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Sustainable development framework for the Gogar Burn – River Habitat Survey analysis

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1. Background

1.1 Introduction

The Centre for Ecology and Hydrology (CEH) was commissioned by the Scottish Institute of Sustainable Technology (SISTech), to analyse River Habitat Survey (RHS) data on the Gogar Burn, south-east Scotland, as part of the Sustainable Development Framework for the Gogar Burn.

1.2 Objectives

Conduct analysis of the RHS data in order to;

- Explain the ecological value of the existing river channel of the Gogar Burn.
- Advise on the types of plants, habitats and channel structure that would be desirable in a restored river channel alignment given the River Habitat Survey scores.

1.3 Field methodology and timing of survey

Four RHS surveys have been conducted on Gogar Burn. Two randomly selected reaches were surveyed in September 1995 as part of the UK reference set of RHS sites (referred to in the report as reference sites). Phase 1 of the Sustainable Development Framework for the Gogar Burn Project highlighted that it would be useful to have additional RHS data points further downstream the Gogar Burn, as theses two reference sites were located upstream of the main area of interest, which is the area where the burn joins the Gyle, the new RBS headquarters, and Edinburgh airport (table 1). Hence, a further two sites were selected by CEH and surveyed by Scottish Environment Protection Agency (SEPA) staff in January 2006 for this project. These two RHS sites were located in specifically selected areas of the catchment near Edinburgh Airport (site 1) and the Royal Bank of Scotland headquarters (site 2). These were done using the most recent (2003) version of the RHS methodology (Raven et al 1997 and 1998). All the available RHS surveys have been carried out in the lower part of the catchment so no information is available on the upland area (which is likely to be more natural).

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Table 1 Location of River Habitat Survey sites on the Gogar Burn

Site	NGR
Edinburgh Airport (site 1)	NT155732
Royal Bank of Scotland HQ (site 2)	NT168720
2579 (Reference site)	NT170706
2599 (Reference site)	NT150692

1.4 General Description of the Gogar Burn

Gogar Burn rises at an altitude of 270m and flows for approximately 20km before joining the river Almond at an altitude of 25m. It has a catchment area of over 40km^2.

Almost all of the catchment's solid geology is based on carboniferous limestone with small areas of basalt. The drift geology is predominantly boulder clay/morainic drift (figure 1).

The land use is a mixture of arable and grassland with some woodland. Much of the lower section of the river is heavily urbanised and some of it has been culverted.

