RIVER HEALTH PROGRAMME:

SITE CHARACTERISATION FIELD-MANUAL AND FIELD-DATA SHEETS

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LIST OF CONTRIBUTERS

This manual is the product of two workshops and contributions from aquatic scientists and biomonitoring practitioners. Thanks to all for their valuable contributions: Annelise Gerber, Chantel Petersen, Chris Dickens, Christa Thirion, Colleen Todd, Dean Ollis, Juanita Moolman, Justine Ewart-Smith, Liesl Hill, Mark Graham, Mike Silberbauer, Neels Kleynhans, Toni Belcher and Tovho Ndiitwani.

INTRODUCTION TO SECTIONS A, B AND C

This field-manual and associated field-data sheets have been developed for the River Health Programme of the National Aquatic Ecosystem Health Biomonitoring Programme (NAEHBP). It is based on a manual previously developed for deriving ecological reference conditions (Dallas 2000) and is aimed at standardising data collected at biomonitoring sites. The manual incorporates information necessary to characterise a site, to provide an indication of catchment condition and land-use, together with relevant abiotic and biotic (invertebrates, fish, riparian vegetation) information. The information described in this field-manual pertains to the Rivers Database (Ewart-Smith *et al*. 2003). The field-manual and associated field-data sheets are divided into three sections as follows:

Section A: Site-specific information which is assessed during or after the first site visit. It includes:

- General site information, including data collected at a site and data sourced via desktop and spatial (GIS) analysis
- Location details

Section B: Information related to catchment condition and land-use, which is assessed during the first site visit and checked on subsequent site visits. It includes:

- Photographic record
- Condition of local catchment, including the potential impact on river health
- Channel condition
- Index of Habitat Integrity
- Channel morphology

Section C: Field-based data collected during each site visit. It includes:

- General site visit information
- Stream dimensions
- Substratum composition
- Invertebrates: biotopes present, SASS, biotopes sampled (IHAS modified)
- Fish: Fish habitats (velocity-depth classes), habitats sampled and effort, fish caught
- Riparian vegetation (still to be completed)

The field-manual provides details of the information to be collected, together with the format and methodology where relevant. It does not include guidelines as to the calculation of indices and conclusions as to the health of a river.

GUIDELINE FOR SECTION A: SITE INFORMATION - TO BE FILLED IN BEFORE OR DURING INITIAL SITE VISIT

1 GENERAL

This includes information to be collected at a site, together with desktop information generated either before or after a site assessment.

SITE INFORMATION – ASSESSED AT A SITE

RHP Site Code: The following standard has been adopted for naming sites for the River Health Programme: Secondary catchment code, 1st four letters of river name, 1st five letters of location. E.g. X2CROC-VELOR (Crocodile River @ Veloren Vallei Nature Reserve), X3MARI-VERSA (Martisane River @ Versailles). The site code needs to be a unique entry, so if a duplicate site code will result with the standardised naming method, a change to the location code should be made.

Project Site Number: A number (e.g. B1, B2, D1, D2, etc) used for graphical presentation of information on maps. The number will be assigned by the person who initially assesses the site, i.e. Site Owner.

River: Name of river assessed; based on 1:50 000 maps. Need to validate on the National Naming Convention website (http://sagns.dac.gov.za), (South African Geographical Names System).

Tributary of: Parent river, e.g. Marite is a tributary of the Sabie.

Latitude/Longitude: Co-ordinates of the site, either degree-minute-second or GPS (decimal degrees, e.g. 18.98718^{o}, or degrees & decimal minutes, WGS 84).

Site Description: Details of site location, e.g. farm name, road-bridge, village, etc.

Map Reference: Based on 1: 50 000 map sheet code, e.g. 3418BB or 1:10 000 orthophoto code, e.g. 3418BB18.

Site Length: Length of river assessed, this is the length necessary to represent the river reach.

Altitude: Altitude from the GPS.

Longitudinal Zone: Based on Rowntree and Wadeson's (2000) geomorphological zonation of river channels (see Table 1). Using these descriptions the assessor should allocate a site to a longitudinal zone. The longitudinal zones for many rivers are being generated using DEM procedures (Moolman, RQS, DWAF, pers comm.).

Hydrological Type: Based on the following types: *Perennial*: flows continuously all year round; *Seasonal*: flows annually at a predictable time of year, but ceases to flow for some time each year; *Ephemeral*: flows periodically every few years. Note: Hydrological type should be recorded for "natural" conditions and for "present-day" conditions.

Associated Systems: Indicate the presence of important systems that may be associated with the site or river, e.g. wetlands or estuaries, and estimate distance.

DESKTOP / SPATIAL (GIS) INFORMATION

Classification of sites into political regions, ecoregions, catchments, geological types, etc. is easily done using the appropriate Geographical Information System (GIS) coverages. Relevant GIS covers are available from the RHP website, Resource Quality Services, Department of Water Affairs and Forestry **(http://www.dwaf.gov.za/iwqs/gis_data/RHPdata.htm).** Visit website for further updates. Assigning spatial information to a site is particularly important for subsequent querying, extraction and analysis of data from the Rivers database.

Rivers coverage: (1: 500 000)

Political Region: One of nine regions.

Water Management Area: DWAF's 19 water management areas.

Ecoregion Level I: One of 31 as identified in Kleynhans *et al.* (2004).

Ecoregion Level II: One of 135 as identified in Kleynhans *et al.* (In prep).

Secondary Catchment Code: DWAF secondary drainage region.

Quaternary Catchment Code: DWAF quaternary drainage region.

Water Chemistry Management Region: One of seven as identified in Day *et al.* (1998).

Vegetation Type: Based on Low and Rebelo's (1996) potential natural vegetation of South Africa, Lesotho and Swaziland.

Geological Type: Based on Vegter's (1995) simplified lithostratigraphic units.

Contour Range: Altitude range within which site falls - estimated from a 1:50 000 map.

Source Distance: Distance from source of river estimated from a 1: 50 000 map or extracted from the table which is included as a table in the rivers coverage).

Stream Order: Estimated on the 1: 500 000 Rivers Coverage.

Rainfall Region: Season in which the majority of rain falls.

DWAF Gauging Station: Indicate the presence of a DWAF gauging station (quality and/or quality) and estimate distance upstream or downstream of the site.

Note: Land use information per secondary catchment is also available via the RQS RHP website.

Note: The Water Management System generates a cover of water quality monitoring stations about once a month or on demand (http://www-dwaf.pwv.gov.za/IWQS/wms/index.htm). Hydstra (in the Hydrological Services directorate) can generate coordinates for flow gauging stations (http://www.dwaf.gov.za/Hydrology/).

Table 1. Geomorphological zonation of river channels (after Rowntree and Wadeson 2000).

