'State of the Rivers' Project

Report 2. Implementation Manual

By

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EXECUTIVE SUMMARY

This implementation training manual presented in this report is designed to outline a proposed scheme for implementing the 'State of the Rivers' Project. It includes the following aspects：

1. It suggests the establishment of a proposed organisational structure for implementation of the 'State of the Rivers' Project on a State-wide and Regional basis. A 'State-Wide' Group would be established to direct and organise and oversee the implementation with Regional Groups implementing the surveys in each catchment.

2. It explains all the steps required for planning, scheduling and implementing the methodology in a practical and simple way.

3. It provides a package for training regional staff to implement the 'State of the Rivers' Project in the form a seminar. The graphics material for the seminar is provided and the manual itself provides an explanation of all the relevant issues.

4. It provides an explanation and practical guide for the completion of the surveys and data sheets.

5. Provide a training package for the technical staff to be involved in the surveys which consists of a workshop followed by trial surveys of actual sites immediately before the start of the surveys. A 'hands on - learn as you do' approach is recommended.

6. It explains the use of the data entry, report generating, data analysis and other DBASE IV programs developed for the project including the linkage to GIS.

7. It explains the way the package can be used to support Integrated Catchment Management Programs using GIS and a hierarchical numbering system for the sub-catchment elements identified by the method.

8. It suggests the ways in which the package can be further developed during the course of the Project.

1 Introduction

This report provides a manual for implementation of the 'State of the Rivers' Project Methodology. The development of the methods are is described in an accompanying report Anderson (1993).

This manual provides a training package and outlines the procedures and steps in implementing the methodology. The reader is directed to Anderson (1993) for full details of the development of the methodology itself, the pilot survey, validation of the method, the literature review and justification for the approach taken.

The methodology that has been developed includes the following aspects:

- An overview of the aims, objectives and approach adopted for the project.
- An outline of the steps required to implement the methodology.
- Procedures for gathering the relevant information and for planning the surveys in a new catchment.
- Methods for initially sub-sectioning the rivers and streams into 'homogenous' stream sections in terms of their natural physical and ecological attributes, and their current condition.
- The design and development of the set of 11 datasheets, one for each of the major components to be used in surveying and classifying the sites Sub-catchment Element; Hydrology and Water Quality; Site Description; Reach Environs -Temporal and Spatial; Channel Habitat; Cross-sections; Bank, Bed and Bar Condition; Vegetation; Aquatic Habitat; and Scenic, Recreational and Conservation Values.
- Procedures for selecting survey sites during a reconnoitre survey and for conducting a full survey at the selected sites using the data sheets.
- Procedures for subdividing the catchment into a series of sub-catchment elements each corresponding with one of the 'homogeneous' stream or river sections.
- The design of a series of 11 linked databases for recording and analysing the data on each data sheet and a set of input and output summary programs using the DBASE IV package.
- Methods for linking the 'State of the Rivers' database to other sources of data including HYDSYS and the Commission's GIS package, and for providing data and analyses in a form suitable for Integrated Catchment Management.

The aims and objectives of this training manual are to:

1. Establish an organizational structure for implementation of the 'State of the Rivers' Project on a State-wide and Regional basis.

2. Outline and explain all the steps required for implementing the methodology in a practical and simple way including a proposed organizational structure for the project.

3. Provide a package for training regional staff to implement the 'State of the Rivers' Project and steps in the planning and implementation of the project within each Region.

4. Provide an explanation and guide for the completion of the data sheets.

5. Provide a package for training the technical staff to be involved in the surveys in the survey procedures and use of the datasheets.

6. Explain the use of the data entry, report generating, data analysis and other DBASE IV programs developed for the project including the linkage to GIS.

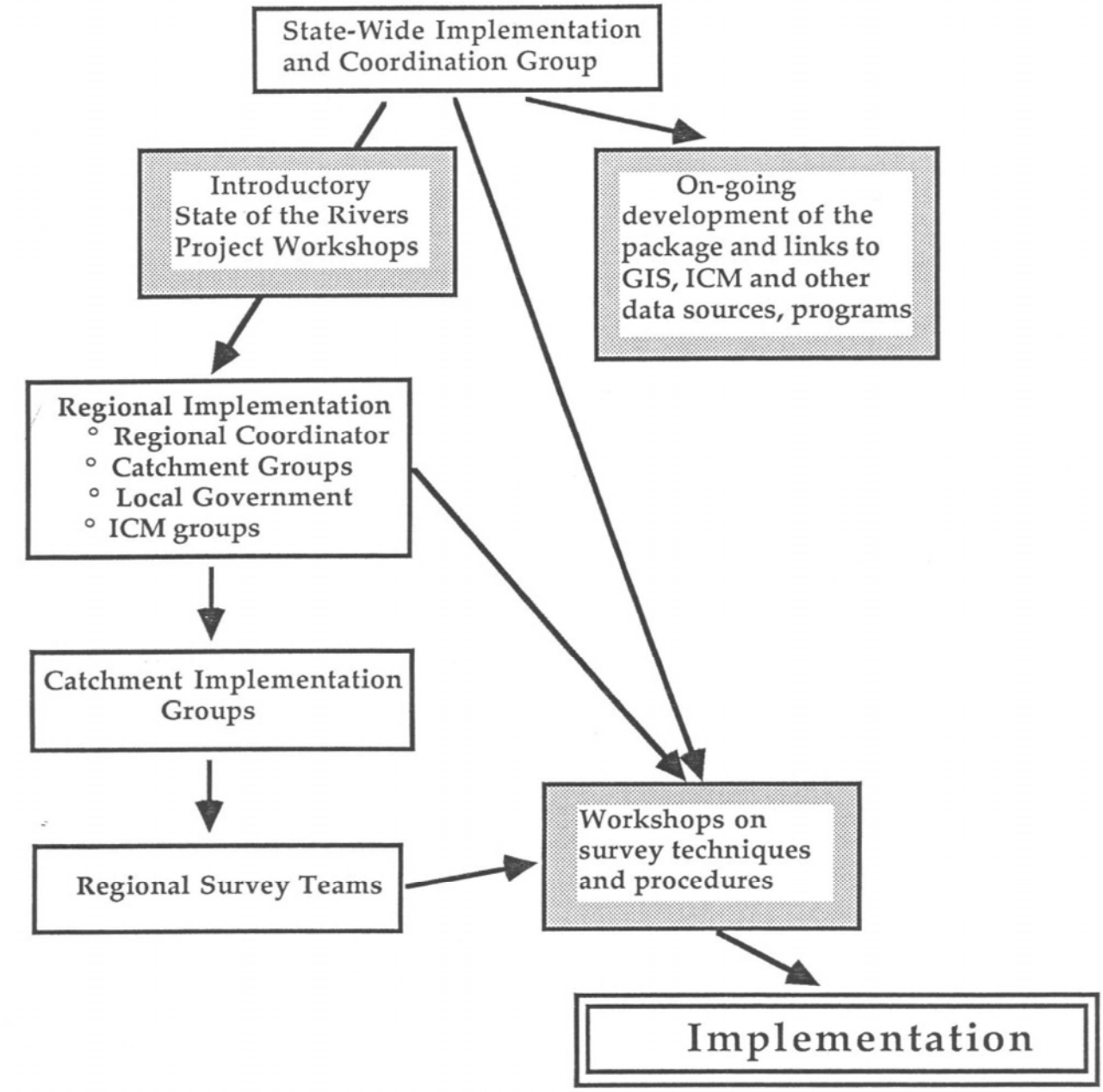
2 Overview of the Organizational Structure, Implementation Strategy and Steps for Implementing the Methodology

The proposed organizational structure for implementation of the 'State of the Rivers' Project is shown below. Also shown is the proposed implementation strategy.

Organizational Structure

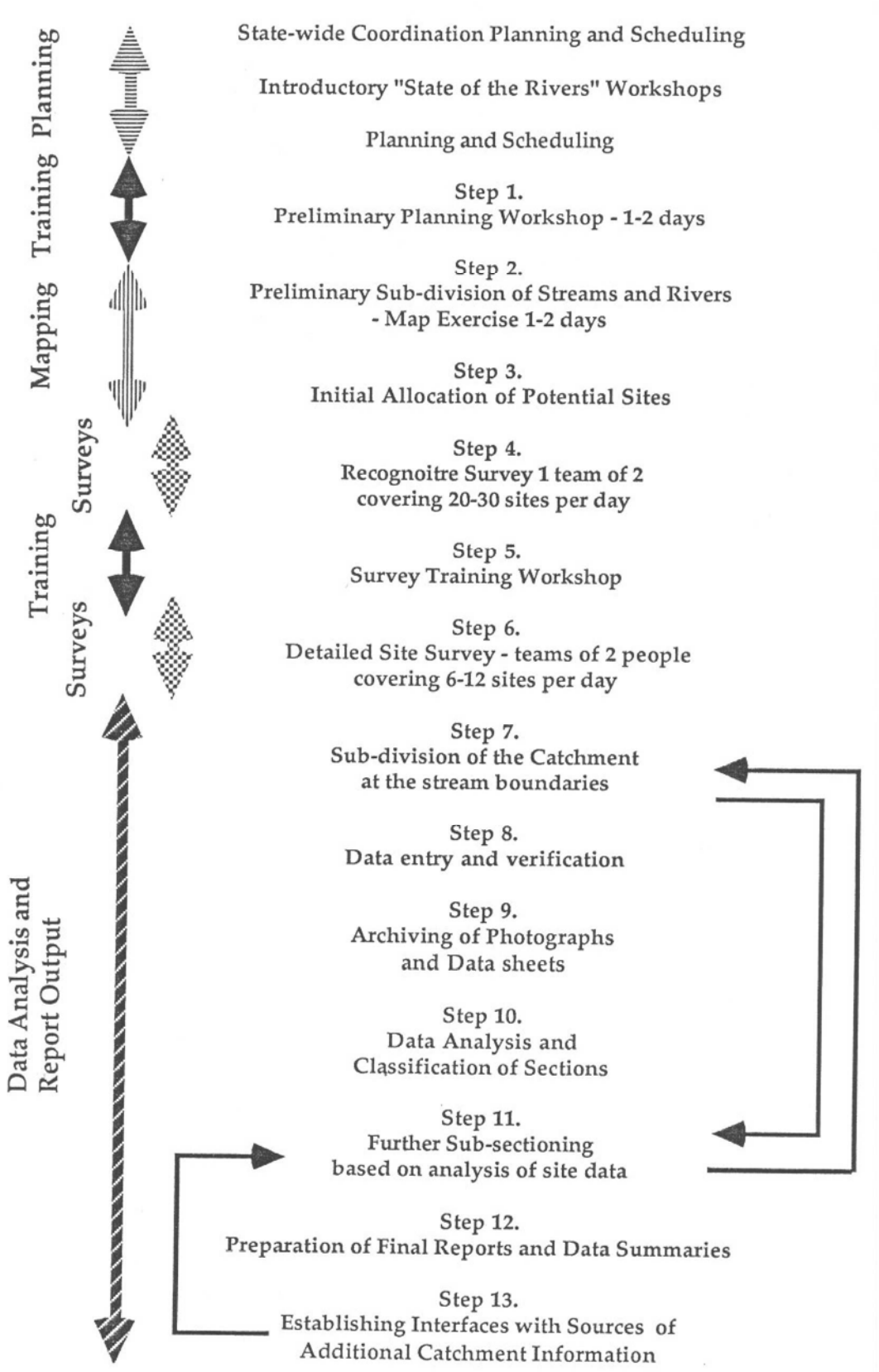
Group	Representation	Roles and Responsibilities
State-Wide Implementation and Coordination Group	Head-Office Dept. and Representatives or Inter-Regional Group	Coordination and establishment of State-wide priorities. Program development and consistency in application Promotion of the project. Planning and organising the training programs. Liaise with and support for Regional and Catchment Implementation Groups Maintain links with ICM and various other Departments and groups.
Regional Implementation Groups	Regional Officers designated as representatives for the project within each Region.	Implementation of the project within Regions including joint efforts required for catchments extending into more than one region. Planning and organization of the project within the regions Liaison with the State-wide Group. Establishment and supervision of the Catchment Implementation Groups.
Catchment Implementation Groups	Regional Officers with representatives from Local Government, ICM and other local co unity groups	Planning and implementation of the project within each catchment. Collection and analysis of all existing relevant data.
Regional Catchment Survey Leaders	Regional Scientific Officer(s)	Organize and maintain equipment and other resources required for the survey. Day to day organization. Data entry, verification and sub-sectioning. Preparation of reports and data summaries
Regional Survey Teams	Regional Scientific and Technical Officers and others selected to conduct the survey.	Surveys and data collection for each catchment or sub-catchment.

Implementation Strategy



The 'State of the Rivers' Project is implemented by the State-Wide Implementation and coordination Group using this manual and two training packages for workshops: - one designed to introduced the concepts and broad scale aspects of the methodology, and the other a practical training workshop for staff to be engaged in conducting the surveys (Appendix 13.1 and 13.2). Outlines of the workshops and graphics materials for presentation at these workshop are included as appendices for this implementation manual. It should be emphasised that the approach taken to training is a 'hands-on' approach focused on 'learning by doing' rather than an elaborate seminar program.

Outline of the Steps in the Methodology



3 Organisational Structure

3.1 State-Wide Implementation and Coordination Group

This group is needed to oversee the implementation of the project throughout the State within a reasonable time-frame. It is suggested that the entire State would need to be surveyed in a 3-5 year period. This group would also set priorities, run the training programs, establish liaison with other relevant groups and links with other Government programs, and generally promote and monitor the implementation of the project. Such supervision is also required to maintain consistency in the data collected and in the analyses and reports generated from the surveys. This group should also be responsible for planning a State-wide 'State of the Rivers' assessment within a 3-5 year period combining the results of surveys in all the catchments in Queensland.

There is a need for on-going development of the different components of the package and potential modifications required for its implementation in different areas of the State (e.g. the channel country, and wet tropics areas). There is also a need for further development of the analysis programs and the condition classification criteria integrating all the component information. The links between the 'State of the Rivers' database and other sources of data, for example the GIS package, hydrology (through HYDSYS), and water quality (through HYDSYS and other sources of information) also need to be maintained. Without such a group the project would be unlikely to succeed, and the consistency crucial for comparisons between catchments would be impossible to maintain. This group is also required to ensure that the established targets and objectives are met on time.

This group would be responsible for running the introductory workshops and the survey methodology workshops which are required to implement the project through the Regions.

3.2 Regional Implementation Groups

Regional Implementation Groups and Officers should be established in each Region to schedule, plan and supervise the implementation of the project on a catchment by catchment basis within each Region. Some of the catchments will occur in more than one region requiring a coordinated approach between regions. It is essential that all of the surveys within the one catchment be carried out by the same small survey team to ensure consistency.

Regional workshops organised by the State-Wide Group would introduce Regional staff, Local Government, ICM groups and other interested groups and individuals to the methodology. This group would then set up the catchment implementation groups and plan the implementation within the region. This would included scheduling, staff allocation and training. It would also include the gathering of the resources required for the surveys, establishing the databases and the software and hardware required for analysis of the data.

These groups should include scientific officers (Project Officers) designated to be responsible for the running of the surveys in each catchment including the compilation of existing information and the initial subdivision of the stream and rivers into 'homogenous' sub-sections. These officers should also be responsible for data entry and data analyses, on-going maintenance of the database system and the production of the data summaries and

reports.

These Regional groups should liaise with the State-wide group on a regular basis for updates on changes to the methodology and for answering queries about the methods and their application in particular catchments.

3.3 Catchment Implementation Groups

The surveys and condition summaries should be undertaken within catchment boundaries as the fundamental unit of assessment. Separate catchment groups should be established for each catchment consisting of the Project Officers, the survey teams, Local Government and ICM group representatives and other groups and individuals who have access to information relevant for the survey, or are potential users of the data collected. This group should oversee the collation of all relevant information, set priorities for surveys in different areas and establish links to the community to establish local contacts and to advertise and promote the project locally. This group, through the project officer, should also be responsible for archiving the data, maintaining the databases and producing the output required for various purposes. Some knowledge of DBASE IV would be an advantage for this task. This group would also plan and schedule the survey training exercise with initial assistance from the State-Wide Group.

3.4 Regional Catchment Project Leaders and Survey Teams

Each group for the surveys would be led by a Project Officer. Each survey team would consist of two staff - either Regional Scientific and/or Technical Officers. Each team will require its own set of equipment and a vehicle. Generally 2-4 teams of 2 staff would be required. A minimum of two teams will ensure that the.- surveys can be completed rapidly, and therefore under similar discharge and other river conditions. Spreading the load between two or more groups also helps to ensure that the surveys are completed quickly to minimise disturbance to other activities. It also generates a sense of competition and team spirit which helps to achieve a good result.

It is suggested that the more experienced or qualified staff act as the survey team leaders. These leaders would be expected to be more committed to the project, being available for the reconnoitre survey and for most of the time during the full survey of the sites. Keeping the number of these leaders small will improve the consistency and will reduce training costs. It is suggested that these leaders attend surveys in another catchment as observers prior to undertaking their own surveys.

Again there are advantages in keeping the number of other staff involved in the full survey small (less than 8 staff for each catchment) to increase consistency and reduce staff training requirements. This has to be offset against the need to 'spread the load' allowing the task to be spread out so that the other commitments for each participant in the Regional Office can still be met. There are obvious advantages in choosing staff with good local knowledge of the catchment and with suitable experience and qualifications.

The question of whether people other than the staff of the DPI could be involved in the surveys depends on the circumstances applying in each Region. There is no doubt that many outside people would have more than adequate qualifications and experience to undertake the surveys which were designed to have minimal requirements in terms of qualifications or

previous experience. There are practical issues of insurance cover, availability and approvals for use of DPI vehicles and equipment and possible travel expenses which need to be addressed. However, *a priori* there would be no real reason why outside people could not be involved, and there may be many advantages such as local knowledge and specific skills such as in plant identification which would be an asset. Involving members of local Integrated Catchment Management groups in the surveys would have many advantages in allowing them to fully understand the project. The surveys would benefit from their local knowledge. However, it is important that the objectivity and consistency of the surveys are maintained, and so the decision will require a case by case decision. Setting minimal qualification requirements (such as a degree or diploma) or demonstrated previous experience in a related field would help to ensure that the people involved were capable of the work involved.

4 Implementation Strategy

The 'State of the Rivers' Project should be implemented as a Regional project under the direction of the State-Wide Implementation Group. This group would be responsible for the co-ordination of the project and supervision of the Regional Implementation Groups. The project would be implemented through two training exercises: Regional Introductory Workshops, and Workshops on Survey Techniques and Procedures. The State-Wide Group would be responsible for setting priorities, establishing targets and schedules and liaising with the regions to implement the project. This group would provide the initial training staff and would act to provide advice and support for the Regions. It would also be responsible for the on-going development of the project and compilation of data on a State-wide basis.

Once State-wide priorities have been established, the Regions involved should be contacted and given general advice on the project, resource requirements and scheduling. In establishing the schedules and implementation plans the following points should be considered:

- Each Region will have to be involved in surveys of a number of catchments.
- The surveys should be scheduled for the dry season or the drier times of the year. Seasonal rainfall patterns are therefore a consideration in scheduling the surveys in different areas.
- An implementation plan to cover the whole State within a reasonable period of time (3-5 years) should be developed to direct and schedule the Regional implementation.
- Initially at least, the training staff to run the workshops should come from the State-Wide Implementation Group. There will be a need to schedule the various workshops in terms of the availability of the staff available.
- While there would appear to be advantages in perhaps organising a single major introductory workshop for all regions, there is merit in keeping the workshops small and dealing with individual local issues and differences in application of the project in different areas of the State.
- There are major advantages in having the Regional Project Officers, and Survey Team leaders attend surveys in other Regions as observers before commencing implementation in their own areas.
- The major catchments may need to be surveyed by major sub-catchments rather than all at once.
- Some of the catchments will cross Regional boundaries requiring a joint approach between Regions.

4.1 Regional Introductory Workshops

The aim of the introductory workshops is to introduce regional staff to the "State of the Rivers" Project -- its aims and objectives, its resource requirements, its targets and outputs, its linkages with other data sources and what is required to implement the project within the Regions. This workshop of about 2-3 hours duration, should be in the form of a seminar followed by group discussion. It should involve all the Regional staff to be involved in the project, including the survey staff, as well as representatives from Local Government, ICM groups and other groups and individuals for which the project is relevant.

As the project develops this could involve participation of staff who have been involved in previously completed projects in their Regions. Completed reports and data summaries would be very useful to demonstrate the type of output - which can be produced.

This workshop should also be directed at identifying the major issues which are relevant for the Region, the staff and other resources which are available, and the priority areas needing special attention. The major sources of information and contacts relevant for the survey should also be identified. This would include the availability of maps (topographic, soils, geology and land use), relevant previous studies (environmental, resource surveys, local plans, flood studies, water resource development plans) and specific information (such as local vegetation keys, list of rare and endangered plants and animals and their habitats, aquatic and riparian floral' and faunal surveys). .

Appendix 2 (see Section 13.2) provides a set of overheads which could be used for the seminar. This should be accompanied by summary documents (possibly including copies of this manual) and copies of the data sheets and explanatory notes.

A Regional Implementation Group should be set up before (preferable) or after the workshop. This group would then proceed to plan and organise the implementation the of the project with assistance from the State-Wide Group (see 6. Steps for Implementing the Methodology). The project would be implemented on a catchment by catchment basis with the potential for separate Catchment Implementation Groups to be established within the one Region.

Alternatively, it may be decided that essentially the same DPI team should conduct all the surveys, with local experts being drawn into the group for each separate catchment. Once the surveys have been planned and scheduled the training program for teaching the survey techniques and procedures can be organised.

4.2 Initial Sub-sectioning of the Rivers and Streams and Reconnoitre Survey

The Regional Implementation Group and the Project Officers may need some assistance with this aspect. This depends on the experience and confidence of the Regional staff. Copies of relevant sections of this report will provide a guide to what is required. In some instances (probably for the first catchment survey in each Region) the State-Wide group may need to provide someone to undertake this aspect including the reconnoitre survey, as it is a crucial aspect of the methodology.

It is preferable for permanent survey team leaders to be selected for the surveys. It is/these leaders who should be involved in the reconnoitre surveys. This will be invaluable in locating the sites for the full surveys which follow.

4.3 Workshops on Survey Techniques and Procedures

The workshops to train staff in the use of the datasheets, survey equipment and techniques (see 13.1 Appendix 1) should be focused on a 'learn as you do' approach and therefore should be scheduled to occur at the start of the first catchment survey in the Region. These workshops should initially be run by members of the State-Wide Group or other staff who have been involved in previous surveys in other Regions. The workshop contents and approach are essentially identical to those adopted for the pilot survey.

The workshops will require 1 full day, but the first few days of the actual survey should also be seen as part of the training process. It should consist of a 2-3 hour seminar in the morning introducing the data sheets, the equipment to be used and the survey techniques and procedures. Appendix 1 (see Section 13.1) provides a set of overheads for this first part of the workshop. The afternoon should be devoted to a trial survey of a set 2-3 local sites selected to include a range of conditions and stream types in the catchment. The people present should be split into teams of two with experienced staff moving between groups to answer questions and to help explain how the survey should be conducted. Each person present should be asked to complete at least one of all the datasheets. The experienced staff should also be available to lead the teams during the first one or two days of the actual survey, and to check the datasheets to ensure that they are being completed adequately.

These first surveys should be done slowly to allow the staff to become more
familiar with the techniques. The team leaders should be responsible for checking that all sheets have been completed adequately at each site. The Project Officer leading the survey should be responsible for allocating the set of sites to be surveyed by each team each day.

Once the Project has started the experienced staff who have completed a survey could act as the trainers for other staff in their own Regions and in neighbouring Regions. Having staff attend surveys in other Regions as observers prior to undertaking their own surveys would also be very helpful. On-going feed-back and advice from the State-Wide group would be necessary to maintain consistency and standards.

Some minor modifications to the datasheets may be required for the different Regions. This mostly involves vegetation surveys. The methods allow for a checklist of species to be recorded which includes species which are to be surveyed at every sites and a local or regional group of species. Some modification of the procedures may be needed to cope with surveys in unusual areas such as intermittent streams or areas where the streams and rivers does not have a defined permanent channel or set of anabranches. These modifications and further developments of the methodology are the responsibility of the State-Wide Group.

5 Maps, Equipment, Resource Requirements and Options

The basic resource requirements for the project are outlined in Anderson (1993). This includes preliminary estimates of the minimum number of sites, staff and time required for surveys in catchments of different size (see 5.3.13). It is suggested that the ideal arrangement is for 2 teams of 2 staff to conduct the full surveys and for one of these teams to conduct the reconnoitre surveys. A Regional Project Officer would be required to conduct the initial sub-sectioning of the stream and rivers prior to the surveys, and to define the sub-catchment elements. This officer would also be responsible for the data entry and verification, and for conducting the data analyses and generating the output. Final database information should be transferred to the State-Wide Group for compiling into a State-Wide database.

The following section outlines details of the other equipment and resources required for the project.

5.1 Maps

The main issue is the map scale preferred for different aspects of the project.

5.1.1 Initial Sub-sectioning of the Streams and Rivers and Site Allocation

It is suggested that the idea scale for the working maps and the catchment base map is 1:25,000. This may be impractical or too expensive in the larger catchments where 1:50,000 may be more appropriate. Where maps at these scales are not available then the finer scale maps available should be used. Maps at 1:25,000 include many details on the location of falls, rapids, weirs, fords and other details on the in stream habitat which are invaluable for the surveys. This scale of map is also ideal for navigation and locating potential survey sites that are easily assessable.

5.1.2 Map Scales for Initial Sub-division of the streams and rivers

It is suggested that a scale of 1:100,000 or 1:250,000 would be adequate for use in conducting the initial subdivision using soils, geology, land use, vegetation cover and basic topography. Locating the barriers and major changes in stream habitats should be done using 1:25,000 maps if available. Recognising the upstream limits of streams in terms of a map scale is probably not appropriate as it is best done by on-site inspection during the reconnoitre survey. There will be considerable variation in different areas of the State.

5.1.3 Map Scales for Output and Linkage to GIS

This is difficult because to define because it partially depends on the resolution required for different uses of the data. The major consideration is the availability of digitised map information. Currently there is very little digitised information available at scales finer than 1:250,000 and it is unlikely that information finer than 1:100,000 will be available for only a very small percentage of the State. This in fact limits the dependency of the project on GIS for output. It would be unwise to set map scales for output and analysis in GIS when these were neither achievable nor operable because such scales were unavailable or too expansive to capture. In fact it means that an alternative output system independent of GIS should be

developed as an interim measure.

It is suggested that if available the information should be linked to GIS topographic and digitised streams and rivers at a scale of 1:50,000 or 1:100,000. The latter is probably what can be realistically set as a target given the current situation in terms of the GIS program.

5.2 Equipment

The following list of equipment is required for each survey team (2 people):

- Four-wheel drive vehicle with radio equipment and recovery gear.
- 3-5m long punt or small boat on roof rack (preferred) or trailer with suitable outboard motor and other equipment. Larger boat for large rivers and estuaries where several sites can be surveyed from the one launch spot.
- Compass and rangefinder for large estuaries and rivers.
- Portable GPS unit (e.g. "Magellan") with back-up batteries and operational manual. Additional high resolution antennae are preferred.
- Survey staff and survey tapes (50m).
- Portable, battery operated echo-sounder with transducer mounted into a 'kick-board' or other suitable float and attachment points for ropes and survey tapes.
- Inclinometer
- sediment sampler - "Ekman" grab type, or simply a closed length of pipe with attached chain and rope for collecting surface sediment samples in deep water.
- 35mm camera and colour slide film (64-100ASA) - average of 5 shots for each site.
- Set of 1:25,000 or 1:50,000 laminated working maps with sites and other information marked on them with water-proof markers. Sets of data sheets, staplers, pencils and erasers.
- Vegetation keys, or photographs for identifying key plant species.
- 30m length of rope.
- Field box and protective containers for the equipment.
- Personal field equipment such as waders, boots, wet-weather gear.

5.3 Resources and Options

The time and staff resources required for the project outlined in 5.3.12 and 5.3.13, (Anderson 1993) are suggested minimum requirements. The methodology is expandable allowing more sites to be surveyed in particular catchments or sub catchments as required for specific uses of the data. Some advice on these aspects may be required during the course of the project. Some form of sensitivity analysis and assessment of the output amongst users may be undertaken to modify the suggested site allocation.

It is suggested that the full surveys be conducted concurrently by two independent teams of two staff each with its own set of equipment. The surveys could be done by one team or by three or more teams. There are obvious advantages and disadvantages in this. It is suggested that two teams is the right balance between the staff requirements, training effort and objective of completing the survey in a reasonable period of time. Most surveys can be completed in a 2-3 week period, which again would seem to be a reasonable compromise between the resources available and the resolution required.

6 Steps for Implementing the Methodology

The fundamental details of the steps for implementing the methodology are provided in the first report (Anderson 1993). The aim here is to outline the more practical aspects of the implementation from the stage of the preliminary planning workshop for a particular catchment after the introductory workshop has been held.

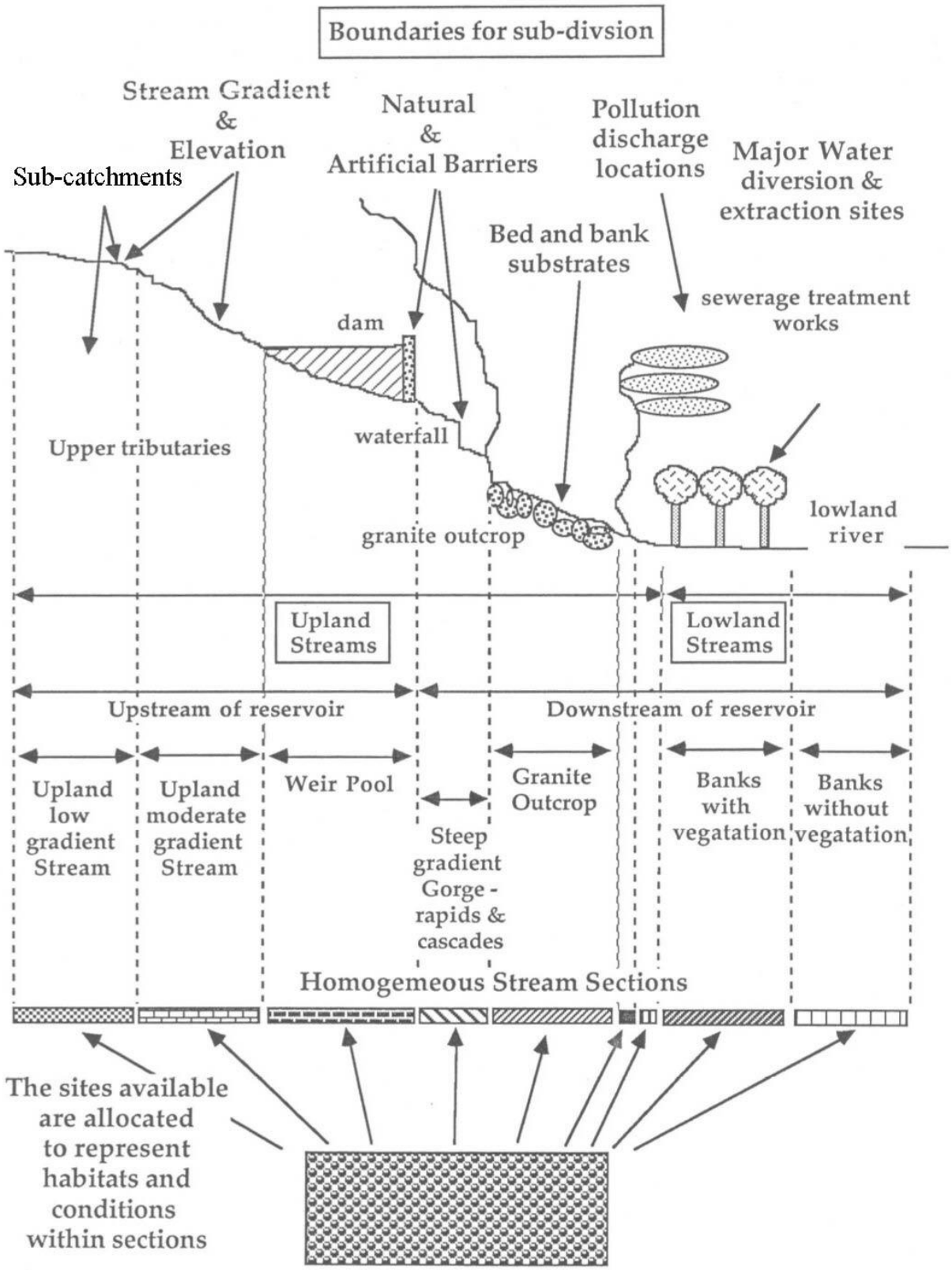
6.1 Step 1. Preliminary Planning Workshop – 1 – 2 days

The aim of the workshop is to examine various local maps and data relevant for the study and to discuss important local issues. The various relevant data sources should be gathered together and examined before the meeting, including relevant maps (topographic, soils, geology, land use, vegetative over, land use planning), flood studies, flora and fauna surveys, water quality studies and records. The workshop should involve local government representatives, land care and integrated catchment management groups and other interested groups and individuals who may provide information and assistance for the survey, or who are potential users of the information.

6.2 Step 2. Preliminary Sub-division of Streams and Rivers - Map Exercise 1-2 days

The concept of "homogeneous stream sections" is fundamental to the methodology. The natural and modified attributes of streams are not randomly distributed. Streams within the same sub-catchment are likely to be more similar to each other than to streams in other sub-catchments. Likewise the stream drainage network provides the basic link between stream sections. What happens upstream, or in the upper catchment affects downstream sections in a cumulative way. For example, if the upper catchment is cleared, all downstream sections if the river will be affected by the changes in runoff dynamics and sediment yield which may be produced. The concept of stream order recognizes that the flow characteristics, channel dimensions and most physical and biological characteristics of streams will change progressively as more and more tributaries combine into larger streams. This is the basic thrust for integrated catchment management - that is because the streams are interconnected in the drainage network they have to be managed in an integrated way considering this linkage and processes for upstream impacts to be expressed downstream. This concept also provides the basis for the sampling strategy for the "State of the Rivers" methodology. It is a stratified sampling strategy, based on using available information to subdivide the area to be sampled into strata or regions which share similar characteristics. The areas within the strata are much more similar to each other than to areas in other strata. This concept is extended to encompass a basic mechanism for sub-dividing all the stream and river sections in the catchment into units which basically share the same natural and disturbance features. The basic unit is referred to as the "homogeneous stream section". The length of stream within these sections is "homogeneous", that is basically similar in the attributes that we are interested in. This includes the physical and ecological features and condition, and the basic characteristics of the stream that is present (size, substrates, flow regime, etc.). Obviously how far this process continues depends on the scale of resolution and the priority given for the various sources of information judged to be important for the purposes of the methodology.

Homogeneous Stream Sections



In essence the process of sub-dividing the rivers and streams into homogeneous sections involves an hierarchical procedure of using various sources of information to successively sub-divide the rivers and streams into smaller and smaller units until the notion of homogeneity is satisfied. Initially the rivers and streams in the catchment are divided into sub-catchment sections in terms of the major tributaries. Then barriers, geology, soils, slopes and other information is used to assign further boundaries for subdivision. This process continues using the visual inspections carried out in the reconnoitre. Sites are then located in each the subsections identified which are *representative* of the attributes and condition within the section. Finally the analysis of the site surveys may reveal heterogeneity within the sections which requires that additional section boundaries have to be added. The process is therefore an on-going one aimed at ensuring that the sections are homogeneous and are adequately described by the sites chosen to be representative of them.

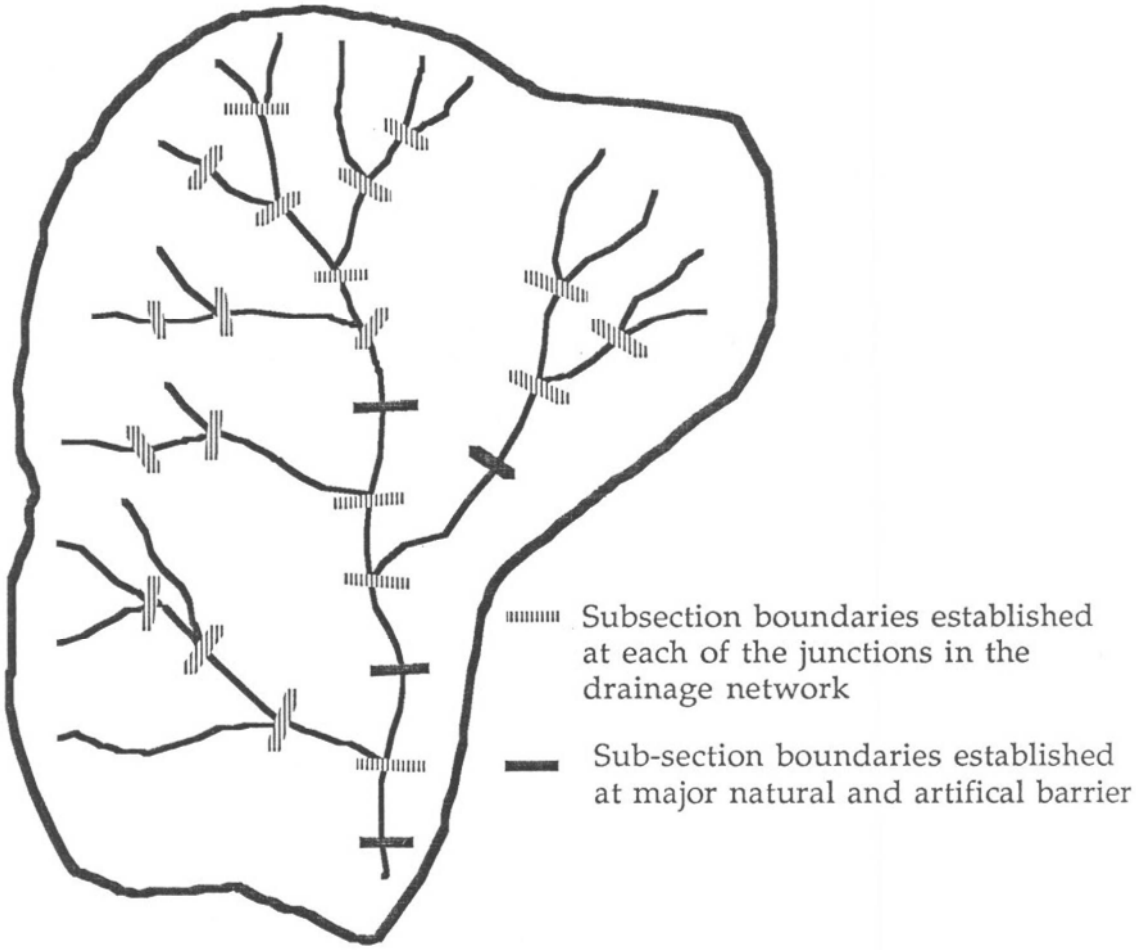
The aim of the initial mapping exercise is to take all the available information and maps, and to select and use appropriate attributes to begin the subdivide the streams and rivers into "homogeneous stream sections". The type and extent of information available will vary greatly in different catchments. When available 1:25,000 series maps should be used for this initial subdivision as these maps show some in stream river characteristics such as the location of falls, large pools, fords roads and tracks and other details important for the survey. When these maps are unavailable the finest scale maps possible should be used to prepare a base map. The preliminary sub-section boundaries are drawn directly onto laminated base maps .using water-proof markers.