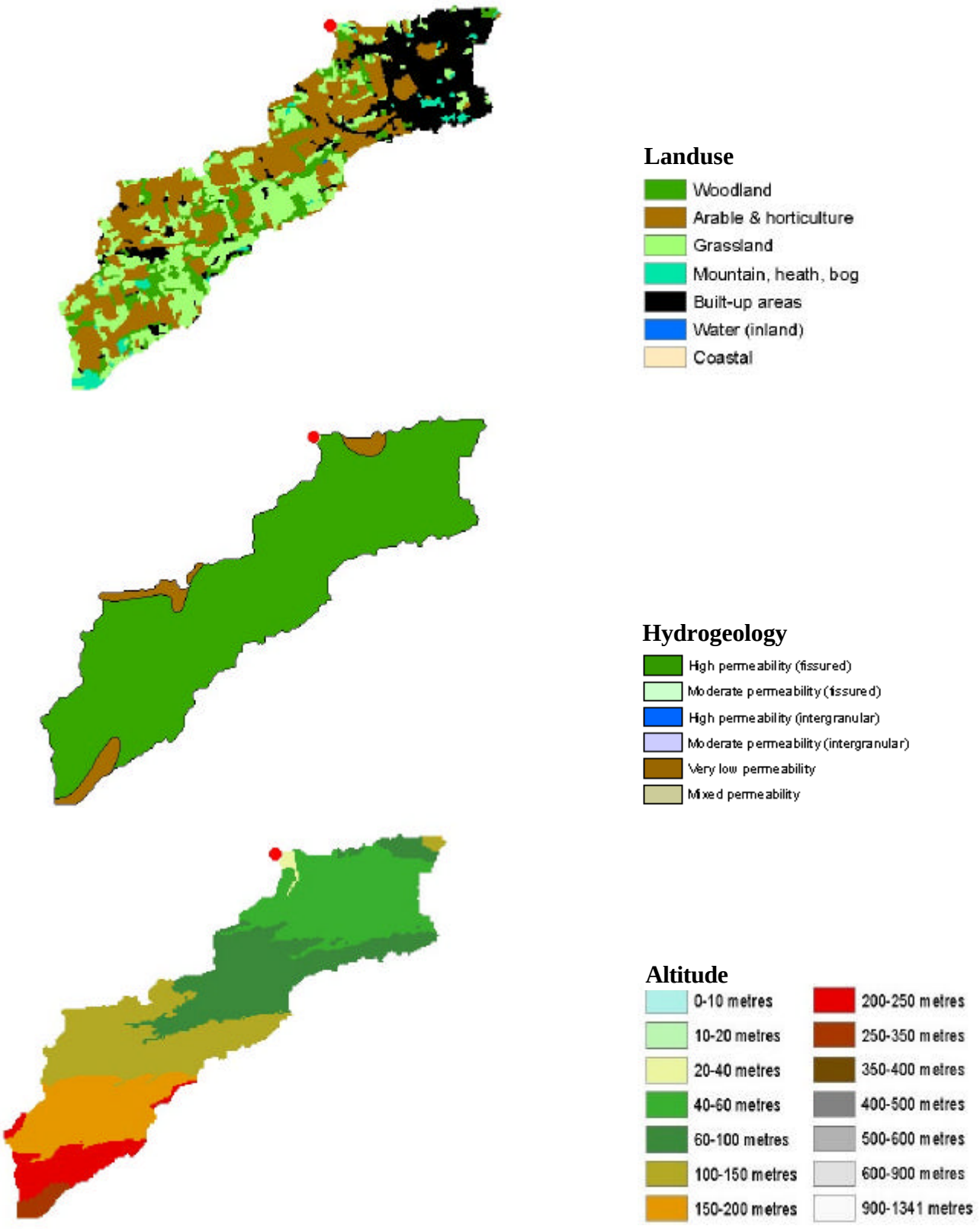

Figure 1 Landuse, hydrogeology and altitude on the Gogar Burn catchment

Acknowledgements to National River Flow Archive

1.5 Rivers in urban environments

When rivers are one of the few remaining natural features in a landscape (as is the case with Gogar Burn), they are valuable for wildlife as they provide corridors which allow the movement of plants and animals from one area of habitat to another. Rivers may also be important for human recreation. Although the habitat quality of these watercourses usually compare poorly with those in rural areas, they may compare well with other urban rivers and their rarity in the urban landscape increases their importance.

1.6 River Habitat Survey Methodology

River Habitat Survey (RHS) is a system for assessing the character and quality of rivers based on their physical structure. Physical structure is one of the primary factors in determining the aquatic biological communities of rivers.

The survey consists of two components, namely data collection in the field and data derived from maps. The field survey takes place over a 500m length of river. Data on a variety of variables are recorded including bank and channel materials/substrates, modifications, natural features, channel vegetation, surrounding land use, channel dimensions and artificial features. The map-based attributes include data on variables such as slope, altitude, geology and flow category.

1.7 Habitat Quality and Habitat Modification

RHS uses two scoring systems to indicate habitat quality and the degree of site modification. The **Habitat Quality Assessment (HQA)** is a broad measure of how natural a site is and the diversity of the physical habitat of the site. It is calculated according to the presence and extent of habitat features of known wildlife interest recorded in the field survey part of the survey form. The scoring system is subjective but gives a consistent measure for comparisons and provides a method of evaluating the relative quality of a site and potential impact of management. However, the HQA score of a site should not be compared to sites on different river types or be used on its own to determine management actions.

The **Habitat Modification Score (HMS)** measures artificial modification to the physical structure of the channel, such as alteration to the bank and channel (e.g. resectioning and reinforcement) and artificial structures like bridges and weirs. Like the HQA score, the scoring system is subjective but provides a consistent measure of comparison between sites.