Longitudinal Zone	Characteristic Gradient	Diagnostic Channel Characteristics
A. Zonation associated with a 'normal' profile		
Source zone	not specified	Low gradient, upland plateau or upland basin able to store water. Spongy or peaty hydromorphic soils.
Mountain headwater stream	> 0.1	A very steep gradient stream dominated by vertical flow over bedrock with waterfalls and plunge pools. Normally first or second order. Reach types include bedrock fall and cascades.
Mountain stream	0.04 - 0.99	Steep gradient stream dominated by bedrock and boulders, locally cobble or coarse gravels in pools. Reach types include cascades, bedrock fall, step-pool, plane bed. Approximate equal distribution of 'vertical' and 'horizontal' flow components.
Transitional	0.02 – 0.039	Moderately steep stream dominated by bedrock or boulder. Reach types include plain-bed, pool-rapid or pool riffle. Confined or semi-confined valley floor with limited flood plain development.
Upper foothills	0.005 - 0.019	Moderately steep, cobble-bed or mixed bedrock-cobble bed channel, with plane bed, pool-riffle or pool-rapid reach types. Length of pools and riffles/rapids similar. Narrow floodplain of sand, gravel or cobble often present.
Lower foothills	0.001 - 0.005	Lower gradient mixed bed alluvial channel with sand and gravel dominating the bed, locally may be bedrock controlled. Reach types typically include pool- riffle or pool-rapid, sand bars common in pools. Pools of significantly greater extent than rapids or riffles. Floodplain often present.
Lowland river	0.0001- 0.001	Low gradient alluvial sand bed channel, typically regime reach type. Often confined, but fully developed meandering pattern within a distinct floodplain develops in unconfined reaches where there is an increase in silt content in bed or banks.
B. Additional zones associated with a rejuvenated profile		
Rejuvenated bedrock fall / cascades	> 0.02	Moderate to steep gradient, often confined channel (gorge) resulting from uplift in the middle to lower reaches of the long profile, limited lateral development of alluvial features, reach types include bedrock fall, cascades and pool-rapid.
Rejuvenated foothills	0.001 - 0.02	Steepened section within middle reaches of the river caused by uplift, often within or downstream of gorge; characteristics similar to foothills (gravel/cobble bed rivers with pool-riffle/ pool-rapid morphology) but of a higher order. A compound channel is often present with an active channel contained within a macro channel activated only during infrequent flood events. A floodplain may be present between the active and macro-channel.
Upland floodplain	< 0.005	An upland low gradient channel often associated with uplifted plateau areas as occur beneath the eastern escarpment.

Note: Definitions of terms are available in Rowntree and Wadeson (2000). (See NAEHBP Report Number 13. (http://www.csir.co.za/rhp).

LOCATION DETAILS

This is a sketch of the site location to enable a new assessor to find it. It therefore needs details such as direction of north, road access to site, road names or codes, bridges/crossings, gauges/instream barriers, buildings, scale and flow direction. The landowner's name, contact number, permit and key details, and farm name and registration code should also be recorded.

GUIDELINE FOR SECTION B. CATCHMENT CONDITION AND LAND-USE - reassessed on each site visit

This section is aimed at assessing the condition of a site and catchment upstream of the site. It incorporates information pertaining to land-use, channel condition, habitat integrity and channel morphology. The site is assessed initially, with subsequent site visits re-assessing the catchment condition and land-use, and modifying the data sheet if conditions have changed in the interim period.

1 PHOTOGRAPHIC RECORD

Photographs of the upstream and downstream views need to be taken when the site is first assessed. Bank to bank or specific features (e.g. riffle) may also be photographed. Photographs of subsequent site visits may be included if desired. These photographs will be available for viewing in the Rivers Database.

2 CONDITION OF LOCAL CATCHMENT

Indicate using the rating scale the land-use(s) present within and beyond the riparian zone of the river. If this is not easily determined or absent, approximate for 10 m width.

Rating Scale
0 - None: none in vicinity of site, no discernible impact.
1 - Limited: limited to a few localities, impact minimal.
2 - Moderate: land-use generally present, impact noticeable.
3 - Extensive: land-use widespread, impact significant, small areas unaffected.
4 - Entire: land-use 100% in area, impact significant.

Indicate the potential impact of each land-use on river health.

Indicate the level of confidence for each land-use present: high, medium or low. High confidence would be based on the assessor having a thorough knowledge and understanding of the site and area of at least 5 kilometres upstream. Low confidence would be based on the assessor having knowledge based on the site visit only and some supplementary information such as land-use (NLC 2000, http://www.csir.co.za/environmentek/nlc2000).

Provide comments on the distance upstream or downstream if relevant, and on the time since a disturbance, e.g. livestock watering.

Note: 1) Afforestation refers to exotic forest plantations.

2) Agriculture has been split to account for crops, livestock and irrigation.

3) Impoundment refers to dams but also includes diversion weirs, farm dams, etc.

4) Wilderness area refers to an area with limited anthropogenic modification(s) but which is not officially a nature conservation area.

5) Disturbance by wildlife refers to trampling associated with wildlife watering, similar to livestock watering.

3 CHANNEL CONDITION - IN-CHANNEL AND BANK MODIFICATIONS

Using the same rating scale as for 3.2, indicate the extent of in-channel and bank modifications affecting the site and estimate the distance upstream or downstream if appropriate. If the modification is at the site, distance will be zero. Provide comments of relevance such as presence of a fish ladder, height of dam/weir wall, etc.

4 INDEX OF HABITAT INTEGRITY

Within the RHP the Index of Habitat Integrity (IHI, Kleynhans 1996) is applied on a site basis. It aims to assess the number and severity of anthropogenic perturbations on a river and the damage they potentially inflict on the habitat integrity of the system. These disturbances include abiotic factors, such as water abstraction, weirs, dams, pollution and dumping of rubble, and biotic factors, such as the presence of alien plants and aquatic animals which modify habitat. The emphasis in the present assessment is placed on the field-based site assessment, supplemented, where possible, with information gleaned from other sources such as catchment study reports, Integrated Strategic Plans (ISPs) of DWAF per Water Management Area, Ecological Reserve Studies (which may include aerial video material for the river), the land cover database for South Africa (NLC 2000), together with local knowledge. It should be noted that any site-based assessment will lack longitudinal continuity and therefore may not adequately reflect the habitat integrity of the river. Aspects considered in the assessment comprise those instream and riparian zone perturbations regarded as primary causes of degradation of a river ecosystem. The severity of each of these impacts is assessed, using scores as a measure of impact (Table 2).

The assessor must assign a confidence level (high, medium or low) to each criterion based on his/her knowledge of the site and catchment. High confidence would be based on the assessor having a thorough knowledge and understanding of the site and area of at least 5 kilometres upstream. Low confidence would be based on the assessor having knowledge based on the site visit only and some supplementary information (e.g. land cover). Whilst it is near impossible to remove all subjectivity involved in making Index of Habitat assessments, descriptions of each criterion are provided to assist with the assessment (Table 3).

Table 2. Summary of the scoring procedures used to determine the Index of Habitat Integrity.

Impact Class	Description	Score
None	No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability is limited.	1 - 5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are fairly limited.	6 - 10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not affected.	11 - 15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.	16 - 20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21 - 25

Weightings and calculation of instream and riparian status

Once a score has been allocated to an impact, it is moderated by a weighting system, devised by Kleynhans (1996, 1999a). Assignment of weights is based on the relative threat of the impact to the habitat integrity of the riverine ecosystem. The total score for each impact is equal to the assigned score multiplied by the weight of that impact (Table 4).

