CHAPTER 2. SELECTION OF POTENTIAL REFERENCE SITES AND GROUND-TRUTHING OR PRELIMINARY SITE SCREENING

Summary

This chapter describes the process of selecting potential reference sites, identifying homogeneous regions, and ground-truthing or preliminary sites screening. The process is illustrated for Mpumalanga which was the region selected for developing the reference condition protocol. Lessons learnt and recommendations for this component are provided.

2.1 INTRODUCTION

The selection of potential reference sites and subsequent site screening to ensure that they are representative of the homogenous region for which they provide a reference is a critical stage if reference conditions are to become an important interpretative tool within the RHP. The selection of "least-impacted" sites which are exposed to minimal anthropogenic influences provides the basis on which future monitoring is conducted. The selection of reference sites is likely to be an iterative process, with sites being eliminated due to unforeseen anthropogenic effects, and additional sites being added as funding allows or the geographic area represented by the reference sites is expanded. The quality and quantity of reference sites, encompassing a range of river types, is important for the narrative/qualitative comparison with monitoring sites and for the future development of predictive models such as RIVPACS or AusRivAS. Hence, consideration should be given to preserving the reference sites in perpetuity (Eekhout *et al.* 1996).

2.2 SELECTION OF POTENTIAL REFERENCE SITES

The following criteria could be considered in the selection of reference sites (adapted from Brown *et al.* 1996 and Reynoldson & Rosenberg 1996). The potential reference site should:

1. be representative of the streams for which it provides a reference. This implies that homogeneous regions within the geographic area under consideration need to be ascertained. The spatial framework described in section 1.3 would be followed and river types identified. Ideally reference sites should be selected within each homogeneous region.
2. be minimally-disturbed, and hence reflect the "unimpacted" condition. In reality, this often represents the "least-impacted" condition, particularly in lower reaches of rivers which experience the cumulative effects of all the disturbances in the upstream catchment (Eekhout *et al.* 1996).
3. have an appropriate variety of biotopes and substrates.
4. be relatively accessible and safe during sampling operations.
5. if possible, have a natural channel and stable banks.
6. if possible, have a natural hydrograph.

7. if possible, have natural riparian vegetation.

The site could also:

8. have links to existing on-going monitoring projects where least-impacted sites have been identified.
9. be situated nearby DWAF gauging stations (in order to link with existing hydrological and water chemistry data).

In practice, selecting sites in upper catchments which conform to all the above criteria is simpler than for sites located lower down in the catchment. Locating sites which conform to criteria 5, 6 and 7 is particularly problematic as one moves longitudinally down the catchment. Eekhout *et al.* (1996) developed a seven-step protocol for the selection of reference sites as follows.

1. The *a priori* selection of *ca* 20 least-impacted sites within each of the pre-defined river types.
2. Preliminary site screening and elimination of disturbed sites, i. e the ground-truthing phase.
3. Data collection, i.e. rapid assessment sampling of the biota and/or physical habitat at the remaining sites.
4. Data screening, i.e. multivariate analysis of results for each river type, and examination of outliers.
5. Final reference site selection, i.e. statistical analysis of data obtained at the remaining sites to assess degree of variability likely to be encountered and to help the optimal number of sites needed to represent each river type.
6. Repeat of the multivariate analysis and elimination of outliers until the desired number of sites remain.
7. Testing.

The proceeding sections describe the steps followed in identifying homogeneous regions for rivers in Mpumalanga, selecting potential reference sites and ground-truthing.

2.2.1 Identifying homogeneous regions

The delineation of river types for Mpumalanga, incorporating DWAF primary catchments B and X, has been documented in Dallas & Fowler (2000). Briefly, the spatial framework was followed to the level of sub-region. Level 3, namely river types, were identified during the ground-truthing phase. The following ecoregion (level 1) and sub-region (level 2) groupings were delineated (Table 2.1).

2.2.2 Selection of "least-impacted" sites

The following sources of information were utilised to select potential reference sites:

- local knowledge (meeting with local experts)
- land-use maps (Geographical Information Systems, CSIR)
- existing DWAF biomonitoring sites identified by local experts as being least impacted.

Anthropogenic factors potentially impacting on a site need to be considered and may aid in selecting reaches or sites. Factors to consider include those that are present at or upstream of the site and which

Table 2.1 Ecoregion (level 1) and sub-region (level 2) grouping of rivers in Mpumalanga.

Ecoregion	Sub-regions represented
Bushveld Basin	Mountain Stream, Foothills (cobble bed), Foothills (gravel bed), Lowland Floodplain
Central Highlands	Mountain Stream, Foothills (cobble bed), Foothills (gravel bed)
Great Escarpment Mountains	High Gradient Mountain Stream, Mountain Stream, Foothills (cobble bed), Foothills (gravel bed), Rejuvenated Cascade, Rejuvenated Foothill
Highveld	Mountain Stream, Foothills (cobble bed), Foothills (gravel bed), Upland Floodplain, Rejuvenated Foothill
Lebombo Uplands	Foothills (gravel bed), Rejuvenated Foothill
Lowveld	Mountain Stream, Foothills (cobble bed), Foothills (gravel bed), Rejuvenated Cascade, Rejuvenated Foothill

may have a detrimental effect on the biotic and abiotic characteristics of the site. These include activities potentially affecting:

- The stream hydrology such as impoundments, water abstraction, intensive agriculture, etc.
- Receiving water quality such as impoundments, catchment urbanisation, intensive agriculture, livestock grazing, mining, pollution sources, etc.
- Substrate composition, bed and bank stability such as modification of the channel, bank degradation, vegetation clearing, etc.

Table 2.2 is modified from the AusRivAS protocol (AusRivAS 2000) and describes the types and characteristics of impacts used in discriminating least-impacted reaches and sites in the AusRivAs. Once potential reference sites were identified, they were allocated to ecoregions and sub-regions (when