This first stage is directed at identifying the boundaries the 'homogeneous stream sections' without actually collecting any information. It should be emphasised that this is only a mapping exercise designed to initially recognize the major types of streams and rivers present and their condition, and also to initially allocate the sites. The section boundaries may easily be changed during the reconnoitre phase, during the actual survey, or later in response to the analysis of the site data or the actual compilation of the catchment data. The sub-sectioning of the rivers and streams into homogeneous sections is therefore an on-going iterative process.

Key attributes controlling the natural physical and ecological features of the stream are used dependent on the information availability in each catchment. A set procedure for sub-dividing the rivers and streams can not be formally established because the type of information and its relevance and importance will vary in different areas of the State. It should be emphasised that no data is complied at this stage, it is only an exercise to allocate the sampling effort. Data complied during and after the survey is compiled and used for a more formal classification. Some of the more important attributes listed in approximate order of importance for the project are:

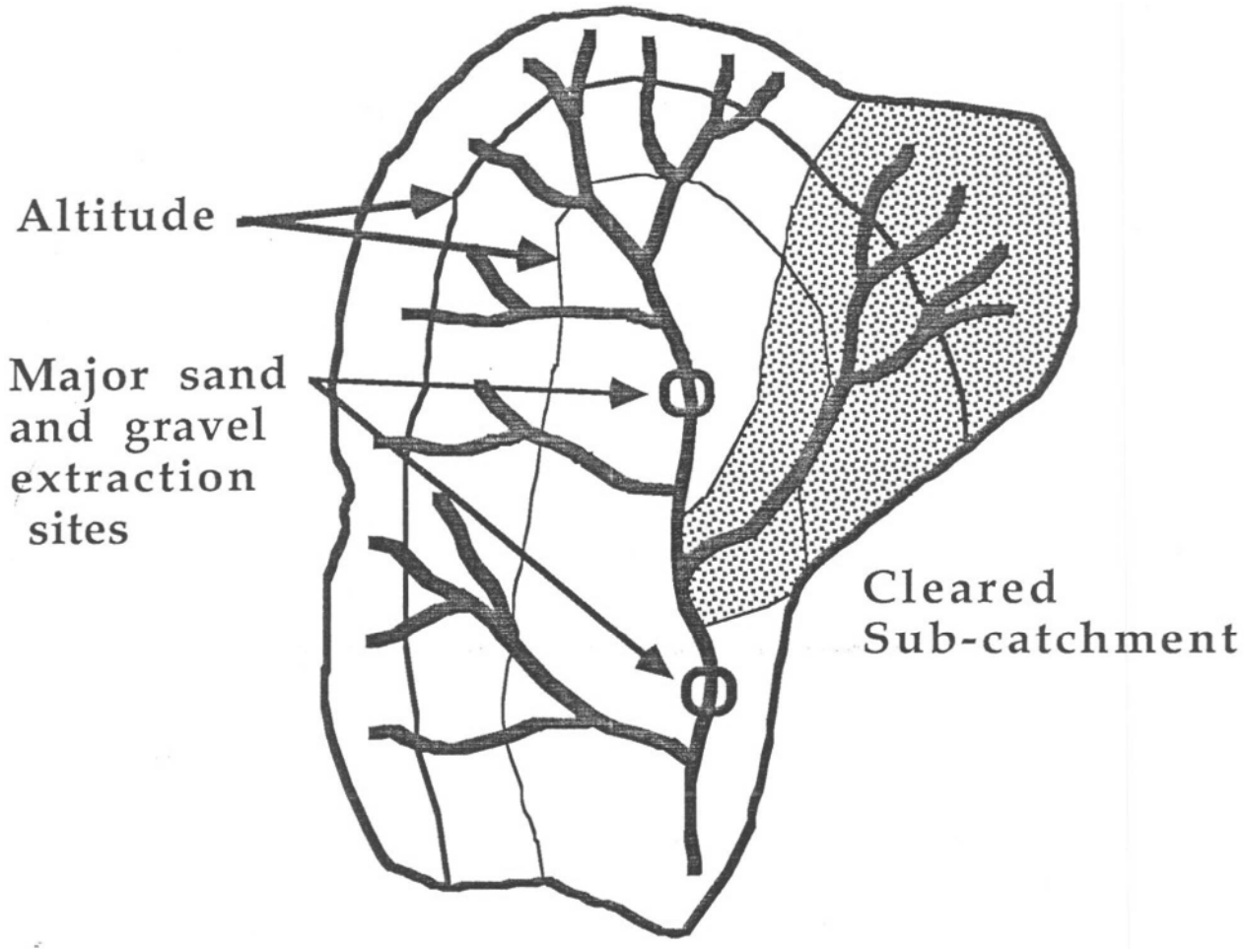
- **Sub-catchment structure / stream order -** the addition of each new tributary to the major channel changes the hydrology and also affects sediments, channel morphology, channel habitat diversity (pools riffles runs etc.), substrates, bed and bank condition and the general features and the ecology of the stream. Sub-section boundaries are therefore established at each tributary junction, up to a scale of about 1:100,000. The tributaries are similarly divided into sub-section elements.
- **Natural and Artificial Barriers and Obstructions -** barriers are established at major artificial dams and weirs; at natural barriers such as water falls, rapids, in stream

wetlands; and at other locations of barriers and obstructions. Dams and weirs act as sediment traps and lead to changes in flow regimes downstream. The entire reservoir, weir pool or natural lake is designated as one or more distinct sections because of the different habitat upstream of such barriers. These and other barriers such as water falls and rapids act as barriers to fish movement and the passage of other animals often leading to changes in community structure.



- **Altitude, catchment slope and stream gradient** - Altitude itself is an important parameter affecting local climate and the of many plant and animal species. Catchment slope affects run-off dynamics and this influences channel morphology. Stream gradient is also of fundamental importance for stream classification as it affects flows, sediments and many other physical and biological features of streams. The altitude categories chosen will depend on the catchment its topography and location. Likewise the categories for stream gradients will depend on local conditions. Some of the obvious boundaries are the upstream and downstream ends of gorges where streams descend rapidly from coastal escarpments, waterfalls and rapids, tidal limits and the upstream limits of the broad alluvial floodplains. Climatic and rainfall maps may also help to identify suitable boundaries.

- **Geology and soils -** Again the geology and soils of the catchment and the geology beneath the stream bed are important in affecting the channel morphology and other features of streams.



Additional section boundaries are located using altitude, extent of clearing of the sub-catchments, site of major disturbance and other parameters.

- **Land Use, Vegetation type and Vegetative cover -** Sub-section boundaries should be established at major discontinuities in existing vegetation, for example conservation areas (National Parks, State Parks and conservation areas and other reserves), forests, plantation areas, and boundaries of natural vegetation types. Major land use types, and urban boundaries may also be used to identify different stream sections.

- **Land System and climatological boundaries -** Land system and c1imatological boundaries can also be used to sub-section the streams. Again the locations where the boundaries between different land system types intercept drainage lines can be used as the location of stream section boundaries.

- **Tidal limit and boundaries between intermittent and permanent streams -** Boundaries are also established at the tidal limits and between permanent and intermittent stream sections.

- **Source or discharge points for pollution or disturbances -** Pollution discharge points and locations of major sources of disturbances are also important. Sites downstream will be affected. Examples of such sites and disturbances are ;- sewerage and industrial discharge points
    - sand and gravel extraction
    - dairies, piggeries and cattle feedlots
    - sites with flood gates, levee banks, other control structures, tide barrages, etc.

- **Sites of major stream diversion -** These represent potential sources of disturbance to conditions downstream.

- **Locations of major discontinuities of stream condition or river management activities -** These disturbances including channelization and bank protection works.

- **Aerial Photography and reconnaissance by plane of helicopter -** Good quality, recent aerial photography is an excellent source of information for conducting the initial subdivision and inspections from the air may also be useful. However, it should be emphasised that the focus of the study is on the instream attributes, most of which cannot be seen or assessed remotely. The use of these techniques depends on the availability of materials and staff trained in their use. The time and financial resources required may be better used in expanding the reconnoitre, ground-level inspections, except in the larger catchments. This provides information at the scale needed for the sub-section rather than the broad scale overview.

6.3 Step 3 - Initial Allocation of Potential Sites

Using this preliminary information, the potential number of sites which can be surveyed dependent of the resources available, and the established resolution and priorities can be allocated to the sub-sections. This can be done on based relative sub-catchment size or length of streams present. However, it may be decided that more detail is required in one particular sub-catchment for various reasons. Approximately 120-130% the projected maximum number of sites predicted to be completed in the time allocated should be assigned to the catchment. This allows for choice between potential site locations after the reconnoitre phase. The allocation of the sites is an hierarchical process moving down through the various levels of stream and river classification made after the sub-section boundaries have been assigned.

6.4 Step 4 - Reconnoitre Survey - one team of 2 covering 20-30 sites per day

Using the base map prepared by this initial subdivision a reconnoitre survey is conducted to further test the notion of homogeneity of the sections and to continue the subdivision process using visual assessment. A series of potential survey sites, representative of the habitats and condition within the sections are also identified, located and photographed. Once again this is essentially a map exercise at this stage with only the 'Site Description' datasheet being completed and a set of photographs taken. This saves considerable time during the full

survey of the sites. Again this process is directed by the number of sites which can be allocated to the catchment and in turn to each of the sub-section. Each sub-section should include at least one representative site. Additional sites can be allocated at approximately equal distances apart along the stream length within the sections (systematically allocated to the strata).

The major consideration in selecting the sites is the extent to which they represent the stream or river characteristics and physical and ecological conditions within the sections. An overriding consideration in the choice of sites is ease access. Sites selected should be easily accessible and easily located. In practice most of the sites will be locate upstream of bridges, or fords or locations where the river of stream is close to roads or tracks. Locating the actual survey site 50 – l00m upstream of a ford or bridge should eliminate the effects of the structure on the conditions at the site.

Allowing more travelling time for negotiating difficult tracks, or for walking across farm land without road access may be justified for the less disturbed sites with difficult access. But it must be remembered that each site should be able to be completed in about one hour including travelling time. Having local residents accompany the survey team during the reconnoitre is invaluable both in navigating and finding potential sites. Contacting local land owners is also very helpful but the benefits have to be balanced by the extra time taken. This means that it is probably only justified in upstream less disturbed sections where no fords or other access points are readily available.

Sites should be selected which are representative of the local habitats and conditions in the area, but which also include the deepest pool in the area and the range of channel habitat types (pools, riffles, runs etc.) present in the section. Sites may be located immediately upstream and downstream of barriers such as waterfalls, rapids and weirs as this saves travelling time.

The location of potential sites are marked onto the working maps. It is also a good idea to also record a summary of key features as notes on the map. These notes can then be used to check existing subsection boundaries, to add new ones and also to select sites for the full survey. The notes should include maximum depth and width of pools, condition of riparian vegetation, channel habitat type and bed substrates. The sense of scale and resolution need to be kept in mind when conducting the reconnoitre survey. Initially allocating numbers site to the subsections helps with this process.

6.5 Step 5 - Training Workshop

The workshop has been previously described (see 4.3)

6.6 Step 6 - Detailed Site Survey - teams of 2 covering 6-12 sites per day

The detailed site survey is then conducted at the series of potential sites allocated for each section. Some sites may only be partially surveyed, with only a location and a set of photographs being taken. Additional sites may be added at this stage. The precise location of the survey reaches may also be varied from that described due the reconnoitre survey. Notes taken during the reconnoitre can be used to select between several potential sites available for each area.

A set list of sites within a small local area should be allocated to each survey group each day. This reduces travelling times between sites. The emphasis should be on meeting the target of 8-10 sites per day. Spending too long at one site is to be avoided, by sticking to a maximum time of one hour per site including travelling times. The sets of data sheets should be checked for completeness before moving onto the next site. Taking a photograph of an appropriate label for each film (date and first site number) on each film will help to sort out the films when they are returned after processing.

At the end of each day the completed data sheets should be collected and safely stored, and the location of any new sites added to the base map and working sets of maps.

6.7 Step 7 - Sub-division of the catchment at the stream boundaries

Sub-catchment boundaries are drawn on the base maps for each of the stream and river sections. This can be done manually using the elevations on the topographic maps, or later using the GIS if the topographic information has been captured. The data sheets for the sub-catchment boundaries can then be completed including the numbering code and the location of the centroid for the element, the downstream limit on the major drainage line and other information. Each homogeneous stream section then has its associated sub-catchment element and one or more sites representative of the physical and environmental conditions and habitat features within the section.

Optionally these sub-catchment elements can then be digitised or scanned and entered into a GIS system, which can then be used to obtain information on the catchment area, average elevation, major and minor stream lengths and other relevant information. This depends on the availability of digitised river and streams and topography for the area. Otherwise the basic information can be obtained manually. .

6.8 Step 8 - Data entry and verification

The data recorded on the set of datasheets for each site are then entered into the databases and verified. Additional non-survey data can be added. Data entry formats and programs are available which simplify this task. Careful checking of the data entered is essential.

6.9 Step 9 - Archiving of Photographs and Data sheets

The' photographic record and 'the data sheets themselves should be properly archived so as to provide an efficient bench mark for future studies.

6.10 Step 10 - Data Analysis and Classification of Sections

Once the data entry has been completed the various data analysis, classification and report generating programs can be run and the results examined. The classification can then be revised and verified against other available information on the condition of the streams and rivers in the catchment. Various analysis and report generating programs are included in the package. Data relating to the sites themselves, either individually or grouped in various ways can be produced as summary reports. This includes grouping the sites into sub-catchments or using other criteria. Classified site and section groups can be generated using various criteria that can be transferred to the GIS for producing summary maps. Reports and data summaries

can also be produced relating the 'homogeneous' sub-sections.

6.11 Step 11 - Further Sub-sectioning

The analysis of the site data and the verification of the output may reveal that further sub-sectioning may be required. This can be done by reworking the base map and modifying the sub-sectional information.

6.12 Step 12 - Preparation of Final Reports and Data Summaries

The final reports and data summaries can then be prepared.

6.13 Step 13. -Establishing Interfaces with Sources of Additional Catchment Information

For subsequent more detailed analyses including investigation of the sources and processes of problems relevant for integrated catchment management it will be necessary to establish links with other sources of information. A GIS system can be used for this purpose by making use of the sub-catchment and subsection boundaries. Alternatively separate linked databases can be established in DBASE IV or in other databases compatible with DBASE IV (see 5.3.11 in Anderson 1993).

7 Database Manual

The database system for the project has been set up using the DBASE IV package. The objective was to keep it a simple as possible and this means that some basic understanding of DBASE IV is required to operate the package.

7.1 Opening the Database System

The databases and the various programs are set up in a sub-directory (STATE) of the DBASE directory. To open the package requires the following commands:

cd\dbase\state

<enter> - opens the state sub-directory

dbase

<enter> - opens the DBASE IV package

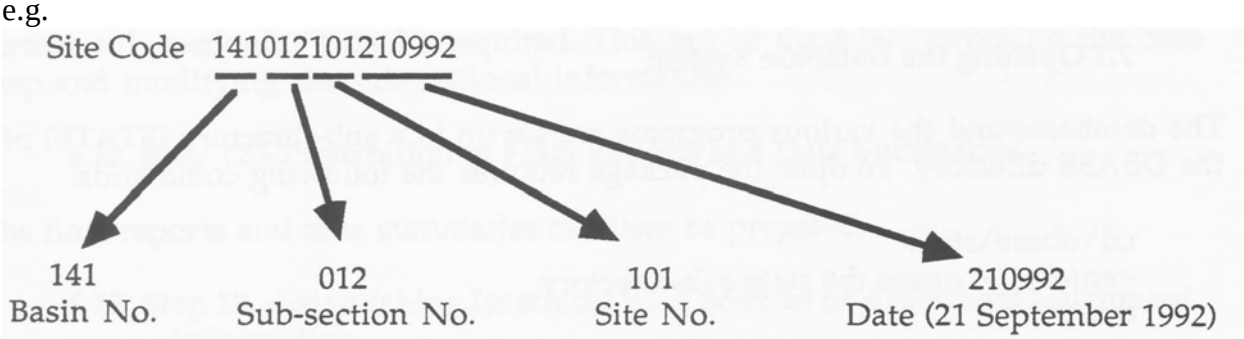
The various programs are displayed using the catalogue facility of DBASE IV which provides a simple means of operating any of the packages.

Initialisation

The program "setup" (listed under the applications menu) is used to perform the basic setup for the program allowing the basin and survey number to be set and setting up the various arrays and other elements for the programs. This should be run at the start of each session.

7.2 Structure of the Database System

There are 11 separate databases for the survey data each linked through the site code field. This site code is automatically generated when the input program is run.
e.g.



Databases (in alphabetical order)

Name	Database
AQUATIC	Aquatic Habitat (sheet 10)
BANK	Band Condition (sheet 7)
BED&BAR	Bed and Bar Conditions (sheet 8)
CHABITAT	Channel Habitat (sheet 5)
CROSS	Cross-Sections (sheet 6)
ENVIRONS	Reach Environs - Temporal and Spatial (sheet 4)
HYDRO	Hydrology (sheet 2)
RATBLANK	Non-survey Database for the Blank Ratings
RATINGS	Non-survey Database for the Rating Formulae
SCENIC	Scenic, Recreat. and Conservation Values (sheet 11)
SUBSECT	Sub-Section Element (Sheet 1)
VEG	Vegetation (Sheet 9)

These databases are listed alphabetically under the "data" column of the catalogue. The structure of the databases can be altered in the following way :

choose the database from the 'Data' column of the catalogue
< Enter>

--> Use File Modify structure/order Display data

choose 'Modify structure/order'
< Enter>

This then opens the structure of the database which can then be altered using the menus and standard procedures (refer to DBASE IV manual).

7.3 Data Entry Forms

A data entry form has been created for each database and associated data sheet. These forms

mirror the layout on the data sheets and provide a simple way of entering the data. Each of the forms has the same name as its associated database.

These forms are listed under the "forms" column of the catalogue.

The layout of the forms can be altered, and various fields can be added or deleted in the following way :

choose the database from the 'Data' column of the catalogue
<Enter>

---> *Use File Modify structure/order Display data*

choose 'Use File'
< Enter>

choose the form from the 'Form' column of the catalogue
<Enter>

---> *Display data Modify layout*

choose 'Modify layout'
< Enter>

This then opens the form for displaying the database which can then be altered using the menus and standard procedures (refer to DBASE IV manual).

7.4 Entering Data

Entering data is a simple matter of opening the database and then opening the associated entry form.

7.4.1 Entering the Survey Data

Important: The programs have been written in a way that assumes that there is a complete set of all the survey sheets for every site surveyed. This has been done for a number of reasons but basically it is easier to deal with blank sheets of data than missing sheets of data. This applies to the following data sheets:

Survey Unit in the Databases

- **Sheet 3 Site Description**
- **Sheet 4 Reach Environs - temporal and spatial**
- **Sheet 5 Channel Habitat**
- **Sheet 6 Cross-sections**
- **Sheet 7 Bank Condition**
- **Sheet 8 Bed and Bar Conditions**
- **Sheet 9 Vegetation**
- **Sheet 10 Aquatic Habitat**
- **Sheet 11 Scenic, recreational and conservation values**

There must be one of these sheets entered for every site surveyed, even if some of the

sheets were not filled in. This applies to the 'photograph only' sites were only the Site Description sheet has been completed.

To facilitate this a data entry program has been written called "SIN.PRG" (listed as SIN under the "applications" column of the catalogue). This program automatically opens each of the databases and data entry forms in turn and also automatically enters the common data (date, basin, sub-section, site and tributary name on each sheet) into each of the databases as it is opened.

This program 'SIN' should always be used when entering the survey data.

It is used in the following way:

choose 'SIN' from the 'Applications' column of the catalogue < Enter>

--> *Run application Modify Application*

choose 'Run application' < Enter>

--> *Are you sure you want to run this application?*

Yes *No*

choose 'Yes'

The program will then ask a series of questions to obtain the information which is common to all databases and are used to generate the 'site code'.

Once entered this information is stored and is automatically entered into each database as its form is opened. This saves time and is essential for ensuring that this information is identical on each of the component databases forming the complete set.

--> *day* =
enter the day from the date on the 'Site Description' datasheet e.g. 12 <Enter>

---> *day* = 12

month =
enter the month from the date on the 'Site Description' datasheet e.g. 03 <Enter> .

--> *day* = 12
month = 03

year =
enter the year from the date on the 'Site Description' datasheet e.g. 92 <Enter>

---> *day* = 12
month = 03
year = 92

recorder =
enter the recorder's Name from the 'Site Description' datasheet e.g. Bill Smith
<Enter>

---> *day* = 12
month = 03
year = 92
recorder = Bill Smith
assistant =
enter the assistant's Name from the 'Site Description' datasheet e.g. Tom Jones
<Enter>
---> *day* = 12
month = 03
year = 92
recorder = Bill Smith
assistant = Tom Jones

/In the same way the Basin, Sub-section number and site number and tributary name can be entered (e.g.).

---> *day* = 12
month = 03
year = 92
recorder = Bill Smith
assistant = Tom Jones
basin = 141
sub-section = 99
site number = 99
tributary = Coes Creek

<Enter>
---> Opens up a new 'Site Description' sheet onto which the above information has been entered.

The rest of the data from the Site Description sheet can then be entered into the appropriate fields.

7.4.2 Entering the Sub-section Data

This is done by running the 'SUBSIN' program:

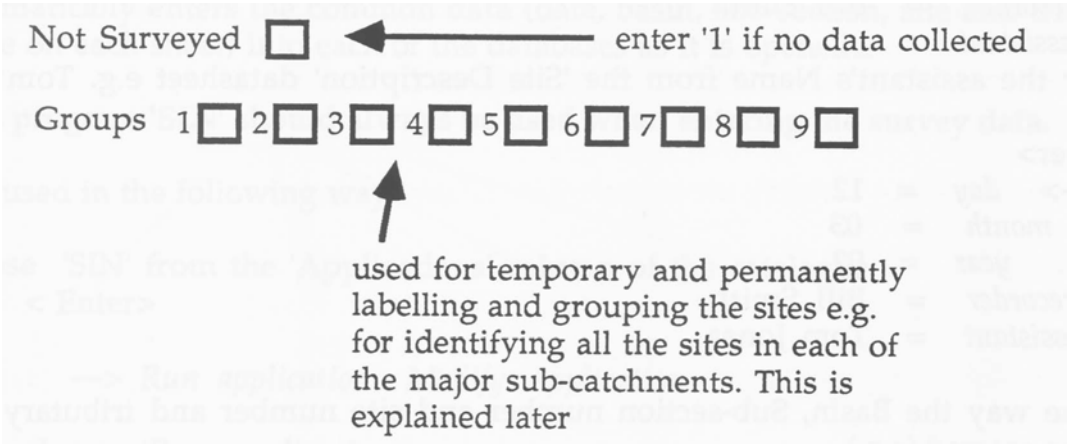
choose 'SUBSIN' from the 'Applications' menu of the catalogue.
<Enter>
then provide the required information as described in 7.4.1 and begin entering the data (no site information is entered).

7.4.3 Entering the Hydrology Data

This is done by running the 'HYDROSIN' program:

choose 'HYDROSIN' from the 'Applications' menu of the catalogue. <Enter>
then provide the required information as described in 7.4.1 and begin entering the data.

There are some fields in the database which are shown on the Site Description form but which are not shown on the data sheet itself. The use of these fields is explained later.



Once all the data has been entered onto the form:

<Control> <End> pressed simultaneously saves the record and opens up the next database and form.

To exit from the program at any stage:

<escape> pressed twice or more in rapid succession -->

*** *INTERR UPTED* ***

DO *loader*

Cancel *Ignore* *Suspend*

choose 'Cancel'
<Enter> then exits from the program and returns to the catalogue.

NOTE: If it is necessary to exit from the program, the incomplete set of database records has to be deleted from the databases (see Editing and Deleting Records).

Special Note for the Cross-Sections Datasheet

The SIN.PRG program is set up for entry of 2 cross-sections at each site - one for a pool and one for a rapid, run or one of the other channel habitat types with higher flows. However, at certain sites only one cross-section is taken. The cross section datasheet also allows for extra pages to be added when there are more than 8 readings, with up to a maximum of 15 such

readings being catered for in the database. Also cross-sections may not be measured at some sites. These different possibilities are dealt with in the following ways.

1. No cross-section taken
Mark the first sheet as not surveyed (enter '1' in the 'not surveyed' box) Delete the second sheet (see below).

2. Only a single cross-section taken.
Complete the first form.
Mark the second form as a record for deletion and delete it in the following way:

<PlO> opens up the menus
choose 'mark record for deletion' in the 'Records' menu
<Enter> marks the second record for deletion
choose 'Erase marked records' in the 'Organise' menu.
<Enter> packs the database erasing the marked second and unwanted cross-section

3. Allowing for additional pages for a cross-section
Complete the first page (including entry of "1" in the field Page No. for Extra Readings). This entry will activate the creation of an additional record for the extra data.

7.5 Editing data

Data in existing records can be edited at any time using the 'Editor' program:

choose 'EDITOR' in the 'Applications' menu
<Enter>
then enter the database file (e.g. SITE) and entry form names (e.g. SITE) when prompted by the program and then the site number.

The record can then be edited.

7.6 Deleting Records

Records can be deleted in a number of ways:

Known records numbers or records at the end of the database - These can be deleted using the catalogue.

Choose the database from the 'Data' menu of the catalogue < Enter>

--> *Use File*

Modify structure/order Display data

choose 'display data'
< Enter> displays the data in BROWSE mode from the top of the database <PlO> to get access to the menus
choose 'last record' or 'record number' {?} from the 'Go to' menu to select the record

<Enter> locates the record
choose 'mark record for deletion' in the 'Records' menu
<Enter> marks the record for deletion
choose 'Erase marked records' in the 'Organise' menu.
<Enter> packs the database erasing the marked record.

Specific Sites - These can be deleted by selecting the sites for editing (see 7.4) and then marking and erasing the record.

More detailed searches - Simple searches can be made using the search facilities built into the BROWSE and EDIT facilities of the DBASE IV package (see the manual).

Choose the database from the 'Data' menu of the catalogue < Enter>

---> *Use File*

Modify structure/order Display data

choose 'display data'
< Enter> displays the data in BROWSE mode from the top of the database <FIO> to get access to the menus
move the cursor to the field to be searched
choose 'match capitalisation' = yes or no from the 'Go to' menu
choose 'Forward search' from the 'Go to' menu to find the record
check that the record highlighted is the one required and then mark and delete the record.

More complicated searches can be conducted using the LOCATE command (see DBASE IV manual).

7.7 Verifying Records

Because the data entry forms mirror the datasheet layout the data is best checked on the screen rather than by printing hard copy. Query forms for checking the fields against maximum and minimum values could be developed to reduced errors, but there is no substitute for careful checking when first entering the data.

7.8 "Housekeeping" Programs

A series of housekeeping programs have been included to help manage the databases. All of these programs are run from the catalogue screen by running the application.

DUPS - This program checks for duplicate records entered for the same site for all the databases or for a single stipulated database. Such duplicates interfere with the report and data summary programs. When found the record appears on the screen where it can be marked for deletion, or other checks made.

SITE_CHK - This program checks the integrity of the database by ensuring that a full set of at least one record for each of the survey datasheets is present for every site number included in the SITE.DBF database.

CHGSECT - This program allows the sub-sections to which the sites are allocated to be changed. It requests the site and sub-section numbers for each change or a sequence of site numbers and designated sub-section numbers to be changed. The changes are then made to all of the databases.

GROUPCHG - This program is similar to CHGSECT but it allows the sites to be allocated to various groups by entering site numbers and group categories. These changes are then made to all of the databases.

CHANGRAT - This program is used to change the scaling factors for the calculated ratings for various groups of sites. The scaling factors can be changed manually or automatically by using the maximum value recorded for each rating in each group.

NEWGRP - This program allows sites to be allocated new group categories. All databases are changed.

NOSURVEY - This program is used to automatically mark all the databases and "not surveyed" when the SITE database record has been marked as "not surveyed" ("1" entered into the field). This avoids having to change all these manually.

7.9 Data Output Programs and Reports

Various programs have been provided for generating summaries and reports. All reports are produced using the REPORTS.PRG. Reports can be written to the screen, to a printer and to a file. There are a wide range of options for grouping sites and sub-sections and various other options. A series of procedures are used to support these report programs (e.g. REPORT_A, REPORT_B etc.). These report programs are also used to generate the ratings for each of the components (see the next section). There are two major approaches:

1. Site Summaries - Data for the sites is summarized ignoring the classification of the sites into the sub-sections. These summaries are mostly used for preparing general whole catchment and major catchment summaries of the data. Output can be generated for various groups of sites and compared with designated standard or pristine sites within each group.

2. Sub-section Summaries - Data summaries are prepared for the sites grouped into the sub-sections. The sub-sections may be grouped in various ways and again the results can be compared with designated standard or pristine sites for each group.

7.9.1 Site Summaries

A group of site summary program have been written to provide rapid and simple statistical summaries of the major attributes, targets and outputs described in Section 7., in Anderson (1993). These summary programs only produce screen output. Listed in alphabetical order, with the names providing the obvious links to the components these programs are :

AQUATER
CHABITER
BANKER

B&BER
CROSSER
ENVIRER
SCENER
VEGER

Each of these programs is run by selecting it in the 'Applications' menu of the catalogue and pressing

<enter>

each program then asks for entry the group selected such as GPl = I, or GP2 > 2, or the output can be generated for all groups combined, or for each individual group listed as a separate output (by entering "ALL").

These programs were used to provide the initial analysis of the data for the pilot survey on the Maroochy River catchment (see Section 10. Anderson , 1993). Sample outputs from these programs are provided in Appendix 3 (Section 13.3).

The more detailed site summary reports are produced using the REPORTS program. This program is run by selecting it from the 'Applications' menu and pressing <enter>
then it is simply a matter of choosing the 'SITE' options from the listed options.

7.9.2 Sub-Section Summaries

These reports generate a summary report for all components as output to the screen or to a printer. The reports may be produced for individual sub-sections summarizing the data collected for the sites within these sections, or for stipulated groups of sub-sections (e.g. for maj6r sub-catchments or other grouping). Once again standard sites can be stipulated for comparison. The grouping for the subsections may be different from those used for the sites. The procedures are the same as for the site summaries (7.10.1) except that the Sub-Section options are chosen. Sample outputs are provided in Appendix 3 at the end of this report.

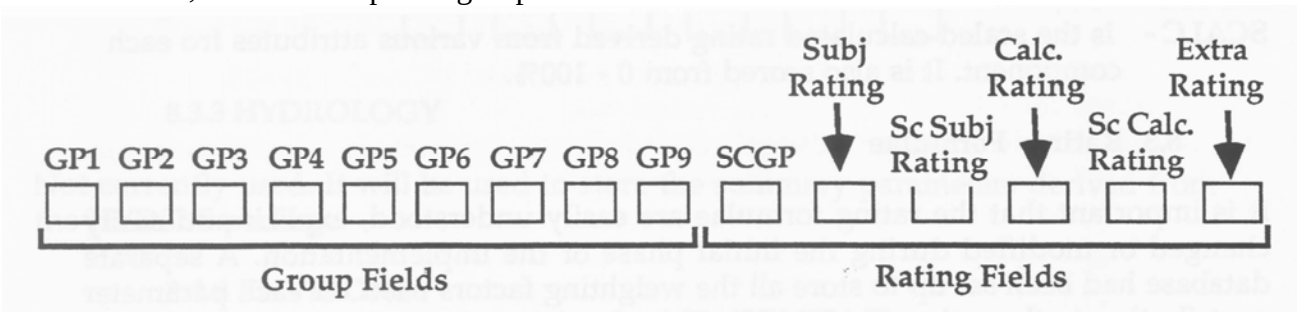
7.10 Generating Groups and Classification Criteria

Groups can be generated using the Group fields and various selection criteria. This process may be required for ICM, for example putting sites with remnant riparian zones of various widths into various categories, such as >50m, 20-49m, 10-19m, 5-9m and <5m. The program NEWGRP has been provided for this purpose. This can also be done using the REPLACE command in DBASE IV (see manual).

8 Ratings, Groups, Classification and Condition Assessment

The classification procedures inherent in the "State of the Rivers" assessment depend on having a set of grouping fields. The sites are already grouped into sub-sections, but it will be necessary to also group sites and sub-sections in other ways - for example to group sites or sub-sections into sub-catchments or into various categories in terms of one of the condition criteria. To simplify the analysis and presentation of the data it is important that the supporting programs of the package enable this to be done and also allow the results of various analyses to be permanently recorded. This saves time by avoiding delays in having to

re-calculate the ratings or the group classifications every time they are needed. This need is satisfied by having a series of group fields and rating fields present on each site record for each datasheet, and also a separate group for the sub-sections.



8.1 Group Fields

There are 9 group fields for each database (information type), and a separate set for the sub-sections. These can be entered manually or by program (NEWGRP), for sub-catchments, estuarine-non-estuarine and various other classifications.

SCGP is a special grouping field set aside for the scale groups for the ratings.

8.2 Rating Fields and Scaled Rating Fields

Each database (information type) includes five rating fields - both for the semi subjective rating made during the surveys, and calculated rating derived from the objective data collected. Each rating field is generally scored as a percentage with 100% representing pristine conditions. These ratings are generated by the analysis

programs of the package.

SUBJ - the subjective rating scored from - 100%.

CALC - the calculated rating derived from various attributes fro each component. It is also scored from 0 - 100%.

EXTRA - is used to store an extra derived rating or value for classifying the sites and sections.

It is important that these ratings can be scaled. The concept is that a western draining stream in the Murray-Darling Basin can not be compared on the same scale as a tropical rainforest stream. Each rating can therefore be scaled using the scaling fields. These are also generally entered as a percentage (e.g. 80% ==> multiply the raw rating by 100/80). These scaling factors can be entered manually, but there are also a program (CHANGRAT) which assign scales for selected groups of sites. For example it may be decided that the scales should be set to the maximum values in each sub-catchment. The program will automatically determine these maximum ratings and will assign them to each site /sub-section in each subcatchment (using one of the group fields). The scales may also be set on a regional basis or using some other criteria. The are probably of most relevance when comparing catchments, but they may also be important in sub-catchments and in other areas such as estuaries, tidal/non-tidal, upland/lowland, and various altitude and vegetation pattern grouping. These scaling factors are stored in the RATINGS database (described below).

SSUBJ is the scaled subjective rating scored from 0 - 100%.

SCALC- is the scaled calculated rating derived from various attributes fro each component. It is also scored from 0 - 100%.

8.3 Rating Formulae

It is important that the rating formulae are easily understood, explicit and easily changed or modified during the initial phase of the implementation. A separate database had been set up to store all the weighting factors used for each parameter contributing to the rating (RATINGS). This also stores the scales for each category of the group field used for scaling purposes. The formulae used to derive the various ratings are described below for each component. The various weights and values assigned initially assigned have been shown in bold text. Each of these values can be changed in the RATINGS database.

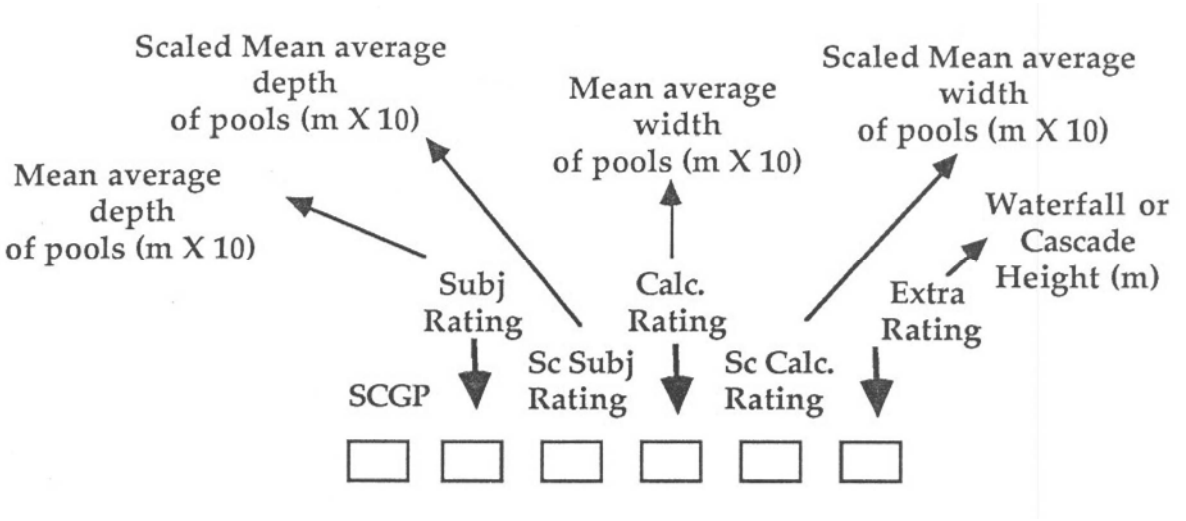
The ratings are generated as an option in the REPORTs program. This automatically calculates the ratings and assigns them to the appropriate component database or the sub-section database. All reports include statistical summaries of the rating fields produced by recalculating them for the stipulated report group and for the ratings stored for each site or sub-section.