Based on the relative weights of the criteria, the impacts of each criterion are estimated as follows: Rating for the criterion /maximum value (25) x the weight (percent). Example: for a criterion which receives a rating of 10 in the assessment, with a weighting of 14, the impact score is calculated as follows: 10/25 x 14 = 5.6

The estimated impacts of all criteria calculated in this way are summed, expressed as a percentage and subtracted from 100 to arrive at a present status score for the instream and riparian components, respectively. The Index of Habitat Integrity scores (%) for the instream and riparian zone components are then used to place these two components into a specific class. These classes are indicated in Table 5.

Table 3. Descriptions of criteria used in the IHI assessment (Kleynhans 1996).

Criterion	Description
Water abstraction	Direct abstraction from within the specified river/river reach as well as upstream (including tributaries) must be considered (excludes indirect abstraction by for example exotic vegetation). The presence of any of the following can be used as an indication of abstraction: cultivated lands, water pumps, canals, pipelines, cities, towns, settlements, mines, impoundments, weirs, industries. Water abstraction has a direct impact on habitat type, abundance and size; is implicated in flow, bed, channel and water quality characteristics; and riparian vegetation may be influenced by a decrease in water quantity.
Extent of inundation	Destruction of instream habitat (e.g. riffle, rapid) and riparian zone habitat through submerging with water by, for example, construction of an in-channel impoundment such as a dam or weir. Leads to a reduction in habitat available to aquatic fauna and may obstruct movement of aquatic fauna; influences water quality and sediment transport.
Water quality	The following aspects should be considered; untreated sewage, urban and industrial runoff, agricultural runoff, mining effluent, effects of impoundments. Ranking may be based on direct measurements or indirectly via observation of agricultural activities, human settlements and industrial activities in the area. Water quality is aggravated by a decrease in the volume of water during low or no flow conditions.
Flow modification	This relates to the consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow such as an increase in duration of low flow season can have an impact on habitat attributes, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed modification	This is regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment. The effect is a reduction in the quality of habitat for biota. Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation is also included. Extensive algal growth is also considered to be bed medication.
Channel modification	This may be the result of a change in flow which alters channel characteristics causing a change in instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Presence of exotic aquatic fauna	The disturbance of the stream bottom during exotic fish feeding may influence, for example, the water quality and lead to increased turbidity. This leads to a change in habitat quality.
Presence of exotic macrophytes	Exotic macrophytes may alter habitat by obstruction of flow and may influence water quality. Consider the extent of infestation over instream area by exotic macrophytes, the species involved and its invasive abilities.
Solid waste disposal	The amount and type of waste present in and on the banks of a river (e.g. litter, building rubble) is an obvious indicator of external influences on stream and a general indication of the misuse and mismanagement of the river.
Decrease of indigenous vegetation from the riparian zone	This refers to physical removal of indigenous vegetation for farming, firewood and overgrazing. Impairment of the riparian buffer zone may lead to movement of sediment and other catchment runoff products (e.g. nutrients) into the river.
Exotic vegetation encroachment	This excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Encroachment of exotic vegetation leads to changes in the quality and proportion of natural allochthonous organic matter input and diversity of the riparian zone habitat is reduced.
Bank erosion	A decrease in bank stability will cause sedimentation and possible collapse of the river bank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or encroachment of exotic vegetation.

Table 4. Instream and riparian criteria used to develop the Index of Habitat Integrity. Each criterion is weighted (Kleynhans 1996).

Instream Criteria	Wgt	Riparian Zone Criteria	Wgt
Water abstraction	14	Water abstraction	13
Extent of inundation	10	Extent of inundation	11
Water quality	14	Water quality	13
Flow modification	7	Flow modification	7
Bed modification	13		
Channel modification	13	Channel modification	12
Presence of exotic macrophytes	9		
Presence of exotic fauna	8		
Solid waste disposal	6		
		Decrease of indigenous vegetation from the riparian zone	13
		Exotic vegetation encroachment	12
		Bank erosion	14

Table 5. Habitat Integrity classes (from Kleynhans 1999).

Class	Description	Score (% Of Total)
A	Unmodified, natural.	90 - 100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place, but the assumption is that ecosystem functioning is essentially unchanged.	80 - 89
C	Moderately modified. A loss or change in natural habitat and biota has occurred, but basic ecosystem functioning appears predominately unchanged.	60 - 79
D	Largely modified. A loss of natural habitat and biota and a reduction in basic ecosystem functioning is assumed to have occurred.	40 - 59
E	Seriously modified. The loss of natural habitat, biota and ecosystem functioning is extensive.	20 - 39
F	Modifications have reached a critical level and there has been an almost complete loss of natural habitat and biota. In the worst cases, the basic ecosystem functioning has been destroyed.	0 - 19

A spreadsheet model to calculate the IHI is available from the author of the model (Email: KleynhansN@dwaf.gov.za).

5 CHANNEL MORPHOLOGY

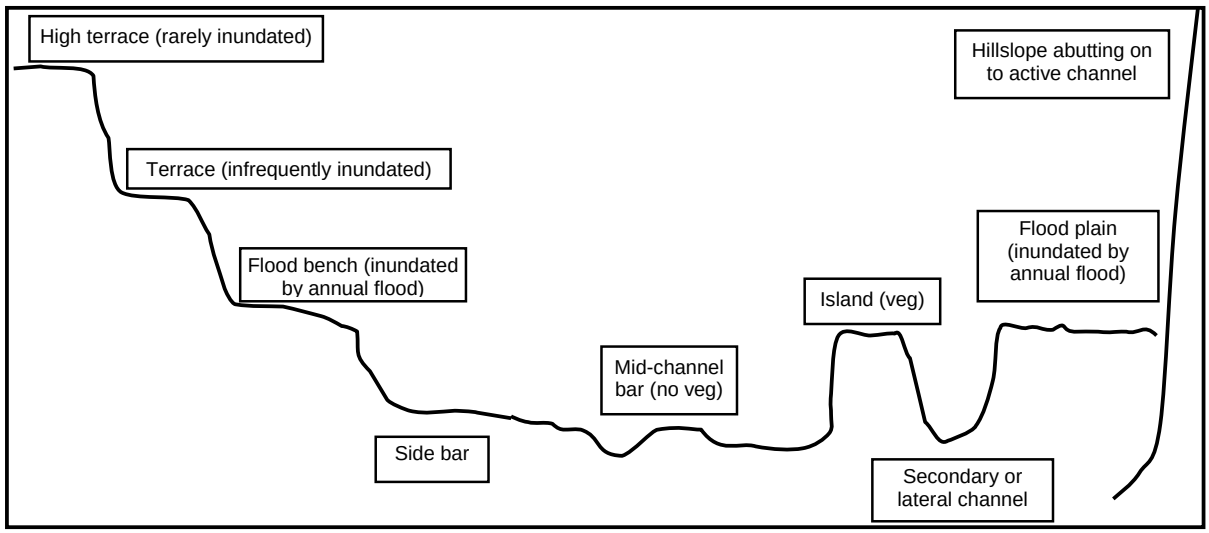
Channel type: River channels may be classified into two broad types: bedrock channels and alluvial channels (Rowntree and Wadeson 1999, 2000), with a mixture also occurring.