When describing a site the HQA and HMS scores should be used in conjunction to suggest how habitat quality and physical modification might be linked. It should be remembered that HMS scores relate to channel modifications only, whereas HQA scores are derived from the channel and riparian zone.

1.8 Comparison with other sites

The two reference sites on the Gogar Burn are located upstream of the airport and RBS sites, and in a less urban environment. Therefore, they are useful comparators and act as a benchmark. This is especially true of the most upstream reference site which is relatively unimpacted and has good habitat quality.

As aquatic and bank vegetation vary seasonally it is recommended that RHS surveys should be carried out in the summer months when the vegetation is most obvious (although surveys in upland rivers with little emergent vegetation can be carried out over an extended season). As the airport and RBS surveys were conducted in January, any comparisons of vegetation with the reference sites (which were surveyed in September) should be treated with caution.

The airport and RBS surveys were also conducted during a period of high flow which is likely to alter flow patterns and hampers visibility of substrates, channel vegetation and riparian vegetation.

The habitat quality of the RHS sites at the airport and the RBS HQ was compared to that of the reference sites situated upstream.

2 Survey Results

The scores derived from the RHS data and the comments on the survey forms show that the channel near the airport and the RBS headquarters is heavily modified and with poor habitat quality (table 2). Impacts to the channel include bridges, weirs and embankments to protect airport buildings and agricultural land. The scores for both the airport and RBS sites are similar to those of the downstream reference site.

Table 2 Habitat Quality Scores

	Habitat Quality Score	**Habitat Quality Class**	**River Habitat Quality Class**	**Management Objectives**
Airport	34	3 (Fair)	4 (Poor)	Rehabilitate
RBS HQ	41	4 (Poor)	4 (Poor)	Rehabilitate

Table 3 illustrates the component scores of the sites. Bank vegetation structure and flow type scores were significantly lower in the airport and RBS sites than at the reference sites.

Table 3 Comparison of HMS and HQA scores and their component scores

	Airport	**RBS HQ**	**2579**	**2599**
HQA score	34	41	42	55
Flow type	4	4	7	9
Channel substrate	3	2	4	6
Channel features	4	4	5	2
Channel vegetation	3	3	6	4
Bank features	4	5	1	7
Bank vegetation structure	4	3	12	12
Land use	4	4	2	4
Point bars	0	1	0	0
Trees & Tree features	1	2	5	11
HMS score	30	36	31	3

2.1 Channel vegetation

Aquatic macrophytes provide an important habitat for invertebrates and fish. In the Gogar Burn, no channel vegetation was recorded at the airport and RBS sites, which compares poorly with the variety and extent of vegetation at the reference sites (Table 4). The airport and RBS surveys were done in winter so the channel vegetation may have been sparse due to seasonal dieback and increased turbidity impaired visibility of submerged vegetation. Other explanations for the lack of channel vegetation could be: loose substrate which can prevent secure rooting of plants, increased flow velocity due to bank resectioning or spate flow and large quantities of suspended sediment and pollution (both past and present), especially in the form of run-off in high rainfall. Vegetation types recorded at the reference sites are more likely to flourish at the airport and RBS sites than other species if the correct physical habitat is created. Amphibious vegetation (plants rooted at the edge of the river or on the bank, with shoots or leaves trailing into the water) was most common at the reference sites. Examples include creeping bent-grass (*Agrostis stolonifera*), floating sweetgrass, (*Glyceria fluitans*), marsh foxtail (*Alopecurus geniculatus*), water forget-me-not (*Myosotis scorpioides*) and amphibious bistort (*Persicaria amphibia*). Bryophytes might also grow well at the airport and RBS sites.

