger relationship between ILU and R.A.T score than the Article 5 approach based on river length.

Given the more complex nature of executing the area-based method on GIS, and the fact that no improvement in the relationship is gained; it is not recommended that the method to calculate % ILU is changed for the refined risk assessment. However the 50m buffer applied to the river line could be increased to ensure all ILU zones are picked up in the risk assessment.

However, it should be reconsidered in the second RBMP cycle following further trials and research.

### 2.5.5 Optimising the Risk Assessment Threshold for Intensive Land Use

Since a correlation between % ILU and R.A.T score does not readily highlight an appropriate risk assessment threshold between good status and less than good status, optimising the percentage ILU risk assessment threshold used is undertaken by maximising the number of sites assigned risk correctly or conservatively whilst minimising the number assigned risk incorrectly when compared with R.A.T field data (refer to Figure 6c).

#### 2.5.5.1 Assumptions

Based on the findings of the preceding sections in Chapter 2.0 the following assumptions are made as a basis for optimising the risk assessment threshold between “at risk” and “not at risk” with respect to ILU:

- Improved Grassland is included as an ILU Type
- Lowland Meandering and Pool Riffle rivers are more sensitive to ILU pressures
- Calculation of % ILU is based on the length of river flanked by ILU zones

Whilst bedrock and step pool cascade rivers may not be as sensitive to ILU pressures based on the field data obtained in this Study, and may not be at risk in terms of status from this pressure, it is recommended that all river types are included in the risk assessment for the first RBMP cycle, thereby ensuring a conservative approach. Removing bedrock and step pool cascade rivers from the ILU risk assessment with confidence would require a robust GIS-based channel typology dataset to enable separation of river waterbodies into specific morphological channel types. Whilst this is under development through Work Package 6 of the Freshwater Morphology PoMS Study, there are national data gaps in relation to river valley confinement that compromise its accuracy at present. This should be revisited for the risk assessment undertaken in second RBMP cycle.

Therefore the dataset analysed with the objective of optimising the risk assessment threshold is %ILU (Including Improved Grassland) against R.A.T score for all channel types as per Figure 11.

### 2.5.5.2 Threshold Optimisation Matrix

In optimising where the % ILU risk assessment threshold line lies, the number of sites falling into Quadrant 3 (refer to Figure 6c) should be minimised whilst optimising the number of sites assigned risk correctly (Quadrants 1 and 4); and the number of sites conservatively assigned “at risk” whilst not classified at risk in the field.

### 2.5.5.3 Optimum Risk Assessment Threshold for Intensive Land Use

Table 9 summarises the number of sites in the following categories at a range of % ILU thresholds for all channel types (refer to Figure 6c):

- Risk assigned correctly (Quadrant 1 + Quadrant 4)
- Risk assigned incorrectly (Quadrant 2)
- Risk assigned conservatively (Quadrant 3)

There are 71 sites in total.

**Table 9: Number of Sites Assigned Risk Correctly, Conservatively and Incorrectly in relation to % ILU Thresholds**

| % ILU Threshold | Correct | Conservative | Incorrect |
|---|---|---|---|
| **30** | 6 | 64 | 1 |
| 40 | 11 | 58 | 2 |
| 50 | 20 | 48 | 3 |
| 60 | 32 | 36 | 3 |
| **70** | 43 | 24 | 4 |
| 80 | 56 | 10 | 5 |
| 90 | 64 | 2 | 5 |
| 95 | 65 | 1 | 5 |

The % ILU figures highlighted are the Article 5 thresholds.

In general, the number of sites assigned risk correctly increases as the percentage threshold increases above the Article 5 threshold between “not at risk” and “probably at risk” of 30%. Therefore it is recommended that this threshold should be increased. This is reinforced by the fact that overall there is a lower number of sites incorrectly assigned regardless of the threshold used suggesting that ILU alone does not pose a significant threat to morphological status.

As the percentage threshold increases, the number of sites assigned risk correctly increases. However, the number of sites assigned incorrectly also increases. The degree of conservative risk assignment decreases as the percentage threshold increases.

In refining the threshold, the level of correct risk assignment and incorrect risk assignment should be balanced against the level of conservative risk assignment.

Figure 15 presents the data in Table 9 in graphical format.

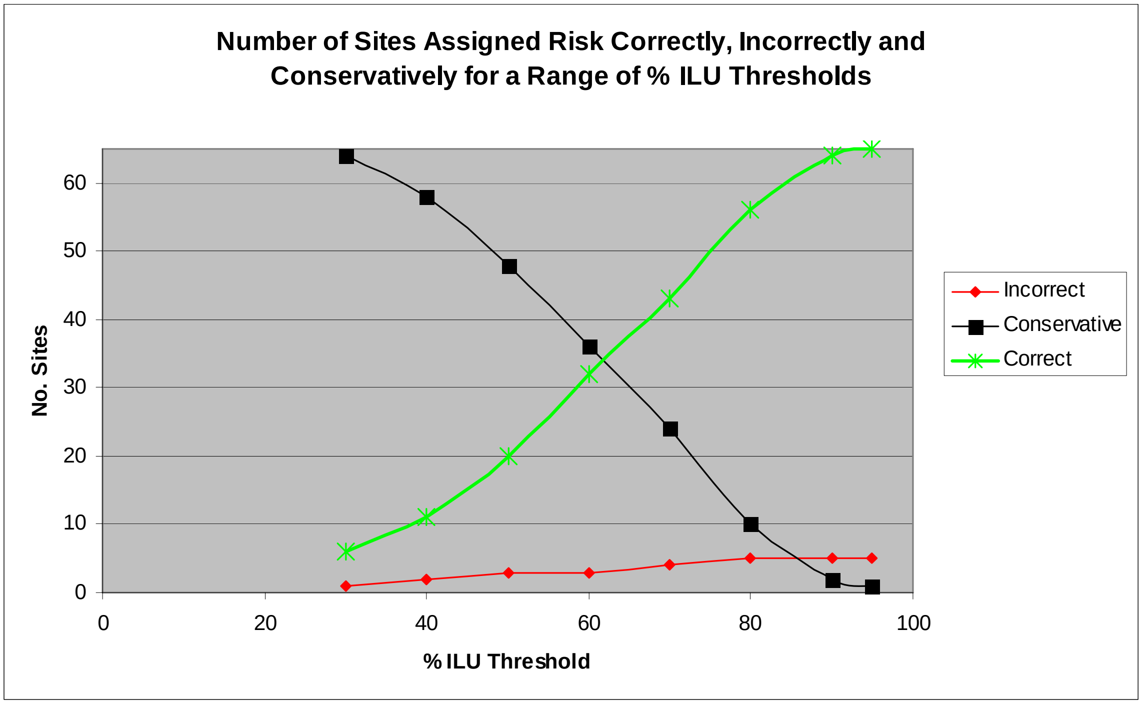


**Figure 15: No. Sites Assigned Risk Correctly, Incorrectly and Conservatively for a Range of % ILU Thresholds**

Figure 15 illustrates that the number of sites assigned risk incorrectly steadily increases as the % ILU threshold increases. The number of sites assigned correctly also increases significantly whilst the degree of conservative risk assignment decreases.

Therefore a high risk assessment threshold increases the likelihood that sites will be assigned risk incorrectly and reduces the safeguard provided by using a conservative approach.

As the percentage threshold increases, the number of sites assigned risk conservatively reduce – these sites now fall into the low risk, good R.A.T score category (Quadrant 4) and are assigned risk correctly. Based on the results, the ILU percentage could increase beyond 70%.

Since lowland meandering and pool riffle rivers are more sensitive to ILU pressures, Table 10 summarises the number of sites in the following categories at a range of % ILU thresholds for all lowland meandering and pool riffle types to determine if 60% applies when looking at these types only:

- Risk assigned correctly (Quadrant 1 + Quadrant 4)
- Risk assigned incorrectly (Quadrant 2)

- Risk assigned conservatively (Quadrant 3)

There are 40 sites in total.

**Table 10: Number of Sites Assigned Risk Correctly, Conservatively and Incorrectly in relation to % ILU Thresholds (Lowland Meandering and Pool Riffle Only)**

| % ILU Threshold | Correct | Conservative | Incorrect |
|---|---|---|---|
| 30 | 5 | 34 | 1 |
| 40 | 8 | 30 | 2 |
| 50 | 14 | 23 | 3 |
| 60 | 19 | 18 | 3 |
| 70 | 24 | 12 | 4 |
| 80 | 29 | 6 | 5 |
| 90 | 34 | 1 | 5 |
| 95 | 35 | 0 | 5 |

Figure 16 presents this data in graphical format.

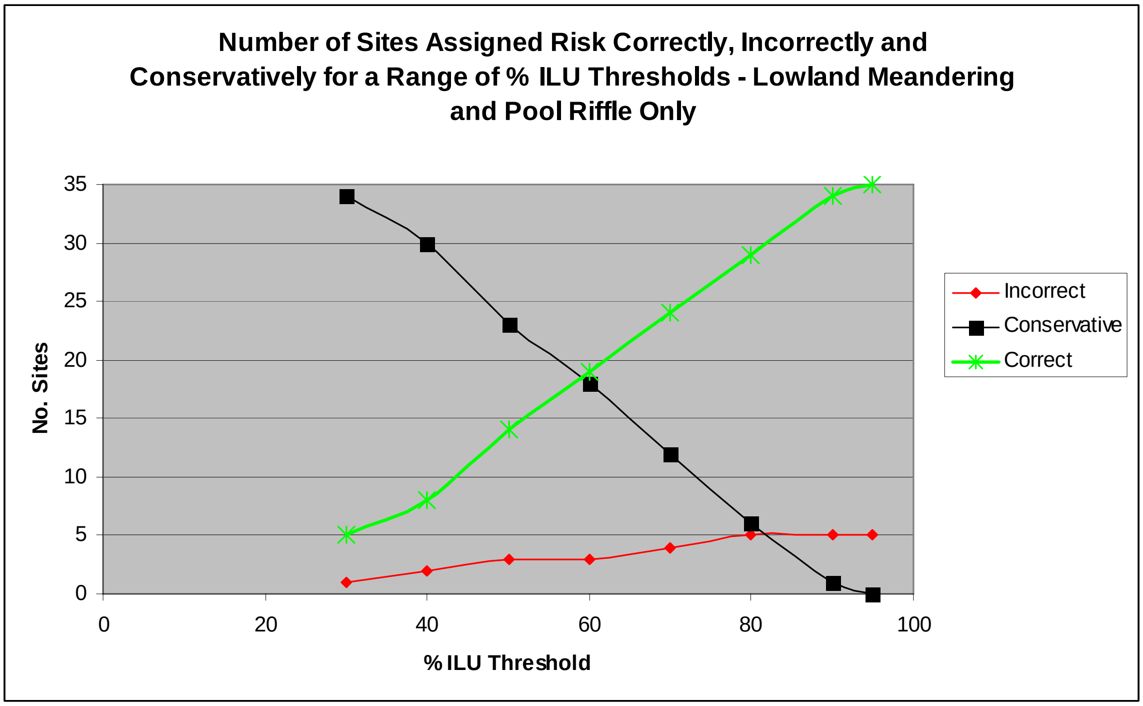


**Figure 16: No. Sites Assigned Risk Correctly, Incorrectly and Conservatively for a Range of % ILU Thresholds (Lowland Meandering and Pool Riffle Only)**

Similarly, based on the results, the ILU percentage could increase beyond 70%.

### 2.5.6 Recommendations on Intensive Land Use Risk Assessment Refinement – Pre Workshop

In summary, the list of findings and recommendations for refinement of the ILU Risk Assessment is as follows:

- Risk Assessment of ILU pressures is more difficult given its indirect nature
- Improved Grassland should be included as an ILU Type since it improves the relationship between % ILU and R.A.T score
- Lowland Meandering and Pool Riffle rivers are more sensitive to ILU pressures
- Calculation of % ILU should be based on the length of river flanked by ILU zones as per the Article 5 Risk Assessment methodology. However, this should be reviewed for the second RBMP cycle following further research on the spatial impact of ILU pressures
- Consideration should be given to increasing the 50m buffer applied in the risk assessment to ensure all ILU zones are included.
- The risk assessment threshold between 'at risk' and 'not at risk' should be increased from 30%
- Whilst lowland meandering and pool riffle rivers are found to be more sensitive to ILU pressures, it is recommended that all river types should be included in the risk assessment for the first RBMP and reviewed for the second RBMP cycle when GIS based channel typology is completed.

**<u>Workshop Follow Up</u>**

### 2.6 Intensive Land Use Risk Assessment, Fitness for Purpose

The recommendations outlined in Section 2.5.6 were presented to the extended Steering Group at the Freshwater Morphology Workshop on 4th April 2008 (insert link to workshop proceedings)

The main points raised by workshop delegates were:

- The GIS based high level risk assessment method is not sensitive enough to reflect the pressures and impacts associated with ILU. There are several variables which are not accounted for, such as direct (e.g. cattle poaching) and indirect nature of different land uses, soil types, seasonality of intensity of land use, such as forestry harvests. More research into this is needed.
- Raising the intensive land use risk assessment threshold to 70% would not be appropriate in areas of forestry on peatland. It sends a misleading message that this coverage of forestry and peatland within a catchment is acceptable in all cases.

- It may be worthwhile to have individual risk assessments for each of the intensive land use pressures rather than grouping them together.

- Intensive land use pressures are assessed in other POMS studies.

- Measures to address ILU pressures have been identified through other National PoMS studies, particularly those addressing diffuse and urban pollution. Furthermore, the equivalent GIS based risk assessment for diffuse pressures includes forestry, peat, and agriculture as sources. Therefore, it is possible that the necessary steps to identify and deal with ILU pressures are already being covered, and since this risk assessment is not sensitive enough to adequately reflect the pressures and impacts, it may be appropriate to remove it from the morphological risk assessment.

- Overgrazing is not picked up through other pressure based assessments, but the problem areas can readily be identified through expert judgement so that improvement measures can be included in the River Basin Management Plans.

## 2.7 Intensive Land Use – Final Recommendations – Post Workshop

- The Article 5 ILU risk assessment used a 30% threshold to distinguish between waterbodies that were “at risk” and those that were “not at risk” of meeting status objectives. The 30% threshold was based on the proportion of a river stretch running through one of 4 ILU zones, within 50m of the channel. These were:
    - Arable
    - Forestry
    - Urban
    - Exploited Peat

- This study has found that applying a 30% threshold places several waterbodies “at risk” when in fact; the R.A.T score on the ground (i.e. observed impact) indicated good or indeed high status.

- Several analyses within the Pilot Study were undertaken to determine how this threshold could be refined to better reflect the impact of ILU.

- The comparison of percentage ILU with R.A.T scores on the ground revealed no meaningful relationship. A range of moderate to high R.A.T scores was found at waterbodies with 0 to 100% ILU along the river length.

- Alternative methods, within the limits of the Pilot Study data, were trialled such as calculating % ILU based on area of ILU zones upstream within the catchment. Whilst it is widely considered that this is a more accurate approach, the relationship was not improved in this Study, and should be further investigated in follow up WFD based research projects.

- The inclusion of Improved Grassland was found to improve the relationship, but only slightly.
- Workshop feedback confirmed that the nature of ILU pressures and impacts contains many variables that are not accounted for in the high level GIS based risk assessment.
- The main aim of risk assessment is to perform initial screening on a national basis to identify candidate waterbodies for which measures should be considered within RBMP's. It was commented that the ILU risk assessment methodology is too crude to provide any meaningful identification of waterbodies that may be at risk and as such, is not effective in serving this purpose.
- Furthermore, since good or high R.A.T scores were found at waterbodies with % ILU as high as 70% or greater, it is depicting a misleading message that high levels of ILU pressures such as forestry are acceptable in all cases.
- Therefore it is recommended that the ILU element of the morphology risk assessment is omitted.
- However, the fact remains that several river waterbodies will require improvement measures to address ILU pressures such as forestry, peat exploitation, urbanisation and agriculture, and they must be identified for the RBMP's. It is considered that these measures, and the waterbodies requiring them, are all identified in other national PoMS Studies and will be included in RBMPs as measures to address problems such as siltation, substrate damage, loss of riparian zones and cattle poaching
- Therefore it is recommended that the ILU element of morphological risk assessment is omitted, and that the associated improvement measures are identified by reference to diffuse risk assessment and other Programmes of Measures, whilst using expert input where needed for 1st RBMP.
- Research into the development of a more detailed, but practical GIS based risk assessment method is recommended
- Measures to address areas of known impact, such as overgrazing should be included in the RBMP's by utilising expert judgement from the PoMS Study technical steering committee.