- *Bedrock*: bedrock bed
- *Mixed bedrock and alluvial*: mixture of bedrock and alluvial beds, with dominant bed material(s) of sand, gravel, cobble and/or boulder.
- *Alluvial with dominant type(s)*: alluvial bed, with dominant bed material(s) of sand, gravel, cobble and/or boulder.

Using the cross-sectional diagram (Figure 1), indicate the presence of each feature on the left and right-hand banks of the site. Features are described below.

- *High terrace (rarely inundated):* relict floodplains which have been raise above the level regularly inundated by flooding due to lowering of the river channel.
- *Terrace (infrequently inundated):* area raised above the level regularly inundated by flooding.
- *Flood bench (inundated by annual flood):* area between active and macro-channel, usually vegetated.
- *Side bar:* accumulations of sediment associated with the channel margins or bars forming in meandering rivers where erosion is occurring on the opposite bank to the bar.
- *Mid-channel bar:* single bar(s) formed within the middle of the channel; flow on both sides.
- *Island (vegetated)*: island formed within the middle of the channel that is vegetated; flow on both sides.
- *Secondary or lateral channel:* a second channel that flows adjacent to the primary channel.
- *Flood plain (inundated by annual flood):* a relatively level alluvial (sand or gravel) area lying adjacent to the river channel which has been constructed by the present river in its existing regime.
- *Hillslope abutting on to the active channel*

Figure 1 Cross-sectional diagram showing relevant channel features.



GUIDELINE FOR SECTION C: FIELD-BASED DATA FOR EACH SITE VISIT

1 GENERAL SITE VISIT INFORMATION

Water level at time of sampling: Note - the active channel is the channel that is regularly inundated such that channel form is maintained and is free of established terrestrial vegetation.

Water level	Description
Dry	No water flowing.
Isolated pools	Pools that have a trickle of water between them, but no evident flow.
Low flow	Water well within the active channel; water probably not touching the riparian vegetation.
Moderate flow	Water within the active channel; water likely to be touching riparian vegetation in places.
High flow	Water filling the active channel; water completely into riparian vegetation.
Flood	Water above active channel.

Velocity and discharge estimates: Optional measurement of water surface width and stream velocity for the calculation of discharge. Measure velocity at 1 metre intervals across the stream/river, recording each associated depth (m).

Significant rainfall in last week: Indicate the presence and extent of any rainfall event preceding the site visit that is likely to have raised the water level. Rainfall data may be obtained from the South African Weather Service (http://www.weathersa.co.za/). Recent rainfall maps may be viewed at http://www.weathersa.co.za; for long-term records send an E-mail to info2@weathersa.co.za and give the latitude and longitude of the locality. The bureau will send a list of nearby stations, if any, from which you can choose the most relevant.

Canopy Cover: Estimate the extent of cover of riparian vegetation over the stream: Open, Partially open or Closed canopy.

Impact on channel flow: Organic debris, either from upstream imported during flood events or local, can impede the flow of water in the river and alter stream habitat. Rate impacts on a scale of 0 to 3, as follows: 0 - no impact, 1 - limited impact, 2 - extensive impact, 3 - channel blocked.

Water chemistry – data should be recorded in this section if doing the full RHP assessment.

Instrument positioning: Instruments should be positioned in clearly-flowing points of the river where possible, otherwise location of meter and hydraulic biotope type be specified.

Samples collected? Details of the filtering, freezing, preservation and analysis method should be recorded, as well as the institute responsible for analysing the sample.

Variables measured: pH, conductivity, temperature, dissolved oxygen, % O_2 saturation are routinely measured. The value and units should be recorded.

Water turbidity: Indicate the "colour" and degree of visibility through water column or of the riverbed (it is more difficult to assess substratum composition if the river is turbid).

- *Clear:* water transparent, riverbed visible.
- *Discoloured:* water clear, but with a definite tinge to it, usually brown, green or cloudy (riverbed still visible).
- *Opaque:* water cloudy, riverbed not visible.
- *Silty:* usually after a rainfall event, when silt loads are elevated.

Record turbidity (NTUs) if a turbidity meter is used; record Secchi depth (m) if a Secchi disc is used.

2 STREAM DIMENSIONS

Estimate the width of the macro-channel, active-channel and water surface width, and the height of the left and right bank using the categories provided.

Macro-channel width: The outer channel of a compound channel; bank top is well above "normal" flood levels but may be inundated infrequently (e.g. once in 20 years).

Active channel width: The area of the channel(s) that has been inundated at sufficiently regular intervals to maintain channel form and to keep the channel free of established terrestrial vegetation.

Water surface width: The width of wetted section of the river from bank to bank at 90^{o} to the direction of flow (i.e. the actual water width).

Bank height: The height from surface of water to top of bank. Estimate left (facing downstream) and right banks separately.

Deep-water physical biotope: Average depth of dominant deep-water area that is > 0.5 m deep (e.g. pool or deep run). The average is a rough estimate. Record the type of biotope e.g. pool, backwater, etc.

Shallow-water physical biotope: Average depth of dominant shallow-water area that is < 0.5 m deep (e.g. riffle, run). Record the type of biotope e.g. cobble riffle, bedrock rapid, cascade, etc.

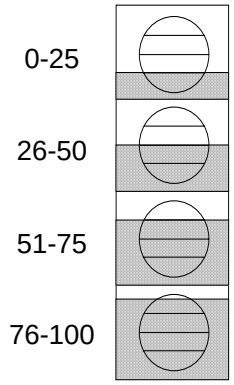
3 SUBSTRATUM COMPOSITION

Estimate the abundance of each substrate type for the stream bed and bank using the following scale: 0 – absent; 1 – rare; 2 – sparse; 3 – common; 4 - abundant; 5 – entire. Size classes for each substratum type have been modified from the Wentworth grade scale and are given below. Units are in mm.

Material	Size class (mm)
Bedrock	
Boulder	> 256
Cobble	100 – 256
Pebble	16 – 100
Gravel	2 – 16
Sand	0.06 – 2
Silt / mud / clay	< 0.06

Degree of embeddedness of substratum (%):

This refers to the deposition of fine grains around coarse particles (e.g. sand around cobbles). Estimate the extent to which boulder/cobble/gravel particles are embedded in the surrounding fine sediments such as small gravel, sand, silt and/or mud.



4 INVERTEBRATE BIOTOPES

Record the **general river make-up**, i.e. pool, run, riffle or a combination thereof. This provides an indication of biotope diversity.

Biotopes have been grouped into two types, namely SASS biotopes and specific biotopes. They relate to the type of habitat available for habitation by aquatic organisms as well as the hydraulic conditions in some instances. SASS biotopes are based on those described in the SASS5 protocol (Dickens and Graham 2002). For stones in and out of current, it is important to record if the substrate is bedrock.