8.3.1 SUB SECT

The SUBSECT database includes the ratings summary for all the sites in the sub-section for each of the individual components described below. There is also a set of ratings for the sub-section itself which is used to store the overall weightings for the sub-section. This is derived from interpreting all of the component data and other information.

8.3.2 SITE

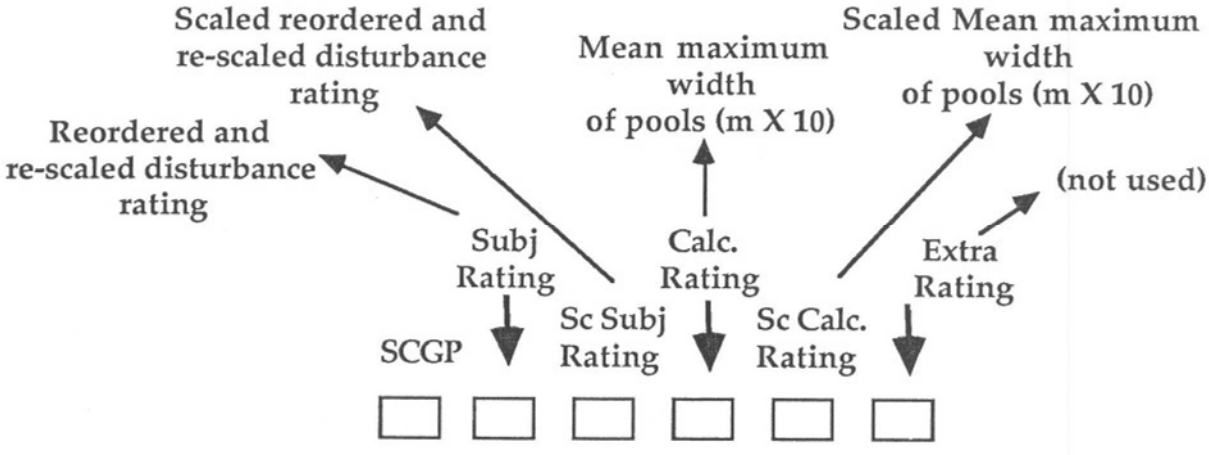
Ratings are not relevant for the information collected on the site database. The fields are used to store information derived from the Channel Habitat form (described below). The mean average depth of pools in the section and mean average width (m X 10), unsealed and scaled, derived from the channel habitat database are recorded as well as the average height of waterfalls, rapids or cascades at the sites. This information is useful for classifying the sites.



8.3.3 HYDROLOGY

Not currently used. It will be used to store the summary parameters derived from the HYDSYS package.

8.3.4 ENVIRONS



Subjective Rating - The subjective rating is simply the re-ordered disturbance rating on the datasheet re-scaled to 100%.

Subjective Rating = (7 - disturbance rating) * 100% /6

Sites with both the riparian vegetation and vegetation on the adjacent land undisturbed with no invasion by exotic species are rated at 100% ("1" in the original code).

calculated Rating - The calculated ratings are derived by reordering the categories used for recording the various types of land tenure, local disturbance and land use. These are then applied using the formula.

Calculated Rating = tenure X (60%)
+ local disturbance X (15%) (none=20%)
+ land use X (20%)

The codes used to convert the tenures for entry into the formulae are as follows:

2=>7,3=>6, 4=>5, 5=>4, 6=>3, 1=>2, 7=>1.

The codes used to convert the land uses for entry into the formulae are as follows:

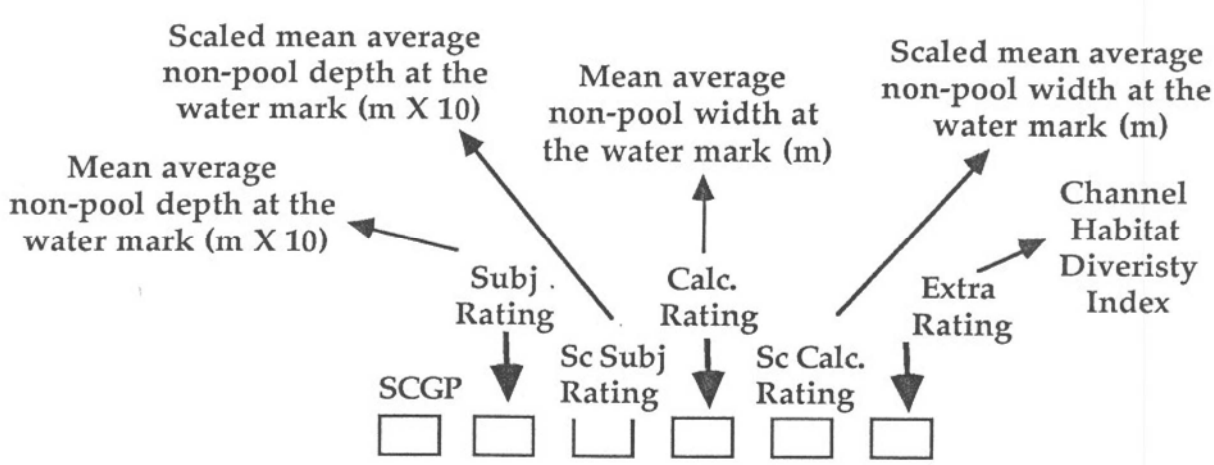
1=>6, 2=>7.....9=>14, 14=>5, 15=>4, 12=>1, 11=>2, 10=>3, 13=>15.

The codes used to convert the disturbance types for entry into the formulae are as follows:

3=>15,4=>14,5=>13,6=>12,10=>7, ... 14=>11, 7=>6,8=>5, 9=>4, 14=>3,
the remaining types remain unchanged.

The average revised code for each type (tenure, land use and disturbance types) is then calculated and then scaled to lOO, before being multiplied by the weightings and added to give the final derived ratings. Site in National and State Parks (tenure = 7 or 6) with land use as a park or reserve, and no local disturbances rate at 100%.

8.3.5 CHANNEL HABITATS



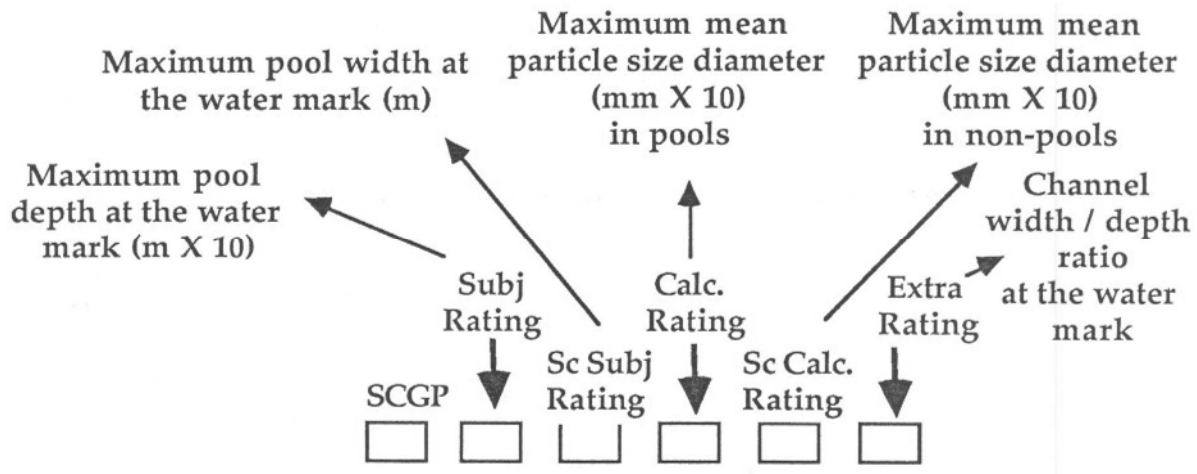
The ratings are not really relevant for the Channel Habitat information. The fields have therefore been used to store other summary information as shown above. In this case the average depth (XIO) and width of the non-pool habitat types (all types except pools and backwaters). Similar information for the pool habitats (pools and backwaters) is stored using these fields in the SITE database.

The Channel Habitat Diversity Index - This is calculated from the formula:

Diversity Index = (Σ In (percent for types present)) - In (100).

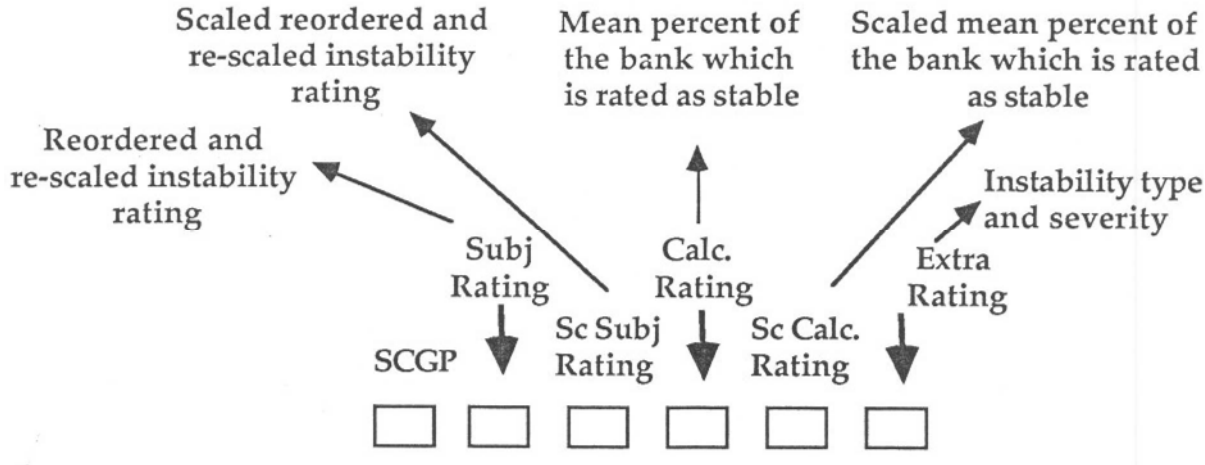
This is similar to other diversity measures with the maximum values (100) occurring when there are a wide variety of types present each of which are present in equal percentages within the reach (e.g. 20% pool; 20% rapid; 20% cascade; 20% riffle; and 20% backwater). Reaches where only one type is present are scored as "l ". Reaches dominated by one type also score low values of the index. This diversity index gives a measure of the diversity of channel habitat types and therefore the range of biological habitats present in the reach. Each channel habitat type has its own set of depths, flows, substrates and gradients.

8.3.6 CHANNEL DIMENSIONS



The ratings are again not really relevant for the channel dimension information recorded in the CROSS database (cross-section data). The fields have therefore been used to store other summary information as shown above. In this case the maximum depth and width of pools at the water mark, and the width / depth ratio have been recorded. Two of the fields have also been used to store the maximum mean particle size diameters for pools and non-pools (X 10). The water mark relates to the usual or more common inundation level in the stream and so this information provides a standardized measure of the size of the stream. The sediment particle sizes are also important for characterising the type of habitats present. (Note: "0" represents particle sizes less than 0.1 mm and "-99" is used to indicate that no sediment information was recorded)

8.3.7 BANK CONDITION



Subjective Rating - The subjective rating is simply the re-scaled "Overall Instability Rating" and the "Susceptibility to Erosion Rating" combined for both banks. Scores of 100% occur when both banks are rated as having minimal instability and susceptibility to erosion. The contribution of the two ratings are weighted.

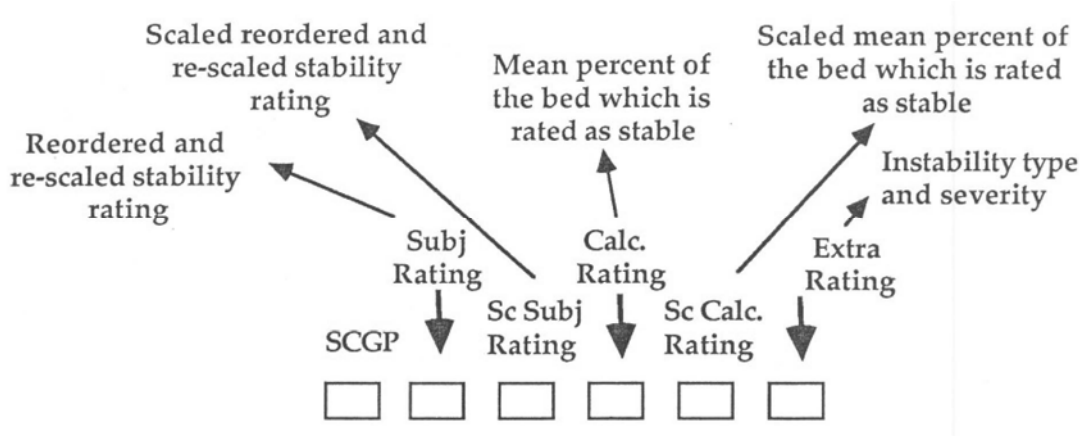
Subjective Rating = (80%) Instability Rating + (20%) Susceptibility Rating

Calculated Rating – The calculated rating is determined from the percentages of the lower and upper banks on both sides which are rated as "Stable" (recorded as 0-100%).

Calculated Rating = (80%) % Upper bank stable + (20%) % Lower bank stable averaged for each bank)

Extra Rating – This is used to record the major direction of the instability, that is in terms of erosion (eroding and slumping), or aggradation. In either case the average erosion (halved) is scored as a percentage reduction from 50%, and the average aggradation (halved) is scored as a percentage increase from 50%. The maximum of the two scores as positive and negative shifts from 50% is then recorded in the field. This then represents the dominant direction of the change in condition prevailing at the site.

8.3.8 BED AND BAR CONDITION



Subjective Rating – The subjective rating is simply the re-scaled "Overall Bed Stability Rating". The ratings have been weighted and averaged for both banks.

Stable ("3") => (100%)
Moderate Erosion or Aggradation ("2" or "4") => (50%) Severe Erosion or Aggradation ("1" or "5") => (20%)

Scores of 100% occur when both beds are rated as being stable.

Calculated Rating - The calculated rating is different depending on whether the dominant process is aggrading (bars present) or eroding.

Aggrading Beds (bar size >0; bed stability rating >3)

The bar size as a percentage of the bed is multiplied by 1.5 to derive an initial index (maximum bed sizes are around 70-80%).

The rating is based on the size of the bar. The bed stability rating (BSR) is also taken into consideration. For bar size < 5% the BSR > "3" the value calculated above is used instead of the index of the severity of the aggradation("4" => 50% (Le. 100-50); "5" => 80% (Le. 100-20). Otherwise the index is the average of the bar re-scaled bar size and the index derived

from the BSR.

The indexes are then multiplied by a weighting for the type of bar present (note in reverse to their relative importance because the index is later subtracted from 100%):

Point	=> X (90%)
Alternate	=> X (90%)
Island	=> (95%)
Encroaching Vegetation Obstructions	=> X (95%)
Bar Plain	=> X (85%)
Infilled	=>X (85%)
High Flow deposits	=> X (100%)

The values are then scaled according to the angularity of the bed particles. The more angular the more recent the aggradation with input of new materials from outside the channel.

Index = Index * { (1 + (60%) /1000) * (4 - gravel angularity category) }

The values are then scaled according to the shape of the bed particles. The more rounded the more mobile the particles and the more likely the sediment will continue to be passed downstream.

Index = Index * { (1 + (40%) /1000) * (4 - gravel shape category) }

Eroding Beds (bed stability rating < "3")

T1;1e index for the eroding beds are based on the subjective stability ratings given above. This index is then modified according to the factors controlling the stability, bed compaction, surface cleanliness and the controls present.

Index = Index * { (1 + (50%) /1000) * (5 - compaction category) } (more compaction - less likely to erode)

Index = Index * { (1 + (40%) /1000) * (4 - gravel shape category) } (more rounded - more likely to erode)

Index = Index * { (1 + (50%) /100) * (Log1o (number of factors + 1)
- (60%) /100) * (Log1o (number of control types + 1)}

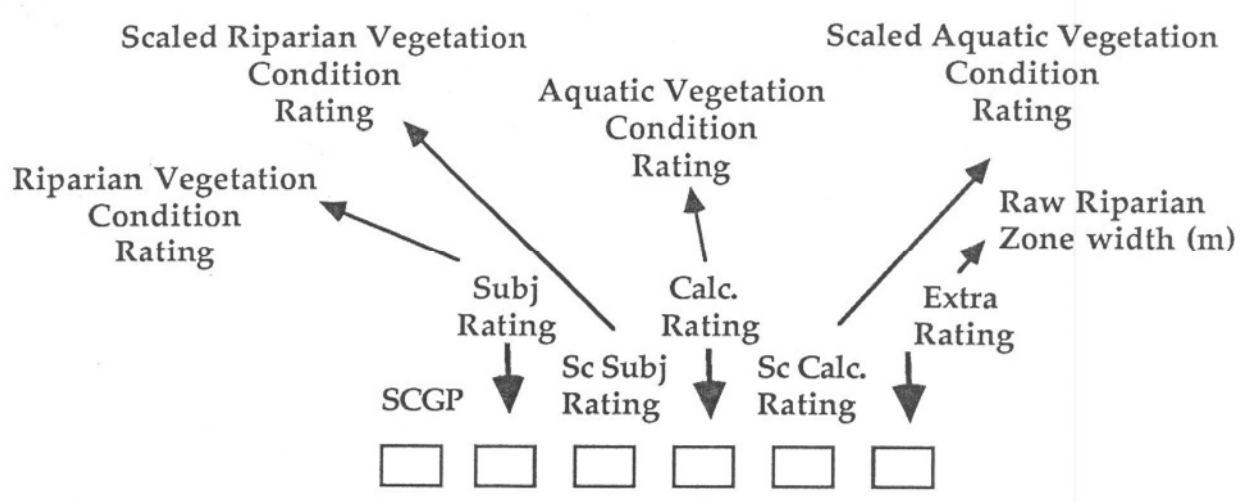
The combined index is derived by adding the index for erosion and aggradation with both set to a maximum of 100%

Index = 100 - (Aggradation index * (100%) /100) - (Erosion index * (100%) /100)

Extra Rating - This is used to record the type and severity of the instability.

Extra Rating = 50 - (erosion index) /2 for erosion dominant
Extra Rating = 50 + (aggradation index)/2 for aggradation dominant

8.3.9 VEGETATION



Subjective Rating - There is no subjective rating - this is already covered by the disturbance rating on the Environs datasheet. A separate rating is made for the riparian vegetation and the aquatic vegetation.

Riparian Vegetation - The rating is based on the width of the riparian zone (50m wide rated as maximum) which is multiplied by a factor relating to the density and structural diversity of the vegetation in the riparian zone. In effect the width of the zone is taken as the original index (re-scaled to 100% for zones> 50m wide), which is then increased or decreased according to the diversity and density of the vegetation present. The maximum score of 100% is recorded for zones 40- 50m or greater in width, which have a good mixture of tall and low tress as well as a -- variety of understorey species. Both overstorey and understorey are required for the riparian vegetation to perform all its functions.

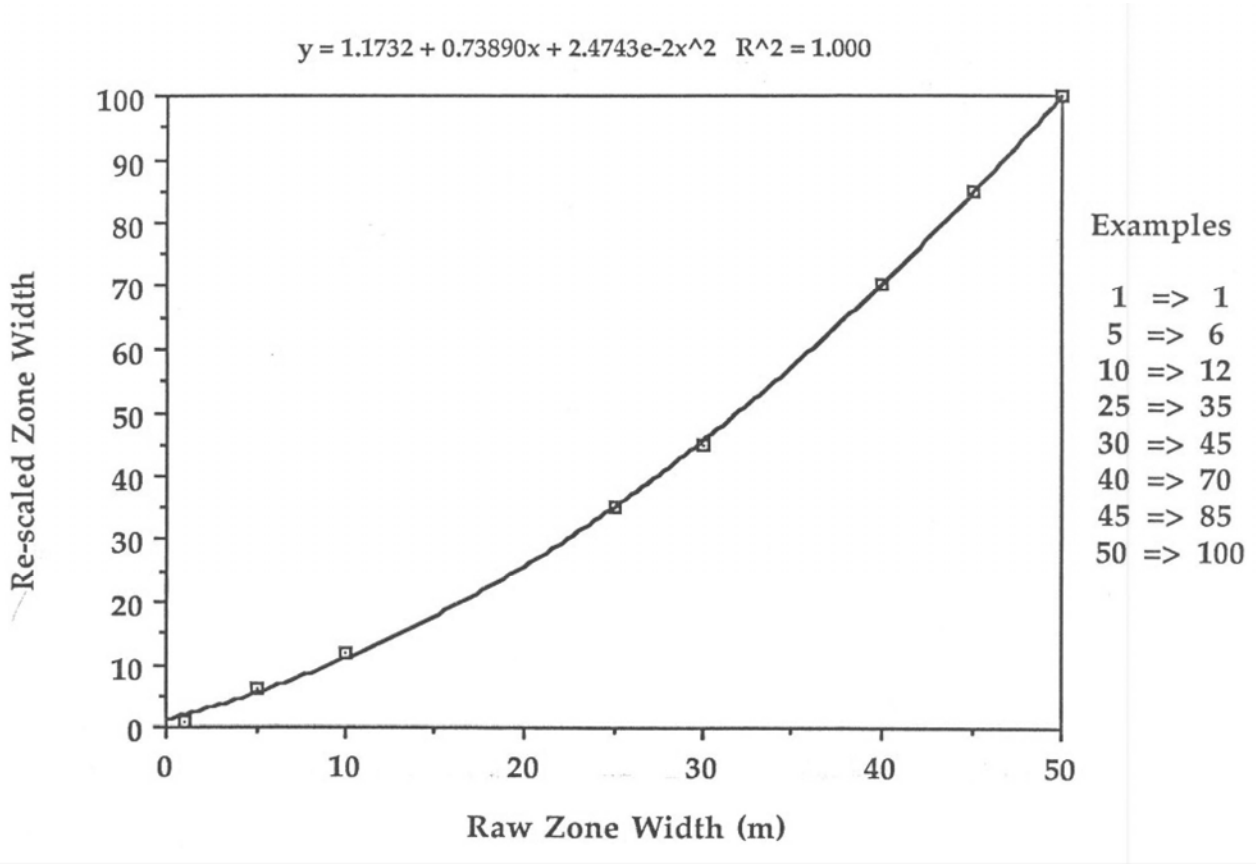
The basic formula is :

Riparian Index = { (100% /100) * width factor} * {(100% /100) * vegetation factor}

The width factor is derived using a quadratic equation to modify the actual recorded width. A non-linear function is used because the value of narrow zones is much less than the wider zones. The parameters of the 2nd order quadratic equation can be changed in the RATINGS database.

Width factor = (1.1732) + (0.7389) * width + (0.024743) * width2

The function used is shown on the next page.



The **vegetation factor** is derived by assigning a weighting to each of the structural types and then adding each component together (each type contributes a maximum of 100% to the rating). A negative factor is applied for the percent of bare ground on in the riparian zones.

Vegetation factor = (100%) (mangroves - set at the maximum)
+ (85%) (tall trees, medium trees)
+ (70%) (small trees and palms)
+ (55%) (shrubs, vines, tree ferns)
+ (40%) (salt marsh plants, rushes, ferns, herbs) + (30%) (grasses and mosses)
- (30%) (% of bare ground)

Note: each component has a maximum of 100% and the total for each group is also 100%. The weighting are scaled in proportion to their value for the riparian zone. Keeping the maximum contribution for each group at
100% ensures that the index relates to the diversity of types present.

Each contributing original cover for each vegetation type is reduced by a set amount depending on the percent of exotic species present.

Species group factor = percent cover by the species group * (30% /100) * % exotics

For example if the cover by tall trees is 70%, and 50% of this cover is by Camphor laurels, this cover is reduced to 70 - (70 * 0.5 *0.3) = 58. When this is multiplied by the weighting for tall trees (85%) this becomes 49.

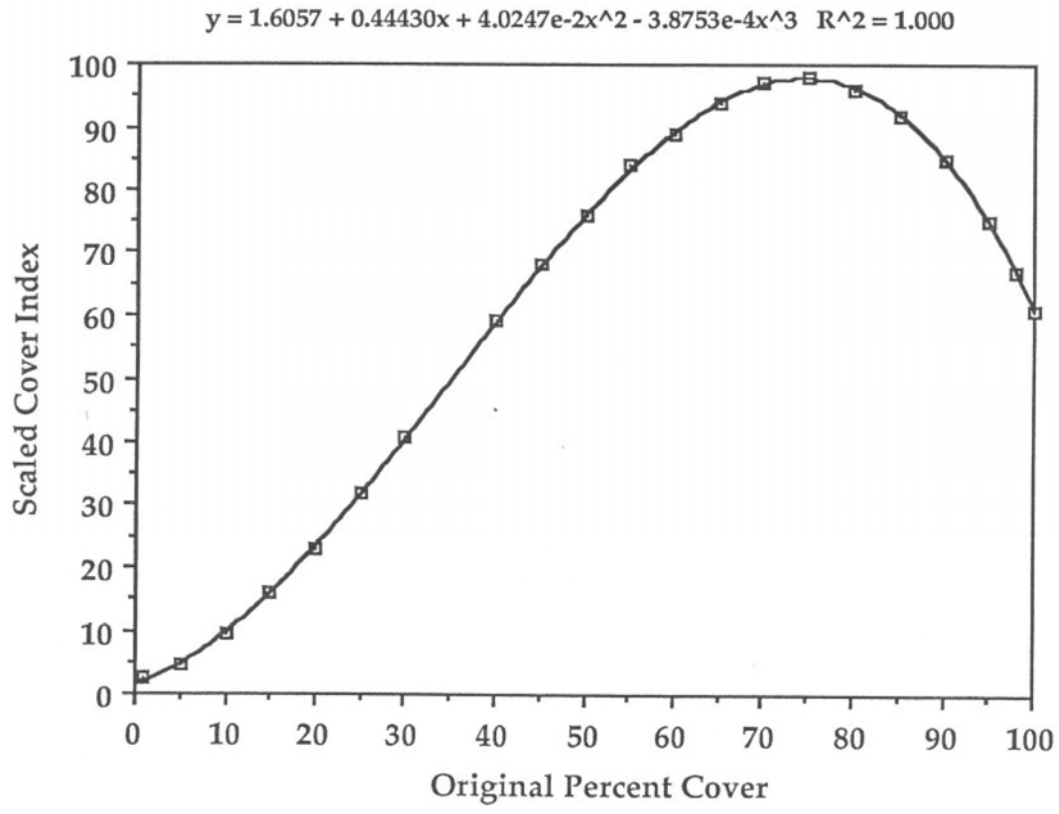
The final rating is produced by multiplying the width and the vegetation factors.
The net effect of the formula is to weight the tall trees, mangroves more highly than the shrubs and reeds, but the maximum rating requires a variety of structural types to be present with relatively high covers. The group weightings have been scaled in consideration of their total contribution to the overall index. Exotic species downgrade the ratings. Narrow widths are rated poorly even if the vegetation cover within the narrow zone is high and diverse. Relatively wide zones of reed or grass, even when >50m wide are downgraded because of the absence of trees and shrubs.

Aquatic Vegetation- The rating is derived by summing the percentage covers for the various aquatic types present.

The basics formula is:

Aquatic Veg. Rating = (50%) (submerged) + (30%) (emergent) + (20%) (floating)

A 3rd order quadratic function is used to reduce the values of types where the recorded covers are in excess of 80% for some attributes. This is necessary because when the covers become too high they have a detrimental effect on habitat values. For example, a stream which is completely chocked with water hyacinths has a degraded value compared with a stream that has only about 30-70% cover. The excessive plant cover may reduce light penetration, and may lead to periodic deoxygenation problems and eutrophication. Likewise a stream that is completely choked with reeds has a downgraded value as the reeds prevent passage of fish, they lead to accumulation of fine sediments and they reduce the diversity of habitat types present in the channel. The quadratic function has the effect of setting the maximum at 80% cover and thereafter reducing the index.



Examples

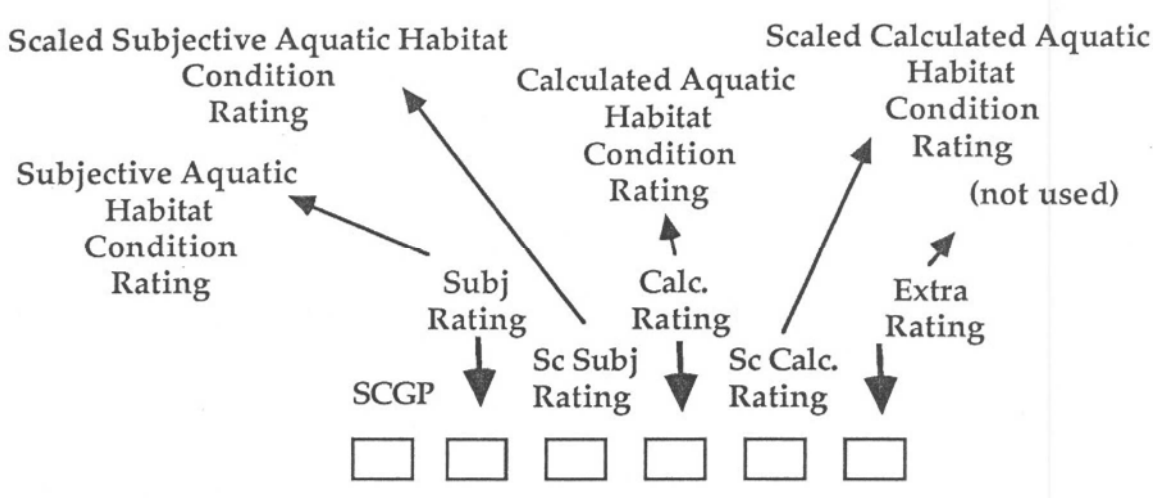
1	=>	2.5
5	=>	4.6
10	=>	9.6
15	=>	16
20	=>	23
30	=>	41
40	=>	59
50	=>	76
60	=>	89
70	=>	97
75	=>	98
80	=>	96
85	=>	92
90	=>	85
95	=>	75
98	=>	67
100	=>	61

The formula can be changed in the program (Function SCVEG).

Cover Index = (1.6057) + **(0.4443)** * % Cover
+ **(0.04033)** * % Cover 2
- (0.00038875) * % Cover 3

The covers are first reduced by (30%) * the % Exotics in each type.

8.3.10 AQUATIC HABITAT



/Subjective Rating – The subjective rating is derived from the re-scaled "Overall Aquatic Habitat Rating".

i.e. Subjective Rating = (5 – Aquatic Habitat Rating) * 100% *I* 4

Calculated Rating – The basic formula is :

Aquatic Habitat Index = (60%) * (instream cover) + (40%) (bank cover)

Instream Cover – Most of the components (logs, branches etc.) are scaled using the SCVEG function (see aquatic vegetation) because cover values in excess of about -- 80% represent degraded.

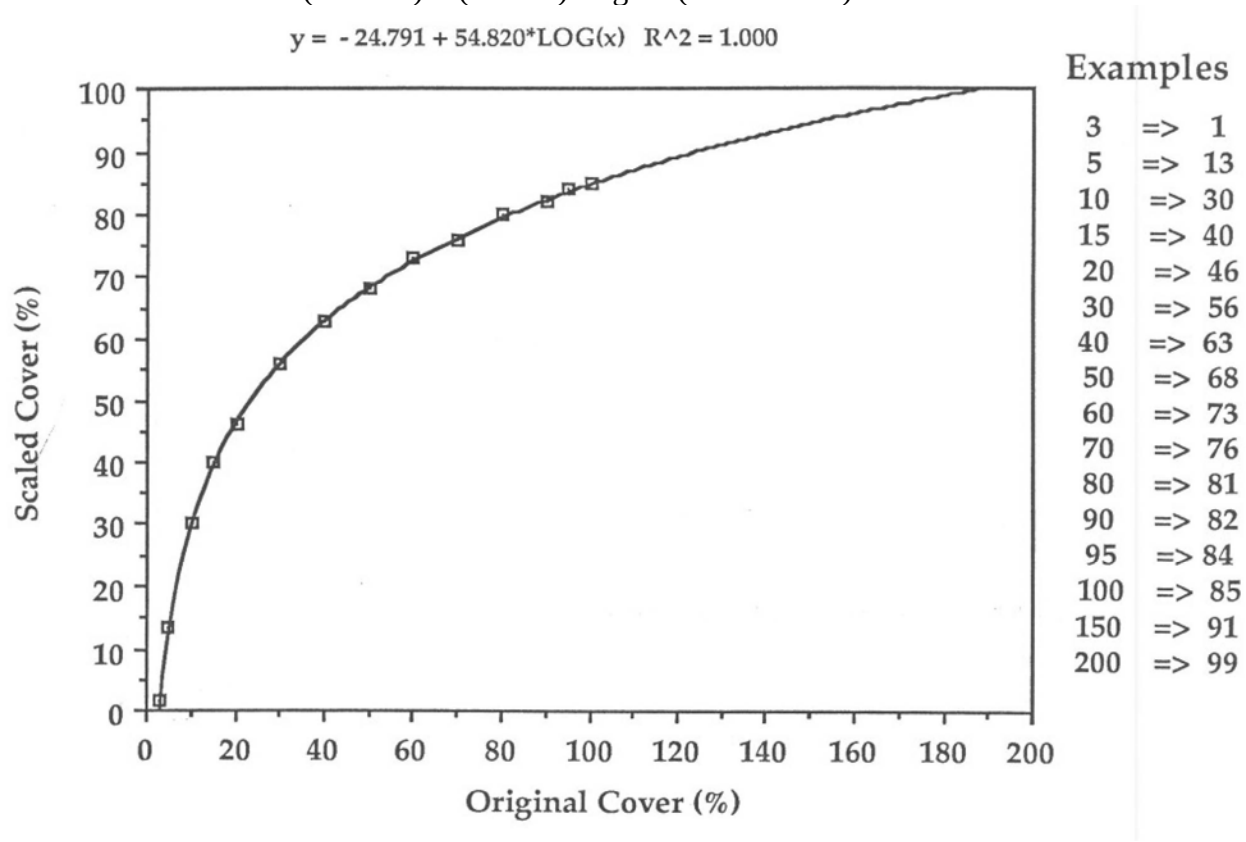
Each type is given its own weighting and then these values are added:

log => (90%); log jam <50% dense => (95%); log jam >50% => <100%) ;
branch => (80%); branch pile <50% dense => (80%); branch pile >50% => (85%); leaf => (40%); macrophyte debris => (50%); algae => (30%);
submerged aquatics => (85%); mangroves => (100%); floating veg. => (80%); emergent vegetation => (80%); roots => (90%); rocks => (75%);
pools> 1 m deep => (50%); man-made cover => (40%).

This may increase the index above 100%.

The final ratings are then re-scaled using a logarithmic function which tends to increase the rating given to small amounts of one type of habitat (see graph on next page), but make it more difficult to reach the 100% rating. The index can be quite high is only a single aquatic habitat component such as logs or log branches cover a reasonable proportion of the bed.

Instream Cover Index = (-24.791) + (54.820) Log 10 (Raw Cover)



Bank Cover - The bank covers are calculated using the predicted maximum widths for each type to derive appropriate multipliers which also take into account the relative importance of the different types (canopy = 85%; man-made = 50% and the rest are left at 100%) and the width which is also used as a multiplier. The basic formula is therefore:

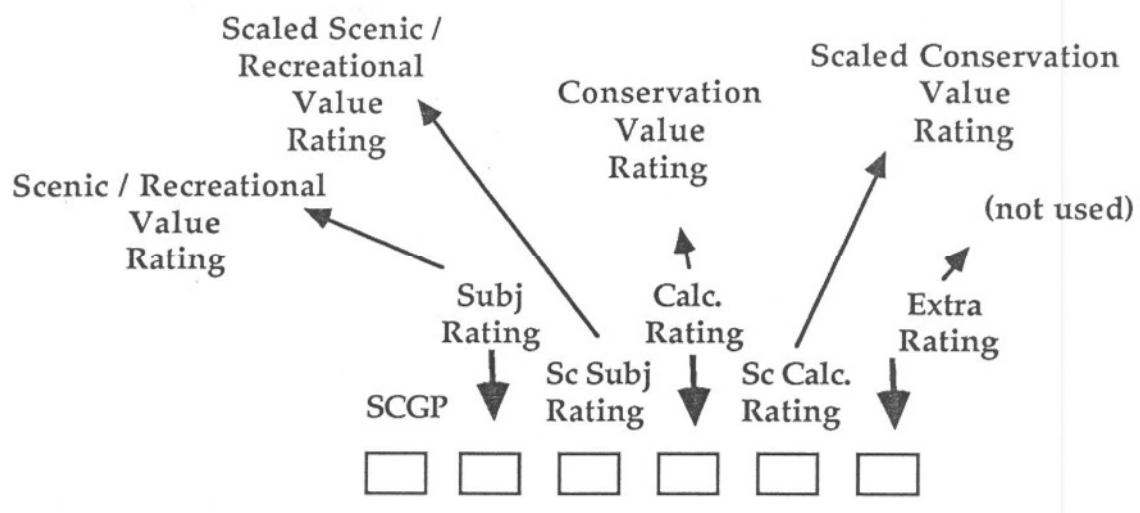
width * % of bank length * Multiplier

The multipliers for the different types are:

Canopy => (8%)
Veg. Overhang => (20%)
Root Overhang => (25%)
Bank Overhang => (40%)
Man-made Overhang=> (40%)

These individual ratings are added together to give the final rating (max. = 100%)

8.3.11 SCENIC, RECREATIONAL AND CONSERVATION VALUES



Scenic / Recreational Value - This rating is derived from the following basic formula:

Scenic / recreational value = (60%) recreational value + (40%) scenic value

Recreational Value = (70%) *Mod (9- Rec. Opport. Rating) /9)
+ (30%) * 100 * (Log 10 (No. of recreational types listed»

Conservation Value = 2 * (Aquatic habitat rating + Riparian Habitat Rating
+ Wildlife Corridor Rating + Aquatic Representative Rating
+ Riparian Representative rating.