## 3.0 OBJECTIVE 2 - CLASSIFICATION

## MORPHOLOGY CLASSIFICATION OF SURVEILLANCE STATUS SITES USING R.A.T SCORE

### 3.1 Background

Following the adoption of the R.A.T Survey technique for morphological classification, a recommendation from the Interim Outcome report of March 2007 was to undertake R.A.T surveys at a range of WFD Surveillance sites, the majority of which were considered "likely high status" in Ireland due to their high biological and chemical quality. By classifying for morphology it could then be determined if these sites can be reported as Good or High Ecological Status having all the necessary biological, chemical and morphological elements in place.

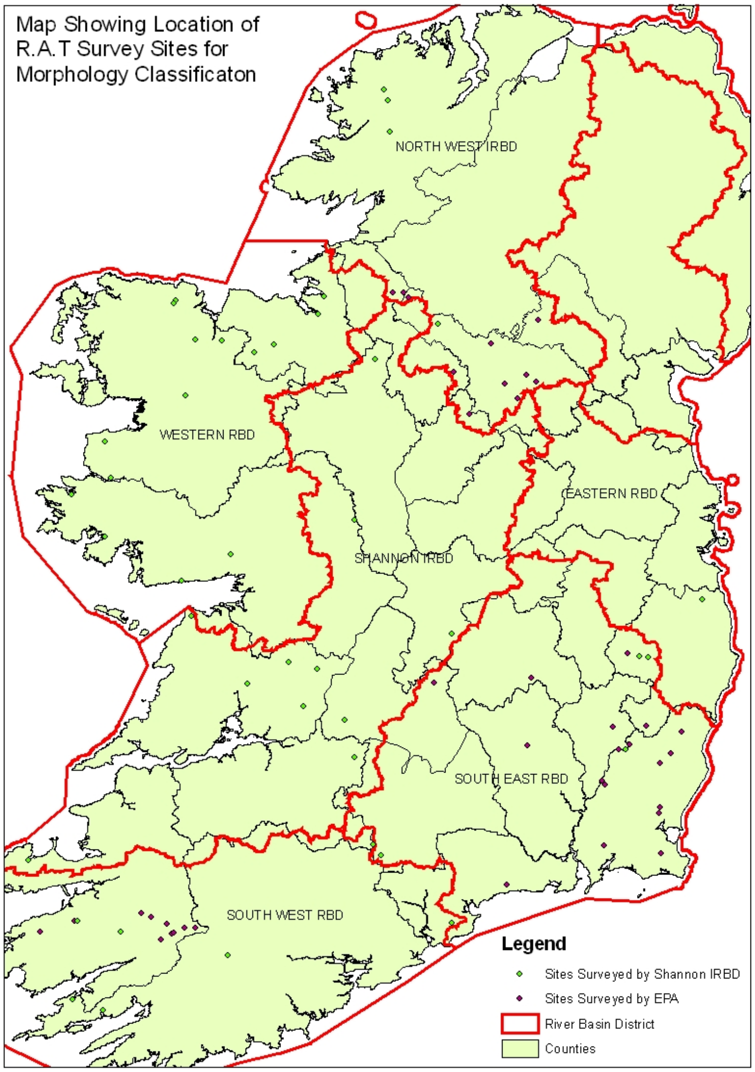


**Figure 17: Location of surveillance sites surveyed using R.A.T for Classification Purposes**

The Shannon IRBD undertook 42 R.A.T surveys of EPA surveillance sites which are "likely high status" sites during 2007 to provide a morphological classification.

EPA also undertook 43 R.A.T surveys of other surveillance sites, some of which were "likely high status" sites during 2007 to provide a morphological classification.

55 likely high status sites were surveyed in total.

Two sites were surveyed by both the Shannon IRBD and EPA on separate occasions. This is the Clody River in the SERBD, located on the border between Counties Carlow and Wexford, and the Caragh River, in county Kerry, SWRBD.

The results of these morphology classifications are presented in this report to facilitate overall status classification by EPA.

Figure 17 shows the geographical location of the 84 river sites surveyed using R.A.T during 2007.

## 3.2 Results

Appendix C includes the Hydromorph score and associated WFD class for each site.

Table 11a outlines the total number of surveillance sites within each WFD morphology class based on the R.A.T survey.

**Table 11a: Number of surveillance sites within each WFD morphology class based on R.A.T Survey**

| WFD MORPHOLOGY CLASS | NUMBER OF SITES |
|---|---|
| High | 32 |
| Good | 37 |
| Moderate | 11 |
| Poor | 4 |
| Bad | 1 |

A total of 82% of the sites surveyed have good or high morphological status.

38% of the sites have high morphological status.

44% of the sites have good morphological status.

Table11b outlines the number of sites within each likely WFD ecological status class, and the corresponding number of these within each *morphology* WFD class when R.A.T surveyed. The likely status was assigned by EPA based on Biological Q score.

**Table 11b: Likely Status and Corresponding Morphology Status when R.A.T Surveyed**

| | | **R.A.T Status (Morphology Status)** | | | | |
|---|---|---|---|---|---|---|
| **WFD Class** | **Likely Ecological Status** | **High** | **Good** | **Moderate** | **Poor** | **Bad** |
| *High* | 55 | 25 | 19 | 8 | 2 | 1 |
| *Good* | 22 | 4 | 17 | 1 | 0 | 0 |
| *Moderate* | 6 | 1 | 2 | 2 | 1 | 0 |
| *Poor* | 1 | 0 | 0 | | 1 | 0 |
| *Bad* | n/a | n/a | n/a | n/a | n/a | n/a |

Of the 55 sites assigned “likely high” ecological status, 25 also had high morphology status. The remaining 30 sites had good, moderate, poor or bad morphology status, and will not therefore be classified as High Ecological Status overall.

Figures 18 (a to e) overleaf represent the WFD morphology classifications per River Basin District.

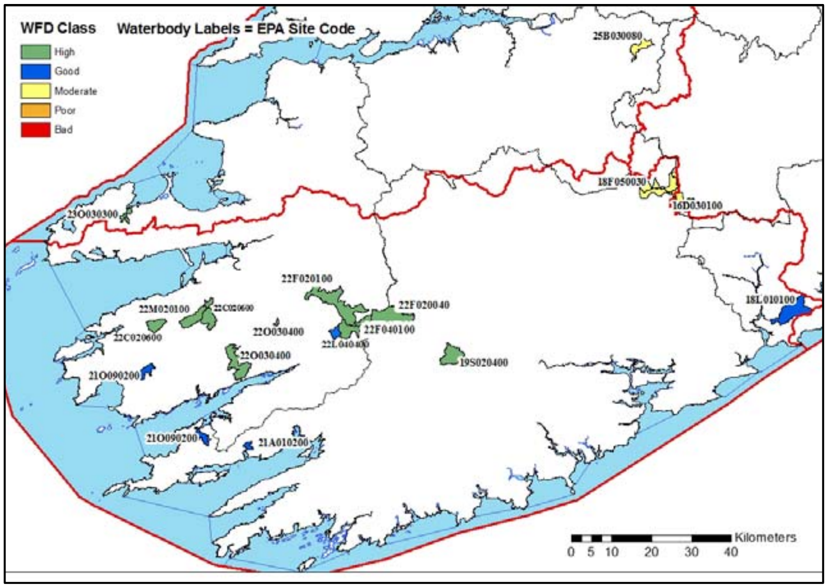


**Figure 18a: SWRBD – WFD Morphology Class of EPA Surveillance Sites R.A.T Surveyed (2007)**

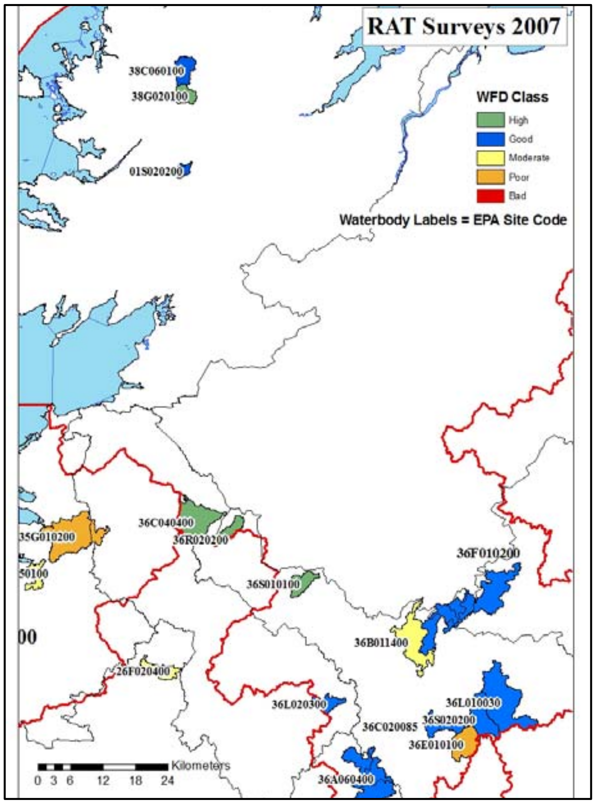


**Figure 18b: NWIRBD – WFD Morphology Class of EPA Surveillance Sites**

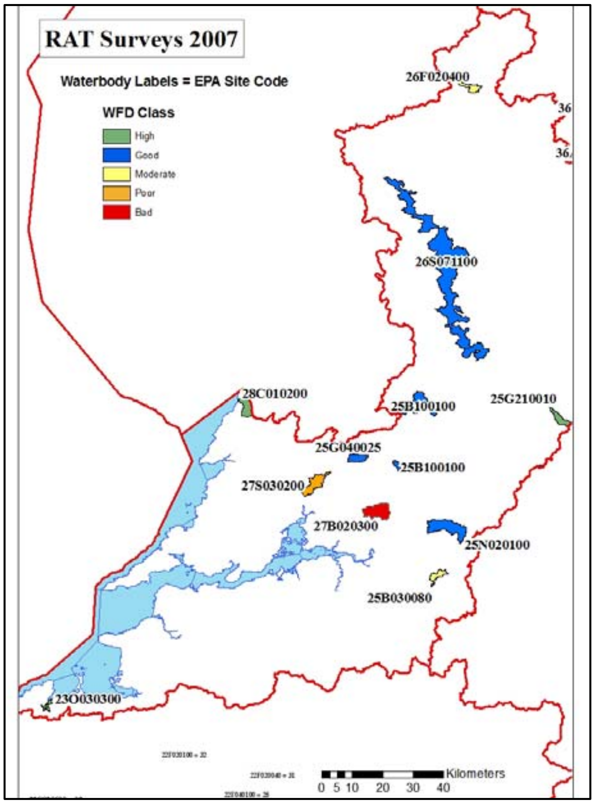


**Figure 18c: ShIRBD – WFD Morphology Class of EPA Surveillance Sites**

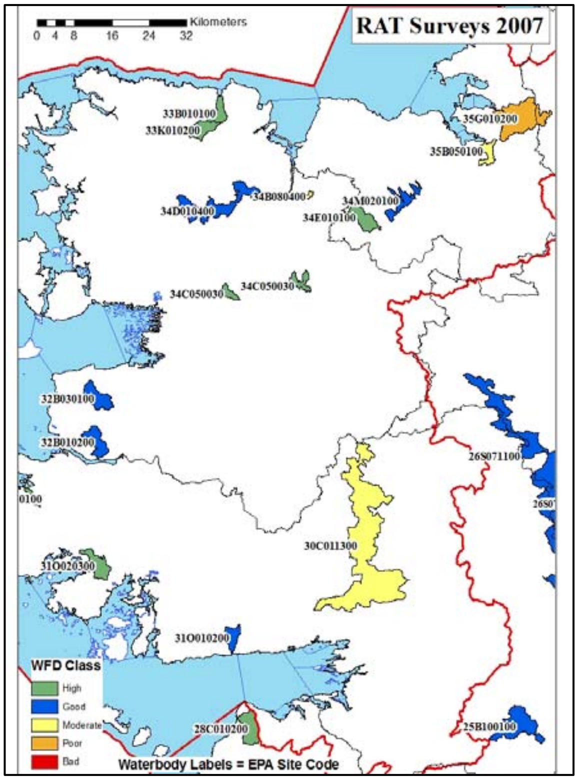


**Figure 18d: WRBD – WFD Morphology Class of EPA Surveillance Sites**

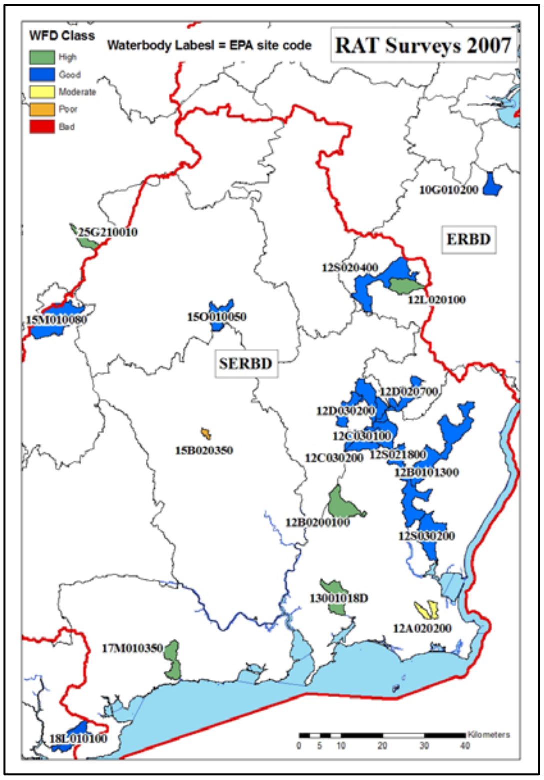


**Figure 18e: SERBD/ERBD – WFD Morphology Class of EPA Surveillance Sites**

Table 11c indicates the number of sites within each WFD morphology class according to River Basin District.

**Table 11c: Number of sites within each WFD morphology class according to River Basin District**

| | HIGH | GOOD | MODERATE | POOR | BAD | TOTAL SURVEYED |
|---|---|---|---|---|---|---|
| **NWRBD** | 4 | 9 | 1 | 1 | 0 | 15 |
| **WRBD** | 6 | 5 | 3 | 1 | 0 | 15 |
| **SWRBD** | 13 | 4 | 2 | 0 | 0 | 19 |
| **ShIRBD** | 4 | 4 | 2 | 1 | 1 | 12 |
| **SERBD** | 4 | 15 | 3 | 1 | 0 | 23 |
| **ERBD** | 1 | 0 | 0 | 0 | 0 | 1 |

One site (EPA 22 / 27B020300), the Glenomra River in County Clare (ShIRBD) was classified as bad morphological status (R.A.T score = 0.17). The R.A.T field sheet recorded over-deepening, over widening, and the presence of embankments all of which contributed to the low score.

One site was surveyed by both the Shannon IRBD and EPA separately –EPA Code 12CO30200 (Clody River, SERBD). Table 12 indicates the scores obtained by each surveyor.

**Table 12: Comparison of R.A.T scores at Clody River by each Surveyor**

| Surveyor | R.A.T Score | WFD Class |
|---|---|---|
| EPA | 0.75 | Good |
| Shannon IRBD | 0.765 | Good |

This is a useful quality assurance check on the consistency of results obtained between different surveyors. Since both results were the same, it can be assumed that the R.A.T survey results will not vary widely between surveyors ensuring a consistent approach nationally.

**Workshop Follow Up**

### The Caragh River – Check on Score

EPA Biologist, John Lucey had local knowledge of this site and disagreed with the score of 0.625 that was assigned. The site was subsequently visited by EPA and R.A.T surveyed. Table 13 indicates the scores obtained by each surveyor.

**Table 13: Comparison of R.A.T scores at Caragh River by each Surveyor**

| Surveyor | R.A.T Score | WFD Class |
|---|---|---|
| EPA | 1.00 | High |
| Shannon IRBD | 0.625 | Good |

EPA classified the site has high morphological status, whereas the Shannon IRBD classified it as good. It was found that the difference in score was due to the fact that the river is a managed fishery. Whilst good correspondence was found between surveyors on the Clody River, there was disagreement in the case of the Caragh. This has highlighted a discrepancy on how managed rivers are scored using the R.A.T methodology. It is recommended that EHS and EPA discuss this and develop a uniform approach when scoring sites.

## 3.3 Issues for Classification

Figure 18f indicates those sites that were identified as “likely high status” based on biological and chemical elements, and the corresponding R.A.T score to confirm whether or not the morphology supports a High Ecological Status classification.