Estimate the abundance of each SASS and specific biotope type using the following scale: 0 – absent; 1 – rare; 2 – sparse; 3 – common; 4 - abundant; 5 – entire. *Specific biotopes* provide further details of the types of biotope within each SASS biotope. Descriptions of some of these have been extracted from Rowntree and Wadeson (1999, 2000). Details of the biotopes are given below:

SASS biotopes		Description
Stones In Current	SIC	Stones in flowing water, may include bedrock
Stones Out Of Current	SOOC	Stones out of any perceptible current (with visible silt seen accumulating on stone surfaces), may include bedrock
Marginal Vegetation In Current	MV-IC	Emerged and submerged vegetation in fast current; at the river's edge or on the edge of in-channel islands
Marginal Vegetation Out Of Current	MV-OC	Emerged and submerged vegetation out of any perceptible current; at the river's edge or on the edge of in-channel islands
Aquatic Vegetation	AQV	Submerged or partially submerged vegetation within the channel, normally in flowing water
Gravel	G	Stones <2cm in diameter
Sand	S	Sand grains <2mm in diameter
Silt/mud/clay	M	Particles <0.06mm in diameter

SASS Biotope	Specific biotope	Description
SIC	Riffle	Occur over coarse alluvial substrates from gravel to cobble; undular standing waves or breaking standing waves.
	Run	Occur over any substrate e.g. gravel, cobble, boulder; ripple flow but surface of water not broken.
	Boulder rapid	A rapid-like feature made up of large immobile boulders.
	Bedrock	Large sheets of rock.
	Chute	Typically occur in boulder or bedrock channels where flow is being funneled between macro bed elements; smooth boundary turbulent flow exhibiting flow acceleration.
	Cascade	Occur over a substrate of boulder or bedrock. Small cascades may occur in cobble where the bed has a stepped structure due to cobble accumulations. Free falling flow, contact with substrate largely maintained
SOOC	Backwater	A morphologically defined area along-side but physically separated from the channel, connected to it at its downstream end; barely perceptible or no flow.
	Slackwater	An area of no perceptible flow which is hydraulically detached from the main flow but is within the main channel; barely perceptible or no flow.
	Pool	An area with direct hydraulic contact with upstream and downstream water; barely perceptible flow.
	Bedrock	Large sheets of rock.
MV		Grasses, reeds, shrubs, sedges, etc. which are adjacent to the river bank. Also includes floating macrophytes such as water hyacinth, parrot's feather, etc.
AQV		Sedges, moss, trailing grasses, filamentous algae, etc. which are submergent or partially submergent, normally in flowing water.
GSM		Gravel, sand or mud present in backwater, slackwater and/or in-channel, i.e. in main flowing part of the channel.

5 INVERTEBRATES - SASS (SOUTH AFRICAN SCORING SYSTEM) ASSESSMENT

Note: do not complete details (shaded section) on SASS sheet if doing a full RHP assessment. The standard SASS5 sampling protocol is to be used (Dickens and Graham 2002). The procedure is as follows:

- Kick stones in current (SIC) and bedrock for 2 minutes if stones are loose, maximum 5 minutes if stones immovable. Note that the above times refer to actual kicking time, and not to time spent crossing the river.
- Kick stones out of current (SOOC) and bedrock for 1 minute.
- Samples collected both in and out of current are combined into a single Stones (S) biotope sample.
- A total length of approximately two meters of vegetation must be sampled, spread over one or more locations, especially where different kinds of marginal vegetation are present (e.g.

reeds plus grasses) in different flow velocities, and aquatic vegetation for a $1m^2$ area.

- Samples collected in and out of current and aquatic vegetation are combined into a single Vegetation (Veg) biotope sample.
- Stir and sweep gravel, sand, mud (GSM) (both in and out of current) for 1 minute total.
- Samples collected in and out of current are combined into a single Gravel, Sand & Mud (GSM) biotope sample.
- Hand picking and visual observation for 1 minute - record in biotope where found (by circling estimated abundance on score sheet).

For each of the 3 major biotopes (Stones, Veg, GSM), tip net contents into tray, remove leaves and twigs, score for 15 minutes per biotope but stop if no new taxa seen after 5 minutes. Estimate abundances as follows: 1 = 1, A = 2-10, B = 10-100, C = 100-1000, D = >1000.

6 INVERTEBRATE BIOTOPES SAMPLED - INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

IHAS attempts to account for the variability in the amount and quality of SASS biotopes which are sampled by the SASS practitioner. This modified version is based on that of McMillan (1998) but has been reduced to include “Habitats Sampled” only. The “Stream Characteristics” components have been excluded since these data are captured elsewhere in the RHP field-data sheet. The scoring system has also been omitted as the method still requires validation.

The aim of the present IHAS assessment is to record details about the SASS biotopes sampled, both to provide immediate information on SASS biotopes assessed and to begin the process of testing and validating the method. In the present version habitats have been divided into stones in current, vegetation and other (stones out of current, gravel, sand, mud). Several aspects are assessed in each and in each case the appropriate number/description is circled.

7 FISH

Fish habitat segments

The reference unit is the fish habitat segment (Kleynhans 1999b), that refers to a portion of a stream in which the fish community remains “generally homogeneous due to the relative uniform nature of the physical habitat” (Ramm 1988). The boundaries of a fish habitat segment can be expected to vary according to the temporal and spatial variability (natural and human-induced) of environmental conditions in a segment. The purpose of defining fish habitat segments are to provide a basis that can be used to specify reference biological conditions in such segments with regard to the indigenous fish species that can be expected to occur, their frequency of occurrence and general health and well-being. In addition, it is potentially possible to define reference habitat conditions that can be expected to occur at a broad level.

Normally, fish sampling should be done during low flow conditions (base flow conditions, usually during the dry season).

FISH HABITATS

Record the general fish habitats available, i.e. slow-deep, slow-shallow, fast-deep and fast-shallow that relate to the broad hydraulic conditions that may be available for different fish species (Kleynhans 1999b, Jordanova *et al.* 2004).

For each velocity-depth class, the presence of features that provide cover for fish (i.e. refuge from high flow velocity, predators, high temperatures, etc.) are taken into consideration (Kleynhans 1999b):

- **Overhanging vegetation:** Thick vegetation overhanging water by approximately 0.3 m and not more than 0.1 m above the water surface. Marginal vegetation is included here.
- **Undercut banks and root wads:** Banks overhanging water by approximately 0.3 m and not more than 0.1 m above the water surface.

- **Stream substrate:** Various substrate components (rocks, boulders, cobbles, gravel, sand, fine sediment and woody debris "snags") that provide cover for fish.
- **Aquatic macrophytes:** Submerged and emergent water plants are included.
- **Water column:** Where there is sufficient water depth, the water column will also function as cover (e.g., in terms of lessening predation from aerial predators).

The relative abundance of both the velocity-depth classes and the cover classes are estimated according to the following guideline: 0=absent; 1=rare; 2=sparse; 3=common; 4=abundant, 5=very abundant.