8.4 Overall Assessment Procedures

The procedures for generating overall condition assessments by combining the outputs from the various components have not been provided in this initial manual. These procedures can only be effectively developed after several catchments have been surveyed and the results compared and analysed. Various formulae could be developed using several criteria, each of which could be weighted in an appropriate way to reflect its relative importance. This is a difficult process and can lead to unfortunate biases (see section 4.5 in Anderson 1993). It could be legitimately argued that the individual components should not be combined using such formulae but that the final assessment should be made by interpreting all the results in qualitative way. Whatever the procedure that is adopted the process of recognising and classifying the sites and sub-sections can be done using the group fields in the databases.

9 Output to GIS and linkage to other Data Sources

The output to GIS for plotting purposes can be simply generated as text files or databases which include the section numbers, or site numbers and the group numbers for each classification. More data could also be transferred to the GIS which could itself be used to further classify the sites and sub-sections using other sources of data. This assumes that the section boundaries and centroids are already stored within the GIS.

10 Hierarchical Order of Sub-sections in the Drainage Network - Linkage to ICM

The drainage code system on the Sub-section data sheet can be used to determine the-"order of the sub-sections in the drainage network. The program SECTUP can be used to produce a list of all the sections which are upstream of a designated section and to mark these sections using one of the group codes.

11 Generating simple map output without using GIS

It is possible to generate simple map output using the DBASE IV package itself, independently of a GIS system.

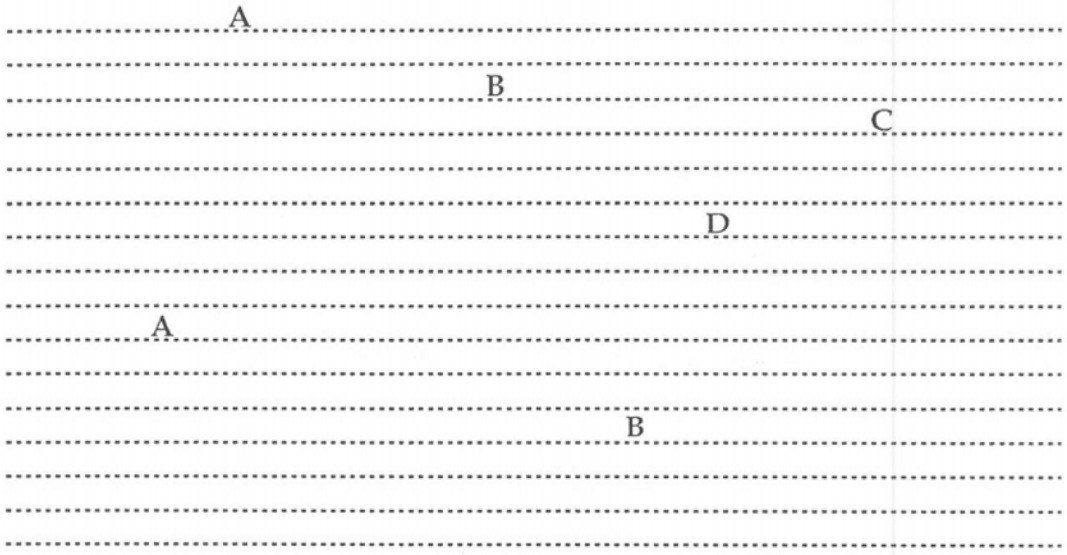
This is done by using a simple formula to convert the grid references for the sub-section centroids, or sites into x and y. co-ordinates, which in turn are used as line and character numbers for the printer.

Various symbols can be printed at the locations for each of these points to designate the classified groups to which each site or section belongs.

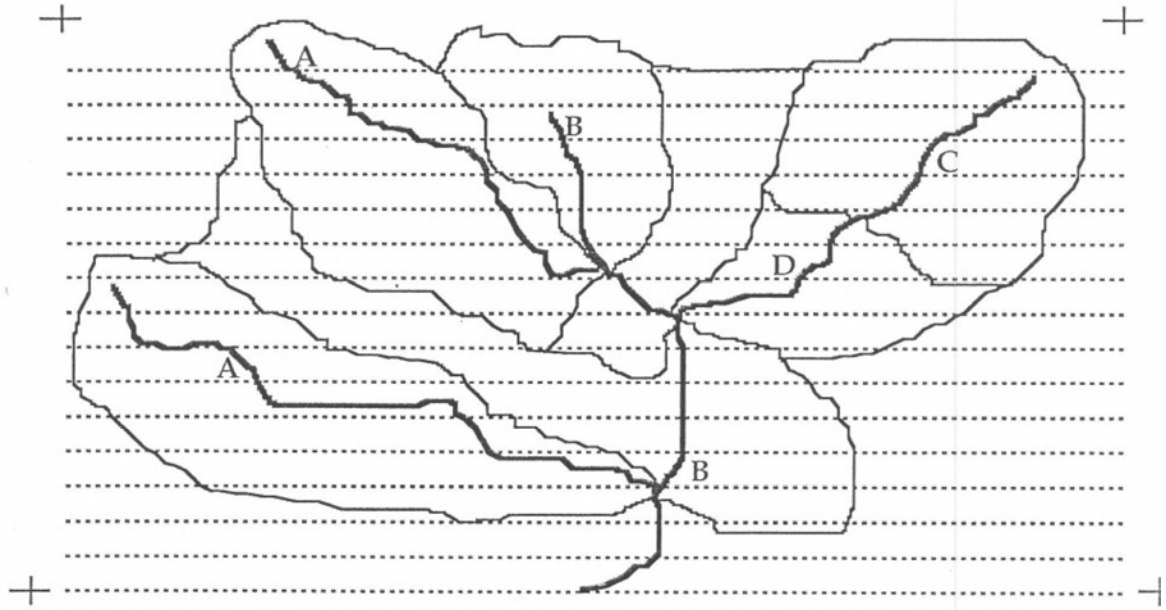
Grid References (or latitudes & longitudes)

494000 (E) 7047700 (N) Sorted by Northings & scaled → Line No. (rows)

Sorted by Eastings & scaled → Column No. (columns)



A transparency of a base map for the area at a suitable scale can then be overlaid and photocopied to produce a simple summary map.



A program to scale and generate the row and column co-ordinates (MAPGEN) is provided.

12 References

Anderson (1993) *'State of the Rivers' Project Report* 1. *Development and Validation of the Methodology. A* report to the Water Resources Commission, Queensland.

13 Appendices

13.1 Appendix 1. Notes on the Datasheets and Survey Procedures

13.1.1 Introduction

This section provides various notes on the datasheets and survey procedures. These notes are intended to be used during the training workshop on the survey methods and techniques. The datasheets have been designed to be self-explanatory but these notes will help to provide and introduction to the approach adopted.

13.1.2 General Organisation and Approach

The following points are essential to understanding the general approach:

- The survey has been designed to ,be completed by independent teams of two people spending 45-60 minutes at each site. Two people are required to conduct the cross-sections - one for taking the measurements and the other for recording the results.

- Normally on arrival at the site the 8 datasheets apart from the cross section sheet are divided between the two people, who each complete 4 of the sheets by themselves. Usually this is expected to take about half the time leaving the- rest of the time for the cross-sections. Certain individuals may feel more competent with some of the sheets and may prefer to fill-out the same sheets at all the sites.

- It is important that ALL the information is completed at each site. It is always hard to distinguish between a real zero and a failure to complete the data sheet. Adequate analysis of the data depends upon having complete records. The survey team leader should check the sheets at each site to ensure that they have been completed.

- The completed datasheet_ should be re-compiled into their original order and 'stapled together.

- Different sites will require different approaches, mostly in terms of the depth of water and other aspects for taking the cross-sections. Shallow sites can be waded. The portable echo-sounder with the transducer attached to a 'kick-board' float can be used at many sites to complete the cross-sections without having to launch a boat. Provided there is access to both sides of the stream (via a bridge, ford or shallow section) a rope can be thrown across the stream, the transducer attached, and readings along the cross-section taken by attaching a tape and pulling the transducer back across the stream. When the rope is in place the transducer can be moved upstream and downstream with the two team members on either bank

to find the point of maximum depth. This is certainly preferable to having to launch a boat from the roof or a trailer in terms of the time and effort required. At some sites there may be no alterative to having to doing some of the sites by boat. In difficult terrain carrying a small punt on the roof is easier than towing a trailer. Also it may be very difficult to find launching points. In estuaries, and in the navigable freshwater sections of the larger rivers, many sites may be able to be surveyed by boat from a single launching point. In this case having a larger boat is a definite advantage.

- Setting targets in terms of the number of sites to be completed in a day, and time limits at the sites are crucial for keeping the surveys on schedule. Organising each team's schedule within a small area, and choosing a mixture of 'easy' and 'hard' sites on each day will help to maintain the target of 8-10 sites per day.

- The surveys can not be completed in wet weather unless the datasheets are printed onto water proof paper, but this is expensive.

- It is preferable to keep the number of personnel involved small and to complete all the surveys within a catchment within a short period of time. This helps to maintain consistency and an intense, concerted effort will achieve more consistent results.

13.1.3 Contacting Local Land Owners

The questions of when, how, and how often land owners should be contacted, are difficult to answer. It is a two-edged sword. It is certainly necessary, and polite to ask permission before entering private land. It is also good for public relations to contact as many people as possible. Also local land owners have an intimate knowledge of the streams and the easy access points. There is certainly a lot to be learned from chatting with them, and these notes can be added to the data sheets. These conversations can provide a unique historical perspective on the changes in the condition of the streams and local theories as to the causes of the problem. However, these contacts can be extremely time consuming - many locals 'like a chat'. Also certain individuals may be untrustworthy and suspicious of what the 'real' intentions of the work may be. Therefore this aspect needs to be carefully managed. Also local land-owners can be very difficult to find! It is therefore suggested that a press release be issued before the survey is conducted informing the local community of the objectives of the study and its methods and coverage in the local area. Telephoning the land owners at night to inform them of the need for access to their land is also a good idea. Likewise the local DPI staff will be able to identify potential problems. Ultimately the selection of locations for the sites will need to be heavily dictated by time and access considerations which will mean that most of them will be upstream of fords and bridges on public roads.

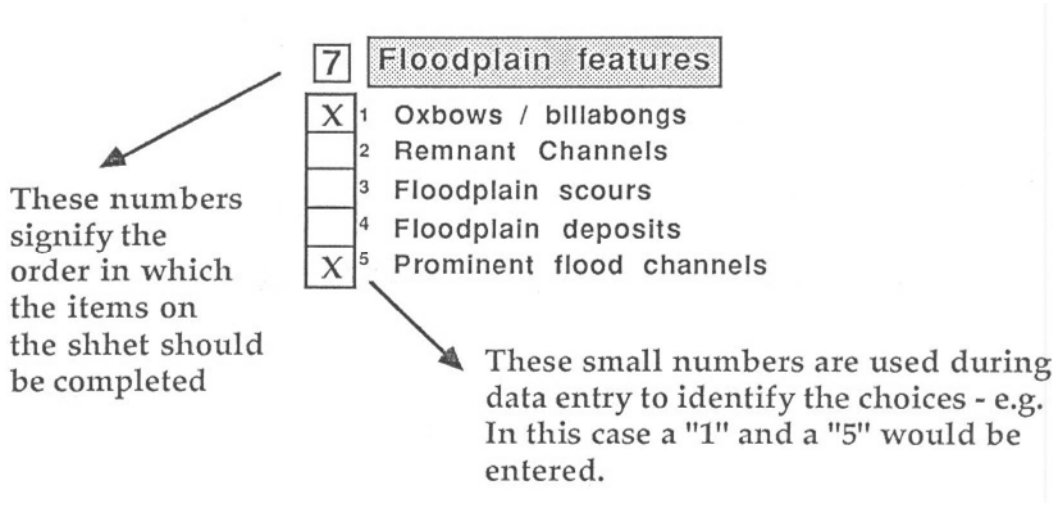
13.1.4 Co-ordinating the Surveys

The survey will need to be co-ordinated on a day-to day basis by the Project Officer. This will involve setting the group of sites to be surveyed on each day, general planning and problem solving, ensuring that the equipment is looked after and maintained. This officer is also responsible for collecting and checking the data sheets, maintaining the base maps and working maps up-to-date as new sites and sections are added, and dealing with film supply and processing, and other spares such as batteries.

13.1.5 General Notes for the datasheets

General Notes - The following notes are relevant for all the sheets:

- The datasheets should be completed using 2B or 3B pencils.
- Entry is made in terms of actual numbers or "X" to signify a choice between alternatives. Usually more than one entry can be made for each field.



- Some of the fields require estimates of a percentage cover for a certain area or within certain boundaries (e.g. for the vegetation and for the organic debris cover). These estimates should be made to the nearest 5%. Certain codes are used to provide extra information either within the field itself or by filling in additional fields (e.g. "water too turbid to estimate - presence only recorded")

  "1" = presence only recorded

  "999" = item not assessed

  "blank or "0" = zero cover absent

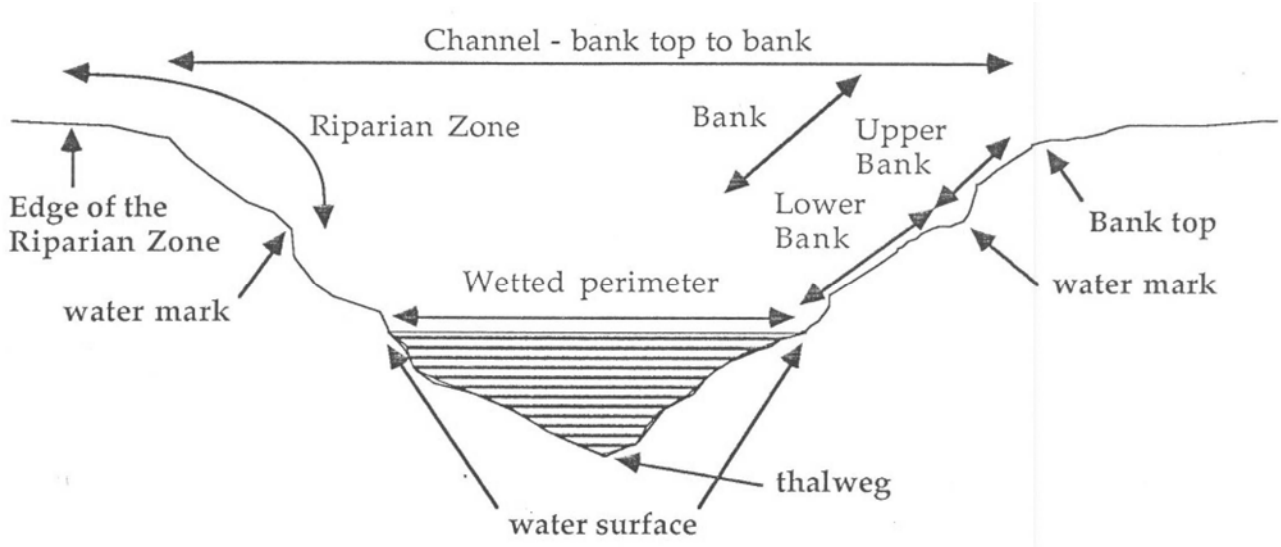
It is particularly important that the boxes provided for "not assessed" and the above codes are used to signify when the item has not been assessed. As in any survey of this type it is difficult but nevertheless extremely important to be able to distinguish between real zeros for absences and missing data or items which were not assessed. This completeness of the data sheets is vital, and the need to fill in all the boxes should be stressed.

Why weren't categories used instead of actual percentages to the nearest 5%. Experience with other similar surveys has shown that with such a comprehensive survey the selected categories would have to vary greatly between the items and this complicates the completion of the sheets. Recorders would have to continually refer to coding sheets to select between the appropriate categories.

How accurate do I have to be? Some inaccuracy and variability in the assessments is assumed. Mostly we are looking for the "plain bloody obvious". Categories will be used to analyse the data and so this reduces assumed need for accuracy. Leaving the categorization until the analysis stage allows for flexibility as we don't get locked into certain presumed ranges. The raw actual percentages are therefore of greater value, but it should be made clear to the survey participants that great accuracy is not required and that their results will be categorised for analysis. Typical analysis categories may be :

Code		Category Range	Description
0	=	0%	Absent
0	=	1% or greater	Present
0	=	5-20%	Rare or low cover
0	=	25-80%	Moderate abundance or cover
0	=	>80%	High abundance or cover (heaps!)

Boundaries - Most of the boundaries used for the various assessments are explained on the appropriate datasheets and detailed explanations should be provided when dealing with each sheet in turn. The following summary gives an initial guide.
water surface

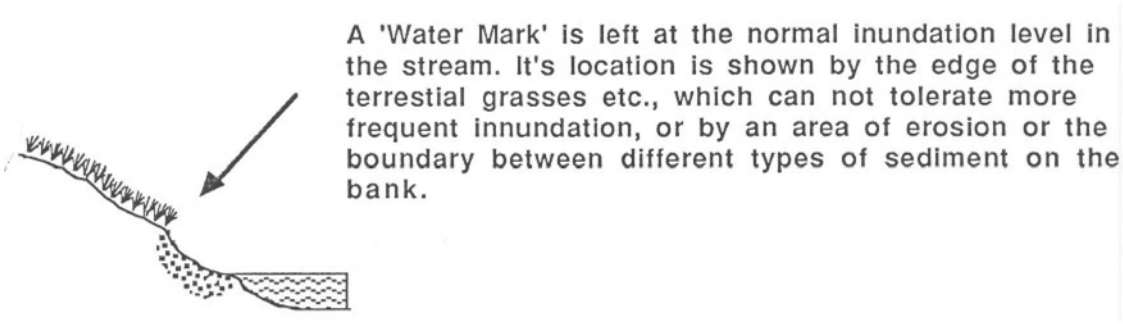


Thalweg - This is the deepest point across a transect. It is important because cross-sections in pools should be taken to intercept the deepest point in a pool, and the 'shallowest' thalweg in a riffle, run or glide.

Bank top, Banks - From a measurement point of view the banks extend from the water's surface (or the water marks if the bed is dry) to the bank top, that is to the point of inflexion the channel profile.

Water Surface - This is obvious. It is used for taking depth measurements for the cross-section profiles and for assessing the instream organic debris cover available for fish and invertebrates. When the bed is dry assessment is made at the 'water mark', Le. assuming that the channel was filled with water to the 'water mark'.

Water Mark -The concept of a 'water mark' is used to provide a reference point for standardising the channel measurements and for marking the boundary between the lower and upper banks. A mark is left on the bank at the normal inundation level for the stream. It is delineated by either the edge of the terrestrial grasses and other vegetation which cannot tolerate more frequent inundation, or an obvious point of erosion or substrate differences along the bank. Its origin, definition and use are described in more detail in 7.5.5 of Anderson (1993).



It is usually fairly obvious when flows are low to average, but it will be submerged at higher flows. It is useful because it can be used to provide a crude standard for depths and widths of water in pools, runs, riffles and other channel habitat types. The flow and discharge conditions during various surveys will differ a great deal depending on local rainfall patterns and weather. This means that the water depths and widths will be highly dependent on these conditions. The 'water mark' corresponds with a standard water level, that is to a 'normal' or 'usual' inundation as signified by an erosional mark or the edge of the terrestrial vegetation. What this level actually represents will probably vary with the climate and seasonal rainfall patterns in different catchments throughout Queensland, nevertheless it is a very useful concept for producing standardized measurements for which there is no real substitute. The hydrological record at gauging stations and the transects taken at these stations may be used to interpret the local meaning of the "depths at the water mark", using the cross-sections taken nearby.

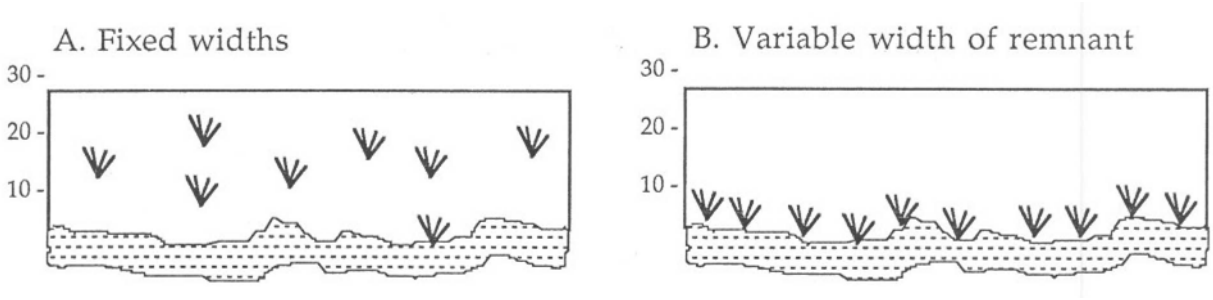
Riparian Zone - It is difficult to derive a precise definition of a riparian zone, particularly for untrained staff. There are many possible definitions. The most relevant feature for our purposes is the vegetation. Ideally it should be possible to identify such a zone irrespective of disturbance or condition, and it should have a fixed with for each size and type of stream, relating to how far and how often the stream or river floods or reaches bank-full stage. However, this is not possible in this survey and so the focus is on identifying the remnant riparian zone using its distinct vegetation.

The riparian zone is an interface between the stream and the surrounding land. The vegetation in it is different because of the influence of the stream in increasing available moisture, flooding and soil characteristics. The vegetation is important or the stream because it contributes organic debris, stabilises the banks and provides shade, and cover for the instream communities.

The general perception of there being a strip of vegetation along the edge of the stream which is different from the rest of the vegetation in the landscape is generally obvious and recognisable by most people. The precise definition of its boundary is more difficult especially when it has been disturbed or partially cleared. The key attributes for assessment are the width of the zone, its longitudinal extent and the condition of its vegetation

communities in terms of density (=cover) and invasion by exotic species. It is also clear that the width of this zone will vary markedly depending on location, the slope of the valley flat, soils and also the extent of disturbance. The options of setting a fixed width, or trying to define the width of the original undisturbed zone or exactly defining the width of the riparian zone in some other ways are impractical and would lead to errors. The untrained staff may be unreliable in applying these definitions.

The strategy adopted was to simply record the width of the *remnant* strip of clearly distinguishable vegetation along the stream margins, on the banks and partially extending onto the floodplain, and to assess the cover by various types of plants within the boundaries of this zone along both banks.



This example illustrates the problems with fixed width zones or with variable
-- zones defined without using the vegetation. In both cases the percentage cover estimates would be the same despite the variation in distribution. Clearly a narrow densely vegetated margin (B) is functionally preferable to than a wide zone where the plants are sparsely distributed *(A).* Recording the riparian vegetation as B with strip lam wide with a density of 50% than as A with a strip 25m wide with a density of 10% is more meaningful.

'Left' and 'Right' Banks - These are distinguished when facing *downstream.*

13.1.6 Notes for the Individual Data Sheets

Additional information regarding each of the components and the design and justification for the survey items is provided in Section 7. (Anderson 1993). This section discusses some of the more practical issues.

Sheet 1 Sub-Section Element - These datasheets are completed once the sub-catchments associated with each of the river and stream sections have been defined. The drainage code system is described in 5.3.11 in Anderson (1993). Information for defining the location of the downstream boundaries and centroid can be obtained manually or using GIS if the relevant information is available. The total upstream distance can be obtained by adding the AMTD's for the main stream and tributaries in the drainage network. The elevations can be obtained manually or from the GIS. A unit code consisting of the date, basin number and sub-section number is generated automatically when the data are entered using the program provided. This is different from the site code used on the other sheets. The date should be common to all sections. It is used only to separate between the original and any follow-up surveys made later.

Sheet 2 Hydrology - This sheet is normally only completed for each gauging station in the catchment, which become special sites in the survey. These gauging stations should also be completely surveyed as they are valuable reference sites and the transects and other

information can be used to compare with the cross-sections and other information obtained during this survey. It is intended that several of the summary programs available in the HYDSYS package be run for each gauging station and that selected summary statistics be incorporated as permanent fields in this database. Likewise water quality summary statistics may also be added at a later date. There is also the option of conducting water quality measurements as a separate task during the surveys. These aspects mostly relate to between catchment comparisons and to the development of a general river and stream classification system.. Further development is .required for these objectives.

Sheet 3 Site Description - The items are largely self- explanatory. The key issue is to be able to precisely re-locate the site during follow-up surveys in 5 or 10 years when major changes may have occurred, including some of the prominent land marks.

BOTH grid references and latitudes/ longitudes should be recorded. It is remarkable how far away groups may be from where they think they are by reading the maps, especially when 1:25,000 maps are not available. Recording both allows for the location to be checked. A good sketch map and description using prominent land marks (houses, bridges, etc.) are also very important for quickly being able to re-find the exact location of the site, including during the actual survey if these descriptions are made during the reconnoitre. Correct labelling of the photographs depends on meticulous notes and a good film identification system. When the slides are developed - all streams look alike!! So use appropriate labelling including taking a picture of a label to positively identify the film. Some of the information will need to be added after the survey (AMTD and catchment area).

GPS -The availability of this equipment is the key to precisely locating the sites, Staff require training in its use, including information when satellites are unavailable and other things affecting the units operation and accuracy. Some estimate of the accuracy of the position estimate (either GPS or via the grid reference) is important for follow-up work.

Sheet 4 Reach Environs - temporal and spatial- The water level estimate includes items for tidal sites (in relation to the state of the tide) and non-tidal sites (in relation to the water mark and bank top). Other information on the prevailing rainfall and season when the survey is conducted are included on Sheet 2 Hydrology. The hydrology records can also be examined to provide the temporal framework for the surveys. Local land .use and disturbances refer to what is obvious at the time of the survey. The categories provided should cover most types present.

Local Vegetation Type - NOTE: This refers to the original undisturbed type of vegetation present when the site was in its pristine condition. This can be deduced from remnant vegetation in the area or local knowledge.

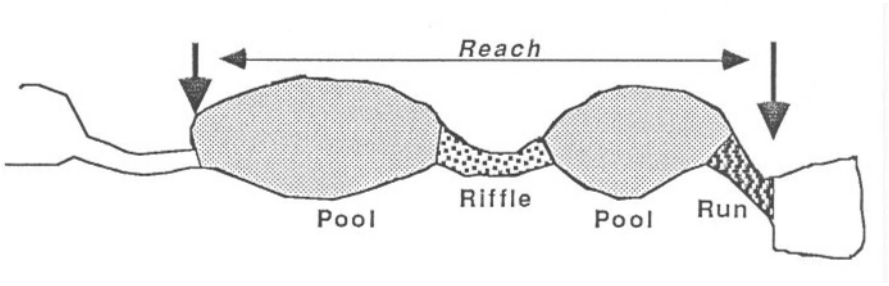
Overall Disturbance Rating -This is a very useful qualitative parameter which combines the extent of clearing of shoreline and valleyflat vegetation, and the extent of invasion by exotic species. Take care to fully understand the categories. Only one rating should be provided for each site.

Sheet 5 Channel Habitat Classification - Select a reach representative of the stream and river section and the range and relative size of the channel habitats present.

Choose an appropriate Reach for the remaining assessment. It should:

1. **Preferably contains at least 2 complete pools and riffle / run habitats.**
2. **The whole length of the reach should be visible at one location.**
3. **The pool should be the largest and deepest In the area.**

Sketch the reach showing the location. and dimensions of the major habitat types. Measure the length, width and height/slope or depth of each channel habitat type and take a transect across each type located at right angles to the shoreline and passing over the point of maximum depth in a pool (low flow area)and maximum flow / bed height for a run or riffle habitat Le. the transect where flows would be expected to be maximal.



The assessment of the average dimensions of each channel habitat type should relate to the whole area, ideally the whole section, or at least to the area in which the reach has been selected for further assessment. Estimate the length of the reach ("if in doubt pace it out"), and sketch it showing the habitat types and the location of the cross-sections. The actual dimensions of the habitat types within the reach are included on the next sheet.

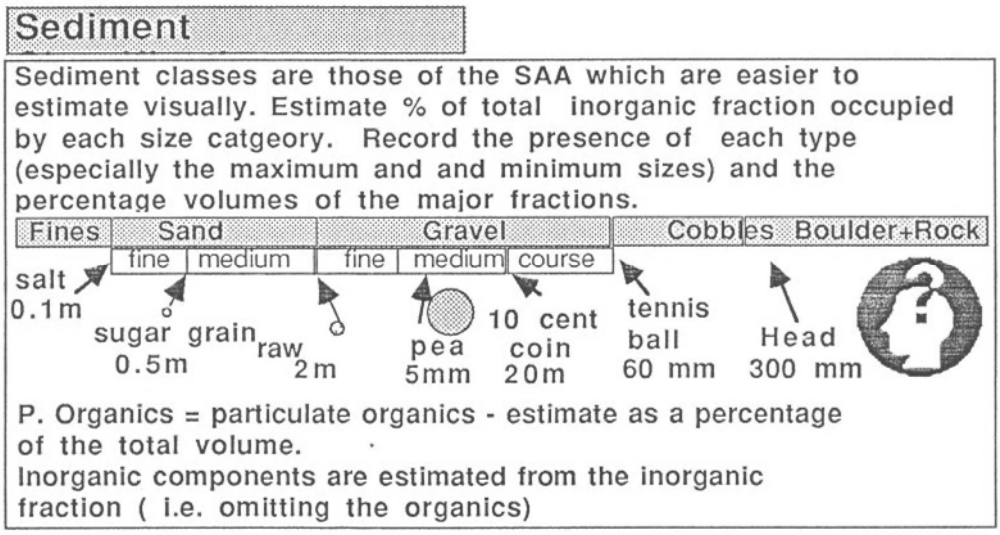
The reach defined on this sheet is used as the boundaries for all subsequent sheets, so it is important that all relevant features can be easily assessed from one or two locations within the reach. In estuaries or deep lowland rivers the entire section should be classified as a pool and '999' entered for the its length. The total length of the reach selected for assessment should be entered as for the other sites.

Sheet 6 Cross-Sections - Cross-sections are required to measure the channel dimensions and sediment particle size composition of the bed and banks for the channel habitat types present in the reach. The aim is to do a cross-section at a low flow point (pool) and at a higher flow point (riffle or run) in each habitat.
Locating the cross-sections at the deepest point in the pools and the shallowest point along the thalweg in the riffle means that the maximum range of channel dimensions and sediment types will be obtained for characterising the instream habitats. Generally it is expected that a minimum of two cross-sections will be taken; more if there are more types present. In deep freshwater channels representing elongated pools, or in estuaries cross-sections should be located on the bends (scour pools) and along straight channel sections. When time is short the focus should be firstly on the pools and then the shallower of the run or riffle sections present.

Begin at the water's margin on the left bank, stretch a tape across the stream at the surface and take a series of distance and depth measurements. A minimum of 3 measurements are required for each cross-section plus the total the width of stream. The database allows for a total of 15 measurements.

Surface sediment samples are collected at some or all of the points where the depths are taken. The particle size composition of these sample is assessed visually in terms of the estimated percentage of total volume. Firstly, estimate the total percentage volume of the

sample which is course organic matter. Then visually estimate the percentage of the total volume of the inorganic fraction which falls into each of the particle size fractions. Keys for identifying the boundaries of the size categories are shown below. The emphasis should be on identifying all of the size fractions present in the sample (using "1"s for the rare fractions), and the percent volumes for the more abundant fractions.



Also measure the width, height and slope for the left and right banks. The lower bank extends from the water surface to water mark. If the bed is dry measure depths below the tape stretched across the stream at water mark level. The upper bank extends from the water mark to the bank top. Complete the measurements on both banks. If the water mark is submerged then no lower bank measurements are taken. Surface samples are also analysed for the lower and upper banks on each side. The presence of rock outcrops on the bed and banks is also recorded.

Sheet 7 Bed and Bar Conditions - The overall stability of the bed is rated qualitatively as well as the factors and controls affecting this stability. The development of different types of bars is also recorded water mark is used as a standard reference point for estimating the proportion of the bed which is a bar. Record the total % of bed surface along the reach protruding out of the water at the water mark, and forming a bar. Identify its type, the features of the gravel in the bed and bars (if present), and the overall stability of the bed and controls and factors contributing to its stability.

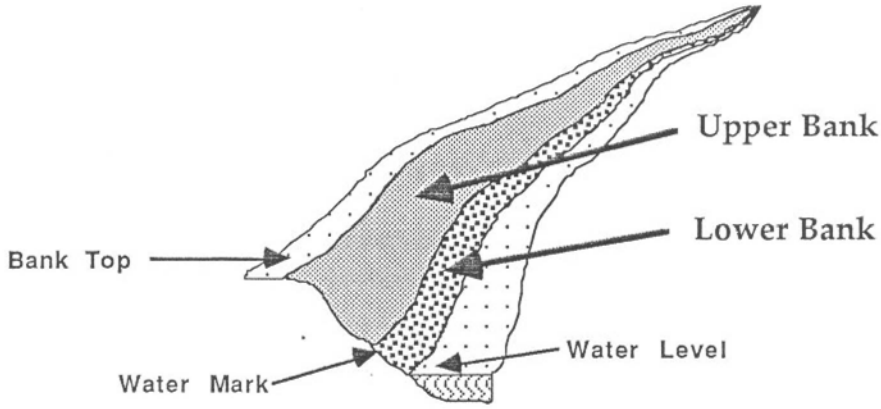
Passage for fish and other organisms - Passage is important for many fish and other organisms. These items aim to assess the general passage of the reach now (that is under the prevailing flow and depth conditions) and at the water mark. Various obstacles are classified in terms of their height and the channel stage which must be reached before they can be by-passed (allowing free passage of fish in low velocity conditions).

1. Score the general passage for the prevailing conditions (now) and for the stage equivalent to the water mark.

2. For obstructions give type, height above water mark and stage when by-passed or over-topped.

Sheet 8 Bank Condition - The assessment is made in terms of the proportion of

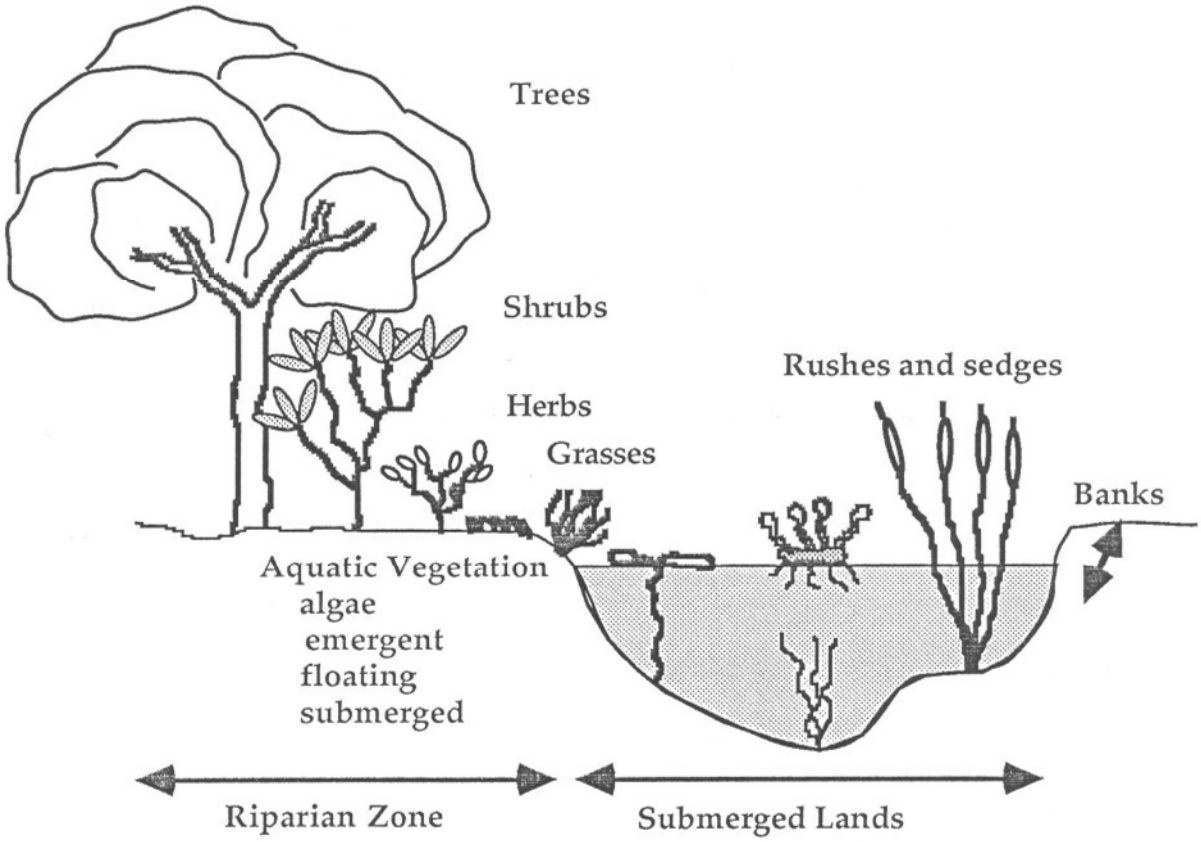
the length of banks in the reach on either side which are classified as bare of vegetation (assessed independently), and as either 'stable', 'eroding', 'slumping' or 'aggrading'. It implies a dominant process, though not necessarily a very recent process. Separate estimates are made for the lower and upper banks.