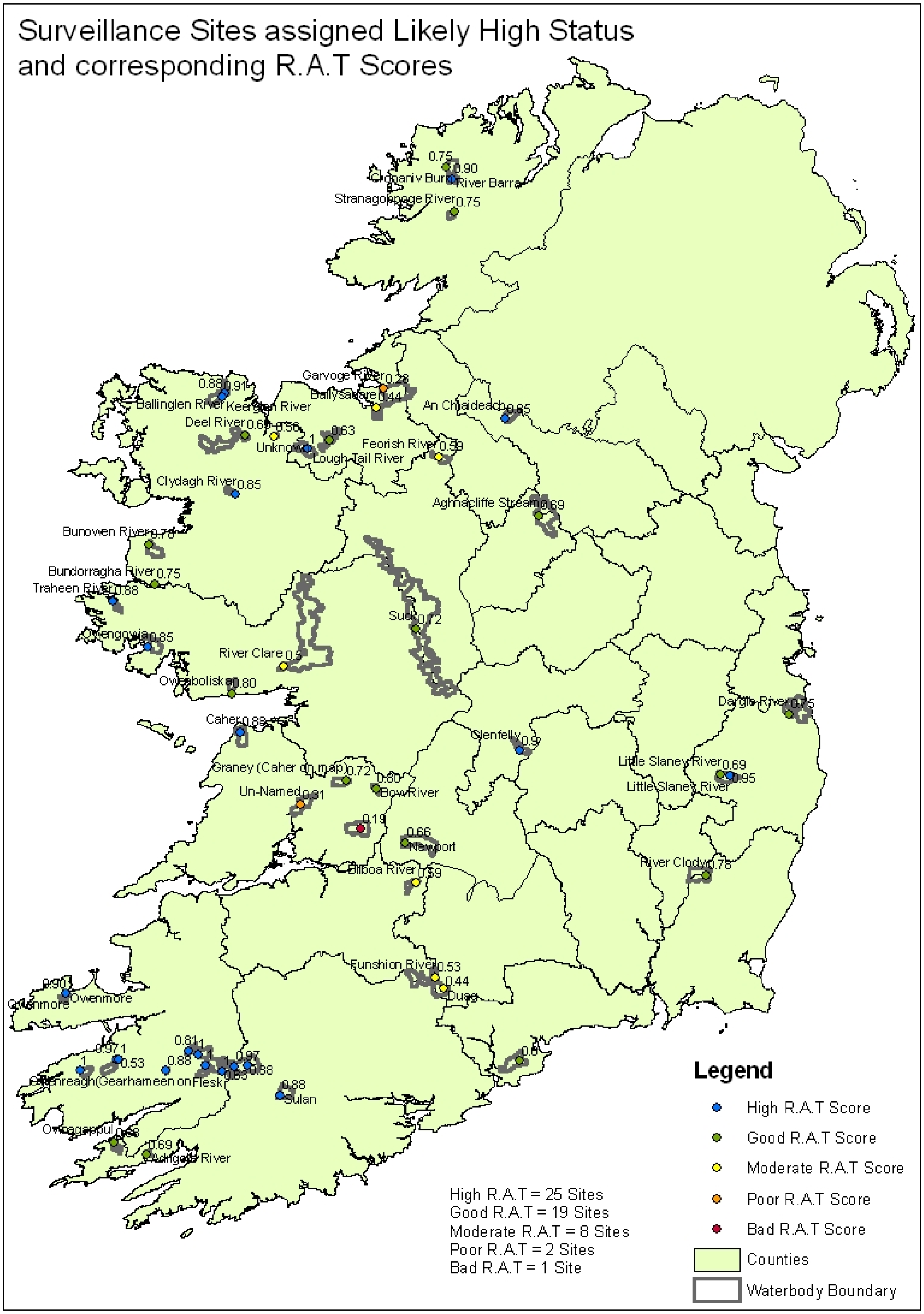


**Figure 18f: Likely High Status Surveillance Sites and Corresponding R.A.T Scores**

Appendix C2 includes a full R.A.T score breakdown of the 55 likely high sites to illustrate the how each physical attribute was scored in the field.

Of the 55 likely high status sites surveyed, 25 have supporting high R.A.T scores. EPA expressed concern that the overall status of a waterbody could be reduced from high to good simply because of a less than high R.A.T score over a small reach within the overall waterbody length. In some cases a R.A.T score could be over a 500m reach, whereas the waterbody length is 5km. This raises the question of waterbody scale when undertaking surveillance monitoring for classification purposes.

Key Recommendation:
Sampling Strategies for Surveillance Monitoring should be developed in the context of the overall waterbody. This may involve surveying several sites within a waterbody to ensure a representative score. Research into methodologies on developing representative sampling strategies is recommended.

*Note: EHS are currently undertaking an exercise to determine an appropriate R.A.T survey length to represent a typical river waterbody. Consultations with EHS have identified the need for more detailed research on this topic also. EPA should liase closely with EHS in this regard*.

The issue of Waterbody Scale is also discussed in Section 4.2 of this report.

# 4.0 OBJECTIVE 3

## MANAGING MORPHOLOGICAL CHANGE

Based on Table 1 the issues to be addressed in this report under Objective 3 are:

4.1 Comparison of MImAS field data with pressure data to assess the applicability of its thresholds for regulation purposes

4.2 Investigate the issue of Waterbody Scale when Selecting Sites for Monitoring

(Further assessment of the MImAS system for regulatory purposes is being undertaken through the Tool Development work package of the overall PoMS Study).

### 4.1 Comparison of MImAS field data with pressure data to assess the applicability of thresholds for regulation purposes

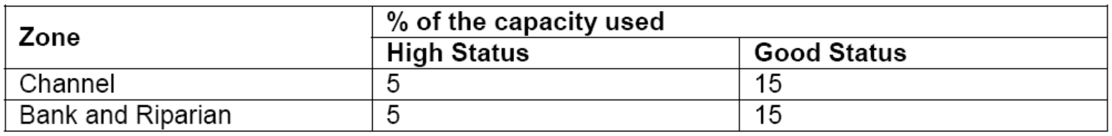
The detailed operation of MImAS within the Scottish Environmental Protection Agency's (SEPA's) Controlled Activities Regulations (C.A.R) including the technical details (modules used and engineering activities assessed) are documented in Literature Review 1 of the overall PoMS Study and the Interim Outcome Report.

In summary, and for the purposes of this report, the following points are of most relevance:

- MImAS assesses the potential for deterioration in morphological status by quantifying the capacity a waterbody has to accept morphological change
- If a proposed engineering activity decreases this capacity below a specified threshold it is deemed a risk to morphological status and further investigation is undertaken or requested from the applicant
- MImAS is not used to make a final decision, rather it is a trigger mechanism to highlight potential risk to status
- Direct pressures such as channelisation are included, indirect pressures such as ILU are not

The capacity thresholds are outlined in Table 13 as percentages of total capacity to accept morphological change

**Table 13: % Capacity Thresholds used in MImAS Tool**



| Zone | % of the capacity used | |
|---|---|---|
| | High Status | Good Status |
| Channel | 5 | 15 |
| Bank and Riparian | 5 | 15 |

In the context of channelisation pressures, the recommended risk assessment threshold between 'good status' and 'less than good' status is 50% Channelisation.

MImAS surveys were undertaken at the Pilot Waterbodies in Ireland during 2007 and the associated MImAS Capacity Scores for the Channel and Bank calculated. These have been compared with % Channelisation to assess the applicability of the 5% and 15% capacity thresholds in the context of regulation.

Figure 19 is a graphical representation of % Channelisation (as calculated for Article 5 risk assessment) against MImAS score for the channel. The pilot waterbodies included are Categories C, J and E (refer to Table 4).

*Note: MImAS surveys were not undertaken in Northern Ireland, nor at EPA Surveillance sites.*

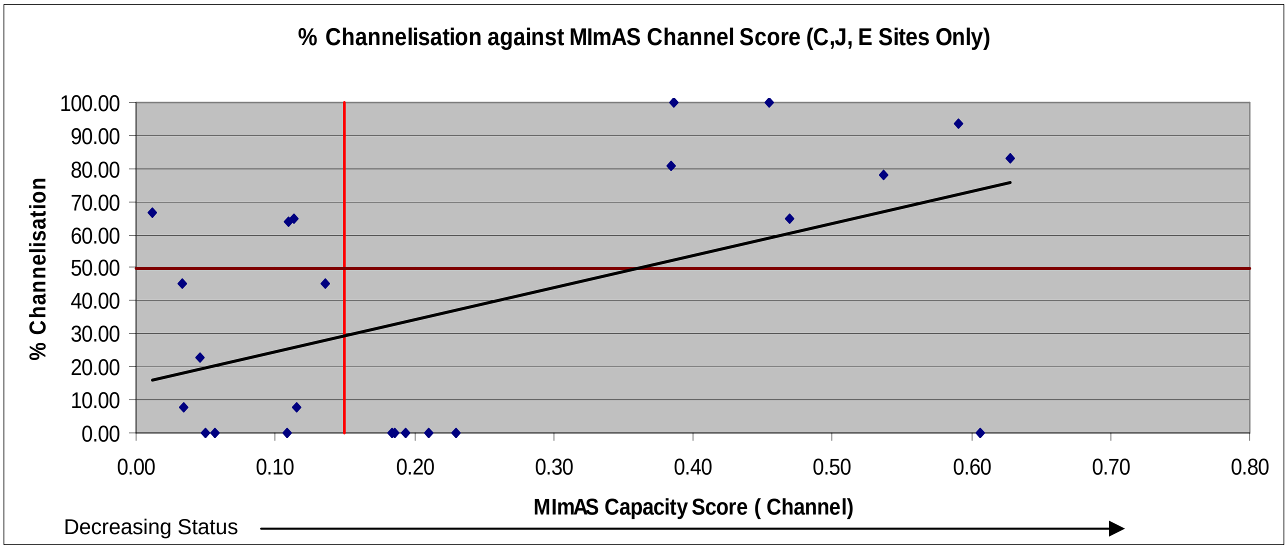


**Figure 19: % Channelisation against MImAS Channel Score.**

5% Capacity used is the threshold between good and high status = **0.05**

15% Capacity used is the threshold between good and less than good status = **0.15**

The boundary between good status and less than good status (0.15) is highlighted on Figure 19. Sites to the right of the line have MImAS scores greater than 0.15 (more than 15% capacity used) and as such are less than good morphological status.

The recommended 50% channelisation threshold for risk assessment is also highlighted on Figure 19. Eight of the 12 sites with less than 50% channelisation had MImAS scores less than 0.15 (good status). Five of these sites had MImAS scores less than 0.05 (high status).

7 of the 10 sites with greater than 50% channelisation had MImAS scores greater than 0.15 (less than good). The 3 sites with greater than 50% channelisation that have good or high MImAS scores are conservative.

Only four sites have 0% channelisation but have less than good MImAS Scores.

Overall this indicates that for regulatory purposes, a 50% threshold for channelisation as for the risk assessment matches the MImAS capacity thresholds in the majority of cases.

Table 14 tabulates the percentage of sites surveyed that are correctly classified or otherwise when using 50% channelisation as the threshold between 'at risk' and 'not at risk' to morphological status.

**Table 14: Percentage of Sites MImAS Surveyed assigned Correctly, Incorrectly or Conservatively using 50% Channelisation (Channel Score)**

| Correct | Conservative | Incorrect |
|---|---|---|
| 68 | 14 | 18 |

Therefore the total percentage of sites classified correctly or conservatively is 82% using 50% channelisation pressure threshold and the MImAS threshold of 15% capacity between good status and less than good status for the channel zone.

Figure 20 is a graphical representation of % Channelisation (as calculated for Article 5 risk assessment) against MImAS score for the bank and riparian zone. The pilot waterbodies included are Categories C, J and E (refer to Table 4).

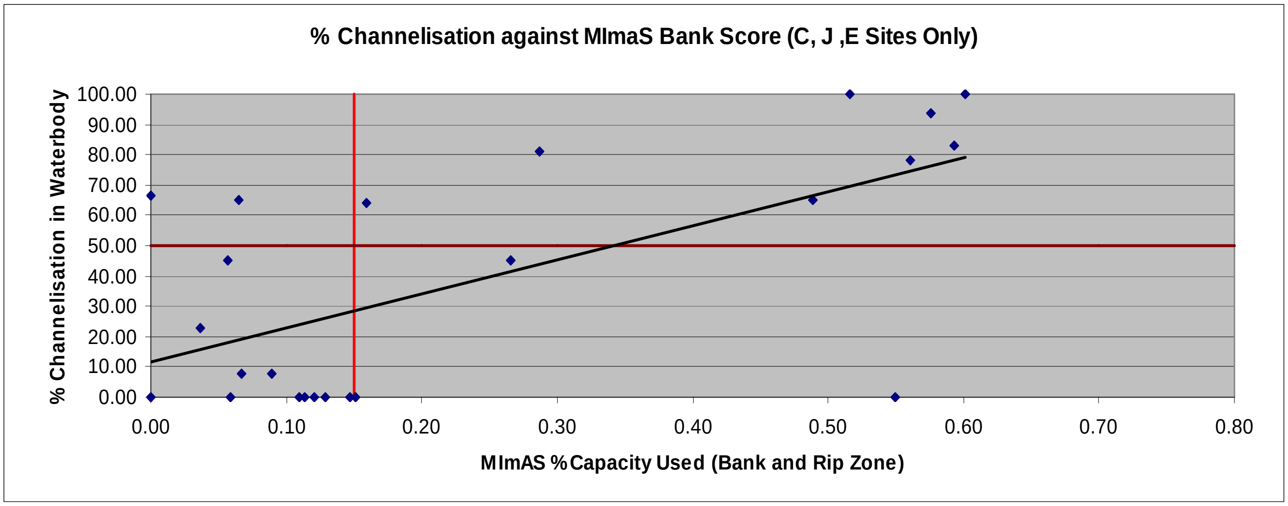


**Figure 20: % Channelisation against MImAS Bank and Riparian Zone Score.**

The boundary between good status and less than good status (0.15) is highlighted on Figure 20. Sites to the right of the line have MImAS scores greater than 0.15 (more than 15% capacity used) and as such are less than good morphological status.

The recommended 50% channelisation threshold is also highlighted on Figure 20.
11 of the 12 sites with less than 50% channelisation had MImAS scores of 0.15 or less (good status). Two of these sites had MImAS scores less than 0.05 (high status).

8 of the 10 sites with greater than 50% channelisation had MImAS scores greater than 0.15 (less than good). The 2 sites with greater than 50% channelisation that have good or high MImAS scores are conservative.

Only 1 site has just under 50% channelisation but has less than good MImAS Scores for bank and riparian zone.

Overall this indicates that for regulatory purposes, a 50% threshold for channelisation as for the risk assessment matches the MImAS capacity thresholds for the bank and riparian zone in the majority of cases. Table 15 tabulates the percentage of sites surveyed that are correctly classified or otherwise when using 50% channelisation as the threshold between at risk and not at risk to morphological status.

**Table 15: Percentage of Sites MImAS Surveyed assigned Correctly, Incorrectly or Conservatively using 50% Channelisation (Bank and Riparian Zone Score)**

| Correct | Conservative | Incorrect |
|---|---|---|
| 86 | 9 | 5 |

Therefore the total percentage of sites classified correctly or conservatively is 95% using 50% channelisation and the MImAS threshold of 15% capacity between good status and less than good status for the bank and riparian zone.

It is recommended that the capacity thresholds used as trigger levels in the MImAS regulatory approach can be used for regulation in Ireland. This is in keeping with the UK Environmental Standards published by the UK Technical Advisory Group in 2007 and ensures a consistent approach with Ireland’s Eco Region Neighbours. The 50% channelisation pressure threshold, as for risk assessment, is also recommended in the context of regulation.

### 4.2 Waterbody Scale

The issue of waterbody scale was identified in the Interim Outcome Report of 2007 by comparing R.A.T and MImAS results with the criteria with which pilot waterbodies were selected.

Land Use pressures such as overgrazing cannot be detected by monitoring a single site within a waterbody. Sampling strategies must be devised so that surveys are representative at a waterbody scale. The fieldwork 2007 included test sites at the upstream and downstream end of waterbodies where possible to demonstrate the importance of selecting morphology monitoring sites that will reflect the overall waterbody in terms of the pressures acting and the impact observed.