Fish habitat (velocity-depth class)	Description
Slow (<0.3 m/s), shallow (<0.5 m)	This includes shallow pools and backwaters. A small seine net (5 m long, 1.5 m deep, mesh size = 1 mm) is usually used to sample fish. In some instances, an electrical shocking apparatus (AC) can be used. Capture results are recorded as number of fish caught during each effort with a net, or the number of fish caught per time unit (minutes) with an electroshocker.
Slow (<0.3 m/s), deep (>0.5 m)	This includes deep pools and backwaters. A large seine net (e.g. 70 m long, 1.5 m deep, mesh size 2.5 cm) can be used. A cast net (e.g. diameter = 1.85 m, mesh size = 2.5 cm) can be used in pools not suitable for beach seining. Capture results are recorded as number of fish caught during each effort.
Fast (>0.3 m/s), shallow (<0.3 m)	Shallow runs, rapids and riffles fall in this category. An electrical shocking apparatus is used in these habitat types. Capture results are recorded as number of fish caught per time unit (minutes).
Fast (>0.3 m/s), deep (>0.3 m)	Deep runs, rapids and riffles fall under this category. An electrical shocking apparatus is used in these habitat types. Capture results are recorded as number of fish caught per time unit (minutes).

Sampling effort and results are reported per velocity-depth class sampled. However, where the mosaic of velocity-depth classes makes it difficult or impossible to do this (e.g. combinations of fast-deep and fast-shallow classes), the dominant velocity-depth class should be used as the unit of reference for sampling effort, but the presence of other velocity-depth classes should also be indicated.

All species sampled are counted and anomalies such as tumours, external parasites and other abnormalities are indicated. Although fish length is usually not measured, age groups can roughly be categorized according to juveniles and adults. The presence of ripe-running individuals can also be noted.

Although guidelines for representative sampling at a site needs specification for streams of different sizes and different fish species richness, sampling at sites in the Crocodile River followed the following general approach:

- Standard electro-shocking effort: > 20 minutes per site (i.e. time electricity actually applied in the water).
- Standard small seine (see above) net effort: 2 efforts per site.
- Standard large seine (see above) net effort: 3 efforts per site.
- Cast net (see above) effort: 20 throws per site.

Other fish sampling methods (e.g., fish traps and fish fykes) can be used where suitable. Destructive sampling methods such as fish poisons and gill nets are not used. It is important to note that not necessarily all velocity-depth classes are present or possible to sample at a site, and that not all sampling methods and apparatus are necessarily applied at a site.

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Appendix A: Version 1 – 03/2005

RIVER HEALTH PROGRAMME:

SITE CHARACTERISATION FIELD-DATA SHEETS

RIVER HEALTH PROGRAMME: FIELD-DATA SHEETS

Assessor Name(s)			
Organisation		Date	/ /

NB: An explanation of the terminology used in the field-data sheets is given in the associated River Health Programme - Site Characterisation field-manual.

SECTION A: SITE INFORMATION (to be filled in before or during initial visit to site)

1. GENERAL SITE INFORMATION

Site information - assessed at the site

RHP Site Code		Project Site Number	
River		Tributary of	

Latitude and longitude co-ordinates:

Degrees-minutes-seconds	or Decimal degrees	or Degrees & decimal minutes	
S ° ' "	S . °	S ° . '	Cape datum Clarke 1880
E 0 ° ' "	E 0 . °	E 0 ° . '	WGS-84 datum HBH94

Site Description							
Map Reference (1: 50 000)		Site Length (m)		Altitude (m)			
Longitudinal Zone	Source zone	Mountain headwater stream	Mountain stream	Transitional	Upper foothill	Lower foothill	Lowland river
	Rejuvenated cascades (gorge)	Rejuvenated foothill	Upland floodplain	Other:			
Hydrological Type: "natural"		Perennial	Seasonal	Ephemeral			
Hydrological Type: "present-day"		Perennial	Seasonal	Ephemeral			
Associated Systems:	Wetland	Estuary	Other:		Distance:		
Additional Comments:							

Desktop / spatial information – data used for classifying a site and subsequent querying of data

Political Region			Water Management Area				
Ecoregion I			Ecoregion II				
Secondary Catchment			Quaternary Catchment				
Water Chemistry Management Region							
Vegetation Type			Geological Type				
Contour Range (m): From: to:							
Source Distance (km)			Stream Order				
Rainfall Region	Summer	Winter	Aseasonal	Other:			
DWAF Gauging Station	Yes	No	Code:		Distance Upstream		Or Downstream

2. LOCATION DETAILS

Sketch a map of the site showing the following details: scale, north, access to site, roads, bridges/crossings, gauges/ instream barriers, buildings, flow direction. Record the following:

Location and Landowner Detail:				Contact No.:	
				Notify Owner?	yes / no
Permit Required?	yes	no	Details:		
Key Needed?	yes	no	Details:		
Farm Name:			Farm Reg. Code:		
Comments:					

SECTION B. CATCHMENT CONDITION AND LAND-USE (to be checked on each visit to site)

Assessor Name(s)			
Organisation			
Date	/ /	Time	

1. PHOTOGRAPHIC RECORD

		Photograph Number	Comments
Photographs	Upstream		
	Downstream		
	Bank to bank		
	Specific features		

2. CONDITION OF LOCAL CATCHMENT - Rate extent (land-use) or impact on a scale of 0 to 4: 0–none; 1–limited; 2–moderate; 3–extensive; 4-entire. Indicate level of confidence: High (H), medium (M) or low (L).

Land-use	Within riparian zone	Beyond riparian zone	Potential impact on River Health	Level of confidence (H,M,L)	Comments (e.g. distance upstream/downstream, time since disturbance, etc.)
Afforestation - general					
Afforestation - felled area					
Agriculture - crops					
Agriculture - livestock					
Agriculture - irrigation					
Alien vegetation infestation					
Aquaculture					
Construction					
Roads					
Impoundment (weir/dam)					
Industrial Development					
Urban Development					
Rural Development					
Informal settlement					
Recreational					
Sewage Treatment Works					
Nature Conservation				N/A	
Wilderness Area				N/A	
Litter/debris					
Disturbance by wildlife					
Other:					

3. CHANNEL CONDITION (In-channel and bank modifications) - Rate impacts on a scale of 0 to 4: 0–none; 1–limited; 2–moderate; 3–extensive; 4-entire

In-channel and bank modifications	Upstream		Downstream		Comments
	Impact score	Distance	Impact score	Distance	
Bridge – elevated; in channel supports					
Bridge – elevated; side channel supports					
Causeways / low-flow bridges					
Bulldozing					
Canalisation – concrete / gabion					
Canalisation – earth / natural					
Gabions / reinforced bank					
Fences – in channel					
Gravel, cobble and/or sand extraction					
Roads in riparian zone - tar					
Roads in riparian zone - gravel					
Dams (large)					
Dams (small) / weir					
Other:					

4. INDEX OF HABITAT INTEGRITY - Rate impacts on a scale of 0 to 25: 0 - none, 1 to 5 - limited, 6 to 10 - moderate, 11 to 15 - extensive, 16 to 20 - extreme, 21 to 25 - critical (see manual for explanation). Indicate level of confidence: High (H), medium (M) or low (L).