Assess the condition of the banks on the left and right side of the stream (FACING DOWNSTREAM). Identify the major types of instability (eroding, slumping & aggrading) and mark the location where they occur on the lower and upper banks. Also record and the slope and shape of the banks, and make an overall assessment of condition of the left and right banks. Features of natural and artificial levee banks are also recorded.

Sheet 9 Vegetation - The vegetation is assessed in terms of the % cover of the surface area of the three zones each with its own set of boundaries:
0 the riparian zone (riparian vegetation)
0 the banks (for rushes and sedges)
0 the submerged lands (aquatic vegetation)

The cover estimate is made in terms of foliage density, that is in terms of the total imaginary shadow cast by the vegetation. Sample cover guides are provided to assist with the estimates (nearest 5%).



The vegetation groups are basically structure and size groups:

Trees = woody, > 2m, 1 stem
Shrub= woody, < 2m /1 stem or, > 1 stem
Herb = not woody, > 1 stem, short
Sedge & Rush = herbaceous/tufted perennial
Submerged aquatic
Floating aquatic
Emergent aquatic

The percent of each type replaced by exotic species is also recorded. A checklist for recording the occurrence (either as rare or abundant) of individual species is also included. The names of the species listed can be altered to suit the range of key plants which should be recorded in each catchment or region.

NOTE: The cover estimates are all made independently, and so the total covers do not necessarily add up to 100%.

The total width of the riparian zone, the percentage of each of the areas which is bare (devoid of vegetation) and the total percent of exotic species present are also recorded.

Sheet 10 Aquatic Habitat - Organic debris cover in the stream, canopy cover over the stream and cover of the banks by vegetation and the banks themselves are recorded. Assessment is made in terms of the total percentage cover by each type within the area or zone specified. Instream organic debris cover is assessed in terms of the submerged lands.

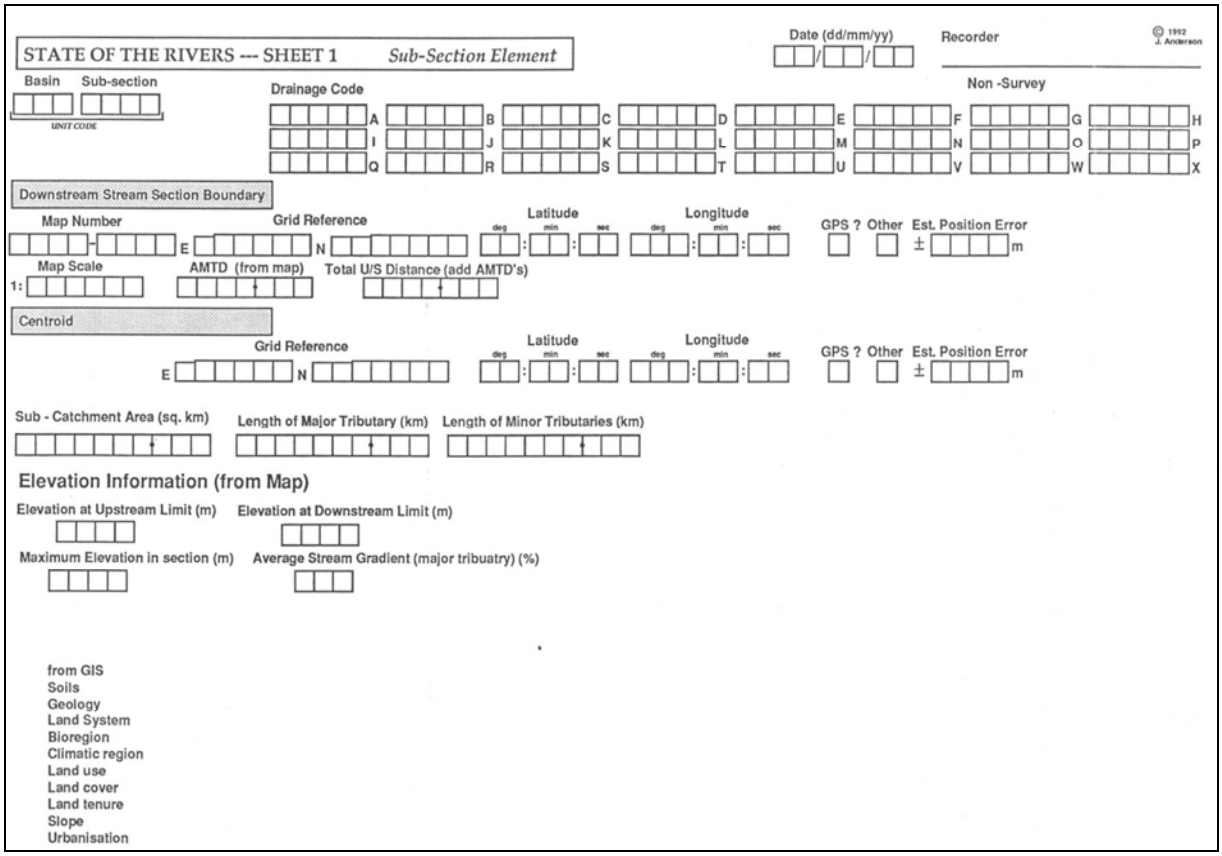
Canopy cover is assessed by regarding each canopy as a solid disc and assessing the total percentage of the water surface in the reach which is covered by a canopy (> 1 m above the water's surface). Vegetation, root, bank and man-made overhangs are assessed in terms of the percentage of the bank length on each side with such overhang present and its width. The types to be assessed are self-explanatory. The overall assessment should be made in terms of the criteria provided considering all the attributes listed (some of which are assessed on other sheets). Recording the number of organic patches present for each of the organic debris categories gives an idea of the distribution of the cover on the bed ("9" = widely distributed all over the bed). If the water is too turbid to estimate percentages, then simply record the presence (Le. as "1") of the obvious cover types in the reach. For example logs and branches may protrude from the surface, and aquatic vegetation and other types of cover may be visible in the shallower areas.

Sheet 11 Scenic, recreational and conservation values - This datasheet is somewhat subjective, but nevertheless important. Classify each site into one of the 8 Recreational Opportunity Types listed using the criteria provided. The types of recreation actually occurring at the sites ("2") or for which the site would be potentially suitable ("1") should be recorded. This will depend on the various features of the stream or river and surrounding lands at each site. The scenic

- values of the sites should also be assessed. The initial conservation value rankings for the sites should be made in terms of the condition of the site and availability of other similar habitats elsewhere the region or catchment. Any rare or endangered species known to occur in the area will obviously increase these rankings, and the species concerned should be listed in the comments section. The habitat at the sites should also be ranked in terms of its overall quality as representative habitat of that type in the region or catchment.

State of the Rivers

Data Sheets



STATE OF THE RIVERS --- SHEET 1 *Sub-Section Element*

Date (dd/mm/yy) / / Recorder © 1992 J. Anderson

Basin Sub-section UNIT CODE

Drainage Code

Non -Survey

A B C D E F G H
I J K L M N O P
Q R S T U V W X

Downstream Stream Section Boundary

Map Number E N Grid Reference Latitude Longitude GPS ? Other Est. Position Error ± m

Map Scale 1: AMTD (from map) Total U/S Distance (add AMTD's)

Centroid

Grid Reference E N Latitude Longitude GPS ? Other Est. Position Error ± m

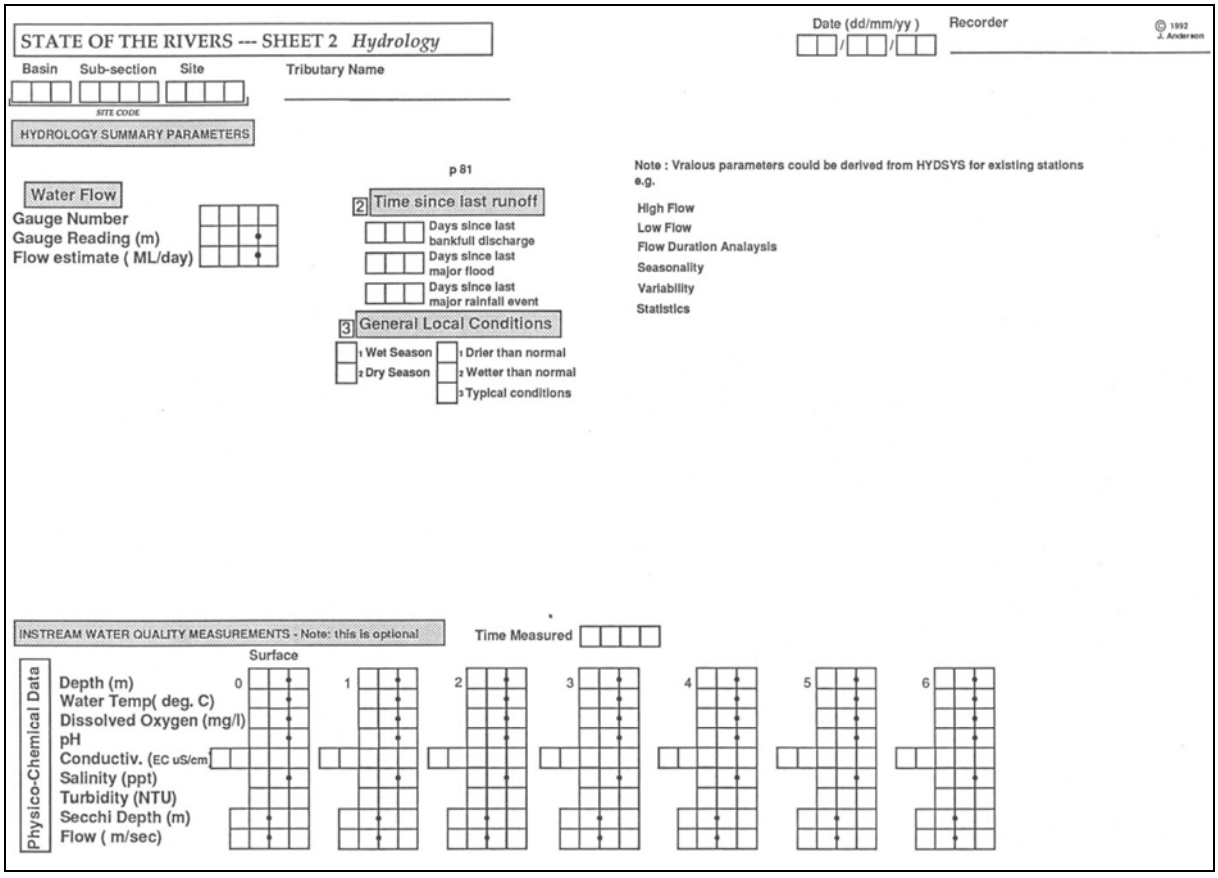
Sub - Catchment Area (sq. km) Length of Major Tributary (km) Length of Minor Tributaries (km)

Elevation Information (from Map)

Elevation at Upstream Limit (m) Elevation at Downstream Limit (m)

Maximum Elevation in section (m) Average Stream Gradient (major tribuatry) (%)

from GIS
Soils
Geology
Land System
Bioregion
Climatic region
Land use
Land cover
Land tenure
Slope
Urbanisation



STATE OF THE RIVERS --- SHEET 2 *Hydrology*

Date (dd/mm/yy) / / Recorder © 1992 J. Anderson

Basin Sub-section Site SITE CODE Tributary Name

HYDROLOGY SUMMARY PARAMETERS

p 81

Water Flow
Gauge Number
Gauge Reading (m)
Flow estimate (ML/day)

2 Time since last runoff
Days since last bankfull discharge
Days since last major flood
Days since last major rainfall event

3 General Local Conditions
1 Wet Season 2 Dry Season
1 Drier than normal 2 Wetter than normal 3 Typical conditions

Note : Vralous parameters could be derived from HYDSYS for existing stations e.g.

High Flow
Low Flow
Flow Duration Analaysis
Seasonality
Variability
Statistics

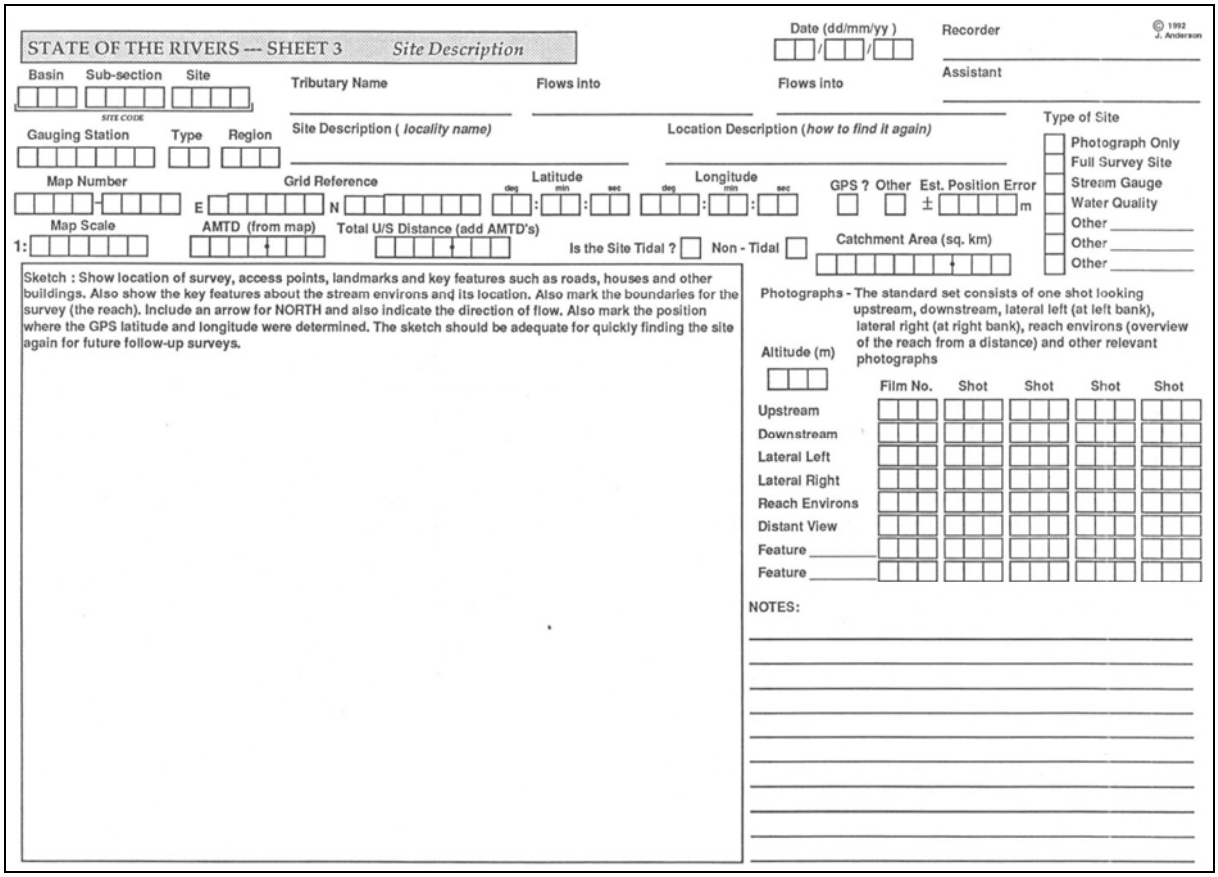
INSTREAM WATER QUALITY MEASUREMENTS - Note: this is optional Time Measured

Physico-Chemical Data

Surface 0 1 2 3 4 5 6

Depth (m)
Water Temp(deg. C)
Dissolved Oxygen (mg/l)
pH
Conductiv. (EC uS/cm
Salinity (ppt)
Turbidity (NTU)
Secchi Depth (m)
Flow (m/sec)

State of the Rivers



STATE OF THE RIVERS --- SHEET 3 *Site Description*

© 1992 J. Anderson

Date (dd/mm/yy) / / Recorder

Assistant

Basin | Sub-section | Site (SITE CODE)

Tributary Name | Flows into | Flows into

Gauging Station | Type | Region

Site Description (*locality name*) | Location Description (*how to find it again*)

Type of Site: Photograph Only; Full Survey Site; Stream Gauge; Water Quality; Other ____; Other ____; Other ____

Map Number | Grid Reference E N | Latitude deg : min : sec | Longitude deg : min : sec | GPS ? Other | Est. Position Error ± m

Map Scale 1: | AMTD (from map) | Total U/S Distance (add AMTD's) | Is the Site Tidal ? Non - Tidal | Catchment Area (sq. km)

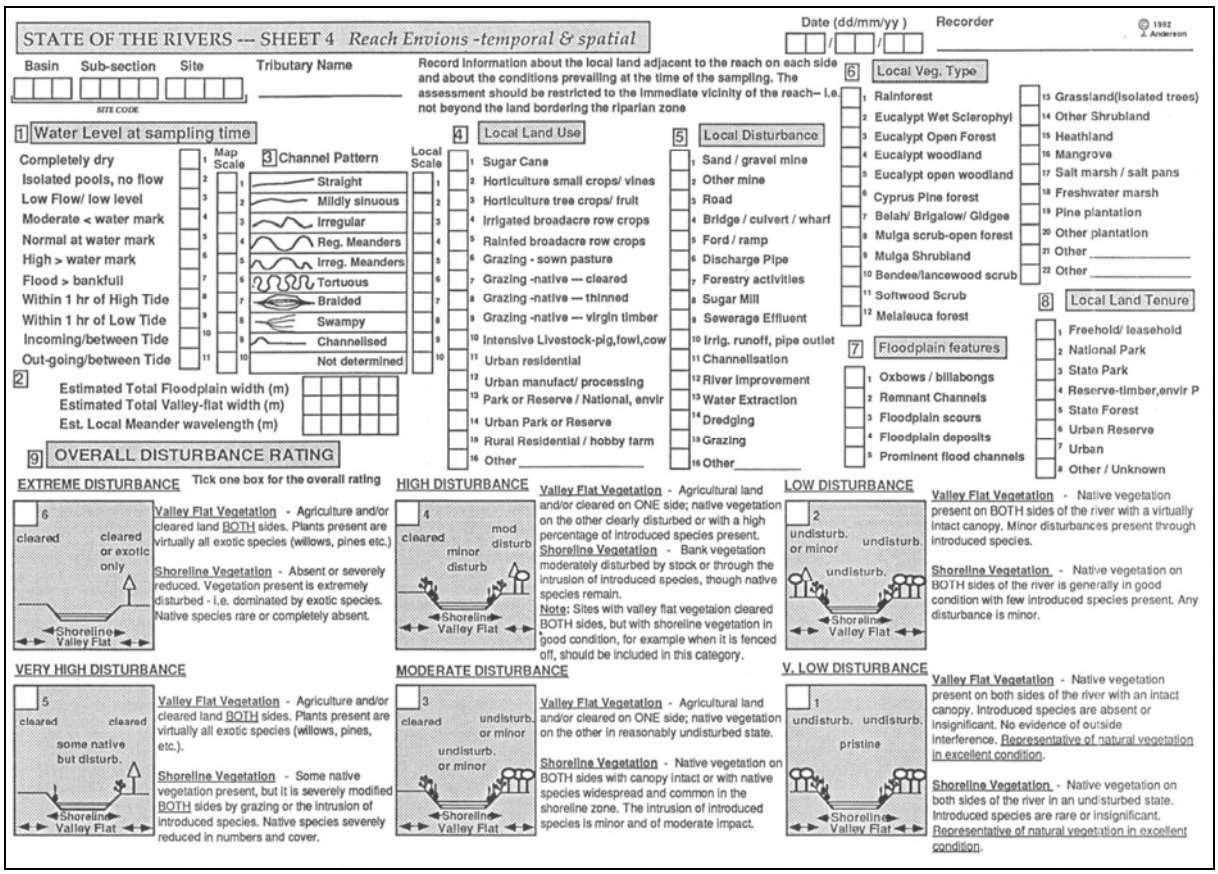
Sketch : Show location of survey, access points, landmarks and key features such as roads, houses and other buildings. Also show the key features about the stream environs and its location. Also mark the boundaries for the survey (the reach). Include an arrow for NORTH and also indicate the direction of flow. Also mark the position where the GPS latitude and longitude were determined. The sketch should be adequate for quickly finding the site again for future follow-up surveys.

Photographs - The standard set consists of one shot looking upstream, downstream, lateral left (at left bank), lateral right (at right bank), reach environs (overview of the reach from a distance) and other relevant photographs

Altitude (m)

	Film No.	Shot	Shot	Shot	Shot
Upstream					
Downstream					
Lateral Left					
Lateral Right					
Reach Environs					
Distant View					
Feature ____					
Feature ____					

NOTES:



STATE OF THE RIVERS --- SHEET 4 *Reach Envions -temporal & spatial*

© 1992 J. Anderson

Date (dd/mm/yy) / / Recorder

Basin | Sub-section | Site (SITE CODE) | Tributary Name

Record information about the local land adjacent to the reach on each side and about the conditions prevailing at the time of the sampling. The assessment should be restricted to the immediate vicinity of the reach-- i.e. not beyond the land bordering the riparian zone

1 Water Level at sampling time (Map Scale)

Completely dry; Isolated pools, no flow; Low Flow/ low level; Moderate < water mark; Normal at water mark; High > water mark; Flood > bankfull; Within 1 hr of High Tide; Within 1 hr of Low Tide; Incoming/between Tide; Out-going/between Tide

2 Estimated Total Floodplain width (m)
Estimated Total Valley-flat width (m)
Est. Local Meander wavelength (m)

3 Channel Pattern (Local Scale)

Straight; Mildly sinuous; Irregular; Reg. Meanders; Irreg. Meanders; Tortuous; Braided; Swampy; Channelised; Not determined

4 Local Land Use

1 Sugar Cane; 2 Horticulture small crops/ vines; 3 Horticulture tree crops/ fruit; 4 Irrigated broadacre row crops; 5 Rainfed broadacre row crops; 6 Grazing - sown pasture; 7 Grazing -native — cleared; 8 Grazing -native — thinned; 9 Grazing -native — virgin timber; 10 Intensive Livestock-pig,fowl,cow; 11 Urban residential; 12 Urban manufact/ processing; 13 Park or Reserve / National, envir; 14 Urban Park or Reserve; 15 Rural Residential / hobby farm; 16 Other ____

5 Local Disturbance

1 Sand / gravel mine; 2 Other mine; 3 Road; 4 Bridge / culvert / wharf; 5 Ford / ramp; 6 Discharge Pipe; 7 Forestry activities; 8 Sugar Mill; 9 Sewerage Effluent; 10 Irrig. runoff, pipe outlet; 11 Channelisation; 12 River Improvement; 13 Water Extraction; 14 Dredging; 15 Grazing; 16 Other ____

6 Local Veg. Type

1 Rainforest; 2 Eucalypt Wet Sclerophyl; 3 Eucalypt Open Forest; 4 Eucalypt woodland; 5 Eucalypt open woodland; 6 Cyprus Pine forest; 7 Belah/ Brigalow/ Gidgee; 8 Mulga scrub-open forest; 9 Mulga Shrubland; 10 Bendee/lancewood scrub; 11 Softwood Scrub; 12 Melaleuca forest; 13 Grassland(isolated trees); 14 Other Shrubland; 15 Heathland; 16 Mangrove; 17 Salt marsh / salt pans; 18 Freshwater marsh; 19 Pine plantation; 20 Other plantation; 21 Other ____; 22 Other ____

7 Floodplain features

1 Oxbows / billabongs; 2 Remnant Channels; 3 Floodplain scours; 4 Floodplain deposits; 5 Prominent flood channels

8 Local Land Tenure

1 Freehold/ leasehold; 2 National Park; 3 State Park; 4 Reserve-timber,envir P; 5 State Forest; 6 Urban Reserve; 7 Urban; 8 Other / Unknown

9 OVERALL DISTURBANCE RATING

Tick one box for the overall rating

EXTREME DISTURBANCE (6)

Valley Flat Vegetation - Agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

Shoreline Vegetation - Absent or severely reduced. Vegetation present is extremely disturbed - i.e. dominated by exotic species. Native species rare or completely absent.

HIGH DISTURBANCE (4)

Valley Flat Vegetation - Agricultural land and/or cleared on ONE side; native vegetation on the other clearly disturbed or with a high percentage of introduced species present.

Shoreline Vegetation - Bank vegetation moderately disturbed by stock or through the intrusion of introduced species, though native species remain.

Note: Sites with valley flat vegetaion cleared BOTH sides, but with shoreline vegetation in good condition, for example when it is fenced off, should be included in this category.

LOW DISTURBANCE (2)

Valley Flat Vegetation - Native vegetation present on BOTH sides of the river with a virtually intact canopy. Minor disturbances present through introduced species.

Shoreline Vegetation - Native vegetation on BOTH sides of the river is generally in good condition with few introduced species present. Any disturbance is minor.

VERY HIGH DISTURBANCE (5)

Valley Flat Vegetation - Agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines, etc.).

Shoreline Vegetation - Some native vegetation present, but it is severely modified BOTH sides by grazing or the intrusion of introduced species. Native species severely reduced in numbers and cover.

MODERATE DISTURBANCE (3)

Valley Flat Vegetation - Agricultural land and/or cleared on ONE side; native vegetation on the other in reasonably undisturbed state.

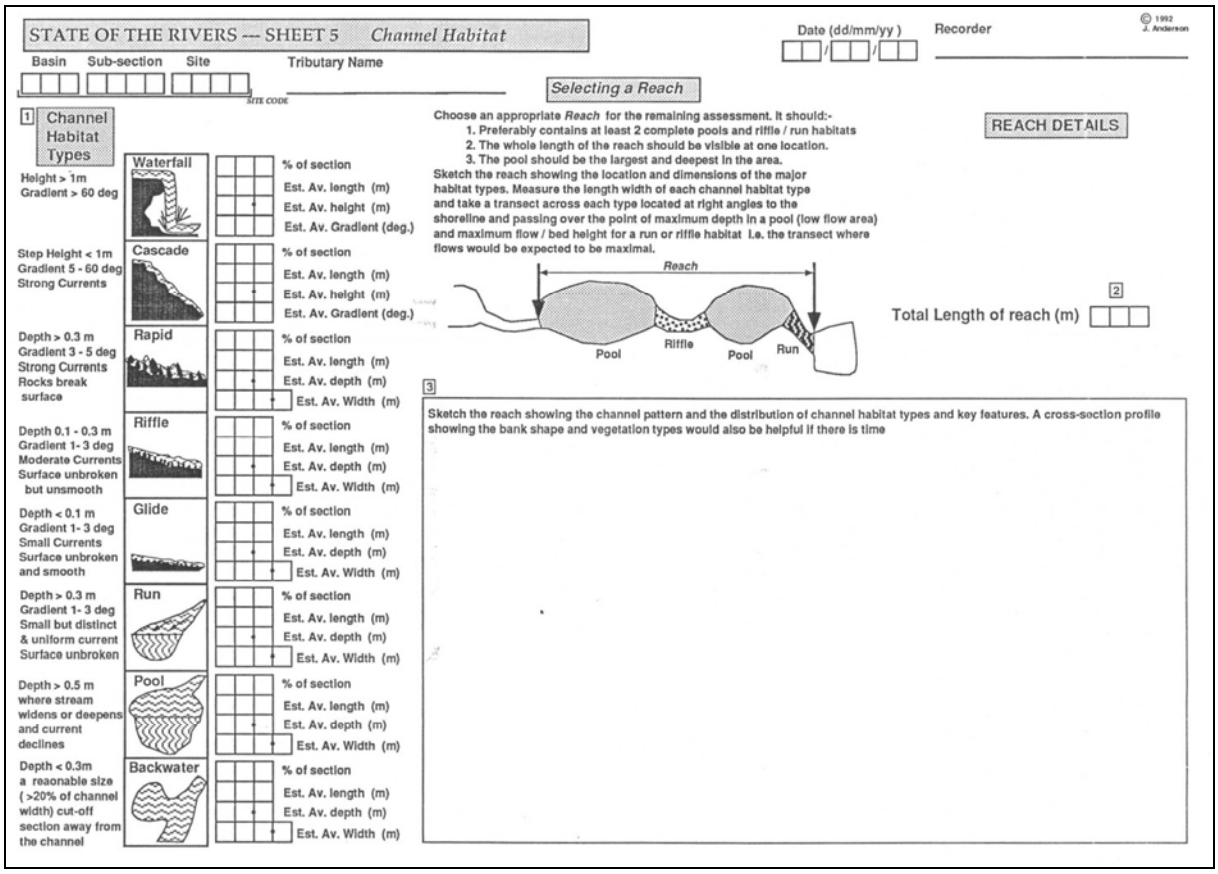
Shoreline Vegetation - Native vegetation on BOTH sides with canopy intact or with native species widespread and common in the shoreline zone. The intrusion of introduced species is minor and of moderate impact.

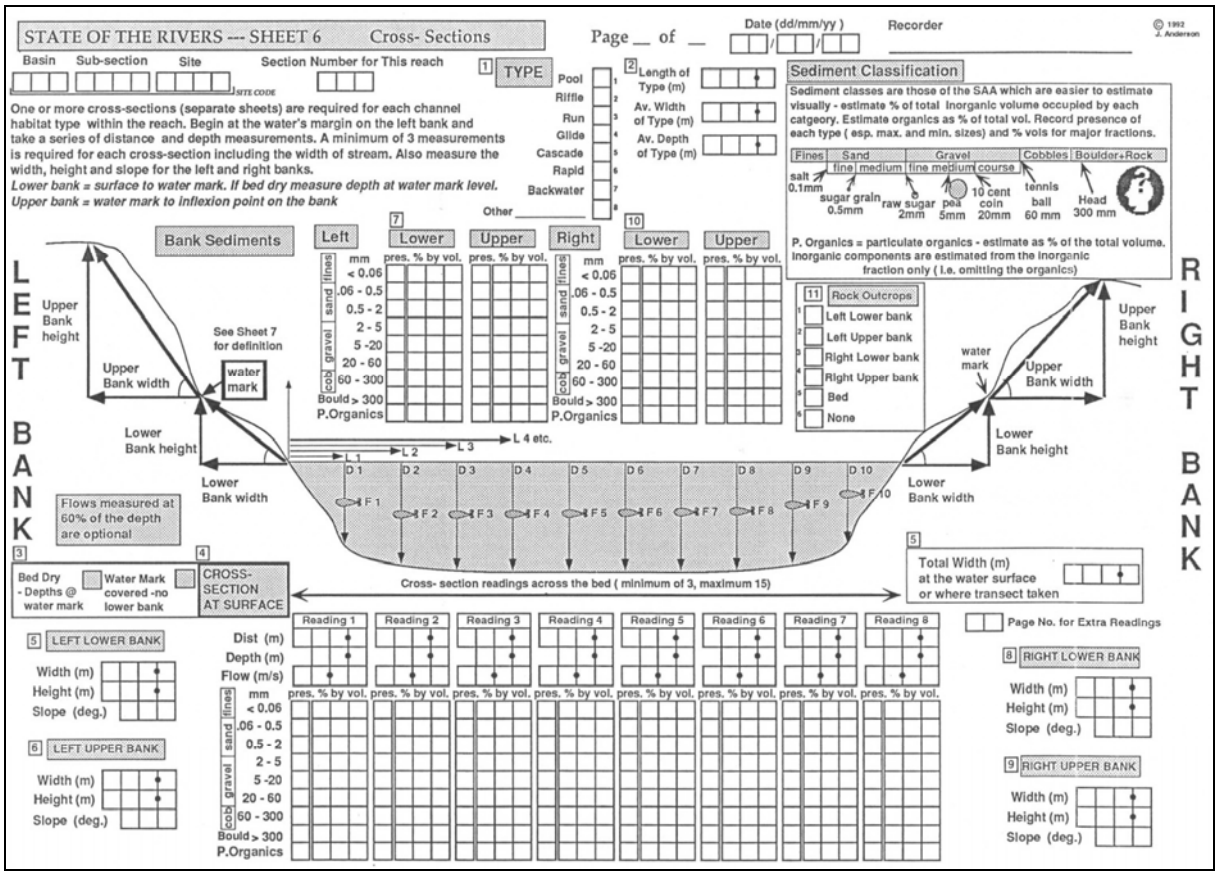
V. LOW DISTURBANCE (1)

Valley Flat Vegetation - Native vegetation present on both sides of the river with an intact canopy. Introduced species are absent or insignificant. No evidence of outside interference. Representative of natural vegetation in excellent condition.

Shoreline Vegetation - Native vegetation on both sides of the river in an undisturbed state. Introduced species are rare or insignificant. Representative of natural vegetation in excellent condition.