The following examples are included in this report:

- Shannon IRBD, Cappagh Waterbody, County Clare
- WRBD, Srahmore catchment County Mayo, feeds Lough Feeagh

### 4.2.1 Shannon IRBD, Cappagh Waterbody, Co. Clare – Importance of Channel Type in Sampling

Figure 21 shows the Shannon Cappagh River Waterbody and surrounding lands. Two sites were surveyed in the waterbody, E1 and E6 using R.A.T, Q Assessment and CBAS.

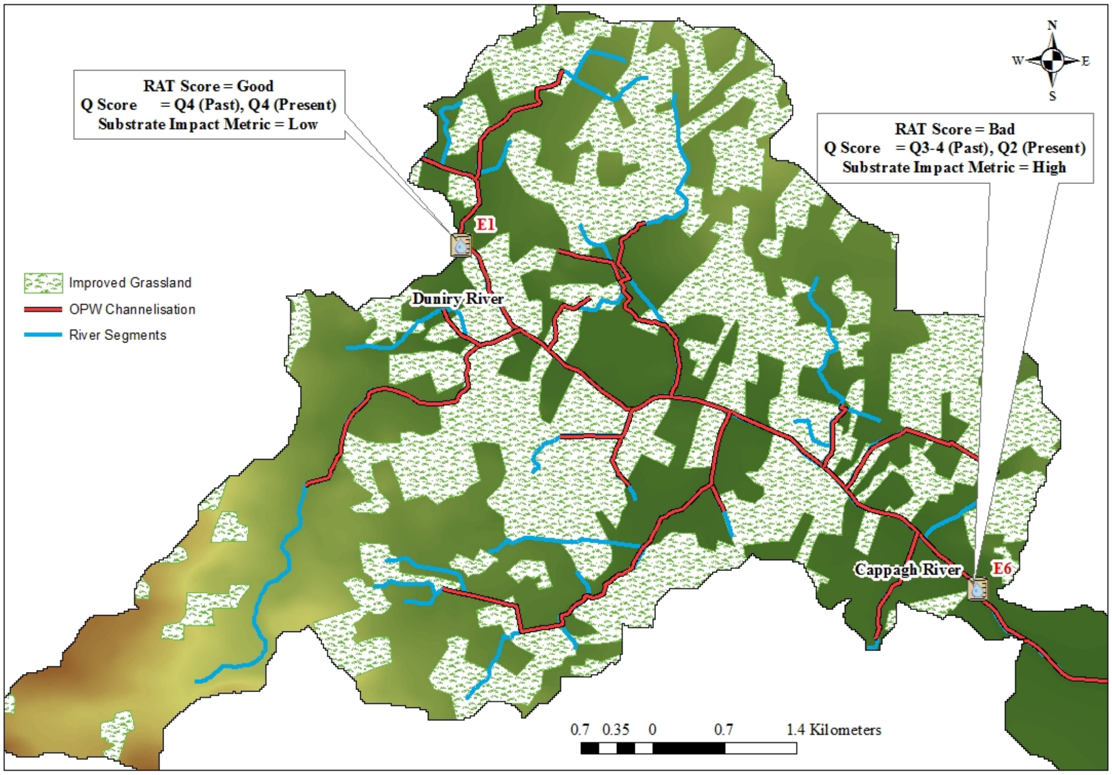


Figure 21: Shannon Cappagh River Waterbody, Co. Clare

A significant deterioration in R.A.T score is detected between the upstream site and the downstream site. Q Score also deteriorates, and the Substrate Impact Metric increases.

Both channelisation and improved grassland pressures are acting on this waterbody, the impact of this combination increases downstream. This highlights the importance of checking channel type when selecting sampling sites. Since lowland meandering and pool riffle sites are more sensitive to these pressures, sampling the upstream channels is unlikely to provide a true reflection of their impact.

Inspection of the Article 5 risk assessment reveals that there are diffuse pollution pressures from septic tanks in the area which is the most likely cause of the low Q score downstream. This should be further investigated when identifying Programmes of Measures.

### 4.2.2 Srahmore Catchment – The Importance of Catchment Context

Figure 22 illustrates the Srahmore catchment in County Mayo.

Sites G3 and G4 were surveyed using R.A.T, Q and CBAS. Site G3 is the Goulaun River at the upstream end of the catchment. Site G4 is the Srahmore River at the downstream end of the catchment just upstream of Lough Feeagh.

Figure 22 indicates the survey scores for morphology and biology at each site. Photographs of each site are presented below.

**Site G4: Goulaun River**

**Site G3: Srahmore River (in flood)**

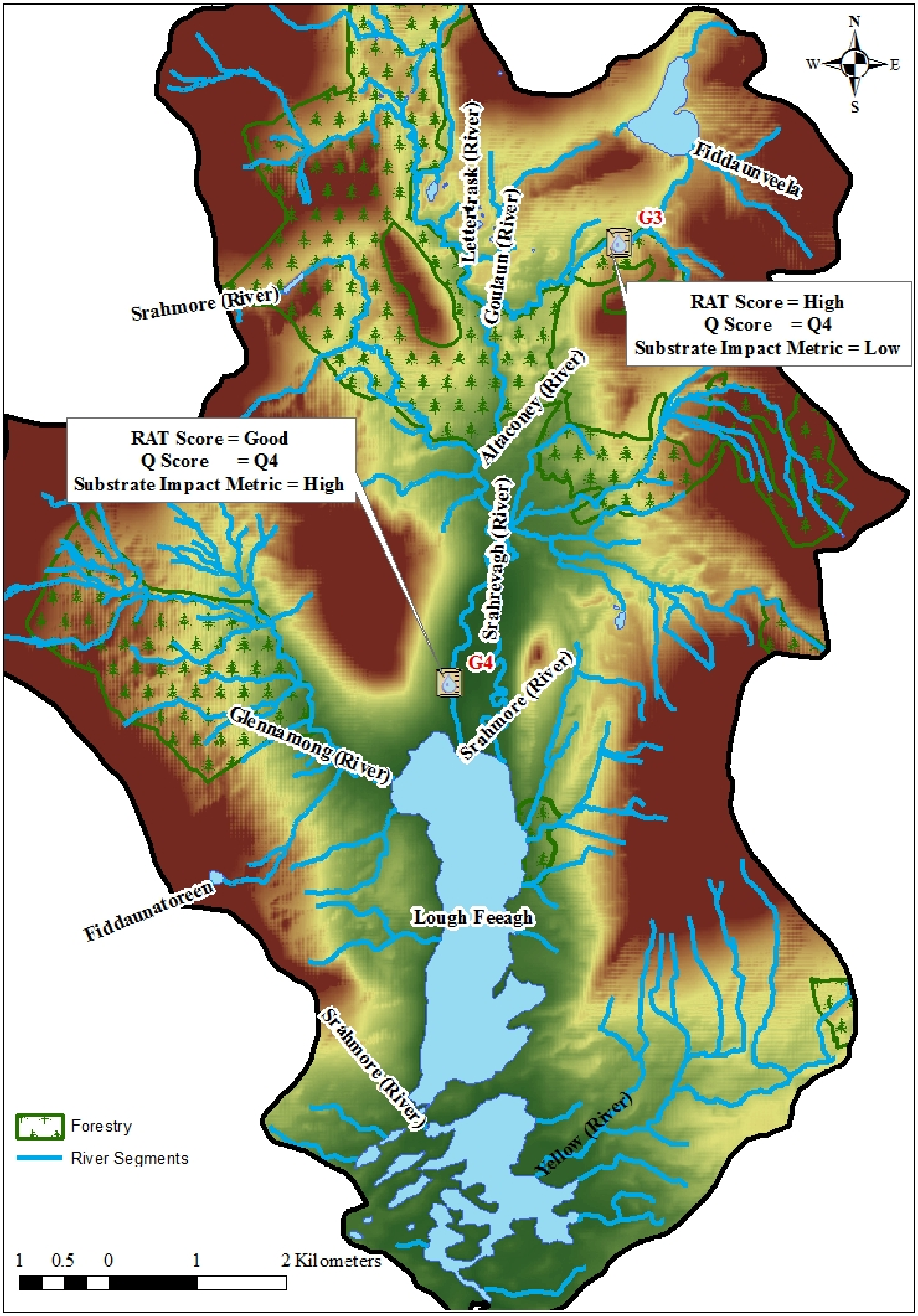


Figure 22: Srahmore Catchment, County Mayo

In addition to the surveys undertaken at each site, a field visit, facilitated by Steering Group member Dr Phil Mc Ginnity (Marine Institute) was undertaken by Project Staff in February 2008 to gain an insight to the overall catchment and to assess if the selected survey sites accurately reflected the morphological pressures.

The Srahmore Catchment is a well researched catchment in Ireland and is known for the current intensive forestry pressures and sheep overgrazing in the past. The deterioration in R.A.T score between the sites is a reflection of the loss of naturalness in the catchment as one moves downstream, although both scores are high or good. However both sites have Q Scores of 4. The Substrate Impact Metric (CBAS) increases from low to high between the sites indicating that the intensive land use between the upstream and downstream site is impacting the siltation regime of the river system.

However, the field visit highlighted that there are sites within the catchment that are more accurate reflectors of the morphological pressure and would have lower R.A.T scores if surveyed. Photographs of areas in the catchment where morphological impact from forestry is more prevalent are provided below.

**Excessive Siltation and Erosion in Upland Streams Downstream or Adjacent to Forested Areas (Srahmore Catchment)**

Whilst these sites are upland channels and would not be expected to have high levels of siltation, the energy of the system has been increased by deforestation increasing run-off, and as such, the natural siltation regime is disrupted.

It is recognised that local knowledge is a significant factor in selecting representative monitoring sites with respect to morphology. However, choosing sites in relation to intensive land use zones such as forestry and overgrazing within the overall catchment is important and can be undertaken when devising sampling strategies. This may be particularly relevant in the context of investigative monitoring which could involve more extensive and catchment based surveys (P. Mc Ginnity, *pers comm*. 2007).

## 4.3 Recommendations for Morphology Management

In summary, the list of recommendations with respect to management of morphology is as follows:

- The capacity thresholds used as trigger levels in the MImAS regulatory are applicable in a regulatory context in Ireland. However this depends if the MImAS system is adopted for regulation in Ireland.

- This is in keeping with the UK Environmental Standards published by the UK Technical Advisory Group in 2007 and ensures a consistent approach with Ireland's Eco Region Neighbours.

- The 50% channelisation threshold, as for risk assessment, is also applicable in the context of regulation.

- Checking channel type when selecting sampling sites is recommended so that sites most sensitive to specific morphology pressures are monitored.

- It is recognised that local knowledge is a significant factor in selecting representative monitoring sites with respect to morphology. However, choosing sites in relation to intensive land use zones such as forestry and overgrazing within the overall catchment is important and can be undertaken when devising sampling strategies. This may be particularly relevant in the context of investigative monitoring which could involve more extensive and catchment based surveys.

# 5.0 CONCLUSIONS AND RECOMMENDATIONS

The conclusions with respect to each Objective are outlined below.

### Objective 1 – Risk Assessment Refinement

### Biology and Morphology

- Morphological pressure can impact biology and therefore ecological status, albeit the impact is more significant when a combination of pressures is acting on a waterbody.

- In general, sites with R.A.T scores less than 0.6 also have less than good Q scores. Similarly high levels of siltation affecting macrophyte populations are reflected by less than good R.A.T scores.

- The substrate impact metric within the CBAS survey denoted by presence or absence of a particular macrophyte species provides an indication of morphological condition.

- Therefore it is recommended that the CBAS survey could be a useful supplementary field technique to R.A.T in morphology monitoring for WFD classification.

### Channelisation Risk Assessment

- It is recommended that the pressure threshold between ‘at risk’ and ‘not at risk ‘from 15% to 50%.

- Lowland meandering and pool riffle rivers are more sensitive to channelisation pressures. Whilst it could be argued that a higher threshold (less stringent) between good status and less than good status could be applied to upland rivers it is recommended that 50% is applied throughout since the majority of rivers subjected to drainage are lowland meandering and pool riffle. Furthermore, the GIS based tool for depicting channel typology at frequent intervals is not yet available. This should be revisited for the second RBMP cycle.

- Whether a channel is maintained or not should be accounted for in the risk assessment. A higher (less stringent) threshold should be applied to rivers that are not maintained. However, maintenance records are not readily available at present. Improvements on this dataset should be made and stored within a morphological alterations database with a view to refining the risk assessment further in the second RBMP cycle

- The lowest gradient rivers (<0.2%) generally score a WFD class (R.A.T score of 0.2) behind lowland rivers within the 0.2-0.5% slope category.

- Since R.A.T is the chosen surveillance monitoring method for EPA and EHS it is recommended that it is modified to account for this in the survey i.e. very low gradient rivers should be scored accordingly, by noting that the reference condition for these rivers is different to higher slope rivers.

- Research into the reference condition of low gradient rivers should be undertaken with a view to refining the R.A.T scoring system further.

*Note:*
*It should be noted that these recommendations were made to EHS and EPA who have advised that the issue of channel slope is being accounted for in the modified version of R.A.T that will be used for surveillance monitoring purposes in 2008.*

### Intensive Land Use Risk Assessment Recommendations

- The current ILU risk assessment methodology is too crude to provide any meaningful identification of waterbodies that may be at risk and as such, is not effective in serving this purpose.

- The comparison of percentage ILU within a waterbody with R.A.T scores on the ground revealed no meaningful relationship.

- The application of alternative methods for quantifying the extent of the ILU pressure did not improve this. A range of moderate to high R.A.T scores was found at waterbodies with 0 to 100% ILU along the river length.

- It is recommended that the ILU element of the morphology risk assessment is omitted.

- However, the fact remains that several river waterbodies will require improvement measures to address ILU pressures such as forestry, peat exploitation, urbanisation and agriculture. These must be identified for the RBMP's.

- These measures, and the waterbodies requiring them, are all identified in other national PoMS Studies and will be included in RBMPs as measures to address problems such as siltation, substrate damage, loss of riparian zones and cattle poaching.

- Measures to address areas of known impact, such as overgrazing should be included in the RBMP's by utilising expert judgement from the PoMS Study technical steering committee.

- Research into the development of a more detailed, but practical GIS based risk assessment method is recommended.

## Objective 2 – Classification

- A total of 82% of the sites surveyed have good or high morphological status.
- 38% of the sites have high morphological status.
- 44% of the sites have good morphological status.
- Of the 55 sites assigned “likely high” ecological status, 25 also had high morphology status. The remaining 30 sites had good, moderate, poor or bad morphology status, and will not therefore be classified as High Ecological Status overall.
- This raises concern about the likelihood of a low R.A.T score over a relatively short reach within a waterbody reducing the number of H.E.S rivers in Ireland.
- Sampling strategies for Surveillance Monitoring should be developed in the context of the overall waterbody. This may involve R.A.T surveying several sites within a waterbody to ensure a representative score.
- Research into methodologies on developing representative sampling strategies is recommended.
- EPA classified one site, the Caragh River in Co. Kerry as high morphological status, whereas the Shannon IRBD classified it as good. It was found that the difference in score was due to the fact that the river is a managed fishery. This has highlighted a discrepancy on how managed rivers are scored using the R.A.T methodology. It is recommended that EHS and EPA discuss this and develop a uniform approach when scoring sites for classification.

## Objective 3 – Morphology Management – Regulation and Sampling Strategies

- The capacity thresholds used as trigger levels in the MImAS regulatory approach can be used for regulation in Ireland. However this depends if the MImAS system is to be used for regulation. The Recommendations for Programmes of Measures Report also, which is also a deliverable of the Freshwater Morphology PoMS Study will address this.
- The 50% channelisation threshold, as for risk assessment, is also applicable in the context of regulation.
- Checking channel type when selecting sampling sites is recommended so that sites most sensitive to specific morphology pressures are monitored.
- It is recognised that local knowledge is a significant factor in selecting representative monitoring sites with respect to morphology. However, choosing sites in relation to intensive land use zones such as forestry and overgrazing within the overall catchment is important and can be undertaken when devising

sampling strategies. This may be particularly relevant in the context of investigative monitoring which could involve more extensive and catchment based surveys (P. Mc Ginnity, *pers comm*. 2007).

**The key recommendations are summarised as follows:**

1. The CBAS survey may be considered as a useful supplement to R.A.T surveys in morphology monitoring, particularly the Substrate Impact Metric.

2. The risk assessment threshold for channelisation should be increased from 15% to 50%.

3. The R.A.T survey should account for the fact that rivers with slope <0.2% have lower expectations in terms of the morphological attributes and their reference condition.