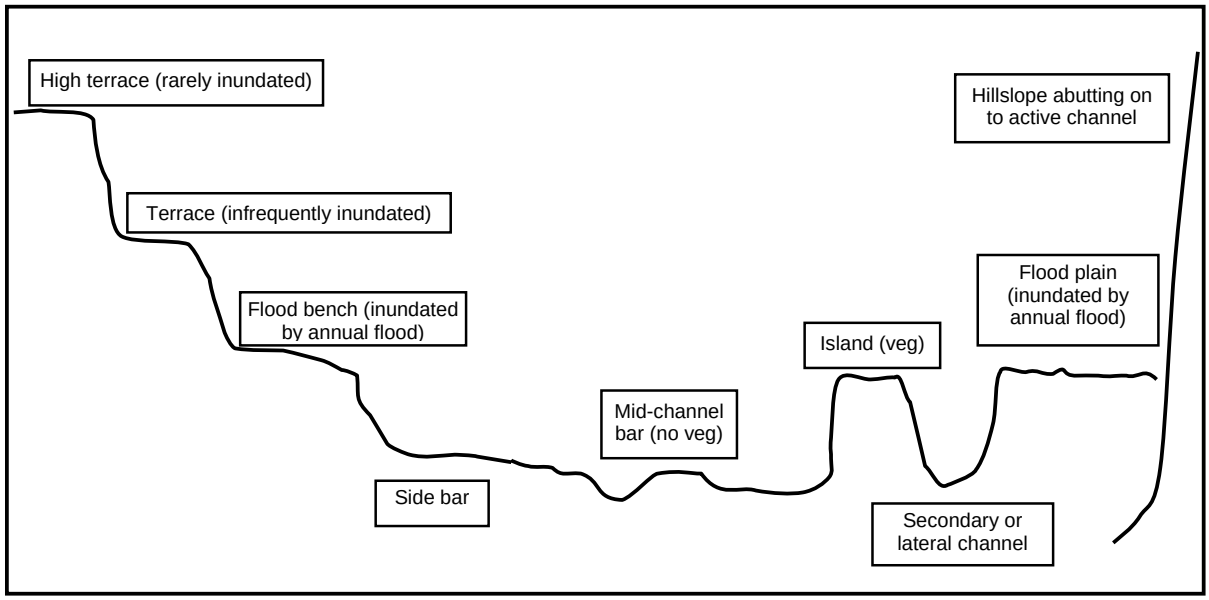
CRITERION	Score	Level of confidence (H,M,L)	Comment
INSTREAM			
Water abstraction (presence of pumps, irrigation etc.)			
Extent of inundation			
Water quality (clarity, odour, presence of macrophytes etc.)			
Flow modifications			
Bed modification (bulldozing of bed)			
Channel modification			
Presence of exotic macrophytes			
Presence of exotic fauna (e.g. fish)			
Presence of solid waste			
RIPARIAN ZONE			
Water abstraction (presence of pumps, irrigation etc.)			
Extent of inundation			
Water quality (clarity, odour, presence of macrophytes etc.)			
Flow modifications			
Channel modification			
Decrease of indigenous vegetation from the riparian zone			
Exotic vegetation encroachment			
Bank erosion			

5. CHANNEL MORPHOLOGY

Channel type: tick channel type indicating dominant type(s)				
Bedrock				
Mixed bedrock and alluvial - dominant type(s)	sand	gravel	cobble	boulder
Alluvial with dominant type(s)	sand	gravel	cobble	boulder

Indicate the cross-sectional features present on the left and/or right banks (see diagram below) – Note Left Bank is when looking downstream.

Cross Sectional Feature	Left Bank	Right Bank
High terrace (rarely inundated)		
Terrace (infrequently inundated)		
Flood bench (inundated by annual flood)		
Side bar		
Mid-channel bar (no vegetation)		
Island (vegetation)		
Secondary or lateral channel		
Flood plain (inundated by annual flood)		
Hillslope abutting onto active channel		



SECTION C: FIELD-BASED DATA FOR EACH SITE VISIT

1. GENERAL SITE VISIT INFORMATION

Assessor Name(s)			
Organisation			
Date	/ /	Time	

Water level at time of sampling -tick appropriate category

Dry	Isolated pools	Low flow	Moderate flow	High flow	Flood

Velocity and discharge estimates - optional

Horizontal distance (m)						
Velocity (ms^{-1})						
Depth (m)						
Water surface width (m):		Discharge (m^3s^{-1}):				

Significant rainfall in the last week? - i.e. likely to have raised the water level

Yes	No	Comment:

Canopy Cover -tick appropriate category

Open	Partially Open	Closed	Comment:

Impact on stream habitat - Rate impacts on a scale of 0 to 3: 0 – no impact; 1- limited impact; 2 – extensive impact; 3 – channel blocked

	Score	Source: local / upstream
Coarse woody debris		
Other:		

Water chemistry data – Recording of the *in situ* measurements is also included in the SASS5 data-sheet – please complete here if doing the full RHP assessment. Instruments should be positioned in the clearly-flowing points on the river where possible.

Instruments in fast flow?	Yes	No	If no, where:	
Samples collected?	Yes	No	Date sent for analysis?	
Water filtered?	Yes	No	Volume filtered (mL):	
Samples frozen?	Yes	No	Other preservation?	
Name of institution to which samples were sent:				

Variable	Value	Units
pH		
Conductivity		
Temperature		
Dissolved Oxygen ($mgLl^{-1}$)		
Percentage O_2 Saturation		

Water turbidity - tick appropriate category

Clear	Discoloured	Opaque	Silty	Comment:
Turbidity (if measured (NTUs)				
Secchi Depth (m)				

2. STREAM DIMENSIONS - estimate widths and heights by ticking the appropriate categories; estimate average depth of dominant deep and shallow water biotopes.

(m)	< 1	1-2	2-5	5-10	10-20	20-50	50-100	>100
Macro-channel width								
Active-channel width								
Water surface width								

Bank height – Active channel			
(m)	< 1	1-3	>3
Left Bank			
Right Bank			

Dominant physical biotope	Average Depth (m)	Specify physical biotope type
Deep-water (>0.5m) physical biotope (e.g. pool)		
Shallow-water (<0.5m) physical biotope (e.g. riffle)		

3. SUBSTRATUM COMPOSITION - Estimate abundance of each material using the scale: 0 – absent; 1 – rare; 2 – sparse; 3 – common; 4 - abundant; 5 - entire

Material	Size class (mm)	Bed	Bank
Bedrock			
Boulder	> 256		
Cobble	100 – 256		
Pebble	16 – 100		
Gravel	2 – 16		
Sand	0.06 – 2		
Silt / mud / clay	< 0.06		

Degree of embeddedness of substratum (%)
0-25
26-50
51-75
76-100

4. INVERTEBRATE BIOTOPES (present at a site compared to those actually sampled)

Summarised river make up: ('pool'=pool only; 'run' only; 'riffle/rapid' only; '2mix'=2 types, '3mix'=3 types)				
pool	run	Riffle/rapid	2 mix	3 mix

Rate abundance of each SASS and specific biotope present at a site using the scale: 0 – absent; 1 – rare; 2 – sparse; 3 – common; 4 - abundant; 5 – entire. Add additional specific biotopes if necessary.