State of the Rivers





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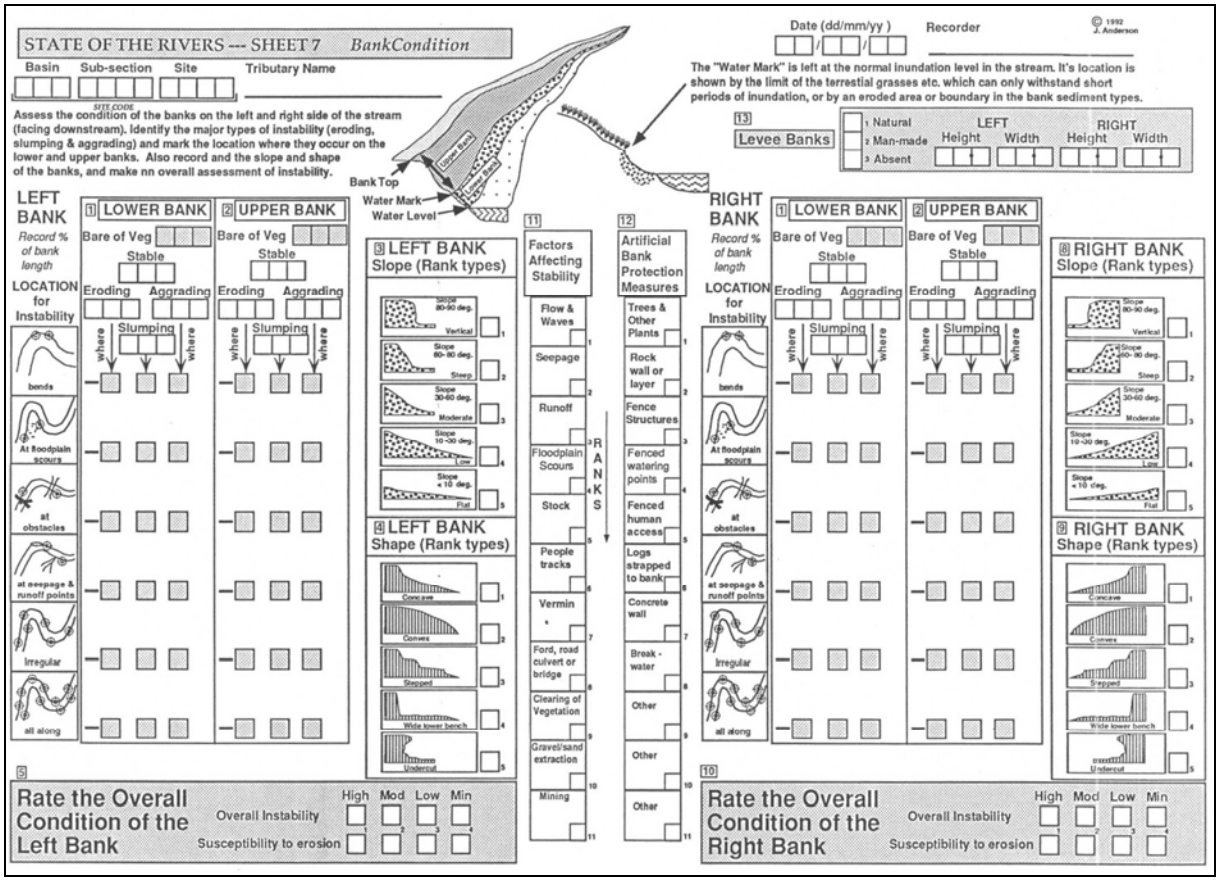

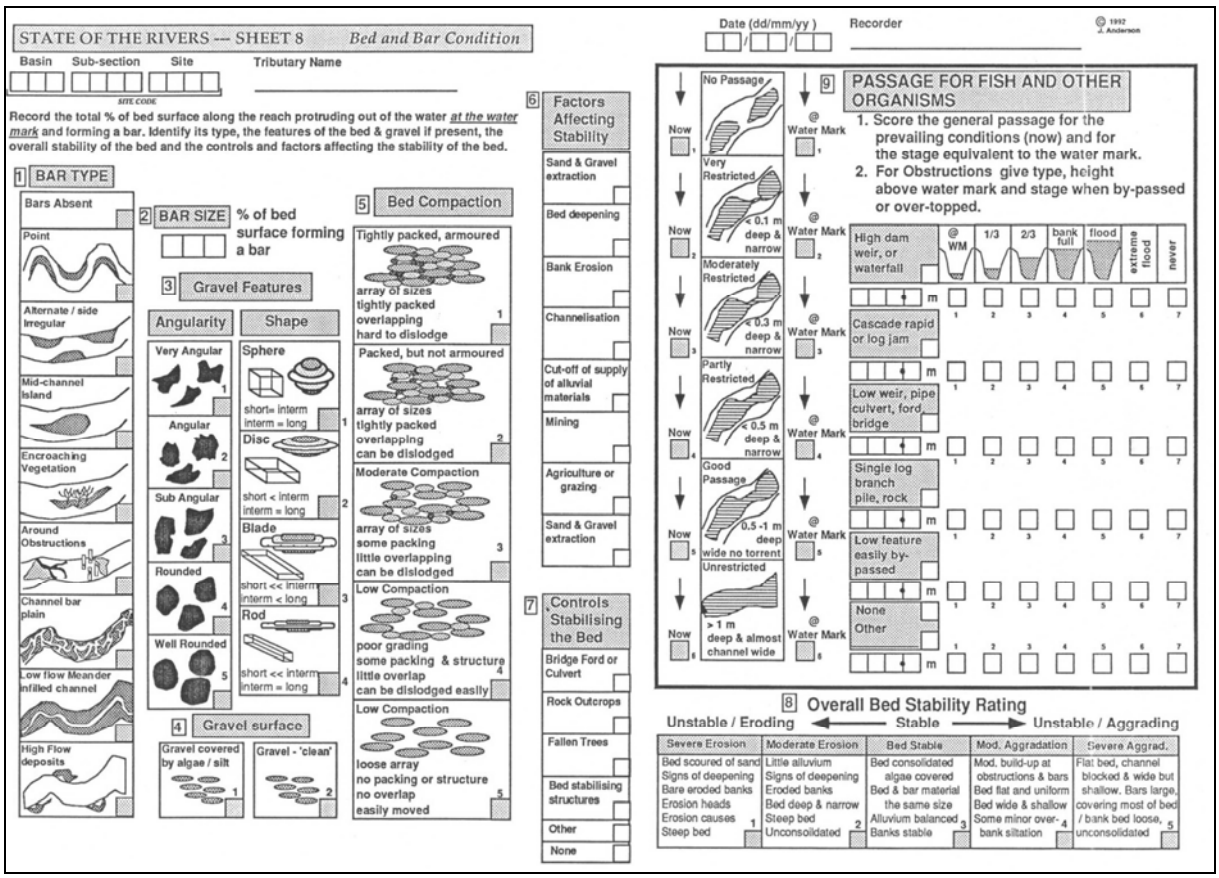

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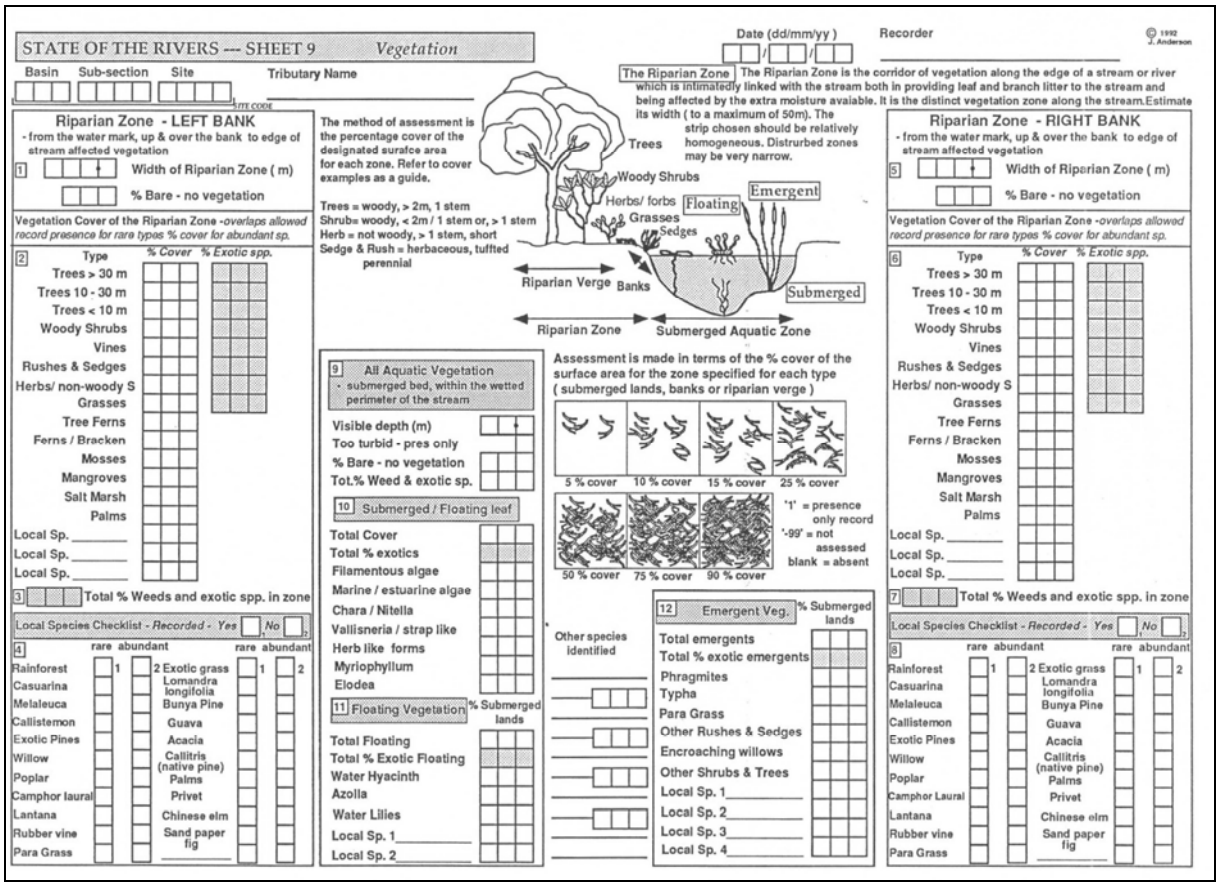

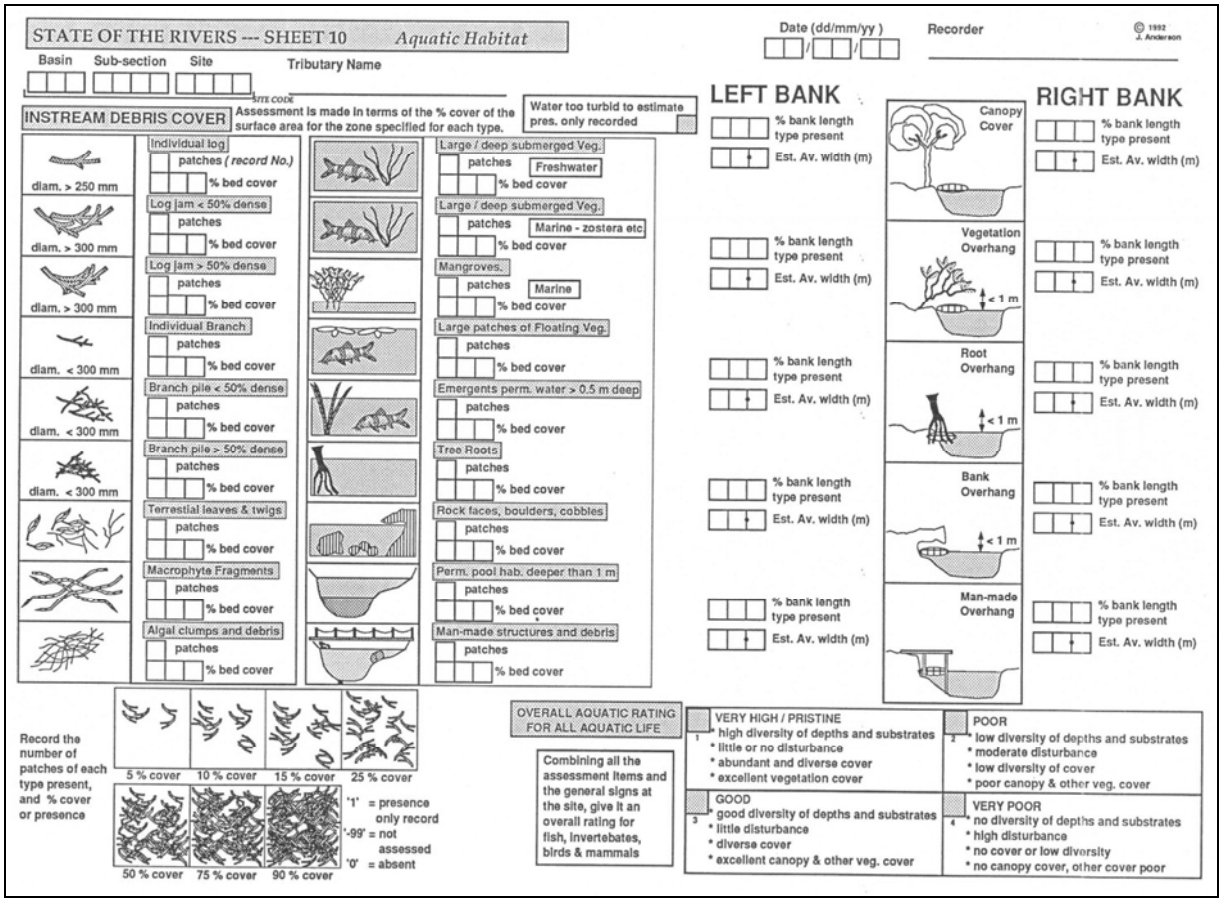

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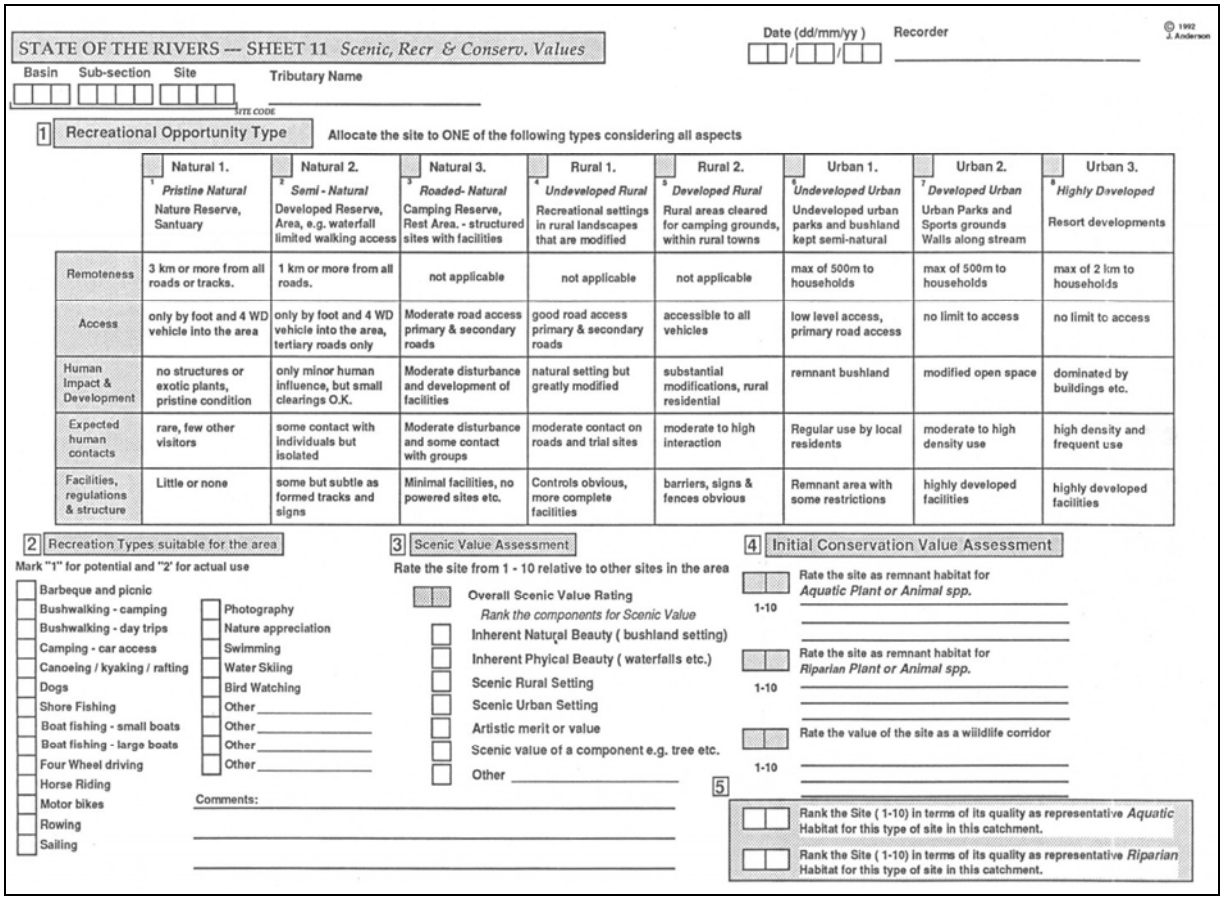


STATE OF THE RIVERS --- SHEET 11 *Scenic, Recr & Conserv. Values*

Date (dd/mm/yy) ☐☐/☐☐/☐☐ Recorder _____ © 1992 J. Anderson

Basin ☐☐☐ Sub-section ☐☐☐☐☐ Site ☐☐☐☐ SITE CODE Tributary Name _____

1 Recreational Opportunity Type Allocate the site to ONE of the following types considering all aspects

	☐ Natural 1. *1 Pristine Natural* Nature Reserve, Santuary	☐ Natural 2. *2 Semi - Natural* Developed Reserve, Area, e.g. waterfall limited walking access	☐ Natural 3. *3 Roaded- Natural* Camping Reserve, Rest Area. - structured sites with facilities	☐ Rural 1. *4 Undeveloped Rural* Recreational settings in rural landscapes that are modified	☐ Rural 2. *5 Developed Rural* Rural areas cleared for camping grounds, within rural towns	☐ Urban 1. *6 Undeveloped Urban* Undeveloped urban parks and bushland kept semi-natural	☐ Urban 2. *7 Developed Urban* Urban Parks and Sports grounds Walls along stream	☐ Urban 3. *8 Highly Developed* Resort developments
Remoteness	3 km or more from all roads or tracks.	1 km or more from all roads.	not applicable	not applicable	not applicable	max of 500m to households	max of 500m to households	max of 2 km to households
Access	only by foot and 4 WD vehicle into the area	only by foot and 4 WD vehicle into the area, tertiary roads only	Moderate road access primary & secondary roads	good road access primary & secondary roads	accessible to all vehicles	low level access, primary road access	no limit to access	no limit to access
Human Impact & Development	no structures or exotic plants, pristine condition	only minor human influence, but small clearings O.K.	Moderate disturbance and development of facilities	natural setting but greatly modified	substantial modifications, rural residential	remnant bushland	modified open space	dominated by buildings etc.
Expected human contacts	rare, few other visitors	some contact with individuals but isolated	Moderate disturbance and some contact with groups	moderate contact on roads and trial sites	moderate to high interaction	Regular use by local residents	moderate to high density use	high density and frequent use
Facilities, regulations & structure	Little or none	some but subtle as formed tracks and signs	Minimal facilities, no powered sites etc.	Controls obvious, more complete facilities	barriers, signs & fences obvious	Remnant area with some restrictions	highly developed facilities	highly developed facilities

2 Recreation Types suitable for the area

Mark "1" for potential and "2" for actual use

- ☐ Barbeque and picnic
- ☐ Bushwalking - camping
- ☐ Bushwalking - day trips
- ☐ Camping - car access
- ☐ Canoeing / kyaking / rafting
- ☐ Dogs
- ☐ Shore Fishing
- ☐ Boat fishing - small boats
- ☐ Boat fishing - large boats
- ☐ Four Wheel driving
- ☐ Horse Riding
- ☐ Motor bikes
- ☐ Rowing
- ☐ Sailing
- ☐ Photography
- ☐ Nature appreciation
- ☐ Swimming
- ☐ Water Skiing
- ☐ Bird Watching
- ☐ Other _____
- ☐ Other _____
- ☐ Other _____
- ☐ Other _____

3 Scenic Value Assessment

Rate the site from 1 - 10 relative to other sites in the area

☐☐ Overall Scenic Value Rating

Rank the components for Scenic Value

- ☐ Inherent Natural Beauty (bushland setting)
- ☐ Inherent Phyical Beauty (waterfalls etc.)
- ☐ Scenic Rural Setting
- ☐ Scenic Urban Setting
- ☐ Artistic merit or value
- ☐ Scenic value of a component e.g. tree etc.
- ☐ Other _____

Comments: _____

4 Initial Conservation Value Assessment

☐☐ Rate the site as remnant habitat for *Aquatic Plant or Animal spp.* 1-10 _____

☐☐ Rate the site as remnant habitat for *Riparian Plant or Animal spp.* 1-10 _____

☐☐ Rate the value of the site as a wildlife corridor 1-10 _____

5

☐☐ Rank the Site (1-10) in terms of its quality as representative *Aquatic* Habitat for this type of site in this catchment.

☐☐ Rank the Site (1-10) in terms of its quality as representative *Riparian* Habitat for this type of site in this catchment.

13.2 Appendix 2 Introductory Workshop on the 'State of the Rivers' Methodology

A set of summary sheets suitable for an overhead projector are provided as source material for the introductory workshop.

State of the Rivers Project

Methodology

Preliminary Overview

Outline

Introduction

Objectives

Features of the Method

Components of the Method

Sampling Strategy

'homogeneous stream sections'

Instream Survey - approach and constraints

Data Components

Features of the Method

1. **To be undertaken on a catchment by catchment basis.**

2. **To be undertaken by Regional Staff of the Water Resources Commission, after a short training programme.**

3. **The focus of the survey is on the streams and rivers themselves - the bed, banks, aquatic and riparian habitats, not on the catchment land areas.**

4. **The methodology will provide an interface with GIS as a source of catchment (land) data and as a method for producing summary information.**

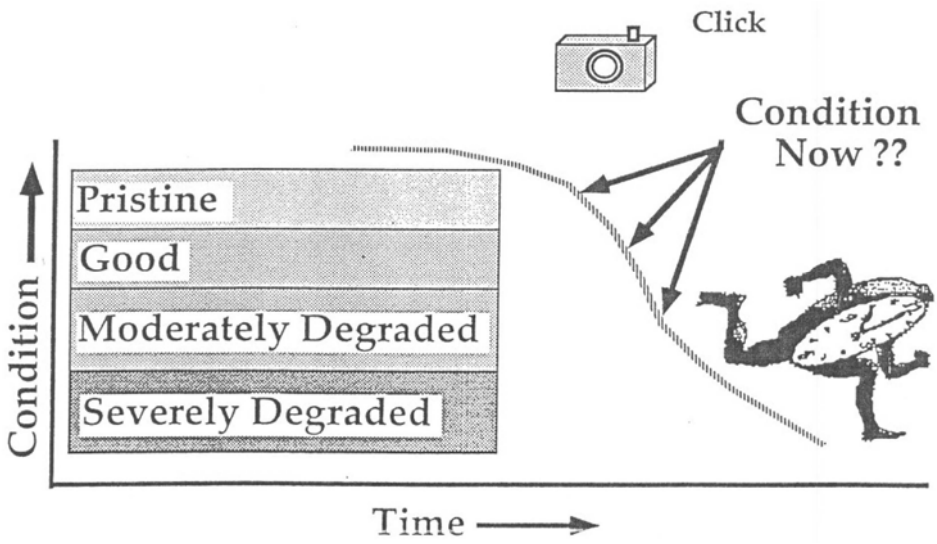
5. **The method will provide a comprehensive set of data and an analysis system for Integrated Catchment Management, focused on instream habitat processes.**

Objective

To provide an assessment of the physical and environmental condition of streams and rivers throughout Queensland.

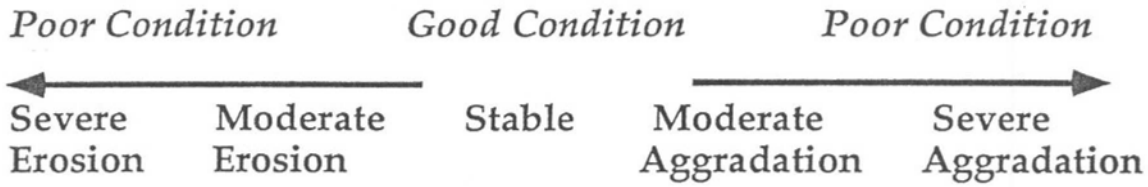
What is Meant by Condition?

The method is a 'snap-shot' approach. The aim is to compare different stream sections within catchment, and different catchments in terms of their current condition. It sets a bench-mark for future comparisons, but does not directly measure the rate of change. The aim is to provide a relative assessment of the State of the Rivers now, and the relative condition of various sections so that the limited resources can be focused on the most severe and urgent problems. Historic data may give a valuable perspective to the 'snap-shot' taken now.

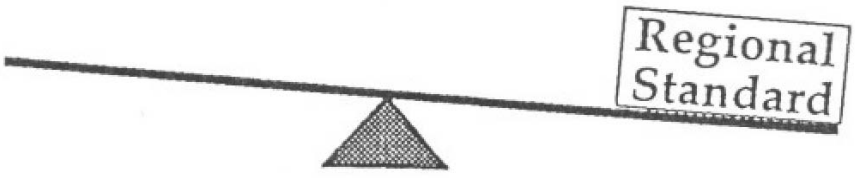


How is Condition Assessed?

In most instances we are rating the extent to which the attributes in the stream or river have declined from their pristine or undisturbed condition. In most instances we will be judging this in terms of the extent to which some perceived value, use or function of the stream have been lost or altered. In some we can use an absolute standard. For example, in relation to bank condition, we will be trying to determine the extent to which the banks have become unstable and have either eroded or aggraded.



In other instances the use of an absolute standard may be inappropriate or impossible. For example it would be inappropriate to try to compare the shoreline vegetation of a stream in an rainforest with that in a western drainage area stream. In these instances the condition will be assessed by' comparison with the best area of similar type in the region or catchment.



Components

1. **A Procedures Manual outlining the methods to be used to conduct the survey and to analyse the data.**

2. **A Set of Data Sheets and Instructions for conducting the survey.**

3. **A Training Manual used to instruct how the survey is to be conducted and the specific details on the data sheets.**

4. **A Database System for Compiling and Analysing the data.**

    a. **User-friendly system using Dbase IV on a PC.**

    b. **Each data sheet corresponds to a linked database in a relational system.**

    c. **Designed to be linked to GIS for input and output.**

    d. **Includes a system for real integration within the catchment using the drainage network and a coding system.**

5. **An Implementation Programme.**

Sampling Strategy

1. **Random Sampling is likely to be very inefficient.**

2. **Rivers are linear systems - what happens upstream affects sections down stream in a cumulative way. Therefore we expect rivers to change progressively down the drainage lines and for adjacent sections of rivers to be relatively homogeneous.**

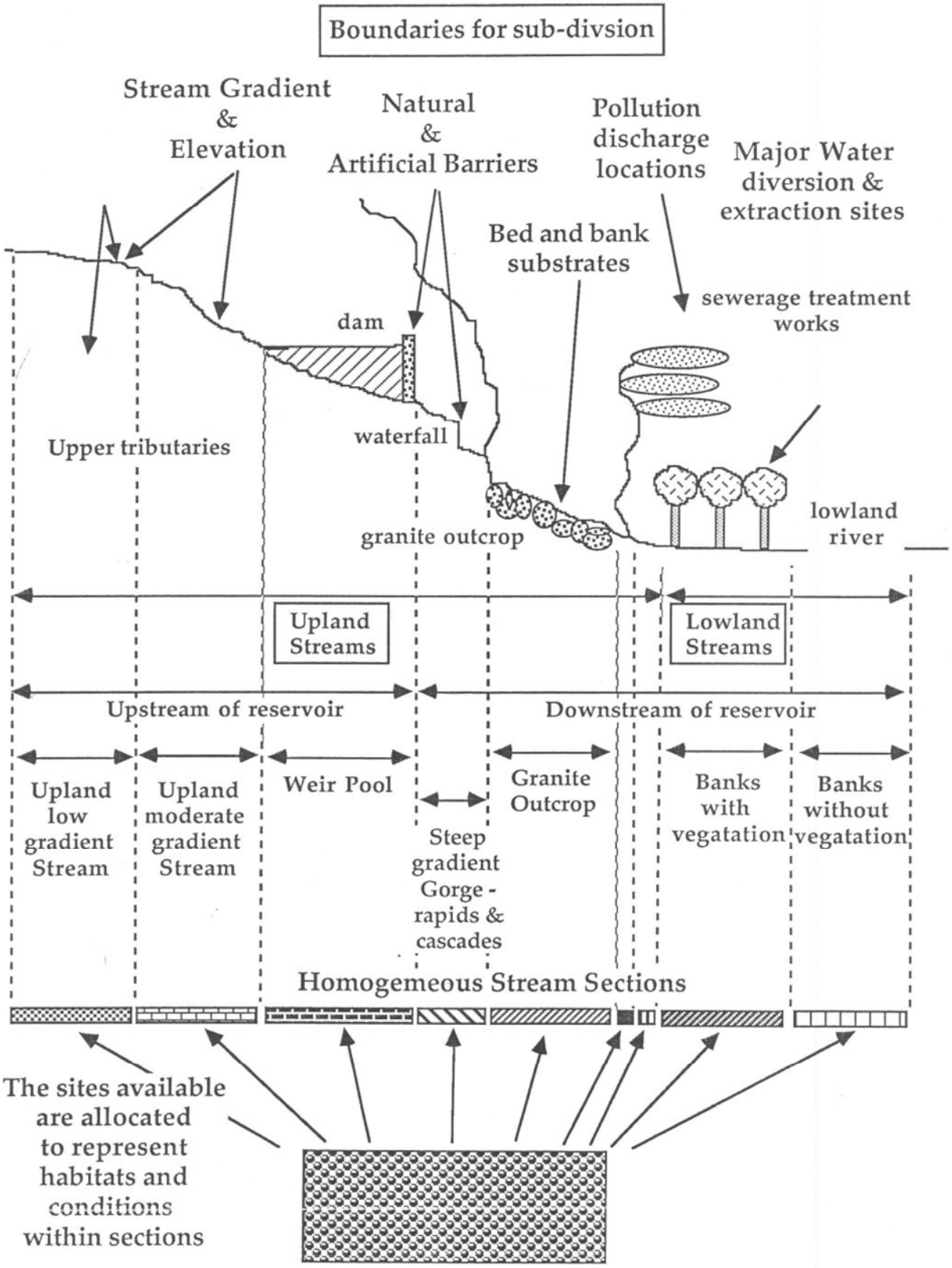
3. **Therefore a Stratified Sampling Technique is likely to be much more efficient. This means that we use available information to initially subdivide that rivers and streams in the drainage network into areas or Strata, which will basically have similar features, and then we sample at representative sites within these areas.**

4. **The aim of the method is to identify what is termed:**

   "Homogeneous Stream Sections"

   i.e. homogeneous for the attributes we are interested in and at the size and scale. relevant for the study.

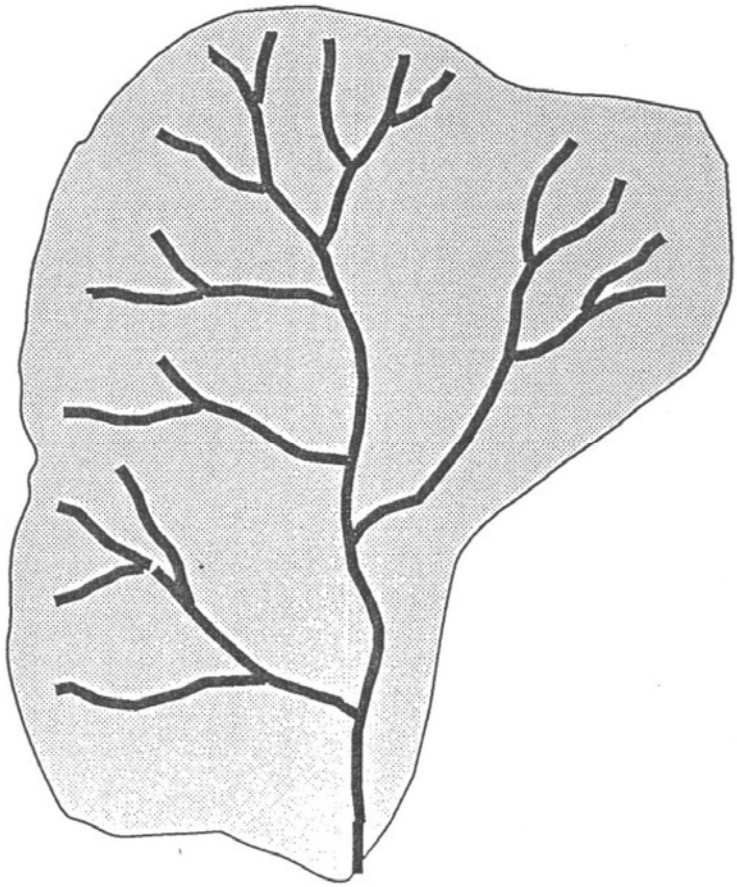
Homogeneous Stream Sections



Homogeneous Stream Sections

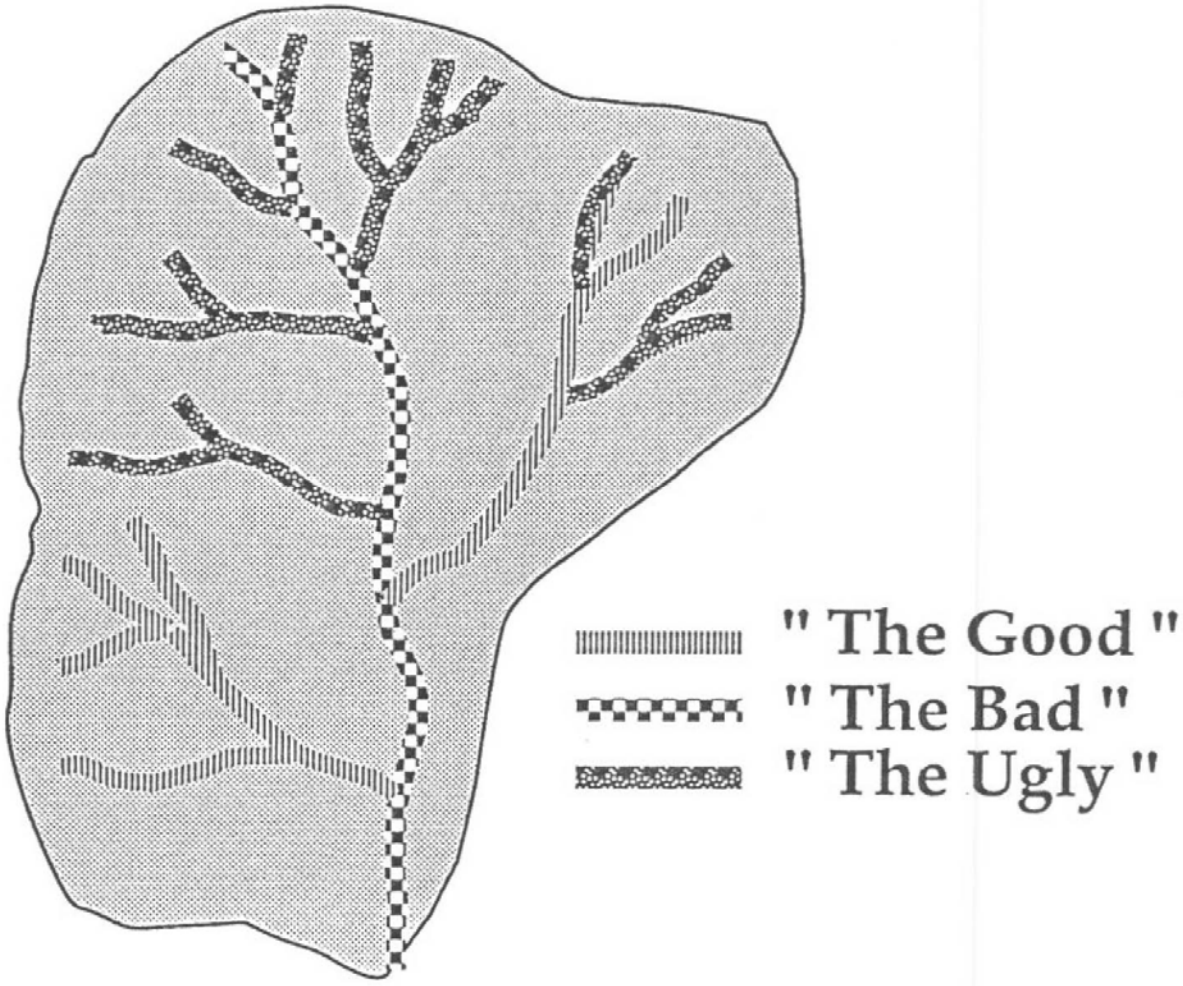
1. In assessing the condition of streams and rivers we have to deal with sections of rivers not points or individual sites.

2. A lot of this is common sense. River sections in different tributaries throughout the catchment will be fundamentally different because their catchments are different. Similarly, the general features of a river will change as it increases in size, as more a more tributaries are added to it.



Homogeneous Stream Sections

2. **Ultimately what we need is a way of classifying all the river and stream sections in a catchment in terms of their features and overall condition.**

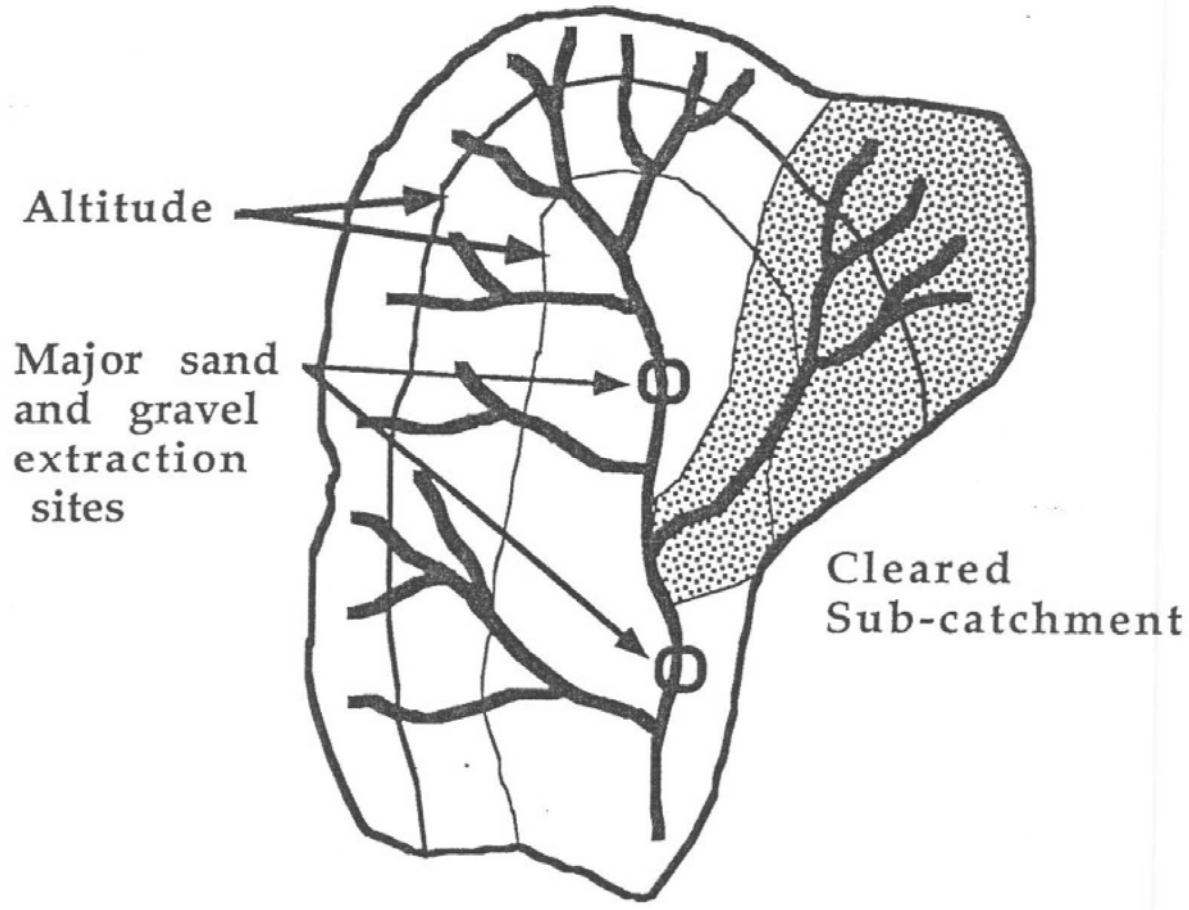


Homogeneous Stream Sections

4. Subdivision Procedure

A. Preliminary Sub-division - Map Exercise

The rivers and catchment is initially subdivided into major sections at the sub-catchment boundaries, and using other available information such as altitude, slope, stream gradient, geology and vegetation cover and land use.

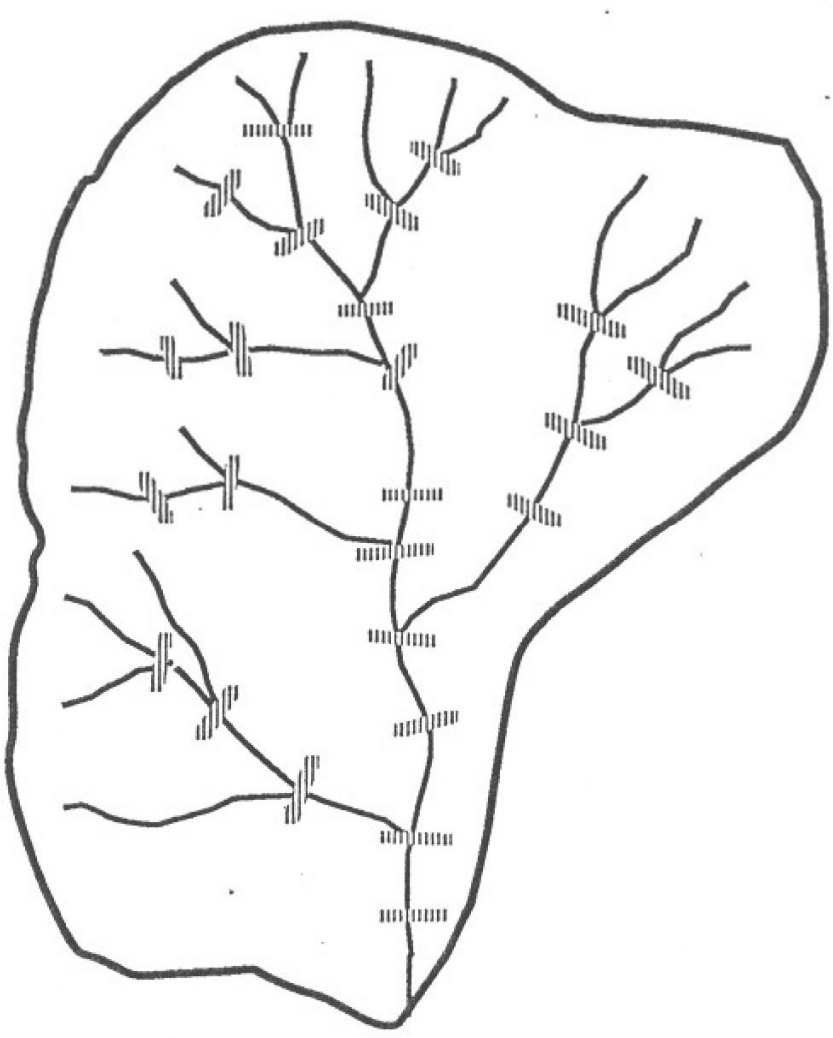


Homogeneous Stream Sections

4. Subdivision Procedure (cont.)

B. Reconnoitre Survey

Using the initial base map a reconnoitre survey is conducted to visually assess the river sections. More sections boundaries are added to maintain the notion of homogeneous stream sections.