Table 4 Comparison of vegetation types at four sites on Gogar Burn (numbers refer to the number of spot-checks at which the vegetation type was recorded)

	Airport	**RBS HQ**	**2579**	**2599**
Bryophytes/lichens	0	0	5	2
Emergent broad-leaved herbs	0	0	0	3
Emergent reeds/sedges/rushes	0	0	2	0
Amphibious	0	0	9	7
Submerged fine/linear-leaved	0	0	2	0
Filamentous Algae	0	0	9	2

2.2 Trees and associated features

Trees can significantly enhance the habitat quality of a river by providing specialised habitats for both terrestrial and aquatic fauna. Their roots help to stabilise the river bank and so help lessen erosion and leaf fall provides an important source of nutrient input and a food source for invertebrates. The larger surface area of trees is better at reducing surface water run-off than other forms of vegetation.

Six features associated with trees are recorded on the RHS form, namely;

- Shading, which may be beneficial to fish
- Overhanging boughs, which are used by kingfishers
- Exposed bankside roots, used by otters (for holts) and some birds (for nests)
- Underwater tree roots, an important habitat for some aquatic invertebrates
- Fallen trees and woody debris which provide a source of organic matter into the system.

Trees were present as occasional clumps at the RBS site but were continuous at the airport site. All the tree related features were recorded at the airport site. Shading, overhanging boughs, exposed bankside roots and underwater tree roots were recorded at the RBS site. The use of trees to enhance the habitat quality of the sites may prove to be one of the easiest and most effective methods available. The use of some tree features by otters is significant as otters have been recorded along much of the Burn.

2.3 Bank and Channel features

The most common bank and channel features are depositional bars. These provide habitat diversity and may become vegetated over time. They are more common in un-impacted channels and may occur on the margins in straight river sections (side-bars), on the inside of meanders (point bars) or in the centre of the channel (mid channel bars). Vegetated side bars were recorded at the airport site, and unvegetated point bars and a mature island were recorded at the RBS site.

Figure 2 Bank reinforcement and resectioning near the RBS headquarters (site 2)

2.4 Bank materials and modifications

The banks at both the airport and RBS sites are extensively engineered with resectioning, reinforcement and embankment (figure 2). The introduction of artificial meanders or the use of soft engineering materials would enhance habitat quality. Eroding cliffs were recorded at site two, suggesting that the banks are beginning to recover from past engineering.

2.5 Alien species

Giant hogweed (*Heracleum mantegazzianum*) was recorded on the bankface of site one. The sap of this invasive species can cause serious blisters to exposed skin and should be eradicated from the site.

2.6 Flows and Substrates

A full length weir is present at the RBS site, which may act as a barrier to migratory fish (figure 3).

High flow levels during surveying are likely to have altered flow patterns at the airport and RBS sites, so comparison with the reference sites may be misleading. However, it would seem likely that there is poor diversity of flow at both of the airport and RBS sites, mainly due to historical engineering of the channel. The introduction of artificial riffles, backwaters or refuges for fish (e.g. boulders) would increase this aspect of the habitat quality of the site, though care must be taken to ensure that these are feasible in such an engineered channel.

Figure 3 Weir at Turnhouse (near Edinburgh airport)

3 Conclusions

As they were conducted in winter and in high flow, the results of the airport and RBS surveys should be treated with some caution. However, it is apparent that both of the surveyed sites in the main area of interest, where the burn joins the Gyle, the new RBS headquarters and near Edinburgh airport, are heavily modified and the channel and bank diversity is poor. Comments by the surveyors on the RHS form suggest that the scheme undertaken at site two has been unsuccessful in providing an environmentally sustainable landscape.

However, even though they are impacted, the sites do provide a rare and important habitat in an urban setting, and data from surveys on the upstream sites suggest that there is potential to improve the habitat quality of the river. A badger sett at the airport site was recorded by the SEPA surveyors, further highlighting the importance of the river as a wildlife corridor. The surveyors also recommended that any restoration should concentrate on in-channel diversity. Increasing the physical diversity of the banks and channel is one of the most effective and simple ways of improving habitat quality of the sites such as the introduction of more diverse flows and backwaters. Other methods to improve habitat quality include the removal of giant hogweed, the increased use of soft engineering materials and enhancing the vegetation structure of the banks where necessary, perhaps through tree planting and management of existing trees. To provide more informed information on the condition of Gogar Burn, it is recommended that additional surveys be carried out in the summer months and during base flow.

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