4. The Intensive Land Use risk assessment should be omitted until research into appropriate methodology is undertaken.

5. Measures to address Intensive Land Use zones should be identified by expert judgement and through other PoMS Studies, and included in the RBMP's.

6. Sampling strategies for morphology monitoring should be at a waterbody scale, perhaps involving several R.A.T surveys per waterbody to ensure representative results.

7. The capacity thresholds used in the MImAS regulatory system can be applied in Ireland, if it is decided that this approach should be adopted.

8. The pressure threshold of 50% channelisation is applicable in a regulatory context.

## 6.0 REFERENCES

- Freshwater Morphology PoMS Study, 2007; *Comparative Studies of Morphological Fieldwork Techniques Interim Outcome Report*

- Working Group on Characterisation and Risk Assessment, 2004; *Guidance on Thresholds and Methodology to be Applied in Ireland's River Basin Districts*

- Shannon IRBD, 2005; *Freshwater Morphology Programmes of Measures and Standards Study, Terms of Reference*

- National Parks and Wildlife Service, Heuff, 1987; *The Vegetation of Irish Rivers*

- Kelly-Quinn et al, 2005; *Water Framework Directive- Characterisation of Reference Conditions and Testing Typology of Rivers*

- EPA National Water Conference 2006, G.Kilroy 13/06/06 Session 2.

- Freshwater Morphology PoMS Study, WP2, 2008; *Channelisation Recovery Assessment*

- Dodkins et al, 2007; *NS SHARE, River Macrophytes Methods Manual*

- Shannon IRBD, 2006; *Freshwater Morphology Programmes of Measures and Standards Study, Literature Review 1*

- Freshwater Morphology PoMS Study, 2007; *Work Package 6 reports on Aerial Survey, GIS based Analysis, Tool Development, Channel Typology.*

# APPENDIX A – SITES SURVEYED

## A1 – PILOT WATERBODIES

## A2 – EPA SURVEILLANCE SITES (R.A.T ONLY)

## A3 – NI SITES

# APPENDIX B – FIELD SHEETS

# APPENDIX C1
# R.A.T RESULTS FOR EPA SURVEILLANCE SITES SURVEYED (OBJECTIVE 2)

| PoMS Study Code | EPA Code | River Name | Surveyed By | Hydromorph score | WFD Class |
|---|---|---|---|---|---|
| EPA1 | 01S020200 | Stranagoppoge River | Shannon IRBD | 0.75 | Good |
| EPA10 | 21A010200 | Adrigole River | Shannon IRBD | 0.6875 | Good |
| EPA11 | 21O090200 | Ownagappul | Shannon IRBD | 0.609375 | Good |
| EPA12 | 22C020600 | Caragh | Shannon IRBD | 0.515625 | Moderate |
| EPA13 | 22O030400 | Owenreagh | Shannon IRBD | 0.875 | High |
| EPA14 | 23O030300 | Owenmore | Shannon IRBD | 0.9 | High |
| EPA15 | 25B030080 | Bilboa River | Shannon IRBD | 0.578125 | Moderate |
| EPA16 | 25B100100 | Bow River | Shannon IRBD | 0.775 | Good |
| EPA17 | 25G040025 | Graney (Caher) | Shannon IRBD | 0.703125 | Good |
| EPA18 | 25G210010 | Glenfelly Stream | Shannon IRBD | 0.890625 | High |
| EPA19 | 25N020100 | Newport | Shannon IRBD | 0.640625 | Good |
| EPA2 | 10G010200 | Dargle River | Shannon IRBD | 0.75 | Good |
| EPA20 | 26F020400 | Feorish River | Shannon IRBD | 0.59375 | Moderate |
| EPA21 | 26S071100 | Suck | Shannon IRBD | 0.703125 | Good |
| EPA22 | 27B020300 | Glenomra River | Shannon IRBD | 0.171875 | Bad |
| EPA23 | 27S030200 | Un-Named | Shannon IRBD | 0.3125 | Poor |
| EPA24 | 28C010200 | Caher | Shannon IRBD | 0.875 | High |
| EPA25 | 30C011300 | River Clare | Shannon IRBD | 0.5 | Moderate |
| EPA26 | 31O010200 | Owenboliska | Shannon IRBD | 0.8 | Good |
| EPA27 | 31O020300 | Owengowia | Shannon IRBD | 0.85 | High |
| EPA28 | 32B010200 | Bundorragha River | Shannon IRBD | 0.75 | Good |
| EPA29 | 32B030100 | Bunowen River | Shannon IRBD | 0.765625 | Good |
| EPA3 | 12C030200 | River Clody | Shannon IRBD | 0.765625 | Good |
| EPA30 | 32T010100 | Traheen River | Shannon IRBD | 0.859375 | High |
| EPA31 | 33B010100 | Ballinglen River | Shannon IRBD | 0.875 | High |
| EPA32 | 33K010200 | Keerglen River | Shannon IRBD | 0.90625 | High |
| EPA33 | 34B080400 | Unknown | Shannon IRBD | 0.546875 | Moderate |
| EPA34 | 34C050030 | Clydagh River | Shannon IRBD | 0.825 | High |
| EPA35 | 34D010400 | Deel River | Shannon IRBD | 0.625 | Good |
| EPA36 | 34E010100 | Lough Tail River | Shannon IRBD | 0.975 | High |
| EPA37 | 34M020100 | River Moy | Shannon IRBD | 0.625 | Good |
| EPA38 | 35B050100 | Ballysadare | Shannon IRBD | 0.4375 | Moderate |
| EPA39 | 35G010200 | Garvoge River | Shannon IRBD | 0.28125 | Poor |
| EPA4 | 12L020100 | Little Slaney River | Shannon IRBD | 0.95 | High |
| EPA40 | 36S010100 | An Chlaideach | Shannon IRBD | 0.85 | High |
| EPA41 | 38C060100 | Cronaniv Burn | Shannon IRBD | 0.75 | Good |
| EPA42 | 38G020100 | River Barra | Shannon IRBD | 0.9 | High |
| EPA5 | 12L020400 | Little Slaney River | Shannon IRBD | 0.6875 | Good |
| EPA6 | 16D030100 | Duag | Shannon IRBD | 0.4375 | Moderate |
| EPA7 | 18F050030 | Funshion River | Shannon IRBD | 0.53125 | Moderate |
| EPA8 | 18L010100 | Licky River | Shannon IRBD | 0.625 | Good |
| EPA9 | 19S020400 | Sulan | Shannon IRBD | 0.859375 | High |
| n/a | 13001018D | Owenduff River | EPA | 0.96875 | High |
| n/a | 15B020350 | Bregagh | EPA | 0.3125 | Poor |
| n/a | 15M010080 | Nore Main | EPA | 0.78125 | Good |
| n/a | 15O010050 | Owveg River | EPA | 0.625 | Good |

| | | | | | |
|---|---|---|---|---|---|
| n/a | 17M010350 | Mahon | EPA | 0.90625 | High |
| n/a | 22F020100 | Flesk | EPA | 1 | High |
| n/a | 22F040100 | Un-named | EPA | 1 | High |
| n/a | 22L040400 | Loo | EPA | 0.78125 | Good |
| n/a | 22F020060 | Flesk | EPA | 1 | High |
| n/a | 22F020060 | Flesk | EPA | 1 | High |
| n/a | 22F020040 | Flesk | EPA | 0.96875 | High |
| n/a | 22F020010 | Flesk | EPA | 0.875 | High |
| n/a | 22F020300 | Flesk | EPA | 0.8125 | High |
| n/a | 22F020250 | Flesk | EPA | 1 | High |
| n/a | 22T180500 | Teeromoyle Stream | EPA | 1 | High |
| n/a | 22C020600 | Caragh | EPA | 1 | High |
| n/a | 22M020100 | Meelagh | EPA | 0.96875 | High |
| n/a | 23O030300 | Owenmore | EPA | 1 | High |
| n/a | 36A060400 | Aghnacliffe Stream | EPA | 0.6875 | Good |
| n/a | 36C020085 | Cavan N | EPA | 0.71875 | Good |
| n/a | 36C040400 | Cornavannoge | EPA | 0.8125 | High |
| n/a | 36C040600 | Cornavannoge | EPA | 0.75 | Good |
| n/a | 36E010100 | Erne | EPA | 0.390625 | Poor |
| n/a | 36B011400 | Erne (d/s Belturbert) | EPA | 0.515625 | Moderate |
| n/a | 36F010200 | Finn - Monaghan | EPA | 0.6875 | Good |
| n/a | 36L020300 | Laheen Stream | EPA | 0.734375 | Good |
| n/a | 36L010030 | Laragh | EPA | 0.734375 | Good |
| n/a | 36R020200 | Roo | EPA | 0.8125 | High |
| n/a | 36S020200 | Stradone | EPA | 0.78125 | Good |
| n/a | 12A020200 | Assaly N | EPA | 0.59375 | Moderate |
| n/a | 12B0101300 | Bann N | EPA | 0.65625 | Good |
| n/a | 12B010500 | Bann N | EPA | 0.671875 | Good |
| n/a | 12B010800 | Bann N | EPA | 0.5625 | Moderate |
| n/a | 12B0200100 | Boro N | EPA | 0.9 | High |
| n/a | 12B020012 | Boro N | EPA | 0.78125 | Good |
| n/a | 12C030100 | Clady N | EPA | 0.75 | Good |
| n/a | 12C030200 | Clady N | EPA | 0.75 | Good |
| n/a | 12D030200 | Douglas Ballon | EPA | 0.625 | Good |
| n/a | 12D020700 | Derry | EPA | 0.65625 | Good |
| n/a | 12S020400 | Slaney | EPA | 0.71875 | Good |
| n/a | 12S021800 | Slaney | EPA | 0.609375 | Good |
| n/a | 12S030200 | Sow N (Kilmallock Br.) | EPA | 0.6875 | Good |
| n/a | 12S030300 | Sow N (Coolmain Br. u/s) | EPA | 0.671875 | Good |
| n/a | 12U010200 | Urrin (Bucks Br.) | EPA | 0.90625 | High |

# APPENDIX C2
# BREAKDOWN OF R.A.T RESULTS FOR “LIKELY HIGH” EPA SURVEILLANCE SITES (OBJECTIVE 2)

Appendix A1

Sites Surveyed using R.A.T and MImAS (per Category) - Ireland only

| Site Category and Number | River Name | Grid letter | X | Y | Type | Date | Time | Rain | Surveyor | Width |
|---|---|---|---|---|---|---|---|---|---|---|
| A1 | Crana River | C | 37578 | 35519 | Pool-Riffle | 24/10/07 | 16:00:00 | ? | DDH | 8 |
| A5 | Lyracrumpane | Q | 98119 | 23174 | Pool-Riffle | 15/10/07 | 14:20:00 | Y | DDH | 5 |
| A6 | Cummeragh | V | 59908 | 72682 | Step-pool / Cascade | 12/10/07 | 17:15:00 | ? | DDH | 7 |
| A7 | Cummeragh | V | 58008 | 71375 | Lowland Meandering | 12/10/07 | 15:00:00 | ? | DDH | 7 |
| A8 | Cummeragh | V | 54509 | 68526 | Step-pool / Cascade | 12/10/07 | 12:20:00 | ? | DDH | 10 |
| B1 | Unknown | Q | 97376 | 19658 | Bedrock | 15/10/07 | 12:30:00 | Y | DDH | 8 |
| B10 | Croanshagh River | V | 77059 | 56791 | Lowland Meandering | 12/10/07 | 10:55:00 | ? | CR | 18 |
| B11 | Toon | W | 19279 | 71015 | Pool-Riffle | 11/10/07 | 17:27:00 | ? | DDH | 6 |
| B13 | Toon | W | 26070 | 69241 | Pool-Riffle | 11/10/07 | 15:00:00 | ? | DDH | 10 |
| B14 | Owenashrone | W | 09476 | 66379 | Step-pool / Cascade | 13/10/07 | 13:40:00 | ? | DDH | 5 |
| B15 | Owveg River | R | 07069 | 20393 | Pool-Riffle | 15/10/07 | 14:25:00 | Y | CR | 11 |
| B2 | Owveg River | R | 07342 | 17776 | Bedrock | 15/10/07 | 16:20:00 | Y | CR | 5 |
| B3 | Ferta | V | 56266 | 82183 | Step-pool / Cascade | 14/10/07 | 14:40:00 | ? | DDH | 7 |
| B5 | Owroe | V | 61198 | 77401 | Step-pool / Cascade | 14/10/07 | 16:50:00 | ? | DDH | 8 |
| B8 | Yellow River | H | 07440 | 16839 | Bedrock | 23/10/07 | 11:27:00 | ? | DDH | 7 |
| B9 | Yellow River | H | 08136 | 13040 | Bedrock | 22/10/07 | 17:20:00 | Y | DDH | 10 |
| C10 | Claureen River | M | 13201 | 80264 | Lowland Meandering | 19/10/07 | 16:45:00 | Y | CR | 10 |
| C11 | Unknown | M | 48709 | 74136 | Pool-Riffle | 19/10/07 | 10:45:00 | Y | CR | 5 |
| C12 | Cloon River | M | 13529 | 72658 | Lowland Meandering | 19/10/07 | 14:30:00 | Y | CR | 30 |
| C13 | Unknown | M | 14733 | 40792 | Bedrock | 18/10/07 | 13:09:00 | ? | DDH | 5 |
| C5 | River Moy | G | 26095 | 01028 | Lowland Meandering | 19/10/07 | 15:02:00 | ? | DDH | 30 |
| C6 | River Moy | M | 27486 | 99282 | Lowland Meandering | 19/10/07 | 16:19:00 | ? | DDH | 40 |
| C9 | Un-Named | M | 10085 | 89371 | Pool-Riffle | 19/10/07 | 10:45:00 | ? | DDH | 5 |
| E1 | Duniry River | M | 72200 | 08944 | Pool-Riffle | 17/10/07 | 17:00:00 | Y | CR | 12 |
| E3 | River Liffey | O | 02790 | 16292 | Lowland Meandering | 26/10/07 | 11:00:00 | ? | CR | 17 |
| E6 | Cappagh River | M | 77213 | 05617 | Lowland Meandering | 17/10/07 | 15:15:00 | Y | CR | 14 |
| E7 | River Liffey | O | 05668 | 14810 | Lowland Meandering | 26/10/07 | 13:00:00 | Y | CR | 15 |
| F2 | Kealduff River | V | 77443 | 73452 | Pool-Riffle | 14/10/07 | 11:40:00 | Y | CR | 8 |
| F3 | Blackwater | V | 79371 | 69487 | Step-pool / Cascade | 14/10/07 | 14:15:00 | Y | CR | 25 |
| H1 | River Fergus | R | 34894 | 76833 | Lowland Meandering | 16/10/07 | 14:40:00 | Y | DDH | 40 |
| H10 | River Liffey | N | 84145 | 19444 | Lowland Meandering | 25/10/07 | 13:45:00 | ? | DDH | 20 |
| H11 | River Liffey | N | 86939 | 21618 | Lowland Meandering | 25/10/07 | 15:50:00 | ? | DDH | 30 |
| H14 | River Liffey | N | 87971 | 27042 | Lowland Meandering | 26/10/07 | 17:30:00 | Y | DDH | 15 |
| H15 | River Liffey | N | 92393 | 29177 | Lowland Meandering | 26/10/07 | 16:00:00 | Y | DDH | 40 |
| H16 | River Liffey | N | 97372 | 32949 | Lowland Meandering | 24/10/07 | 17:00:00 | Y | CR | 17 |
| H17 | River Liffey | O | 00735 | 35853 | Pool-Riffle | 24/10/07 | 14:45:00 | Y | CR | 15 |
| H18 | River Liffey | O | 03514 | 35502 | Lowland Meandering | 24/10/07 | 11:00:00 | Y | CR | 25 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| H19 | River Liffey | O | 09077 | 34978 | Pool-Riffle | 23/10/07 | 12:55:00 | Y | CR | 30 |
| H2 | River Fergus | R | 35202 | 74228 | Lowland Meandering | 16/10/07 | 15:50:00 | Y | DDH | 40 |
| H20 | Santry River | O | 18776 | 40032 | Lowland Meandering | 22/10/07 | 10:45:00 | Y | CR | 6 |
| H21 | Vartry River | T | 22120 | 99241 | Pool-Riffle | 25/10/07 | 16:15:00 | Y | CR | 7 |
| H22 | Unknown | S | 50447 | 56263 | Pool-Riffle | 10/10/07 | 12:00:00 | ? | DDH | 7 |
| H23 | River Feale | Q | 95144 | 32084 | Pool-Riffle | 15/10/07 | 10:40:00 | Y | CR | 50 |
| H24 | Cashen | Q | 89037 | 36508 | Lowland Meandering | 15/10/07 | 16:35:00 | Y | DDH | 80 |
| H3 | River Dodder | O | 08840 | 24050 | Lowland Meandering | 26/10/07 | 15:45:00 | Y | CR | 13 |
| H4 | River Dodder | O | 09750 | 26310 | Pool-Riffle | 26/10/07 | 16:45:00 | Y | CR | 12 |
| H5 | River Dodder | O | 13592 | 28893 | Pool-Riffle | 27/10/07 | 10:25:00 | Y | CR | 6 |
| H6 | River Liffey | N | 92088 | 10376 | Lowland Meandering | 26/10/07 | 11:07:00 | ? | DDH | 20 |
| H7 | River Liffey | N | 84184 | 09711 | Lowland Meandering | 26/10/07 | 12:50:00 | ? | DDH | 20 |
| H8 | River Liffey | N | 81368 | 13650 | Lowland Meandering | 25/10/07 | 11:03:00 | ? | DDH | 25 |
| H9 | River Liffey | N | 81750 | 17862 | Lowland Meandering | 25/10/07 | 12:19:00 | ? | DDH | 15 |
| J1 | Cromoge River | S | 05082 | 62536 | Lowland Meandering | 16/10/07 | 14:00:00 | Y | CR | 10 |
| J2 | River Sheep | R | 91142 | 17813 | Pool-Riffle | 10/10/07 | 15:20:00 | ? | CR | 6 |
| J3 | Unknown | N | 79578 | 89142 | Lowland Meandering | 22/10/07 | 14:35:00 | Y | CR | 6 |
| J4 | Killary Water? | N | 88485 | 85555 | Pool-Riffle | 22/10/07 | 16:50:00 | Y | CR | 6 |
| J5 | Loughlinstown River | O | 25323 | 22959 | Pool-Riffle | 27/10/07 | 11:53:00 | ? | DDH | 6 |