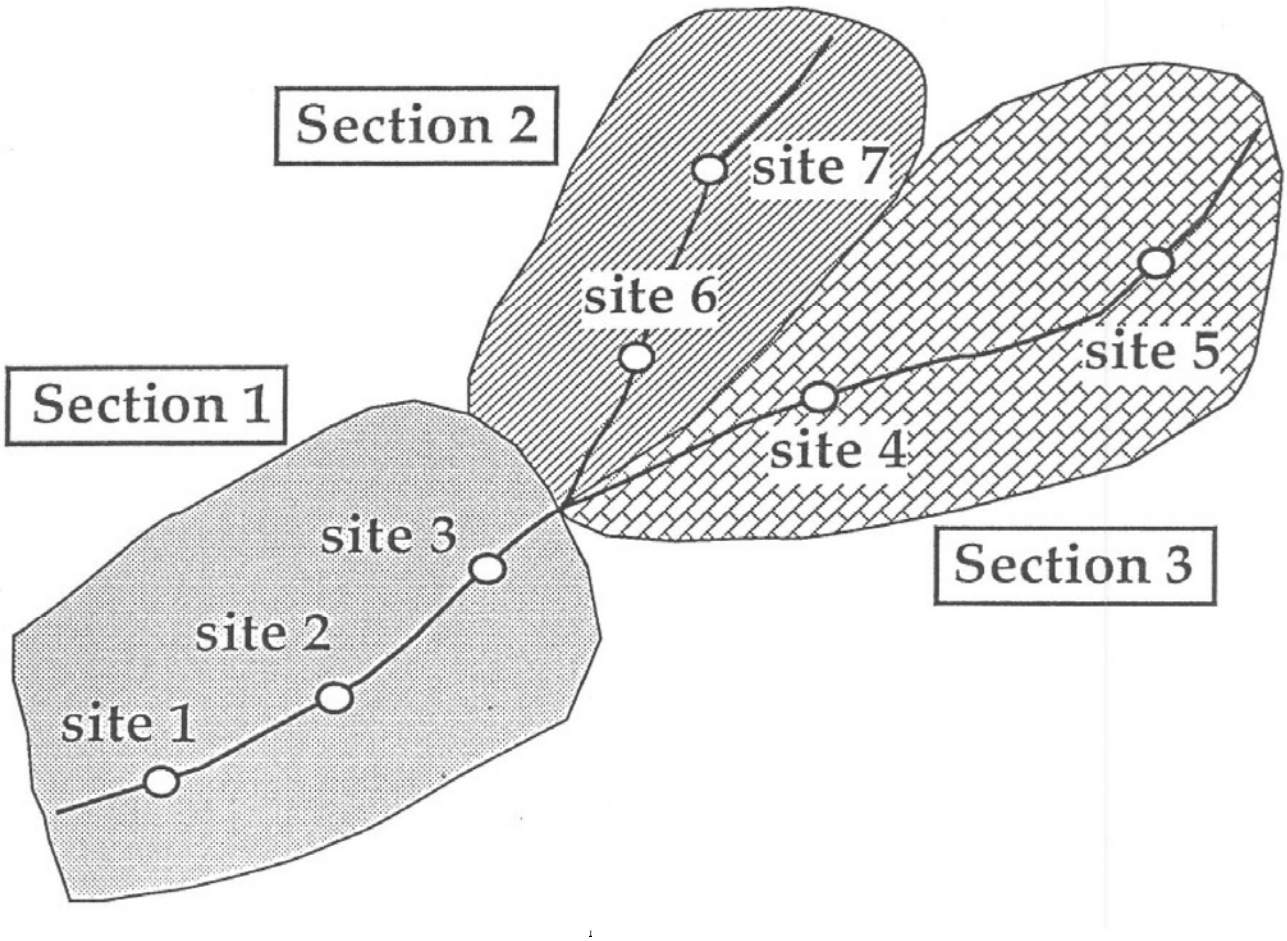


Homogeneous Stream Sections

4. Subdivision Procedure (cont.)

C. Sub-division of the Catchment

Whenever a new section boundary is added the catchment is subdivided also. Each homogeneous stream section then has it's associated sub-catchment element. Sites representative of the section are also chosen during the reconnoitre survey.

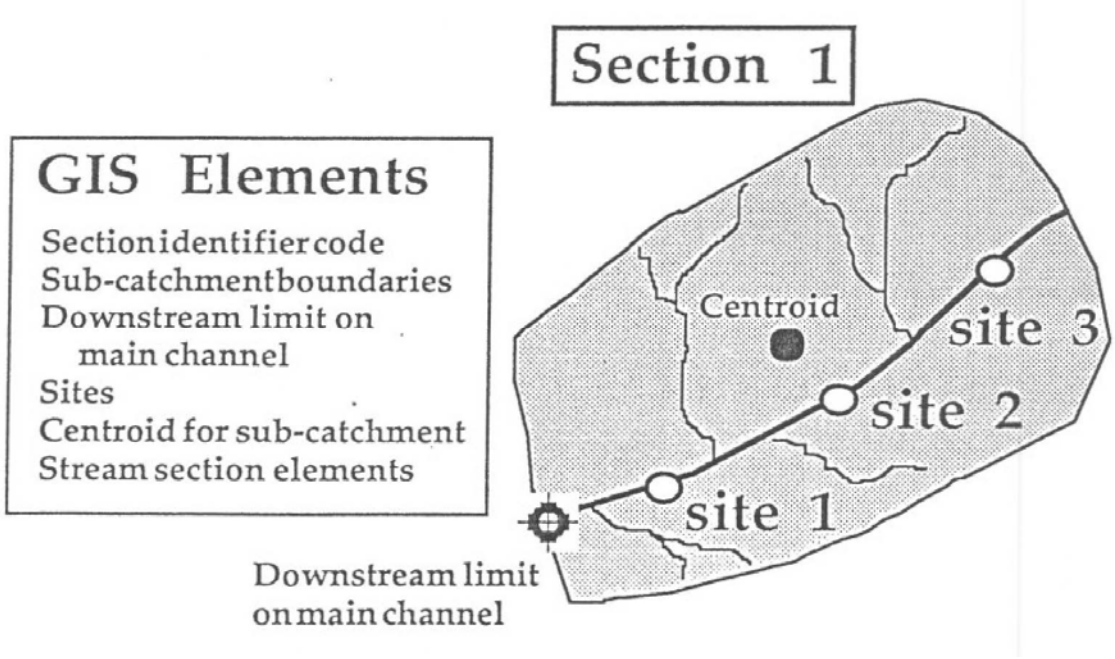


Homogeneous Stream Sections

4. Subdivision Procedure (cont.)

'D. Site Survey & Link to GIS

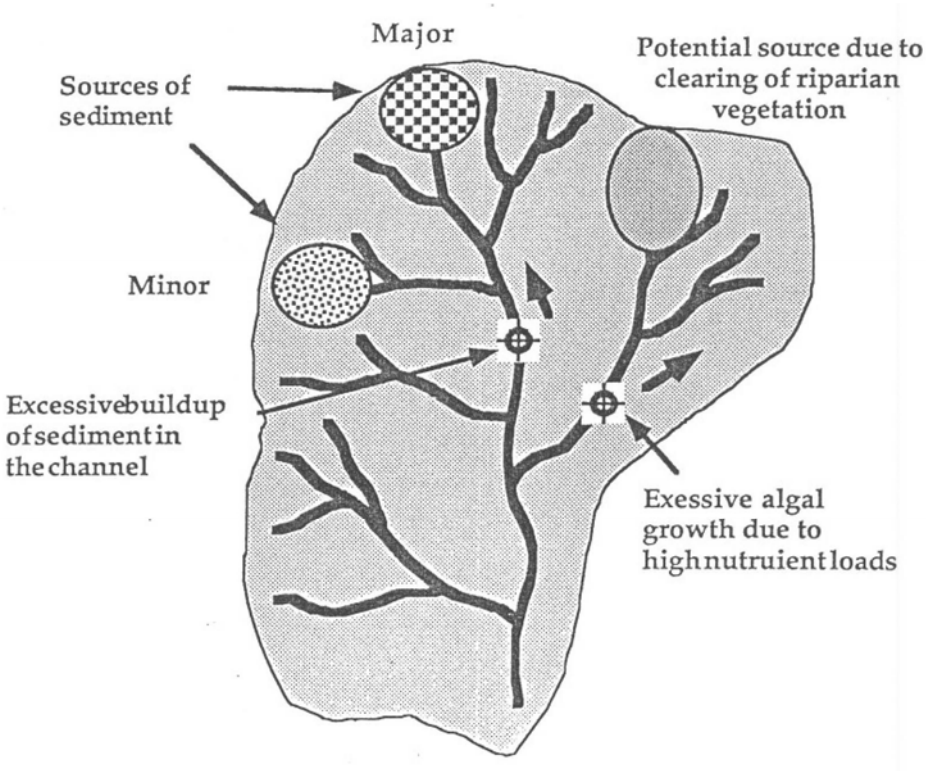
The detailed site survey is then conducted at the series of sites allocated for each section. Once the survey data has been analysed the decision may be made to add further sub-sections in order to keep the sections' homogeneous' in terms of the criteria selected. The system is expandable allowing varying scales of resolution and specificity. Each of the stream sections and it's associated land parcel element becomes an element in the GIS for compiling spatial information throughout the catchment such as land use, soils, vegetation cover etc.



Homogeneous Stream Sections

5. Methods for Integration

In order to provide a method for real integration we need a way to instantly determine which stream sections and sub-catchment land parcels are upstream of a given location in the stream drainage network. An simple hierarchical numbering system has been developed to do this within the data base.



The sections and sub catchment parcels upstream of any point can be recognised and their order in the drainage network determined.

Data Compilation & Analysis

The data collected will be compiled into a series of relational databases using Dbase IV. The data collection unit is the stream section and sub-catchment land parcel.

Types of Data

1. Non Survey Data

A. Section location and definition

B. GIS derived data - the numbering system allows a two-way transfer of data.

C. Hydrologic Summary - The gauging stations are incorporated as special sites in the data base. Hydrological summary data will be extracted using the HYDSYS package and included in the database. Water quality data could be included in a similar way, although it is not currently.

2. Survey Data - includes information collected at one or more sites in each section.

Instream Surveys

1. Approach and Constraints

In conducting these surveys there will never be enough sites and there is always more data that could be collected. The basic practical criteria for the surveys are :

1. The survey is designed to be completed by teams of two members spending about
1 hour at each site.

2. This allows for two teams of two people to survey about 150-200 sites in a three week period (adequate for a catchment of same size as the Mary River).

3. The reconnoitre would require an additional week for two people.

4. Only a minimal set of equipment is required (tapes, portable echo-sounder, boat, GPS, inclinometer, camera etc.).

5. The survey is expandable dependent on the scale of resolution required and the resources available

Instream Surveys

2. Strategy

The survey approach is to collect the following types of data :

1. Raw Data - Raw data will be collected. It will be used to compile the derived data, and will be itself used for specific purposes such as in integrated catchment management. e.g. The distribution of a certain weed species or erosion.

2. Derived Ratings - Various formulae will be used to derive the various overall condition assessments. The method used will be explicit and easily modified.

e.g. Physical Condition =
$A(w_1) + B(w_2) + C(w_3) + D(w_4)$
where A,B,C & D are raw attributes
and w's are weightings

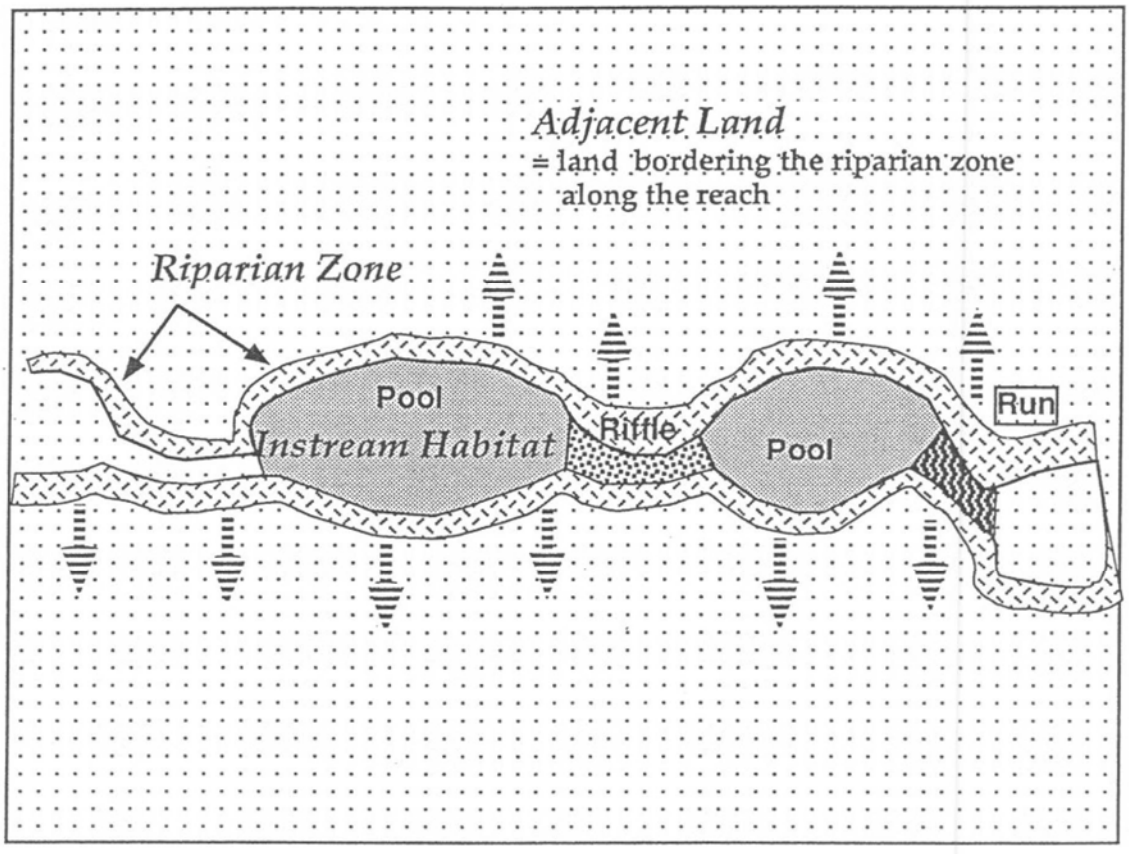
3. Semi-Subjective Ratings - The recorders will be asked to make an overall assessment of the component. The value of these ratings will be increased by asking for the assessments after the raw data has been collected. These ratings will provide a valuable 'first-go' assessment which can be qualified using the derived ratings.

Instream Habitat

The Focus of the Study is on the Instream Habitat i.e. on the condition of the stream itself

- **the bed, bar and banks,**
- **the Riparian Zone,**
- **and the land immediately adjacent to the riparian zone,**

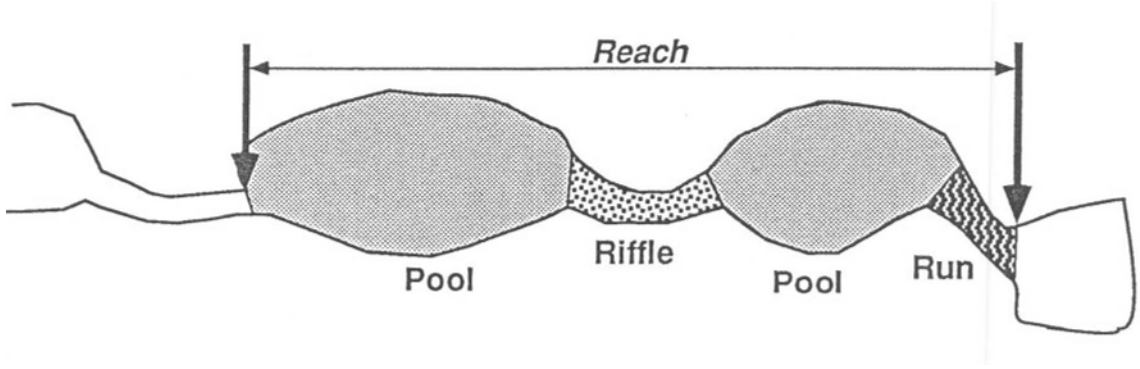
within the boundaries of the selected reach.



Sites = Reaches

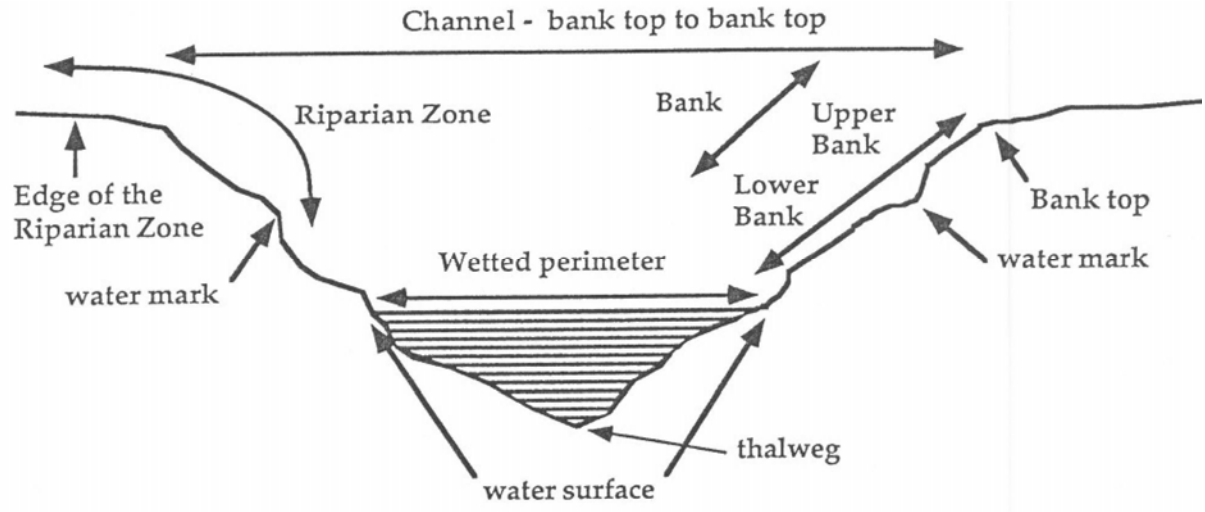
A representative reach is selected at each designated site. The reach should represent the channel habitats present in the section and it should meet the following criteria:

1. **Preferably the reach should contain at least 2 complete pools and riffle / run habitats (represent diversity).**
2. **The whole length of the reach should be visible at one location.**
3. **The pool should be the largest and deepest in the area.**



Boundaries

Most of the boundaries used for the various assessments are explained on the appropriate datasheets. The following summary gives an initial guide.

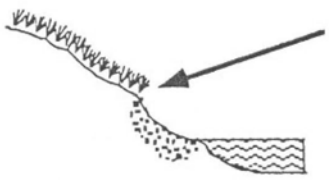


Thalweg - This is the deepest point across a transect. It is important because cross-sections in pools should be taken to intercept the deepest point in a pool, and the 'shallowest' thalweg in a riffle, run or glide.

Bank top, Banks - From a measurement point of view the banks extend from the water's surface (or the water marks if the bed is dry) to the bank top, that is to the point of inflexion the channel profile.

Water Surface - This is obvious. It is used for taking depth measurements for the cross-section profiles and for assessing the instream organic debris cover available for fish and invertebrates. When the bed is dry assessment is made at the 'water mark', i.e. assuming that the channel was filled with water to the 'water mark'.

Water Mark - The concept of a 'water mark' is used to provide a reference point for standardising the channel measurements and for marking the boundary between the lower and upper banks. A mark is left on the bank at the normal inundation level for the stream. It is delineated by either the edge of the terrestrial grasses and other vegetation which cannot tolerate more frequent inundation, or an obvious point of erosion or substrate differences along the bank.



A 'Water Mark' is left at the normal inundation level in the stream. It's location is shown by the edge of the terrestial grasses etc., which can not tolerate more frequent innundation, or by an area of erosion or the boundary between different types of sediment on the bank.

Boundaries Continued

Riparian Zone - It is difficult to derive a precise definition of a riparian zone, particularly for untrained staff. There are many possible definitions. The most relevant feature for our purposes is the vegetation. Ideally it should be possible to identify such a zone irrespective of disturbance or condition, and it should have a fixed with for each size and type of stream, relating to how far and how often the stream or river floods or reaches bank-full stage. However, this is not possible in this survey and so the focus is on identifying the remnant riparian zone using its distinct vegetation.

The riparian zone is an interface between the stream and the surrounding land. The vegetation in it is different because of the influence of the stream in increasing available moisture, flooding and soil characteristics. The vegetation is important or the stream because it contributes organic debris, stabilises the banks and provides shade, and cover for the instream communities.

The general perception of there being a strip of vegetation along the edge of the stream which is different from the rest of the vegetation in the landscape is generally obvious and recognisable by most people. The strategy adopted was to simply record the width of the remnant strip of clearly distinguishable vegetation along the stream margins, on the banks and partially extending onto the £1oodplain, and to assess the cover by various types of plants within the boundaries of this zone along both banks.

Instream Surveys

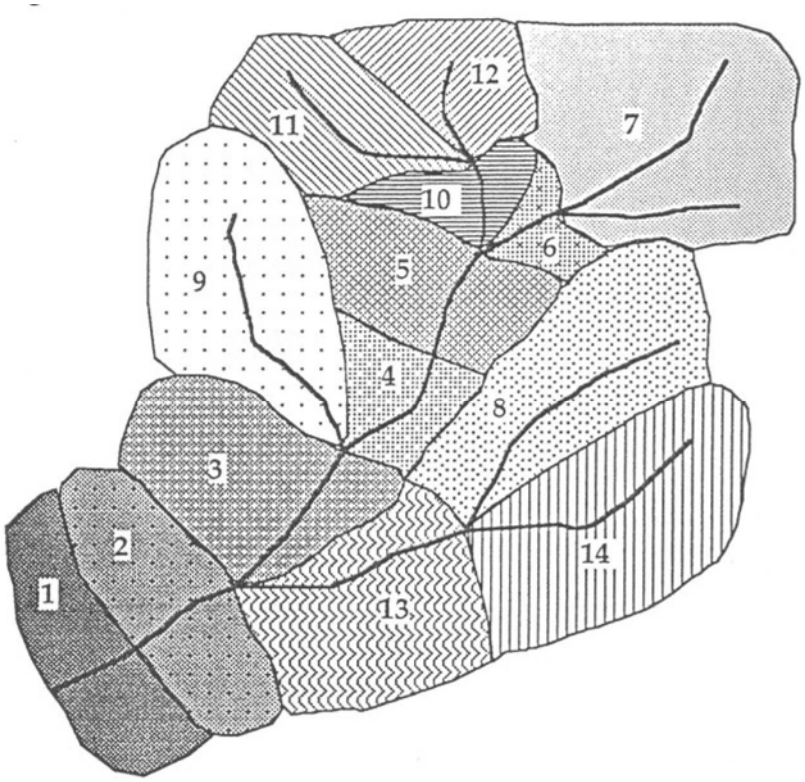
3. *Components*

The following components will included in the surveys (each represents a data sheet and database) :

1. ***1.*** **Stream Section Information *(Non-survey)***
2. ***2.*** **Hydrology and Water Level/Flow conditions *(Non-survey)***
3. **Site Description - site location**
4. **Reach Environs - adjacent land features**
5. **Channel Habitat - pool, riffle, run, cascade, etc.**
6. **Cross-sections - profiles / bed and banks**
7. **Bank Condition**
8. **Bed and Bar Condition**
9. **Vegetation - riparian, bank and aquatic**
10. **Aquatic Habitat**
11. **Scenic, Recreational and Conservation Values**

Sub-section Numbering System

A simple numbering system for the stream sections is used to achieve integration through the drainage network.



The sections along the major channel are first assigned sequential numbers -large numbers are used to allow additional sub-sections to be added with minimal changes. Tributary sub-catchment sections are assigned the number of the main tributary section into which they drain plus a sequential number at successive levels of the hierarchical code. The codes allocated to the stream sections shown above are as follows:

Section		Code		Section		Code	
Number	A	B	C	Number	A	B	C
1.	1000	0	0	8	2000	1000	1000
2.	2000	0	0	9	3000	1000	0
3.	3000	0	0	10	5000	1000	0
4.	4000	0	0	11	5000	2000	0
5.	5000	0	0	12	5000	2000	1000
6.	6000	0	0	13	2000	1000	0
7.	7000	0	0	14	2000	2000	0

State of the Rivers

State of the Rivers Project
Major Types of Data

1. Catchment in the Regional Context
   * *climate, regional land system*

2. Sub-catchment Features
   * *Land use, soils, geology, slope, gradient*

3. Site Description, Location, Drainage code
   * *grid reference, AMTD, identifiers*

4. Reach Environs Information - Spatial
   * *floodplain land use and type, channel pattern, land administration, disturbance*

5. Reach Environs Information - Temporal
   * *conditions prevailing at the time of the survey*

6. Channel Form, Shape & Dimensions

7. Hydrology and Water Quality
   * *Summaries derived from other sources*

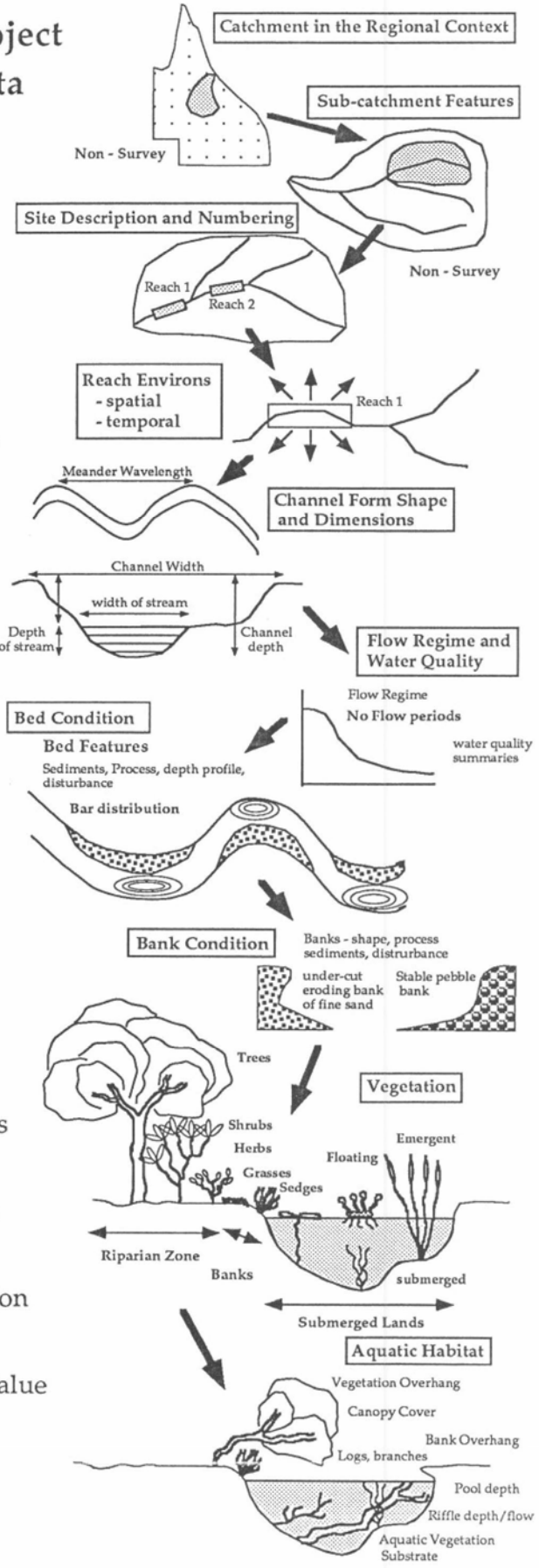
8. Banks - Physical Condition & Process

9. Bed & Bars - Physical Condition & Process

10. Vegetation - Aquatic, Bank and Riparian

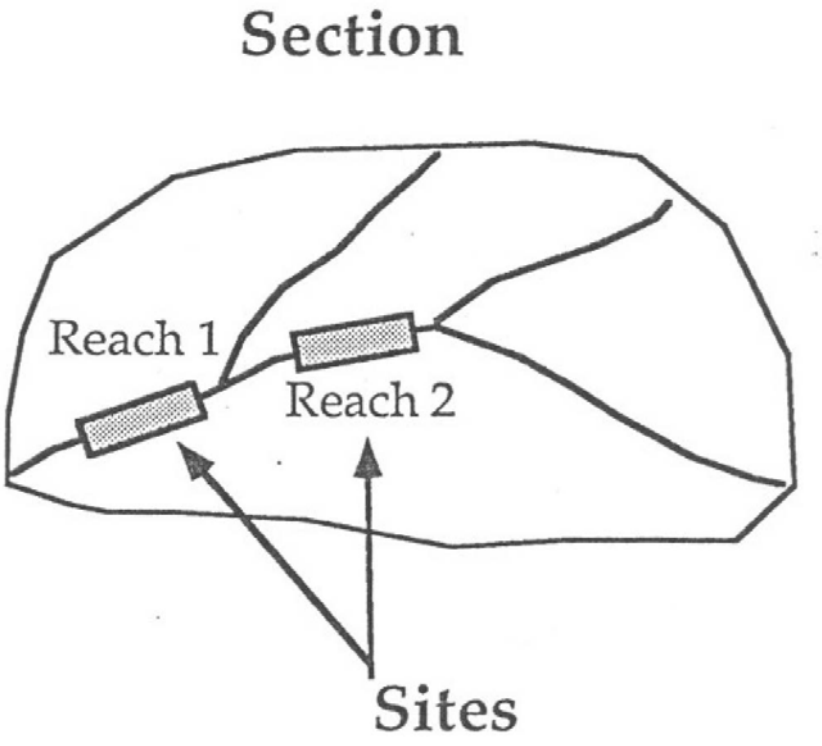
11. Aquatic Habitat Classification & Condition

12. Scenic, Conservation and Recreational Value



Site Description

The aim here is to provide a description of the location of the site using a grid reference or a lat/long (GPS preferred), and using local land marks. The description should be adequate for precisely relocating the site for follow-up surveys. A standard set of photographs is taken of the site.



Reach Environs

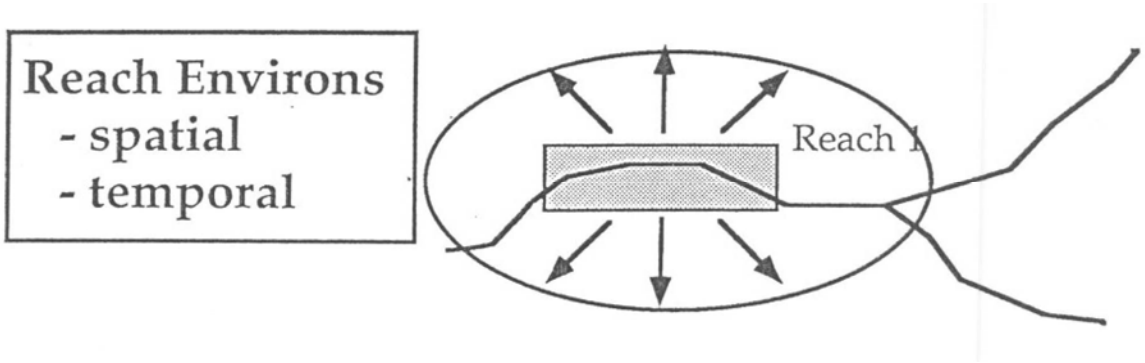
The aim here is to record local information about the land immediately adjacent to the reach. This includes information about the flow and water level conditions prevailing at the time of the survey.

It also includes :-

- ***local land use***
- ***local disturbance***
- ***local vegetation type***
- ***floodplain features (billabongs etc.)***
- ***local land tenure***

An *overall disturbance rating* also made in relation to the extent of clearing and replacement of vegetation by exotic species in the riparian zone and adjacent land.

This local data complements the broader data available form the GIS (spatial) and flow conditions at the gauges (temporal)

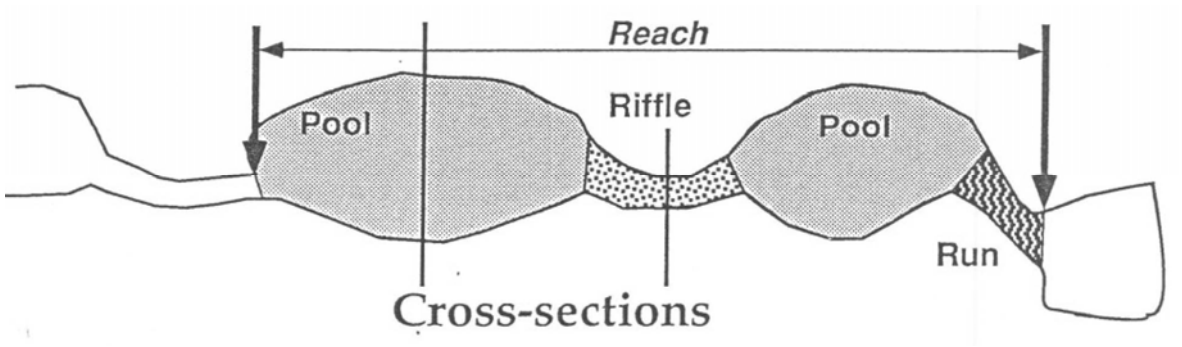


Channel Habitat Classification

The aim here is to classify the segments of the reach into the following broad types:

- **waterfall**
- **cascade**
- **rapid**
- **riffle**
- **glide**
- **run**
- **pool**
- **backwater**

These represent the broad range of aquatic habitats present and the range of sediments, flows and depths present in the reach. This classification is important for both the physical and environmental condition of the stream.

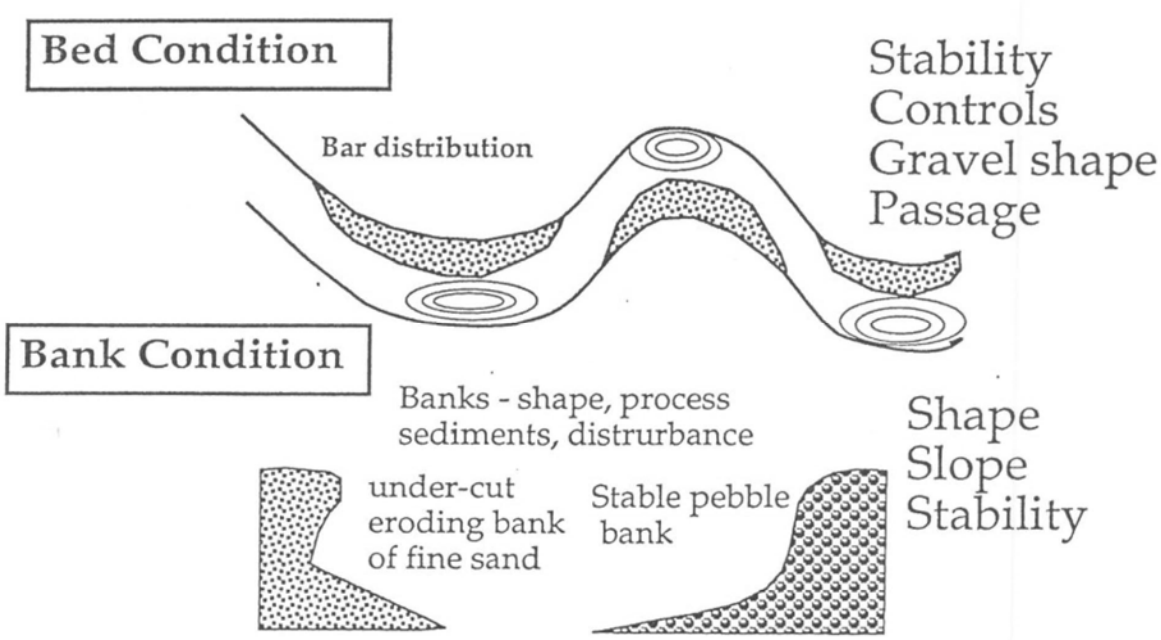


Cross-sections are taken at the point of maximum thalweg depth (pool) and at the point of minimum thalweg depth (max. bed height)(riffle) in the reach.

Bed, Bar and Bank Condition

Two data sheets are used to assess the condition of the bed bar and banks. The assessment is made in terms of the percentage of the bank length, and surface area of the bed, which is stable, eroding or aggrading. The location of the instability (bends, obstacles etc.) and the local factors affecting stability are also assessed to identify the processes involved. Overall ratings of the bed and bank stability are made.

The suitability of the site for general fish passage and for specific barriers at the site is also assessed in relation to the stage at the time the survey is made and of the stage required for the barrier to be effectively by-passed or over-topped.