		Specific Biotope					
SASS Biotope	Rating		Rating		Rating		Rating
Stones in current		Riffle		Run		Boulder rapid	
		Chute		Cascade		Bedrock	
Stones out of current		Backwater		Slackwater		Pool	
		Bedrock					
Marginal vegetation in current		Grasses		Reeds		Shrubs	
		Sedges					
Marginal vegetation out of current		Grasses		Reeds		Shrubs	
		Sedges					
Aquatic vegetation		Sedges		Moss		Filamentous algae	
Gravel		Backwater		Slackwater		In channel	
Sand		Backwater		Slackwater		In channel	
Silt/mud/clay		Backwater		Slackwater		In channel	

5. SASS Version 5 Score Sheet - Note: do not complete details (shaded area) on SASS sheet if doing a full RHP assessment

Version date: Feb 2005

Date:	/ /																
RHP Site Code:	-																
Collector/Sampler:																	
River:																	
Level 1 Ecoregion:																	
Quaternary Catchment:																	
	Temp (°C):																
Site Description:	**pH:**																
	DO (mg/L):																
	Flow:																
	Riparian Disturbance:																
	Instream Disturbance:																

				(dd.ddddd)	
Grid reference (dd mm ss.s)	**Lat:**	**S**			
	Long:	**E**			
Datum (WGS84/Cape):					
Altitude (m):				**m**	
Zonation:					
	Cond (mS/m)				
	Clarity (cm):				
	Turbidity:				
	Colour:				

Biotopes Sampled	**Rating (1 - 5)**	**Time (min)**
Stones In Current (SIC)		
Stones Out Of Current (SOOC)		
Bedrock		
Aquatic Veg		
MargVeg In Current		
MargVeg Out Of Current		
Gravel		
Sand		
Mud		
Hand picking/Visual observation		

Taxon		**S**	**Veg**	**GSM**	**TOT**
PORIFERA (Sponges)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda	13				
Potamonautidae* (Crabs)	3				
Atyidae (Shrimps)	8				
Palaemonidae (Prawns)	10				
HYDRACARINA (Water mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6				
Baetidae > 2 sp	12				
Caenidae (Squaregills/Cainfles)	6				
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13				
Leptophlebiidae (Prongills)	9				
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T	10				
Chlorocyphidae	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4				
Lestidae (Emerald Damselflies)	8				
Platycnemidae (Brook Damselflies)	10				
Protoneuridae	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6				
Libellulidae (Darters)	4				
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (=Pyralidae)	12				

Taxon		**S**	**Veg**	**GSM**	**TOT**
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5				
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6				
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5				
Haliplidae* (Crawling water beetles)	5				
Helodidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae	10				
Psephenidae (Water Pennies)	10				

Taxon		**S**	**Veg**	**GSM**	**TOT**
DIPTERA (Flies)					
Athericidae	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5				
Chironomidae (Midges)	2				
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5				
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae	5				
Sphaeriidae (Pills clams)	3				
Unionidae (Perly mussels)	6				
SASS Score					
No. of Taxa					
ASPT					

Other biota:

Comments/Observations:

Procedure:

Kick SIC & bedrock for 2 mins, max. 5 mins. Kick SOOC & bedrock for 1 min. Sweep marginal vegetation (IC & OOC) for 2m total and aquatic veg 1m². Stir & sweep gravel, sand, mud for 1 min total. * = airbreathers

Hand picking & visual observation for 1 min - record in biotope where found (by circling estimated abundance on score sheet). Score for 15 mins/biotope but stop if no new taxa seen after 5 mins.

Estimate abundances: 1 = 1, A = 2-10, B = 10-100, C = 100-1000, D = >1000 S = Stone, rock & solid objects; Veg = All vegetation; GSM = Gravel, sand, mud SWC = South Western Cape, T = Tropical, ST = Sub-tropica

Rate each biotope sampled: 1=very poor (i.e. limited diversity), 5=highly suitable (i.e. wide diversity)

6. BIOTOPES SAMPLED - INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

This is a measure of the SASS biotopes sampled (modified from McMillan 1998). IHAS requires validation and testing but the basic data remains of value. As an interim measure certain parameters including the scoring system have been omitted. Please circle the relevant values/categories for each parameter.

SAMPLING HABITAT						
Stones in Current (SIC)						
Total length of white water (riffle/rapid) (in metres)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in metres)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's); (<2 or >20 is '<2>20'); (gravel is <2; bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment etc.) (%)	n/a	0-25	26-50	51-75	>75	
Protocol: time spent actually kicking SIC's (in minutes), (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
Vegetation						
Length of marginal vegetation sampled (river banks) (in metres)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation/algae sampled (underwater) (in metres^2)	none	0-½	>½-1	>1		
Marginal vegetation sampled in or out of current	none		In current	Out of current		both
Type of vegetation (percent leafy vegetation as opposed to stems/shoots) (aquatic vegetation only = 49%). (E.g. Mostly leafy = >75%; mostly stems/shoots = 1-25%)	none		1-25	26-50	51-75	>75
Other Habitat / General						
Stones out of current (SOOC) sampled: (in metres^2)	none	0-½	>½-1	1	>1	
Sand sampled: (in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (in minutes) (if all gravel, SIC stone size = '<2'	none	0-½	½	>½**		
Bedrock sampled: ('all'=no SIC, sand, or gravel; then SIC stone size ='>20'	none	some			all**	
Algal presence: ('1-2m^2'=algal bed; 'rocks'=on rocks; 'isol.'=isolated clumps)	>2m^2	rocks	1-2m^2	<1m^2	Isol.	none
Tray identification: (Protocol – using time: 'corr' = correct time)		under		corr		over

7. FISH

FISH HABITAT SEGMENT:	5 km sector:	

FISH HABITAT – Velocity-Depth classes and cover present at site

Estimate abundance of each velocity-depth class and cover type using the scale: 0 – absent; 1 – rare; 2 – sparse; 3 – common; 4 - abundant; 5 – very abundant

SLOW DEEP:	Slow shallow:	Fast deep:	**FAST SHALLOW:**
Overhanging vegetation:	Overhanging vegetation:	Overhanging vegetation:	Overhanging vegetation:
Undercut banks & root wads:	Undercut banks & root wads:	Undercut banks & root wads:	Undercut banks & root wads:
Substrate:	Substrate:	Substrate:	Substrate:
Aquatic macrophytes:	Aquatic macrophytes:	Aquatic macrophytes:	Aquatic macrophytes:
Water Column:	Water Column:	Water Column:	Water Column:
Remarks:	Remarks:	Remarks:	Remarks:

VELOCITY-DEPTH CLASSES SAMPLED AND EFFORT – indicate which velocity-depth classes were sampled. Where the mosaic of velocity-depth classes makes it difficult or impossible to sample classes separately (e.g. combinations of fast-deep and fast-shallow classes), the dominant velocity-depth class should be used as the unit of reference for sampling effort, but the presence of other velocity-depth classes should also be indicated.

Sampling effort	Slow deep (SD)	Slow shallow (SS)	Fast deep (FD)	Fast shallow (FS)
Dominant velocity-depth class				
Electro shocker (min)				
Small seine (mesh size, length, depth, efforts)				
Large seine (mesh size, length, depth, efforts)				
Cast net (dimensions, efforts)				
Gill nets (mesh size, length, time)				

Remarks:

FISH CAUGHT - indicate whether velocity-depth classes were combined

Habitat:	
Sampling method:	
Species	Number (J=juvenile, A=abnormality)

8. RIPARIAN VEGETATION – The relevant method and data-sheets are under development. They will be inserted when validated and ready for general use.