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Appendix A2

EPA Surveillance Sites Surveyed using R.A.T only (per Category) - Ireland only

| Site Category and Number | River Name | Grid letter | X | Y | Type | Date | Time | Rain | Surveyor | Width | Reach Length |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EPA1 | Stranagoppoge River | B | 95899 | 02067 | Bedrock | 23/10/07 | 17:20:00 | ? | DDH | 6 | 500 |
| EPA10 | Adrigole River | V | 81179 | 50731 | Pool-Riffle | 12/10/07 | 16:30:00 | Y | CR | 7 | 500 |
| EPA11 | Ownagappul | V | 69010 | 55079 | Braided / Wandering | 12/10/07 | 14:00:00 | ? | CR | 5 | 500 |
| EPA12 | Caragh | V | 70963 | 86385 | Lowland Meandering | 14/10/07 | 11:05:00 | ? | DDH | 20 | 500 |
| EPA13 | Owenreagh(Gearhame | V | 88402 | 82121 | Braided / Wandering | 11/10/07 | 17:40:00 | ? | CR | 20 | 500 |
| EPA14 | Owenmore | Q | 51312 | 10661 | Step-pool / Cascade | 13/10/07 | 11:55:00 | Y | CR | 8 | 500 |
| EPA15 | Bilboa River | R | 81587 | 51895 | Pool-Riffle | 16/10/07 | 16:45:00 | Y | CR | 17 | 500 |
| EPA16 | Bow River | R | 66590 | 87082 | Step-pool / Cascade | 17/10/07 | 10:00:00 | Y | CR | 8 | 500 |
| EPA17 | Graney (Caher on map) | R | 55463 | 90065 | Pool-Riffle | 17/10/07 | 12:25:00 | Y | CR | 8 | 500 |
| EPA18 | Glenfelly Stream | N | 20268 | 01368 | Pool-Riffle | 16/10/07 | 11:15:00 | Y | CR | 3 | 500 |
| EPA19 | Newport | R | 77362 | 66820 | Pool-Riffle | 16/10/07 | 18:15:00 | Y | CR | 10 | 500 |
| EPA2 | Dargle River | O | 20349 | 14851 | Pool-Riffle | 27/10/07 | 12:50:00 | ? | DDH | 8 | 500 |
| EPA20 | Feorish River | G | 89925 | 10706 | Lowland Meandering | 22/10/07 | 14:39:00 | Y | DDH | 10 | 500 |
| EPA21 | Suck | M | 81655 | 46347 | Lowland Meandering | 17/10/07 | 15:34:00 | ? | DDH | 30 | 500 |
| EPA22 | Glenomra River | R | 61053 | 72074 | Lowland Meandering | 16/10/07 | 10:16:00 | Y | DDH | 7 | 500 |
| EPA23 | Un-Named | R | 38574 | 80850 | Pool-Riffle | 16/10/07 | 12:00:00 | Y | DDH | 1.5 | 500 |
| EPA24 | Caher | M | 16320 | 08259 | Pool-Riffle | 17/10/07 | 12:07:00 | ? | DDH | 5 | 500 |
| EPA25 | River Clare | M | 32229 | 32839 | Lowland Meandering | 18/10/07 | 10:17:00 | ? | DDH | 25 | 500 |
| EPA26 | Owenboliska | M | 12741 | 22500 | Step-pool / Cascade | 18/10/07 | 14:45:00 | ? | DDH | 15 | 450 |
| EPA27 | Owengowia | L | 81825 | 39774 | Bedrock | 18/10/07 | 17:11:00 | ? | DDH | 10 | 500 |
| EPA28 | Bundorragha River | L | 84196 | 63422 | Step-pool / Cascade | 18/10/07 | 14:45:00 | Y | CR | 15 | 500 |
| EPA29 | Bunowen River | L | 81967 | 77952 | Pool-Riffle | 18/10/07 | 16:45:00 | Y | CR | 10 | 500 |
| EPA3 | River Clody | S | 89676 | 58462 | Pool-Riffle | 10/10/07 | 15:35:00 | ? | DDH | 6 | 500 |
| EPA30 | Traheen River | L | 68858 | 56669 | Pool-Riffle | 18/10/07 | 12:10:00 | Y | CR | 5 | 500 |
| EPA31 | Ballinglen River | G | 10247 | 34213 | Pool-Riffle | 20/10/07 | 11:10:00 | Y | CR | 10 | 500 |
| EPA32 | Keerglen River | G | 09201 | 33220 | Pool-Riffle | 20/10/07 | 13:15:00 | Y | CR | 6 | 500 |
| EPA33 | Unknown | G | 28726 | 18148 | Pool-Riffle | 20/10/07 | 11:00:00 | ? | DDH | 5.5 | 500 |
| EPA34 | Clydagh River | M | 14279 | 96543 | Step-pool / Cascade | 19/10/07 | 12:07:00 | ? | DDH | 6 | 500 |
| EPA35 | Deel River | G | 17866 | 18904 | Lowland Meandering | 20/10/07 | 15:50:00 | Y | CR | 25 | 500 |
| EPA36 | Lough Tail River | G | 41472 | 13686 | Step-pool / Cascade | 20/10/07 | 12:10:00 | ? | DDH | 5 | 500 |
| EPA37 | River Moy | G | 49348 | 16811 | Pool-Riffle | 20/10/07 | 13:52:00 | ? | DDH | 10 | 500 |
| EPA38 | Ballysadare | G | 66809 | 29060 | Lowland Meandering | 22/10/07 | 11:14:00 | Y | DDH | 25 | 500 |
| EPA39 | Garvoge River | G | 69321 | 35956 | Lowland Meandering | 22/10/07 | 12:40:00 | Y | DDH | 25 | 500 |
| EPA4 | Little Slaney River | S | 98441 | 91762 | Step-pool / Cascade | 25/10/07 | 13:15:00 | Y | CR | 4 | 500 |
| EPA40 | An Chlaideach | H | 14892 | 24844 | Step-pool / Cascade | 23/10/07 | 12:46:00 | ? | DDH | 6 | 500 |
| EPA41 | Cronaniv Burn | B | 92880 | 18976 | Pool-Riffle | 24/10/07 | 12:12:00 | ? | DDH | 8 | 500 |
| EPA42 | River Barra | B | 94834 | 13949 | Bedrock | 24/10/07 | 10:17:00 | ? | DDH | 4 | 500 |
| EPA5 | Little Slaney River | S | 94943 | 92353 | Pool-Riffle | 25/10/07 | 11:30:00 | Y | CR | 5 | 500 |
| EPA6 | Duag | R | 91919 | 12651 | Pool-Riffle | 10/10/07 | 17:20:00 | ? | CR | 4.5 | 500 |
| EPA7 | Funshion River | R | 88971 | 16808 | Pool-Riffle | 10/10/07 | 12:05:00 | ? | CR | 6 | 500 |
| EPA8 | Licky River | X | 20294 | 85516 | Pool-Riffle | 11/10/07 | 10:10:00 | ? | CR | 6 | 500 |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| EPA9 | Sulan | W | 31165 | 72790 | Pool-Riffle | 11/10/07 | 11:25:00 | ? | DDH | 15 | 500 |

Appendix A3
Sites Surveyed by EHS in Northern Ireland (R.A.T Only) - Used in Study Analysis (Data Provided by EHS)

| Site | Date | Site name | River | IGR | Reach length | Surveyors | Channel Type |
|---|---|---|---|---|---|---|---|
| AGV10 | 14/08/2006 | Upstream from Croan bridge (lwr reach) | Clanrye River | J1452131253 | 250 | DQ/PM | Lowland meandering |
| ALT10 | 14/08/2006 | Jerrettspass bridge (lwr reach) | Newry River | J0657133002 | 250 | DQ/PM | Lowland meandering |
| BAA10 | 14/08/2006 | Above Glen Bridge (lwr reach) | Newry River | J0848535784 | 250 | DQ/PM | Lowland meandering |
| BON10 | 15/08/2006 | Careymill Bridge (lwr reach) | Carey River | D1340940580 | 250 | PM/DQ | pool-riffle |
| BTH10 | 15/08/2006 | B15 Road Bridge | Glenshesk River | D1258640553 | 200 | DQ/PM | pool-riffle |
| CAL10 | 15/08/2006 | Old Gas Works (upp reach) | Tow River | D1078339868 | 250 | DQ/PM | Lowland meandering |
| COL14 | 17/08/2006 | Above Glasdrumman Bridge | Spences River | J3666323342 | 500 | DQ/PM | bedrock |
| CYE12 | 22/08/2006 | Middletown Sewage works | Monaghan Blackwater | H7477038902 | 500 | PM/MT/TR | Lowland meandering |
| DEG10 | 24/08/2006 | Ballynahone Bridge | Butterwater | H8626643230 | 500 | PM/MT/TR | pool-riffle |
| GFF10 | 24/08/2006 | Artsooly Road | Ballymortrim River (Blackwater) | H8421751755 | 500 | PM/MT/TR | Lowland meandering |
| GLK10 | 05/09/2006 | Annacloy | Annacloy River | J4481148052 | 500 | DQ/PM | pool-riffle |
| GSK12(a) | 05/09/2006 | Martin's, The Green | Kilbroney River | J1892519187 | 500 | DQ/PM | pool-riffle |
| GVR10 | 06/09/2006 | Dunmore Bridge | Main River | J0871089521 | 500 | DQ/PM | lowland meandering |
| LIS10 | 12/09/2006 | Glen Ullin | Agivey River | C7927112532 | 500 | DQ/PM | pool-riffle |
| ROO10 | 28/09/2006 | Walk Mill | River Bush | C9389440288 | 500 | PM/CB/JG | Bedrock |
| TWW12 | 24/11/2006 | Forkhill | Kilcurry River | J0147515950 | 500 | PM/DQ | pool-riffle |
| TYN10 | 06/12/2006 | Glenmacoffer | Altanakan burn at glenmacoffer | H5259584227 | 500 | DQ/OR | Bedrock |
| ARN02 | 20/06/2007 | TALL RIVER AT REDMONDS BRIDGE |  | H9348555177 |  | MT/LP | POOL-RIFFLE |
| BAA11 | 24/07/2007 | BALLYEMON RIVER AT CLOGHS UPPER |  | D2238227542 |  | MT/LP | STEP-POOL |
| BAC02 | 26/06/2007 | KILLYGLEN BURN AT BALLYCRAIGY BR |  | D3834904588 |  | LP/CB | POOL-RIFFLE |
| BEM02 | 19/07/2007 | CAREY RIVER AT TORTEIGE |  | D1737039734 |  | MT/LP | POOL-RIFFLE |
| BLK05 | 19/06/2007 | BLACKWATER (ARDS) BALLYMARTIN RD |  | J5044532416 |  | MT/LP | POOL-RIFFLE |
| BLM02 | 26/06/2007 | LARNE RIVER AT OWENS BRDIGE |  | D3796101096 |  | LP/CB | POOL-RIFFLE |
| BLM04 | 29/08/2007 | ROOGAGH AT GARRISON |  | G9431652137 |  | MT/LP | BEDROCK |
| CAR02 | 24/08/2007 | ERNE AT ROSSCOR VIADUCT |  | G9865558552 |  | MT/LP | MEANDERING |
| CGH02 | 24/08/2007 | WATERFOOT R AT LETTER BR |  | H0849865203 |  | MT/LP | POOL-RIFFLE |
| CLE02 | 23/08/2007 | BANNAGH RIVER AT BANNAGH BR |  | H1618665370 |  | MT/LP | MEANDERING |
| CLK02 | 12/09/2007 | BALLINAMALLARD AT BALLYCASSIDY BR |  | H2279550791 |  | LP/OR | POOL-RIFFLE |
| CLK04 | 12/09/2007 | BALLYCASSIDY AT TULLYCLEA BR |  | H2360052987 |  | LP/OR | MEANDERING |
| ECW02 | 10/09/2007 | FINN AT WATTLE BR |  | H2531931357 |  | LP/OR | MEANDERING |
| ESS02 | 06/09/2007 | CLADAGH RIVER AT GORTEEN |  | H1322136707 |  | LP/DL | MEANDERING |
| FOX02 | 29/08/2007 | SILLEES RIVER AT CARR BRIDGE |  | H1312546849 |  | MT/LP/CB | MEANDERING |
| GLM02 | 27/09/2007 | FURY F AT KNOCKROE |  | H5614649403 |  | LP/OR | POOL-RIFFLE |
| KSH02 | 25/07/2007 | OWENNAGLUSH R |  | D1652328279 |  | MT/LP | STEP-POOL |
| KSY02 | 26/07/2007 | CLYTTAGHAN BURN AT DRUMADION |  | D1923431475 |  | MT/LP | STEP-POOL |
| LIS02 | 24/07/2007 | CARNLOUGH RIVER AT DRUMAHOE |  | D2788918210 |  | MT/LP | STEP-POOL |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| MYB02 | 09/08/2007 | OWENCLOGHY R DS OF BRIDGE | | D2878308921 | | MT/LP | POOL-RIFFLE |
| OWY02B | 19/09/2007 | FOXHILL BURN | | H2787252898 | | LP/CB | POOL-RIFFLE |
| ROO11 | 12/09/2007 | BALLINAMALLARD AT MAGHERACROSS | | H2810053768 | | LP/OR | POOL-RIFFLE |
| SIL02 | 20/09/2007 | TRILLICK TRIB | | H3081956545 | | LP/CB | POOL-RIFFLE |
| SIL04 | 27/09/2007 | COONEEN R AT LEGATILLIDA | | H4547239550 | | MT/DL | POOL-RIFFLE |
| SWA02 | 20/09/2007 | AGHAVEA R AT BOYHILL | | H3541639025 | | LP/CB | POOL-RIFFLE |
| TAL02 | 24/09/2007 | LISNABANE BURN | | H3789644719 | | MT/OR | MEANDERING |

**R.A.T SCORING FOR EPA LIKELY HIGH STATUS SITES**

| Site Number | PoMS Stu | EPA Code | River Name | Likely St | WFD Morph Class (R.A.T) | Surveyor | Grid letter | X | Y | Type | Date | Time | Rain | Width | Reach Len | Chan form | Chan veg | Sub cond | Chan flow | Bank Struc | Bank veg | Rip Landus | Flood con | Sum | Total | Hydromorph score | WFD Class (R.A.T) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EPA1 | EPA1 | 01S020200 | Stranagoppoge River | HIGH | Good | Shannon IRBD | B | 95899 | 02067 | Bedrock | 23/10/07 | 17:20:00 | ? | 6 | 500 | 3 | 4 | 2 | 3 | n/a | n/a | 3 | n/a | 15 | 20 | 0.75 | Good | |
| EPA10 | EPA10 | 21A010200 | Adrigole River | HIGH | Good | Shannon IRBD | V | 81179 | 50731 | Pool-Riffle | 12/10/07 | 16:30:00 | Y | 7 | 500 | 3 | 3 | 3 | 3 | 2.5 | 3 | 2 | 2.5 | 22 | 32 | 0.6875 | Good | |
| EPA11 | EPA11 | 21O090200 | Ownagappul | HIGH | Good | Shannon IRBD | V | 69010 | 55079 | Braided / War | 12/10/07 | 14:00:00 | ? | 5 | 500 | 3 | 3 | 3 | 3 | 2 | 1.5 | 1.5 | 2.5 | 19.5 | 32 | 0.609375 | Good | |
| EPA12 | EPA12 | 22C020600 | Caragh | HIGH | Moderate | Shannon IRBD | V | 70963 | 86385 | Lowland Mear | 14/10/07 | 11:05:00 | ? | 20 | 500 | 1 | 3 | 3 | 3 | 1 | 1 | 2 | 2.5 | 16.5 | 32 | 0.515625 | Moderate | |
| EPA13 | EPA13 | 22O030400 | Owenreagh(Gearhameen o | HIGH | High | Shannon IRBD | V | 88402 | 82121 | Braided / War | 11/10/07 | 17:40:00 | ? | 20 | 500 | 4 | 3 | 4 | 3 | 3.5 | 3 | 4 | 3.5 | 28 | 32 | 0.875 | High | |
| EPA14 | EPA14 | 23O030300 | Owenmore | HIGH | High | Shannon IRBD | Q | 51312 | 10661 | Step-pool / Ca | 13/10/07 | 11:55:00 | Y | 8 | 500 | 3 | 3 | 4 | 4 | n/a | n/a | 4 | n/a | 18 | 20 | 0.9 | High | |
| EPA15 | EPA15 | 25B030080 | Bilboa River | HIGH | Moderate | Shannon IRBD | R | 81587 | 51895 | Pool-Riffle | 16/10/07 | 16:45:00 | Y | 17 | 500 | 2 | 4 | 3 | 3 | 1.5 | 1 | 2 | 2 | 18.5 | 32 | 0.578125 | Moderate | |
| EPA16 | EPA16 | 25B100100 | Bow River | HIGH | Good | Shannon IRBD | R | 66590 | 87082 | Step-pool / Ca | 17/10/07 | 10:00:00 | Y | 8 | 500 | 3 | 4 | 4 | 2 | n/a | n/a | 2.5 | n/a | 15.5 | 20 | 0.775 | Good | |
| EPA17 | EPA17 | 25G040025 | Graney (Caher on map) | HIGH | Good | Shannon IRBD | R | 55463 | 90065 | Pool-Riffle | 17/10/07 | 12:25:00 | Y | 8 | 500 | 3 | 4 | 3 | 3 | 2.5 | 3 | 1.5 | 2.5 | 22.5 | 32 | 0.703125 | Good | |
| EPA18 | EPA18 | 25G210010 | Glenfelly Stream | HIGH | High | Shannon IRBD | N | 20268 | 01368 | Pool-Riffle | 16/10/07 | 11:15:00 | Y | 3 | 500 | 4 | 3 | 4 | 3 | 4 | 3.5 | 3 | 4 | 28.5 | 32 | 0.890625 | High | |
| EPA19 | EPA19 | 25N020100 | Newport | HIGH | Good | Shannon IRBD | R | 77362 | 66820 | Pool-Riffle | 16/10/07 | 18:15:00 | Y | 10 | 500 | 3 | 3 | 2 | 3 | 3 | 1.5 | 2 | 3 | 20.5 | 32 | 0.640625 | Good | |
| EPA2 | EPA2 | 10G010200 | Dargle River | HIGH | Good | Shannon IRBD | O | 20349 | 14851 | Pool-Riffle | 27/10/07 | 12:50:00 | ? | 8 | 500 | 4 | 2 | 4 | 3 | 4 | 2 | 2 | 3 | 24 | 32 | 0.75 | Good | |
| EPA20 | EPA20 | 26F020400 | Feorish River | HIGH | Moderate | Shannon IRBD | G | 89925 | 10706 | Lowland Mear | 22/10/07 | 14:39:00 | Y | 10 | 500 | 2 | 1 | 3 | 4 | 2 | 2 | 2 | 3 | 19 | 32 | 0.59375 | Moderate | |
| EPA21 | EPA21 | 26S071100 | Suck | HIGH | Good | Shannon IRBD | M | 81655 | 46347 | Lowland Mear | 17/10/07 | 15:34:00 | ? | 30 | 500 | 3 | 4 | 4 | 4 | 2 | 1.5 | 1 | 3 | 22.5 | 32 | 0.703125 | Good | |
| EPA22 | EPA22 | 27B020300 | Glenomra River | HIGH | Bad | Shannon IRBD | R | 61053 | 72074 | Lowland Mear | 16/10/07 | 10:16:00 | Y | 7 | 500 | 0 | 0 | 0 | 3 | 0 | 1 | 1.5 | 0 | 5.5 | 32 | 0.171875 | Bad | |
| EPA23 | EPA23 | 27S030200 | Un-Named | HIGH | Poor | Shannon IRBD | R | 38574 | 80850 | Pool-Riffle | 16/10/07 | 12:00:00 | Y | 1.5 | 500 | 1 | 1 | 0 | 3 | 1 | 1 | 1 | 2 | 10 | 32 | 0.3125 | Poor | |
| EPA24 | EPA24 | 28C010200 | Caher | HIGH | High | Shannon IRBD | M | 16320 | 08259 | Pool-Riffle | 17/10/07 | 12:07:00 | ? | 5 | 500 | 3 | 4 | 3 | 4 | 3 | 3.5 | 3.5 | 4 | 28 | 32 | 0.875 | High | |
| EPA25 | EPA25 | 30C011300 | River Clare | HIGH | Moderate | Shannon IRBD | M | 32229 | 32839 | Lowland Mear | 18/10/07 | 10:17:00 | ? | 25 | 500 | 2 | 4 | 3 | 4 | 1 | 0 | 1 | 1 | 16 | 32 | 0.5 | Moderate | |
| EPA26 | EPA26 | 31O010200 | Owenboliska | HIGH | Good | Shannon IRBD | M | 12741 | 22500 | Step-pool / Ca | 18/10/07 | 14:45:00 | ? | 15 | 450 | 2 | 4 | 3 | 4 | n/a | n/a | 3 | n/a | 16 | 20 | 0.8 | Good | |
| EPA27 | EPA27 | 31O020300 | Owengowia | HIGH | High | Shannon IRBD | L | 81825 | 39774 | Bedrock | 18/10/07 | 17:11:00 | ? | 10 | 500 | 3 | 2 | 4 | 4 | n/a | n/a | 4 | n/a | 17 | 20 | 0.85 | High | |
| EPA28 | EPA28 | 32B010200 | Bundorragha River | HIGH | Good | Shannon IRBD | L | 84196 | 63422 | Step-pool / Ca | 18/10/07 | 14:45:00 | Y | 15 | 500 | 1 | 3 | 4 | 4 | n/a | n/a | 3 | n/a | 15 | 20 | 0.75 | Good | |
| EPA29 | EPA29 | 32B030100 | Bunowen River | HIGH | Good | Shannon IRBD | L | 81967 | 77952 | Pool-Riffle | 18/10/07 | 16:45:00 | Y | 10 | 500 | 2 | 3 | 4 | 3 | 3 | 3 | 3 | 3.5 | 24.5 | 32 | 0.765625 | Good | |
| EPA3 | EPA3 | 12C030200 | River Clody | HIGH | Good | Shannon IRBD | S | 89676 | 58462 | Pool-Riffle | 10/10/07 | 15:35:00 | ? | 6 | 500 | 3 | 4 | 4 | 3 | 3 | 3.5 | 1.5 | 2.5 | 24.5 | 32 | 0.765625 | Good | |
| EPA30 | EPA30 | 32T010100 | Traheen River | HIGH | High | Shannon IRBD | L | 68858 | 56669 | Pool-Riffle | 18/10/07 | 12:10:00 | Y | 5 | 500 | 3 | 3 | 4 | 3 | 3 | 3.5 | 4 | 4 | 27.5 | 32 | 0.859375 | High | |
| EPA31 | EPA31 | 33B010100 | Ballinglen River | HIGH | High | Shannon IRBD | G | 10247 | 34213 | Pool-Riffle | 20/10/07 | 11:10:00 | Y | 10 | 500 | 4 | 4 | 4 | 2 | 3 | 3.5 | 4 | 3.5 | 28 | 32 | 0.875 | High | |
| EPA32 | EPA32 | 33K010200 | Keerglen River | HIGH | High | Shannon IRBD | G | 09201 | 33220 | Pool-Riffle | 20/10/07 | 13:15:00 | Y | 6 | 500 | 4 | 4 | 4 | 3 | 4 | 4 | 2 | 4 | 29 | 32 | 0.90625 | High | |
| EPA33 | EPA33 | 34B080400 | Unknown | HIGH | Moderate | Shannon IRBD | G | 28726 | 18148 | Pool-Riffle | 20/10/07 | 11:00:00 | ? | 5.5 | 500 | 2 | 3 | 2 | 4 | 2.5 | 2 | 1 | 1 | 17.5 | 32 | 0.546875 | Moderate | |
| EPA34 | EPA34 | 34C050030 | Clydagh River | HIGH | High | Shannon IRBD | M | 14279 | 96543 | Step-pool / Ca | 19/10/07 | 12:07:00 | ? | 6 | 500 | 4 | 4 | 3 | 3 | n/a | n/a | 2.5 | n/a | 16.5 | 20 | 0.825 | High | |
| EPA35 | EPA35 | 34D010400 | Deel River | HIGH | Good | Shannon IRBD | G | 17866 | 18904 | Lowland Mear | 20/10/07 | 15:50:00 | Y | 25 | 500 | 2 | 3 | 3 | 4 | 0.5 | 2.5 | 2 | 3 | 20 | 32 | 0.625 | Good | |
| EPA36 | EPA36 | 34E010100 | Lough Tail River | HIGH | High | Shannon IRBD | G | 41472 | 13686 | Step-pool / Ca | 20/10/07 | 12:10:00 | ? | 5 | 500 | 4 | 4 | 4 | 4 | n/a | n/a | 3.5 | n/a | 19.5 | 20 | 0.975 | High | |
| EPA37 | EPA37 | 34M020100 | River Moy | HIGH | Good | Shannon IRBD | G | 49348 | 16811 | Pool-Riffle | 20/10/07 | 13:52:00 | ? | 10 | 500 | 3 | 4 | 2 | 3 | 3 | 2.5 | 1.5 | 1 | 20 | 32 | 0.625 | Good | |
| EPA38 | EPA38 | 35B050100 | Ballysadare | HIGH | Moderate | Shannon IRBD | G | 66809 | 29060 | Lowland Mear | 22/10/07 | 11:14:00 | Y | 25 | 500 | 2 | 3 | 3 | 3 | 1 | 1 | 0.5 | 0.5 | 14 | 32 | 0.4375 | Moderate | |
| EPA39 | EPA39 | 35G010200 | Garvoge River | HIGH | Poor | Shannon IRBD | G | 69321 | 35956 | Lowland Mear | 22/10/07 | 12:40:00 | Y | 25 | 500 | 0 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 9 | 32 | 0.28125 | Poor | |
| EPA4 | EPA4 | 12L020100 | Little Slaney River | HIGH | High | Shannon IRBD | S | 98441 | 91762 | Step-pool / Ca | 25/10/07 | 13:15:00 | Y | 4 | 500 | 4 | 4 | 4 | 4 | n/a | n/a | 3 | n/a | 19 | 20 | 0.95 | High | |
| EPA40 | EPA40 | 36S010100 | An Chlaideach | HIGH | High | Shannon IRBD | H | 14892 | 24844 | Step-pool / Ca | 23/10/07 | 12:46:00 | ? | 6 | 500 | 4 | 4 | 4 | 3 | n/a | n/a | 2 | n/a | 17 | 20 | 0.85 | High | |
| EPA41 | EPA41 | 38C060100 | Cronaniv Burn | HIGH | Good | Shannon IRBD | B | 92880 | 18976 | Pool-Riffle | 24/10/07 | 12:12:00 | ? | 8 | 500 | 3 | 3 | 4 | 4 | 3 | 2 | 2 | 3 | 24 | 32 | 0.75 | Good | |
| EPA42 | EPA42 | 38G020100 | River Barra | HIGH | High | Shannon IRBD | B | 94834 | 13949 | Bedrock | 24/10/07 | 10:17:00 | ? | 4 | 500 | 4 | 4 | 4 | 2 | n/a | n/a | 4 | n/a | 18 | 20 | 0.9 | High | |
| EPA5 | EPA5 | 12L020400 | Little Slaney River | HIGH | Good | Shannon IRBD | S | 94943 | 92353 | Pool-Riffle | 25/10/07 | 11:30:00 | Y | 5 | 500 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 22 | 32 | 0.6875 | Good | |
| EPA6 | EPA6 | 16D030100 | Duag | HIGH | Moderate | Shannon IRBD | R | 91919 | 12651 | Pool-Riffle | 10/10/07 | 17:20:00 | ? | 4.5 | 500 | 1 | 3 | 3 | 3 | 1 | 0 | 2 | 1 | 14 | 32 | 0.4375 | Moderate | |
| EPA7 | EPA7 | 18F050030 | Funshion River | HIGH | Moderate | Shannon IRBD | R | 88971 | 16808 | Pool-Riffle | 10/10/07 | 12:05:00 | ? | 6 | 500 | 2 | 3 | 3 | 3 | 1 | 3 | 2 | 0 | 17 | 32 | 0.53125 | Moderate | |
| EPA8 | EPA8 | 18L010100 | Licky River | HIGH | Good | Shannon IRBD | X | 20294 | 85516 | Pool-Riffle | 11/10/07 | 10:10:00 | ? | 6 | 500 | 3 | 3 | 2 | 3 | 3.5 | 1.5 | 1.5 | 2.5 | 20 | 32 | 0.625 | Good | |
| EPA9 | EPA9 | 19S020400 | Sulan | HIGH | High | Shannon IRBD | W | 31165 | 72790 | Pool-Riffle | 11/10/07 | 11:25:00 | ? | 15 | 500 | 3 | 4 | 4 | 4 | 3.5 | 4 | 1.5 | 3.5 | 27.5 | 32 | 0.859375 | High | |
| | n/a | 22F040100 | Finow | HIGH | High | EPA | W | 08568 | 81396 | Pool-Riffle | 13/6/07 | | ? | | 500 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 32 | 32 | 1 | High | |
| | n/a | 22F020060 | Flesk | HIGH | High | EPA | W | 09557 | 81771 | Pool-Riffle | 13/6/07 | | ? | | 500 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 32 | 32 | 1 | High | |
| | n/a | 22F020060 | Flesk | HIGH | High | EPA | W | 09557 | 81771 | Step-pool / Ca | 13/6/07 | | ? | | 500 | 4 | 4 | 4 | 4 | | | 4 | | 20 | 20 | 1 | High | |
| | n/a | 22F020040 | Flesk | HIGH | High | EPA | W | 13752 | 83627 | Pool-Riffle | 13/6/07 | | ? | | 500 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 31 | 32 | 0.96875 | High | |
| | n/a | 22F020010 | Flesk | HIGH | High | EPA | W | 18032 | 83618 | Pool-Riffle | 13/6/07 | | ? | | 500 | 4 | 4 | 4 | 4 | 2 | 3 | 3 | 4 | 28 | 32 | 0.875 | High | |
| | n/a | 22F020300 | Flesk | HIGH | High | EPA | V | 96638 | 89384 | Pool-Riffle | 14/6/07 | | ? | | 500 | 3 | 3 | 4 | 4 | 3 | 3 | 3 | 3 | 26 | 32 | 0.8125 | High | |
| | n/a | 22F020250 | Flesk | HIGH | High | EPA | V | 0279 | 87973 | Pool-Riffle | 14/6/07 | | ? | | 500 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 32 | 32 | 1 | High | |
| | n/a | 22T180500 | Teeromoyle Stream | HIGH | High | EPA | V | 56181 | 82222 | Pool-Riffle | 18/9/07 | | ? | | 500 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 32 | 32 | 1 | High | |
| | n/a | 22C020600 | Caragh | HIGH | High | EPA | V | 70934 | 86257 | Pool-Riffle | 20/9/07 | | ? | | 500 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 32 | 32 | 1 | High | |
| | n/a | 22M020100 | Meelagh | HIGH | High | EPA | V | 70070 | 06243 | Pool-Riffle | 20/9/07 | | ? | | 500 | 4 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 31 | 32 | 0.96875 | High | |
| | n/a | 23O030300 | Owenmore | HIGH | High | EPA | Q | 51289 | 10742 | Pool-Riffle | 2/10/07 | | ? | | 500 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 32 | 32 | 1 | High | |
| | n/a | 36A060400 | Aghnacliffe Stream | HIGH | Good | EPA | | | | Pool-Riffle | 13/8/07 | 17:10 | Y | 5 | 50 | 3 | 3 | 3 | 3 | 4 | 3 | 2 | 1 | 22 | 32 | 0.6875 | Good | |

\

## Sheet 1: NS Share Hydromorphological Assessment Field Survey

**Site Identification**

River Name Ballymartin River　Site Number BLK10

WFD Typology 9　H84217 51755

Eas~~tin~~g U/S H84025193　Northing d/s end

**Desk-study notes:**

Expected stream type: D - lowland meandering

Native vegetation types:

Riparian land use:

Pressures: Agriculture -> Rivers Agency FB

Other comments: FB -> artificial berm

**Survey Identification**

Date 24.8.06　Time 14:20

Surveyors PM, TR, MT

**Weather conditions**

Now Sunny　Rain in last week? Yes

**Channel characteristics**

Estimated stream width: 2m　Reach length: 100m

Stream type: lowland meandering

**Photograph numbers and details:**

F10896 (M) D206

D1n OS E1n04

# Sheet 2: Field Assessment of Hydromorphological Condition

| | Bedrock | Step-pool / Cascade | Braided / Wandering | Pool-riffle | Lowland Meandering | Anastomosing |
|---|---|---|---|---|---|---|
| **Channel form and flow types** | 4 | 4 | 4 | 4 | 0<br>4 | 4 |
| **Channel vegetation** | 4 | 4 | 4 | 4 | 0<br>4 | 4 |
| **Substrate condition** | 4 | 4 | 4 | 4 | 0<br>4 | 4 |
| **Channel flow status** | 4 | 4 | 4 | 4 | 4<br>4 | 4 |
| **Bank structure & stability L+R** | ▨ | ▨ | 4 | 4 | 0.5 0.5<br>1<br>4 | 4 |
| **Bank vegetation L+R** | ▨ | ▨ | 4 | 4 | 0 0<br>0<br>4 | 4 |
| **Riparian land use L+R** | 4 | 4 | 4 | 4 | 0 0<br>0<br>4 | 4 |
| **Floodplain connectivity L+R** | ▨ | ▨ | 4 | 4 | 0 0<br>0<br>4 | 4 |
| **Total** | 20 | 20 | 32 | 32 | 5<br>32 | 32 |
| **Hydromorph * Score** | | | | [illegible] | 0.16 | |
| **WFD class **** | | | | [illegible] | BAD | |

* Hydromorph score $= \dfrac{\Sigma \text{ Assessment scores}}{\text{Maximum possible score}}$

** WFD Class

> 0.8 = high

0.6 – 0.8 = good

0.4 – 0.6 = moderate

0.2 - 0.4 = poor

< 0.2 = bad.

## Sheet 1: NS Share Hydromorphological Assessment Field Survey

**Site Identification**

River Name FINN

Site Code FIN02 Nearest GQI site F10 728

Water Body ID GBNI1N363602069

Start U/S or [✓ D/S]* D/S

First site IGR H25319 31357

Last site IGR H 42683 20471

**Desk-study notes**

Expected stream type L-L

Native vegetation types

Rain in last week U/K

Estimated Stream width 35m

Estimated Survey Length 1 km.

Riparian land use Pastures

Rivers Agency Designated? ✓

Pressures Agri.

Other comments Ticks.

**Field Notes**

Stream Type Lowland Meandering

Date 10/9/07

Time 2 45 pm

Surveyors O R + L P.

Bank surveyed from L / R / [✓ Both] / In-Channel*

Weather Conditions Now Dry Sunny

Stream Width (average 3 readings) 40m

Actual survey length (40 times wetted width) 1 km

Stream depth Unknown

Channel Characteristics (e.g. different stream types on the reach)

Pressures

0.5
MODER

* Circle as appropriate

| Photograph number and IGR | Photograph details |
|---|---|
| ① Site 1-2 General looking D/S | |
| ② General macrophytes | |
| ③ Fringing reed | |
| ④ Incoming channel from Lough Savah | |
| ⑤ General D/S site 9 | |
| ⑥ Fringed Reeds x2 Site 10 | |
| ⑦ Major Bridge | |
| ⑧ Deflector | |
| ⑨ U/S of Bridge 750m + | |
| ⑩ D/S of Bridge. | |
| | |

## Sheet 2: NS Share Hydromorphological Assessment Field Survey

**Anthropogenic Impacts**

River Name FINN

Site Code FIN02 Nearest GQI site F100 728

Water Body ID GBNIINW363602069

Date 10/9/07

| **Feature** | | **Tick if present, record as E if >30%** |
|---|---|---|
| Resectioning | | Left Bank ☐ Right Bank ☐ N/K |
| Reinforcement | X | Left Bank ☐ Right Bank ☐ |
| Embankments | X | Left Bank ☐ Right Bank ☐ Set back ☐ |
| Culverts | X | Y / N* |
| Over deepening | X | Y / N* |

| | *Tally* Major | Intermediate | Minor |
|---|---|---|---|
| Bridges | ① | | |
| Weirs | | | |

* Circle as appropriate

Unusual features, particular conditions

Willow, lilies, Coenoplexus.

Swallows. Waterhens.

Elodea lemna. Bit of Poaching.

Other comments (e.g. invasive species or obvious pollution)

Heron, Butterflies, dragonflies

Wetland riparian for first couple of 100metres.
LB - no trees
RB - 300m BL dense.

## Sheet 3: NS Share Hydromorphological Assessment Field Survey

### Field Assessment of Morphological Condition

River Name FINN Site Code FIN02 Nearest GQI site F100 728

Water Body ID GBNIINW36360206$^{64}$ Date 10/9/07

Channel flow status may need to be greyed out if the river is in high flow at time of survey
Greyed out boxes may be scored if considered necessary (note why in comments section)

| | Bedrock | Step-pool / Cascade | Braided / Wandering | Pool-riffle | Lowland Meandering | Anastomosing |
|---|---|---|---|---|---|---|
| Channel form and flow types | 4 | 4 | 4 | 4 | 1<br>4 | 4 |
| Channel vegetation | 4 | 4 | 4 | 4 | 1<br>4 | 4 |
| Substrate condition | 4 | 4 | 4 | 4 | N/V<br>4 | 4 |
| Channel flow status | 4 | 4 | 4 | 4 | 4<br>4 | 4 |
| Bank structure & stability L+R | | | 4 | 4 | 1.5<br>1.5<br>4 | 4 |
| Bank vegetation L+R | | | 4 | 4 | 0.5?<br>0.5<br>4 | 4 |
| Riparian land use L+R | 4 | 4 | 4 | 4 | 0.5<br>0.5<br>4 | 4 |
| Floodplain connectivity L+R | | | 4 | 4 | 1.5<br>1.5<br>4 | 4 |
| Total | 20 | 20 | 32 | 32 | 14<br>32 | 32 |
| Hydromorph *Score | | | | | 28<br>0.5. | |
| WFD class ** | | | | | Mod | |

* Hydromorph score = Σ Assessment sc
Maximum Possible score

** WFD Class> 0.8 = high
>0.6 – 0.8 = good
>0.4 – 0.6 = moderate
>0.2 - 0.4 = poor
< 0.2 = bad.

Top 2

# Sheet 1: NS Share Hydromorphological Assessment Field Survey

**Site Identification**

Bio site F10470

River Name Owencloghy Water

Site Number OW402A

Water Body ID GBNI1NE040403012

Start [✓ U/S] or D/S *

First site IGR D28783 08920

Last site IGR 50m above D28984 09204

**Desk-study notes**

Expected stream type Pool riffle

Native vegetation types

Ash, Hazel

Rain in last week

Estimated Stream width 10 m

Estimated Survey Length 400m

Riparian land use Agriculture

Pressures

Other comments

**Field Notes**

Stream Type Pool-riffle for 250m
150m step pool cascade

Date 8/8/07

Time 13:00

Surveyors W.Parkhill & M.T. and

Bank surveyed from L R / [✓ Both] / In-Channel*
Right to 200m to bridge
Left D/S bridge

Weather Conditions Now Sunny

Stream Width (average 3 readings)
12m 10m 10m = 10m

Actual survey length (40 times wetted width)
10m × 40 = 400m

Channel Characteristics
Pool Riffle → Step Pool/cascade.

Pressures
Bedrock sides D/S of bridge.

**Photograph number and IGR**

Photos w/ RHS

See Photosheet.

**Photograph details**

U/S
SCORE 0.59
CLASS MODERATE

* Please note D/S of bridge typology changes as such there are two RHAT scores w/i this stretch.

D/S
0.975
HIGH

* Circle as appropriate

**Sheet 2: Anthropogenic Impacts**

River Name Owencloghy Water

Site Number OWY2A/470

Water Body ID GBNI1NE040403012

Date 8/8/07

| | |
|---|---|
| Resectioned<br>(Tick or E if >30%) | Left Bank ____ Right Bank ____ |
| Reinforced<br>(Tick or E if >30%) | Left Bank ____ Right Bank ✓ |
| Embanked<br>(Tick or E if >30%) | Left Bank ____ Right Bank ✓ |
| | |
| | **Tally** |
| Bridges | ① |
| Weirs | |
| Culverts | |
| | |
| Over deepened | Y/[✓ N] |
| | |
| Unusual features, particular conditions, | 200m above bridge Pool-Riffle |
| other comments | 50m below " Pool-riffle |
| | 150m cascade/Steppool. |
| | |
| | Giant hogweed. |
| | Natural d/s of bridge where |
| | bedrock. Upstream path being |
| | created on right bank at Site 1. |
| | Farm house being built. |
| | Pipe discharge entering d/s site 1. |
| | Embanked./Poaching above bridge. |
| | D/S vegetation very dense. |
| | |
| | |
| | |
| | |
| | |

250m.

## Sheet 3: Field Assessment of Morphological Condition

River Name Owencloughy River
Site Number OWY2A/470
Waterbody ID NE04040301Z
Date 8/8/07

| | Bedrock | Step-pool / Cascade | Braided / Wandering | Pool-riffle | Lowland Meandering | Anastomosing |
|---|---|---|---|---|---|---|
| **Channel form and flow types** | 4 | 4 | 4 | 3<br>4 | 4 | 4 |
| **Channel vegetation** | 4 | 4 | 4 | 2<br>4 | 4 | 4 |
| **Substrate condition** | 4 | 4 | 4 | 3<br>4 | 4 | 4 |
| **Channel flow status** | 4 | 4 | 4 | 4<br>4 | 4 | 4 |
| **Bank structure & stability L+R** | | | 4 | 1+1 \| 2<br>4 | 4 | 4 |
| **Bank vegetation L+R** | | | 4 | 1+0.5 \| 2<br>4 | 4 | 4 |
| **Riparian land use L+R** | 4 | 4 | 4 | 1+0.5 \| 1.5<br>4 | 4 | 4 |
| **Floodplain connectivity L+R** | | | 4 | 0.5+1 \| 1.5<br>4 | 4 | 4 |
| **Total** | **20** | **20** | **32** | 19<br>**32** | **32** | **32** |
| **Hydromorph *Score** | | | | 0.59 | | |
| **WFD class **** | | | | Moderate. | | |

* Hydromorph score = Σ Assessment scores / Maximum possible score

** WFD Class
> 0.8 = high
0.6 – 0.8 = good
0.4 – 0.6 = moderate
0.2 - 0.4 = poor
< 0.2 = bad.

## Sheet 1: NS Share Hydromorphological Assessment Field Survey

**Site Identification**

River Name Swanlinbar

Site Code SWA02 Nearest GQI site F100 735

Water Body ID GBNI1NW363602050

Start U/S or [✓ D/S] * DS

First site IGR H25319 31357

Last site IGR H25573 31952

**Desk-study notes**

Expected stream type Lowland Mean

Native vegetation types

Rain in last week Yes

Estimated Stream width 25m

Estimated Survey Length

Riparian land use Pastures

Rivers Agency Designated? Yes

Pressures Agri.

Other comments Lowland / Calcareous

**Field Notes**

Stream Type Lowland meandering

Date 10/9/07.

Time 11.50

Surveyors OR + LP.

Bank surveyed from L [✓ R] / Both / In-Channel*

Weather Conditions Now Dry/Sunny

Stream Width (average 3 readings) 25m

Actual survey length (40 times wetted width) 100 m

Stream depth Unknown?

Channel Characteristics (e.g. different stream types on the reach) NO

Pressures Agricultural (cattle poaching)

* Circle as appropriate

| Photograph number and IGR | Photograph details |
|---|---|
| (1) Site 1 Embanked | |
| (2) General 50-100m | |
| (3) Side channel above site above 150m | |
| (4) 200m general | |
| (5) 350m Poaching | |
| (6) 450m more poaching | |
| (7) Last RAT site. | 0.571 |
| | MODERATE. |
| | |
| | |
| | |

## Sheet 2: NS Share Hydromorphological Assessment Field Survey

**Anthropogenic Impacts**

River Name SWANLINBAR

Site Code SWA02 Nearest GQI site F100 735

Water Body ID GBNINW363602050

Date 10/9/07

| **Feature** | **Tick if present, record as E if >30%** | | |
|---|---|---|---|
| Resectioning | Left Bank ☑ Right Bank ☑ | | |
| Reinforcement | Left Bank ☐ Right Bank ☐ | | |
| Embankments | Left Bank ☐ Right Bank ☑ Set back ☐ | | |
| Culverts | Y / [✓ N*] | | |
| Over deepening | Y / N* UK unknown | | |
| | *Tally*<br>Major | Intermediate | Minor |
| Bridges | | | |
| Weirs | | | |

* Circle as appropriate

Unusual features, particular conditions

Possibly overwidened — No perceptible flow

Mountain Ash, Alder, Brambles, Sycamore RB, Willow.

Damson trees, Crab Apple.

Conifers on LB continuous w/ 250m. Conifers 1km.

Fringing reeds, nuphar lutea, Sparganium.

Other comments (e.g. invasive species or obvious pollution)

Dragonfly

Farm ditch RB + LB

## Sheet 3: NS Share Hydromorphological Assessment Field Survey

**Field Assessment of Morphological Condition**

River Name Swanlinbar Site Code SWA02 Nearest GQI site F100 735

Water Body ID GBNIINW36360208 Date 10/9/07

Channel flow status may need to be greyed out if the river is in high flow at time of survey
Greyed out boxes may be scored if considered necessary (note why in comments section)

| | Bedrock | Step-pool / Cascade | Braided / Wandering | Pool-riffle | Lowland Meandering | Anastomosing |
|---|---|---|---|---|---|---|
| Channel form and flow types | 4 | 4 | 4 | 4 | 2<br>4 | 4 |
| Channel vegetation | 4 | 4 | 4 | 4 | 2<br>4 | 4 |
| Substrate condition | 4 | 4 | 4 | 4 | X<br>4 | 4 |
| Channel flow status | 4 | 4 | 4 | 4 | 4<br>4 | 4 |
| Bank structure & stability L+R | ▨ | ▨ | 4 | 4 | 1.5<br>1.5<br>4 | 4 |
| Bank vegetation L+R | ▨ | ▨ | 4 | 4 | 1<br>1.5<br>4 | 4 |
| Riparian land use L+R | 4 | 4 | 4 | 4 | 0.5<br>0.5<br>4 | 4 |
| Floodplain connectivity L+R | ▨ | ▨ | 4 | 4 | 0.5<br>1<br>4 | 4 |
| Total | 20 | 20 | 32 | 32 | 16<br>28<br>32 | 32 |
| Hydromorph *Score | | | | | 0.571 | |
| WFD class ** | | | | | MODER | |

* Hydromorph score = Σ Assessment sc
Maximum Possible score

** WFD Class> 0.8 = high
>0.6 – 0.8 = good
>0.4 – 0.6 = moderate
>0.2 - 0.4 = poor
< 0.2 = bad.