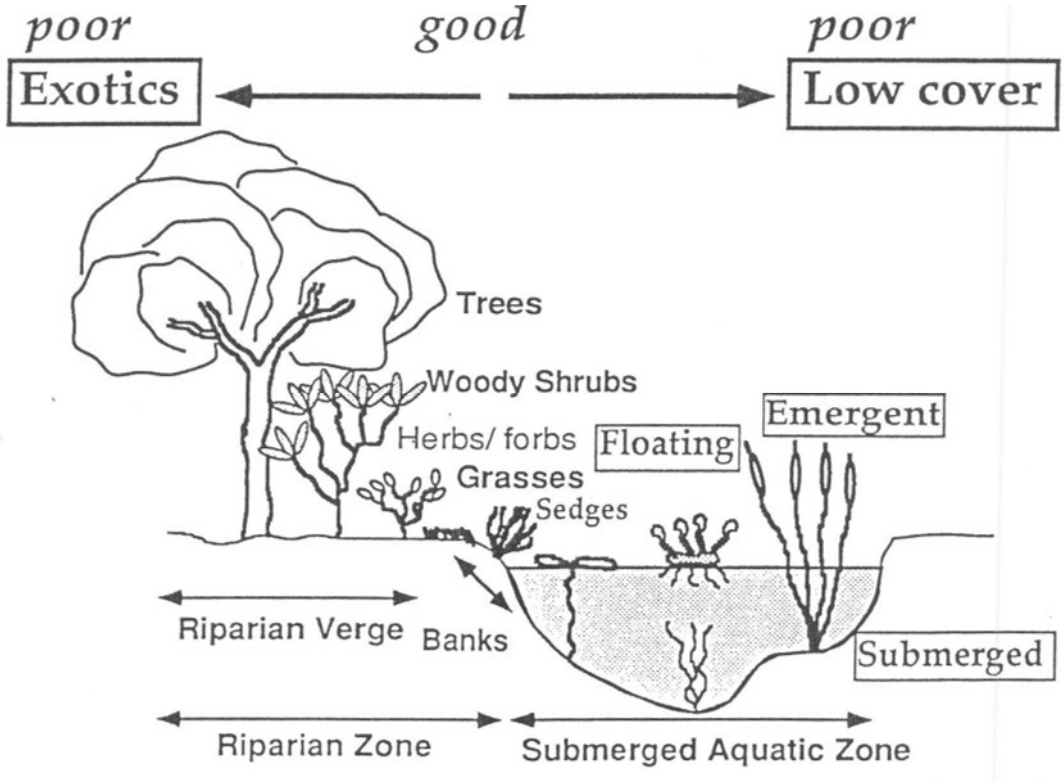
Vegetation

Riparian and aquatic vegetation is becoming recognised as one of the most important features for assessing the condition of streams.

Riparian Vegetation acts to:

Stabilise the banks
Provide shade and shelter
Provide leaf litter and other organic debris to the stream
Provide a remnant wildlife corridor
Provide for enhanced fish habitat
Provide a buffer zone for intercepting sediments and nutrients.

Riparian and aquatic vegetation is assessed in terms of percentage cover for various growth forms and key local native & weed species. The percentage of each group which has been replaced by. exotic species is also assessed.

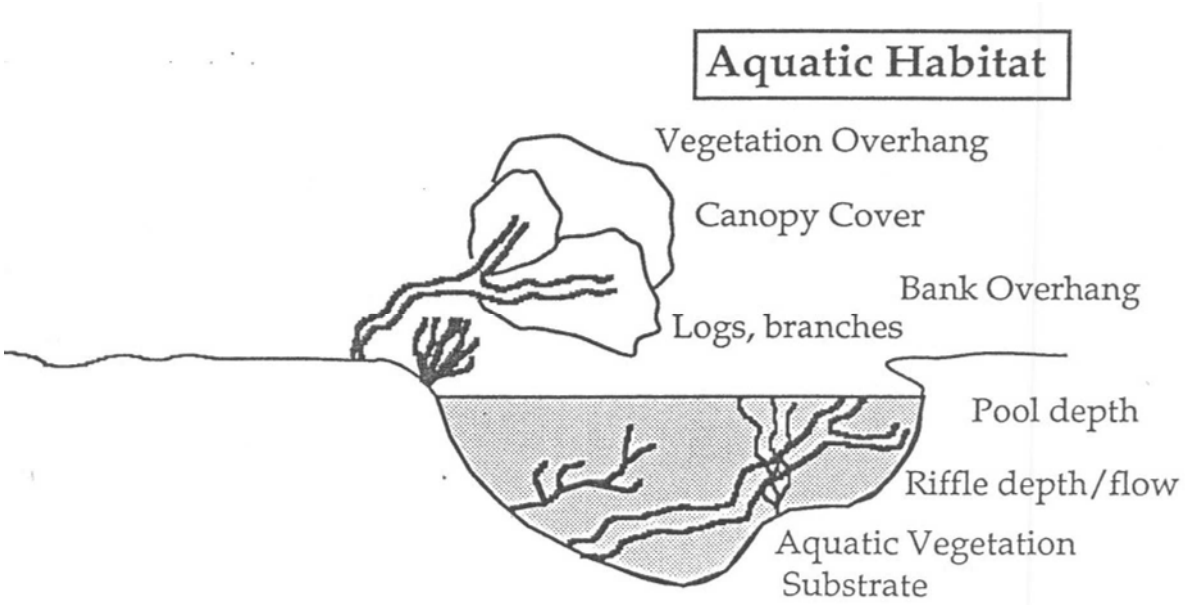


Aquatic Habitat

Some of the attributes collected on the other sheets are important for assessing aquatic habitat. These include:

Channel habitats (pools, riffles and runs)
Depth
Bed Substrates

Cover of various types is also important for fish and invertebrates. Instream cover in the form of logs and branches provide shelter and attachment points, and also increases the diversity of flow and depth in the channel. Bank and vegetation cover also provide shade and shelter for the stream.



Scenic, Recreational and Conservation Values

A preliminary assessment of these' values is made at each site. The sites are classified according to their recreational opportunity type, using remoteness, access, human contact and impact, and facilities available at the site. The suitability of the site for various types of recreation, and their scenic values are also assessed. A preliminary assessment of the conservation values of the sites is made in terms of ratings for the sites as remnant habitats for rare or endangered species of animals or plants, or as wildlife corridors.

Aquatic Habitat Classification

One of the outcomes of the surveys will be to provide the data for 'classifying aquatic habitats. Currently there is no way of doing this, but it is essential for future attempts to rate various sections in terms of the extent to which they are representative of various habitat types. Fish and invertebrate surveys, done by others, will . enable this classification system to be "calibrated". Eventually it will be possible to recognise BIOREGIONS for aquatic habitats, which is the essential first step for conservation.

13.3 Appendix 3 Examples of Output Generated by the Summary Programs

13.3.1 Output from the Program 'ENVIRONER' - all Maroochy River Sites

Overall Disturbance Rating **Total Number of sites = 185**

Rating	No. of Sites
1	9
2	26
3	29
4	27
5	58
6	36

Land Use Types

Type	Number
1	49
2	0
3	6
4	5
5	0
6	19
7	63
8	10
9	3
10	0
11	11
12	5
13	23
14	7
15	36
16	11

Disturbance Types

Type	Number
1	3
2	0
3	49
4	80
5	9
6	3
7	4
8	0
9	1
10	6
11	11
12	7
13	13
14	3
15	62
16	14

Vegetation Types

Type	Number
1	102
2	26
3	23
4	6
5	3
6	0
7	0
8	0
9	0
10	0
11	0
12	12
13	6
14	0
15	2
16	20
17	7
18	2
19	0
20	0
21	2
22	0

Floodplain Features

Type	Number
1	5
2	11
3	12
4	17
5	6

Land Tenure Types

Type	Number
1	155
2	7
3	5
4	4
5	12
6	4
7	2
8	4

13.3.2 Output from the Program 'BANKER' - all Maroochy River Sites

Bank Slopes (L&R added) total number of sites = 186

Type	Number
vertical	101
steep	146
moderate	84
low	46
flat	17

Bank Shapes (L&R added)

Type	Number
concave	163
convex	127
stepped	20
wide low bench	33
undercut	32

Causes of Instability

Type	Number
1	45
2	1
3	22
4	12
5	47
6	19
7	4
8	39
9	67
10	1
11	0

Bank Processes (average % of bank length)

	Bare	Stable	Eroding	Slumping	Aggrading
Lower Left Bank	53.36	55	26.26	1.83	10.05
Lower Right Bank	57.28	51.72	29.62	1.51	8.76
Upper Left Bank	21.19	70.62	20.30	1.64	2.96
Upper Right Bank	20.05	69.78	20.67	1.53	2.61

Overall Bank Instability Rating (L&R added)

Type	Number
high	47
moderate	100
low	151
minimal	60

Overall Bank Susceptibility to Erosion Rating (L&R added)

Type	Number
high	55
moderate	111
low	130
minimal	61

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SOUTH MAROOCHY RIVER

Site/Channel Hab>> No. of Sites 33 Last Site 68 Last Sect 304

	num	mean	sem	max	min		num	mean	sem	max	min
AMTD-map						Altitude	32.0	136.7	16.9	310.0	2.0
AMTD-tot						Cat.Area					
Derived ratings											
C.Pooldep	28.0	9.4	0.7	40.0	1.0	C.Poolwid	28.0	58.1	5.0	100.0	10.0
S.Pooldep	28.0	9.4	0.7	40.0	1.0	S.Poolwid	33.0	1.0	1.0	1.0	1.0
C.Flowdep	17.0	2.8	0.1	16.0	1.0	C.Flowwid	17.0	25.8	4.9	80.0	3.0
S.Flowdep	28.0	9.4	0.7	40.0	1.0	S.Flowwid	28.0	9.4	0.7	40.0	1.0
Ch.Divers	33.0	26.9	2.0	58.4	1.0						
Wfall_Hi	4.0	65.0	13.4	100.0	20.0						
Mean of listed ratings											
C.Pooldep	28.0	9.4	0.7	40.0	1.0	C.Poolwid					
S.Pooldep	28.0	58.1	5.0	100.0	10.0	S.Poolwid					
C.Flowdep	17.0	2.8	0.1	16.0	1.0	C.Flowwid	17.0	25.8	4.9	80.0	3.0
S.Flowdep						S.Flowwid					
Ch.Divers	33.0	26.8	2.0	58.0	1.0						
Wfall_Hi	17.0	21.1	4.6	100.0	3.0						

Channel Habitat-->>No. of Sites 33 Last Site 68 Last Sect 304

	num	mean	sem	max	min		num	mean	sem	max	min
WFall_%	3.0	36.7	6.2	50.0	20.0	Wfall_len	3.0	26.7	8.5	50.0	15.0
WFall_Hi	3.0	11.8	6.4	30.0	2.5	Wfall_Gra	3.0	31.7	2.6	40.0	25.0
Casca_%	15.0	35.9	5.6	100.0	4.0	Casca_len	15.0	27.0	3.7	50.0	0.3
Casca_Hi	15.0	1.6	0.7	5.0	0.3	Casca_Gra	15.0	20.2	3.2	60.0	3.0
Rapid_%	1.0	60.0	0.0	60.0	60.0	Rapid_len	1.0	30.0	0.0	30.0	30.0
Rapid_dep	1.0	0.1	0.0	0.1	0.1	Rapid_wid	1.0	2.0	0.0	2.0	2.0
Riffl_%	13.0	30.2	3.7	70.0	5.0	Riffl_len	13.0	17.1	3.0	60.0	1.0
Riffl_dep	13.0	0.1	1.0	0.2	0.1	Riffl_wid	13.0	1.8	0.5	6.0	0.3
Glide_%						Glide_len					
Glide_dep						Glide_wid					
Run_%	4.0	16.3	*****	100.0	20.0	Run_len	4.0	45.0	15.4	100.0	20.0
Run_dep	4.0	0.8	0.8	1.6	0.3	Run_wid	4.0	5.0	0.4	8.0	1.0
Pool_%	28.0	65.8	3.8	100.0	20.0	Pool_len	28.0	31.7	3.2	100.0	3.0
Pool_dep	28.0	0.9	0.8	4.0	0.1	Pool_wid	28.0	7.6	0.2	25.0	1.0
Back_%						Back_len					
Back_dep						Back_wid					
Reach_len	33.0	52.5	5.0	200.0	7.0						

SOUTH MAROOCHY

Environs Summary	No. sites				25		Last Site			163		Last Sect			74
Categories	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
											17	18	19	20	21	22
Water Lev.	0	2	4	8	11	0	0	0	0	0	0					
CPat_Map	0	0	0	0	0	0	0	0	0	0						
CPat_Loc	0	0	0	0	0	0	0	0	0	0						
Land Use	2	0	0	0	0	4	11	1	0	0	0	0	6	1	3	5
Dist.Typ	0	0	7	11	4	0	1	0	0	1	1	1	2	0	6	0
Veg. Typ	10	3	6	2	2	0	0	0	0	0	0	1	0	0	0	0
											0	0	0	0	0	0
Flood PFe	0	0	0	0	2											
Tenure	16	3	3	1	2	0	1	0								
Dist. Rat.	0	6	8	2	6	3										

	num	mean	sem	max	min		num	mean	sem	max	min
Fplain-wid						V/flat-wid					
Meand-len											
Subj.rat	25.0	55.3	22.9	83.0	17.0	Calc.rat	25.0	57.8	23.3	108.0	27.0
SSubj.rat						Scalc.rat					
Raw Subj.	25.0	55.3	23.0	83.3	16.7	Raw Calc.	25	62			
Scal.Subj	25.0	55.3	23.0	83.3	16.7	Scal.Calc	25	107			

SOUTH MAROOCHY

Bank Summary No. sites 33 Last site 163 last sect 74

Categories	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Stab. fact	3	0	1	1	10	1	1	8	8	0	0					
Prot. typ	0	1	0	0	0	0	0	0	1	0	0					

Levees Natural 0 Man-made 0 None 1

	num	mean	sem	max	min		num	mean	sem	max	min
Levee Ht	2.0	1.5	0.0	1.5	1.5	Levee Wid	2.0	10.0	0.0	10.0	10.0
Low bare	66.0	57.3	36.7	100.0	0.0	Up bare	66.0	14.6	21.9	90.0	0.0
Low stable	66.0	72.5	32.8	100.0	0.0	Up stable	66.0	82.0	25.5	100.0	0.0
Low eroded	66.0	20.0	25.3	85.0	0.0	Up eroded	66.0	13.8	19.9	90.0	0.0
Low slump	66.0	2.7	7.6	40.0	0.0	Up slump	66.0	2.0	9.5	70.0	0.0
Low aggrad	66.0	4.6	13.4	70.0	0.0	Up aggrad	66.0	0.8	3.6	25.0	0.0

	Lower			Upper		
Location	Erod	Slump	Aggrad	Erod	Slump	Aggrad
@Bends	7	2	1	12	1	0
@scours	1	0	0	1	0	0
@obstac	0	0	1	0	0	2
@Seeps	0	3	1	3	2	1
Irreg.	12	3	4	13	4	1
All along	19	4	3	13	0	2

Subjective Ratings
high mod low min

Instabil.
5 11 29 21
Suscept.
5 14 28 19

	num	mean	sem	max	min		num	mean	sem	max	min
Subj.rat	33.0	74.7	20.1	100.0	25.0	Calc.rat	33.0	80.1	21.9	100.0	9.0
Scal.Subj						Scal.Calc					

Ratings Summary for the Group

	num	mean	sem	max	min		num	mean	sem	max	min
Raw Subj	66.0	74.6	22.0	100.0	25.0	Raw Calc	66.0	80.1	24.6	100.0	5.0
Scal.Subj	66.0	74.6	22.0	100.0	25.0	Scal.Calc	66.0	80.1	24.6	100.0	5.0
Major type <50=erosion, >50 = aggrad							33.0	43.5	7.9	51.3	21.0

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SOUTH MAROOCHY

Bed & Bar ConditionNo. Sites 33 Last Site 163 Last Sect 74

Bar Type	None	Point	Altern	Island	EncVeg	Obstru	Bar.pl	Infill	Hi Dep
	25	5	1	3	1	2	0	0	0

	num	mean	sem	max	min
Bar Size(%)	8.0	14.4	2.7	40.0	5.0

Grav Ang	VAngul.	Angul	SubAng	Round	V.Rnd	
	0	5	0	0	0	0

Gr shape	Sphere	Disc	Blade	Rod
	0	10	0	0

Gra surf	algae	clean
	0	0

BedCompac	Armour	Packed	Moder	Low	V. Low
	4	2	3	0	0

Factors Affecting Stability

	SandExtr	BdDeep	BnkEro	Chann	SedTrap	Mining	AgGraz	Other
	0	1	4	2	0	0	19	0

Controls	BrdFrd	Rocks	Trees	Other
	11	12	4	3

Stab.Rat.	Sever Erod	Mod.Erod	Stable	Mod.Aggrd	Sever Agg
	0	2	27	3	1

*** Passage Summary***

	None	Very R	Mod R	Part R	Good	Unrestr
Pass Now->	10	19	1	1	1	1
Pass @wmark	2	3	21	5	0	2

*** Obstructions ***

	Num	Height	num	mean	sem	max	min	Stage When Overtopped: WM	1/3	2/3	Bful	Fld	ExtF	Never
Weir	3		3.0	17.0	5.9	30.0	1.0	0	0	1	0	0	0	2
Rapid	15		15.0	2.3	0.4	10.0	0.5	0	4	3	5	1	1	1
Ford	3		3.0	0.7	0.9	1.0	0.5	0	1	2	0	0	0	0
Log	2		2.0	0.7	0.8	1.0	0.3	0	0	2	0	0	0	0
Low	3		3.0	0.3	0.9	0.5	0.2	0	2	1	0	0	0	0
Othe	0							0	0	0	0	0	0	0
None	30													

	num	mean	sem	max	min		num	mean	sem	max	min
Raw Subj	33.0	90.0	2.8	100.0	20.0	Raw Calc	33.0	80.7	3.3	95.5	20.1
Scal. Subj	33.0	90.0	2.8	100.0	20.0	Scal. Calc	33.0	80.7	3.3	95.5	20.1
Subj. Rat	33.0	90.0	2.8	100.0	20.0	Calc. Rat	33.0	80.6	3.3	95.0	20.0
Scal. Subj						Scal Calc					
Type of instability <50=erosion >50 =aggrad							33.0	51.8	1.4	87.2	22.1

SOUTH MAROOCHY

Aquatic Habitat ->>No. of Sites 33 Last Site 163 Last Sect 74

	num	mean	sem	max	min	No.p		num	mean	sem	max	min
Log Cov	17.0	11.9	1.0	29.0	4.0	17	Pat	17.0	2.5	0.5	9.0	1.0
Loj<50 Cov	1.0	4.0	0.0	4.0	4.0	1	Pat	1.0	1.0	0.0	1.0	1.0
Loj>50 Cov	1.0	4.0	0.0	4.0	4.0	1	Pat	1.0	1.0	0.0	1.0	1.0
bran Cov	15.0	14.0	0.4	19.0	4.0	15	Pat	15.0	5.1	0.3	9.0	1.0
bnp<50 Cov	5.0	10.0	1.2	19.0	4.0	5	Pat	5.0	2.2	0.3	5.0	1.0
bnp>50 Cov	1.0	9.0	0.0	9.0	9.0	1	Pat	1.0	1.0	0.0	1.0	1.0
leaf Cov	17.0	26.1	3.9	79.0	9.0	17	Pat	17.0	7.8	0.3	9.0	1.0
Macr Cov	1.0	89.0	0.0	89.0	89.0	1	Pat	1.0	9.0	0.0	9.0	9.0
Alga Cov	1.0	9.0	0.0	9.0	9.0	1	Pat	1.0	9.0	0.0	9.0	9.0
Fre/sub Cv	2.0	31.5	18.4	59.0	4.0	2	Pat	2.0	9.0	1.0	9.0	9.0
Mar/sub Cv						0	Pat					
Mangr Cov						0	Pat					
Float Cov						0	Pat					
Emerg Cov	2.0	36.5	22.0	69.0	4.0	2	Pat	2.0	5.0	1.8	9.0	1.0
Root Cov	2.0	44.0	23.7	79.0	9.0	2	Pat	2.0	6.5	0.8	9.0	4.0
Rock Cov	21.0	72.3	6.8	99.0	9.0	21	Pat	21.0	7.8	0.4	9.0	1.0
Pool>1 Cov	12.0	51.1	8.4	99.0	9.0	12	Pat	12.0	4.0	0.0	9.0	1.0
	num	mean	sem	max	min	No.p		num	mean	sem	max	min
Man-m Cov						0	Pat					

****BANK COVER****

	num	mean	sem	max	min		num	mean	sem	max	min
Canopy Cv	59.0	64.3	3.8	100.0	5.0	Width	59.0	5.2	0.0	60.0	0.5
Veg O/h Cv	57.0	24.6	1.8	90.0	5.0	Width	57.0	1.2	0.9	3.0	0.2
Root O/h C	22.0	11.5	0.4	30.0	2.0	Width	22.0	0.5	0.9	2.0	0.2
Bank O/h C	18.0	23.9	3.1	50.0	5.0	Width	18.0	0.3	1.0	0.3	0.2
Man O/h C	1.0	5.0	0.0	5.0	5.0	Width	1.0	0.5	0.0	0.5	0.5

** Derived ratings for the group **

Raw Subj	33.0	70.5	3.2	100.0	25.0	Raw Calc	66.0	57.6	1.8	95.2	1.0
Scal. Subj	33.0	70.5	3.2	100.0	25.0	Scal. Calc	66.0	57.6	1.8	95.2	1.0

** Derived ratings from records **

Subj. Rat	33.0	70.5	3.2	100.0	25.0	Calc. Rat
Scal. Subj	33.0	57.7	2.9	86.0	1.0	Scal Calc

	V. High	Good	Poor	V. Poor
Subjective Ratings	8	16	4	5

Vegetation Summary No. of sites 33 Last Site 163 last Section 74

	num	mean	sem	max	min		num	mean	sem	max	min
Rip. wid	66.0	21.9	1.5	50.0	0.5	(Note: maximum width set to 50m)					
%bare	66.0	5.5	0.4	50.0	0.0						
Trees>30m	22.0	52.7	5.8	100.0	5.0	%Exotic	66.0	1.6	0.5	100.0	0.0
Tree10-30	56.0	60.2	2.2	100.0	5.0	%Exotic	66.0	11.4	2.4	100.0	0.0
Tree<10	58.0	17.8	0.8	80.0	5.0	%Exotic	66.0	10.5	2.3	100.0	0.0
Shrubs	54.0	18.9	0.8	60.0	5.0	%Exotic	66.0	3.9	1.2	100.0	0.0
Vines	17.0	12.4	0.4	20.0	5.0	%Exotic	66.0	1.5	0.5	100.0	0.0
Rushes	24.0	15.8	1.2	40.0	5.0	%Exotic	66.0	1.6	0.5	100.0	0.0
Herbs	45.0	22.2	1.4	80.0	5.0	%Exotic	66.0	9.2	2.4	100.0	0.0
Grasses	45.0	44.4	4.0	100.0	5.0	%Exotic	66.0	15.2	3.2	100.0	0.0
Tree Fern	8.0	5.3	0.1	10.0	1.0	Ferns	31.0	9.1	0.1	20.0	1.0
Mosses	28.0	8.0	0.1	20.0	1.0	Mangroves	2.0	10.0	1.0	10.0	10.0
S. marsh						Palms	11.0	26.8	8.3	90.0	5.0
Local sp1	1.0	1.0	0.0	1.0	1.0	Local sp2					
Local sp3						Local sp4					
Local sp5						Tot %exot	66.0	22.6	2.9	100.0	0.0

Checklist of species L&R counted separately for sites 33

	rare	abund		rare	abund		rare	abund
Rainforest	12	12	Casuarina	4	2	Melaleuca	0	0
Callistemon	4	11	Exot.Pines	1	1	Willows	2	2
Popular	0	0	Camphor	7	6	Lantana	4	4
Rubber Vine	0	0	Para Grass	0	4	Exot. Grass	2	4
Lomandra l	6	22	Bunya pine	4	0	Guava	0	0
Acacia	4	6	Native pine	0	0	Palms	0	2
Privet	0	2	Chin Elm	0	2	Sand p fig	0	4
Other spl	2	0	Other sp2	0	0			

Aquatic Vegetation Sites too turbid/no est = 2

	num	mean	sem	max	min		num	mean	sem	max	min
Vis depth	33.0	0.4	0.9	1.0	0.0						
Tot% bare	14.0	78.2	7.5	100.0	10.0	Tot% exot	31.0	0.0	1.0	0.0	0.0
Submerged											
	num	mean	sem	max	min		num	mean	sem	max	min
Total % cov											
	6.0	15.8	5.3	50.0	5.0	Tot. %exot	31.0	0.0	1.0	0.0	0.0
Filament	2.0	45.0	23.7	80.0	10.0	Mar/est al					
Chara/Nite				.		Vallis/str					
Herb/like	3.0	43.3	22.3	100.0	10.0	Myriophyll					
Elodea						Loc. spl					
Loc. sp2						Loc. sp3					
Loc. sp4						Loc. sp5					
Floating											
Tot %cover											
	2.0	15.0	2.5	20.0	10.0	Tot.%exot	31.0	0.0	1.0	0.0	0.0
Water hyac						Azolla					
Water lill											
	2.0	100.0	1.0	100.0	100.0	Loc. spl					
Loc. sp 2						Loc. sp 3					
Emergent											
	num	mean	sem	max	min		num	mean	sem	max	min
Tot % cov	7.0	19.3	6.7	60.0	5.0	Tot % exot	31.0	0.0	1.0	0.0	0.0
Phragmites						Typha	2.0	25.0	2.5	30.0	20.0
Para grass						Rushes&Sed	6.0	34.2	13.2	100.0	5.0
Encr.will	2.0	17.5	7.8	30.0	5.0	Oth.shrubs	1.0	30.0	0.0	30.0	30.0
Loc. sp 1						Loc. sp 2					
Loc. sp 3											

Derived ratings

Riparian Zone Ratings	num	mean	sem	max	min	Aquatic Veg. Ratings	num	mean	sem	max	min
Raw	66.0	37.4	4.0	100.0	0.4	Raw	31.0	5.1	1.0	60.5	1.5
Scaled	66.0	37.4	4.0	100.0	0.4	Scaled	31.0	5.1	1.0	60.5	1.5
Ripar rat	32.0	38.6	6.1	100.0	1.0	Scal Ripar					
Aquat rat	31.0	4.7	1.1	61.0	1.0	Scal Aquat					

SOUTH MAROOCHY

Scen/Rec/Cons Summary

No. of Sites 32 Last Site 163 Last Sect 74

****Recreational Opportunity Types****

Nature 1	Nature 2	Nature 3	Rural 1	Rural 2	Urban 1	Urban 2	Urban3
9	3	0	18	0	0	2	

****Recreation Types****

	Poten	Actual	Total		Poten	Actual	Total
Barb/Picnic	21	0	21	Bushw/camp	9	0	9
Bushw/day	13	0	13	Camp-car acc	7	0	7
Canoe/kyak	9	0	9	Dog exercis	2	0	2
Sboat Fish	4	0	4	Lboat Fish	0	0	0
4-W Drive	4	0	4	Horse Ride	5	0	5
Motor bike	4	0	4	Rowing	2	0	2
Sailing	0	0	0	Photogr	19	0	19
Nature Appr	19	0	19	Swimming	8	0	8
Water Skiing	0	0	0	Bird Watch	6	0	6
Other 1	1	0	1	Other 2	0	0	0
Other 3	0	0	0	Other 4	0	0	0
Other 5	0	0	0	Other 6	0	0	0

Categories	1	2	3	4	5	6	7	8	9	10	11	12
Scen. Val	3	4	3	3	2	5	1	2	3	5		
Nat. Beauty	2	0	12									

(NB ranks are scaled 1 =>3, 2 =>2, rest =>1)

Phy. Beauty	3	0	1
Scen.Rural	3	0	6
Scen.Urban	0	0	1
Artistic	0	0	0
Scen.Comp	3	0	1
Other	0	0	0

Rem-Aquat	6	3	2	2	2	2	4	1	3	7
Rem-Ripar	11	1	2	0	5	2	1	2	2	6
Rem-Wildc	12	1	2	2	2	3	1	3	0	6
Repr-Aquat	7	2	1	4	3	0	4	1	3	7
Repr-Ripar	10	2	0	1	5	3	1	3	1	6

Ratings	num	mean	sem	max	min		num	mean	sem	max	min
Raw Recr	32.0	57.6	0.7	60.0	16.6	Raw Cons	32.0	51.5	4.8	100.0	10.0
Scal.Recr	32.0	57.6	0.7	60.0	16.6	Scal.Cons	32.0	51.5	4.8	100.0	10.0
Recr.Rat	30.0	35.8	1.9	60.0	17.0	Cons.Rat					
Scal.Recr	32.0	51.5	4.8	100.0	10.0	Scal.Cons					

*** Hydrology ratings

Subj_rat

sSubj_rat

Category	20	40	60	80	100
Subj	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Category	20	40	60	80	100
Calc	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Category	20	40	60	80	100
Extra	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Extra

Calc_rat

sCalc_rat

Category	20	40	60	80	100
sSubj	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Category	20	40	60	80	100
sCalc	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

*** Site values ***						WfallHI	21.0	21.1	3.6	100.0	3.0
Pooldp*10	28.0	7.8	0.1	25.0	2.0	Poolwid	28.0	51.6	5.0	100.0	10.0
sPooldep						sPoolwid					

Category	20	40	60	80	100
PooldepX10	26	2	0	0	0
% of Sects	93	7	0	0	0
Riv.Length	54.0	5.0	0.0	0.0	0.0
Riv.Len %	92	8	0	0	0

Category	20	40	60	80	100
S pooldep	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Category	20	40	60	80	100
Pool width	5	9	4	4	6
% of Sects	18	32	14	14	21
Riv.Length	6.3	21.5	11.8	9.5	10.0
Riv.Len %	11	36	20	16	17

Category	20	40	60	80	100
sPoolwid	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Category	20	40	60	80	100
Wfall Ht.	12	7	1	0	1
% of Sects	57	33	5	0	5
Riv.Length	34.3	11.8	1.0	0.0	3.0
Riv.Len %	69	24	2	0	6

*** Environs ratings						Extra					
Subj_rat	36.0	55.7	3.2	83.0	17.0	Calc_rat	36.0	65.6	3.0	108.0	27.0
sSubj_rat						sCalc_rat					

Category	20	40	60	80	100
Subj	5	9	3	7	12
% of Sects	14	25	8	19	33
Riv.Length	15.5	21.0	9.5	15.5	21.8
Riv.Len %	19	25	11	19	26

Category	20	40	60	80	100
Ssubj	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Category	20	40	60	80	100
Calc	0	6	14	6	7
% of Sects	0	17	39	17	19
Riv.Length	0.0	19.8	32.3	10.5	10.8
Riv.Len %	0	24	39	13	13

Category	20	40	60	80	100
sCalc	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Category	20	40	60	80	100
Extra	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

*** Channel Habitat ratings

Flow dep	19.0	2.6	0.2	16.0	1.0
sFlowdep					

Category	20	40	60	80	100
Flow dep	19	0	0	0	0
% of Sects	100	0	0	0	0
Riv.Length	54.0	0.0	0.0	0.0	0.0
Riv.Len %	100	0	0	0	0

Category	20	40	60	80	100
Flow wid	12	4	1	2	0
% of Sects	63	21	5	11	0
Riv.Length	32.5	7.8	4.3	9.5	0.0
Riv.Len %	60	14	8	18	0

Category	20	40	60	80	100
ChanDivers	14	16	6	0	0
% of Sects	39	44	17	0	0
Riv.Length	29.0	38.0	16.3	0.0	0.0
Riv.Len %	35	46	20	0	0

ChanDivers	36.0	23.9	2.1	58.0	1.0
Flow wid	19.0	23.5	4.5	80.0	3.0
sFlowwid					

Category	20	40	60	80	100
sFlowdep	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Category	20	40	60	80	100
sFlowwid	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

*** Channel Dimension ratings						Wid/dep	36.0	10.3	0.3	33.0	3.0
P/wmdep	36.0	15.4	1.1	67.0	2.0	Pool/sed	29.0	498.4	83.1	999.0	1.0
P/wmwid	36.0	9.2	0.2	32.0	2.0	Flow/sed	21.0	457.3	100.8	999.0	1.0

Category	20	40	60	80	100
Pool/wmdep	31	3	1	1	0
% of Sects	86	8	3	3	0
Riv.Length	75.5	4.3	2.5	1.0	0.0
Riv.Len %	91	5	3	1	0

Category	20	40	60	80	100
Poo/sedX10	32	4	0	0	0
% of Sects	89	11	0	0	0
Riv.Length	75.3	8.0	0.0	0.0	0.0
Riv.Len %	90	10	0	0	0

Category	20	40	60	80	100
Pool/wmwid	7	4	0	0	0
% of Sects	24	14	0	0	0
Riv.Length	19.5	4.3	0.0	0.0	0.0
Riv.Len %	32	7	0	0	0

Category	20	40	60	80	100
Flo/sedX10	10	0	0	0	0
% of Sects	48	0	0	0	0
Riv.Length	21.0	0.0	0.0	0.0	0.0
Riv.Len %	42	0	0	0	0

Category	20	40	60	80	100
Wid/Dep rat	31	5	0	0	0
% of Sects	86	14	0	0	0
Riv.Length	71.8	11.5	0.0	0.0	0.0
Riv.Len %	86	14	0	0	0

*** Bank Condition ratings

Subj_rat	36.0	77.3	2.5	100.0	25.0
sSubj_rat					

Category	20	40	60	80	100
Subj	0	1	8	12	15
% of Sects	0	3	22	33	42
Riv.Length	0.0	1.3	17.8	33.3	31.0
Riv.Len %	0	2	21	40	37

Category	20	40	60	80	100
sSubj	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Category	20	40	60	80	100
Calc	1	0	4	8	23
% of Sects	3	0	11	22	64
Riv.Length	1.3	0.0	9.0	22.5	50.5
Riv.Len %	2	0	11	27	61

Category	20	40	60	80	100
sCalc	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Category	50	100
Dir <50 er	35	1
% of Sects	97	3
Riv.Length	82.0	1.3
Riv.Len %	98	2

Dir <50 er	36.0	44.0	0.3	51.0	21.0
Calc_rat	36.0	82.4	2.6	100.0	9.0
sCalc_rat					

*** Bed&bar Condition ratings

Subj_rat	36.0	91.5	2.3	100.0	20.0
sSubj_rat					

Category	20	40	60	80	100
Subj	1	0	4	1	30
% of Sects	3	0	11	3	83
Riv.Length	1.3	0.0	8.5	3.0	70.5
Riv.Len %	2	0	10	4	85

Category	20	40	60	80	100
Calc	1	3	1	6	25
% of Sects	3	8	3	17	69
Riv.Length	1.3	7.8	0.8	11.0	62.5
Riv.Len %	2	9	1	13	75

Category	50	100
Dir <50 er	26	10
% of Sects	72	28
Riv.Length	67.0	16.3
Riv.Len %	80	20

Dir <50 er	36.0	52.4	1.1	87.0	22.0
Calc_rat	36.0	81.6	2.8	95.0	20.0
sCalc_rat					

Category	20	40	60	80	100
sSubj	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Category	20	40	60	80	100
sCalc	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

*** Vegetation Condition ratings

Riparian	35.0	44.1	5.8	100.0	1.0
sRiparian					

Category	20	40	60	80	100
Riparian	17	2	2	5	9
% of Sects	49	6	6	14	26
Riv.Length	41.8	6.5	3.8	11.3	17.8
Riv.Len %	52	8	5	14	22

Category	20	40	60	80	100
Aquatic	32	2	0	2	0
% of Sects	89	6	0	6	0
Riv.Length	74.5	4.3	0.0	4.5	0.0
Riv.Len %	89	5	0	5	0

Category	20	40	60	80	100
Rip wid	20	3	13	0	0
% of Sects	56	8	36	0	0
Riv.Length	50.5	8.0	24.8	0.0	0.0
Riv.Len %	61	10	30	0	0

Rip wid	36.0	24.8	2.4	50.0	1.0
Aquatic	36.0	6.6	1.4	61.0	1.0
sAquatic					

Category	20	40	60	80	100
sRiparian	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Category	20	40	60	80	100
sAquatic	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

*** Aquatic Habitat Condition ratings

Instr Cov	36.0	73.6	3.0	100.0	25.0
sInst Cov					

Category	20	40	60	80	100
Instr Cov	0	4	6	14	12
% of Sects	0	11	17	39	33
Riv.Length	0.0	12.5	13.3	35.3	22.3
Riv.Len %	0	15	16	42	27

Category	20	40	60	80	100
Bank Cov	3	4	7	17	5
% of Sects	8	11	19	47	14
Riv.Length	10.3	11.8	18.3	31.3	11.8
Riv.Len %	12	14	22	38	14

Category	20	40	60	80	100
Extra	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Extra

Bank Cov	36.0	58.5	2.4	84.0	1.0
sBank Cov					

Category	20	40	60	80	100
sInstr Cov	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Category	20	40	60	80	100
sBank Cov	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

*** Scenic & Conservation Value ratingsExtra

Recr/Scen	34.0	35.3	1.4	60.0	17.0
sRecr/Scen					

Cons/Repr	36.0	57.4	4.7	100.0	10.0
sCons/Repr					

Category	20	40	60	80	100
Recr/Scen	10	8	16	0	0
% of Sects	29	24	47	0	0
Riv.Length	28.3	22.8	28.5	0.0	0.0
Riv.Len %	36	29	36	0	0

Category	20	40	60	80	100
sRecr/Scen	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Category	20	40	60	80	100
Cons/Repr	5	10	6	2	13
% of Sects	14	28	17	6	36
Riv.Length	15.3	22.5	16.3	4.5	24.8
Riv.Len %	18	27	20	5	30

Category	20	40	60	80	100
sCons/Repr	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Category	20	40	60	80	100
Extra	0	0	0	0	0
% of Sects	****	****	****	****	****
Riv.Length	0.0	0.0	0.0	0.0	0.0
Riv.Len %	****	****	****	****	****

Channel Dimension All types No. Sites 49 Last Site 163 Last Sect 74

	num	mean	sem	max	min		num	mean	sem	max	min
Tp Length	49.0	27.3	25.5	100.0	1.0	Tp Width	49.0	6.0	6.4	31.0	0.5
Tp Depth	49.0	0.6	0.6	2.3	0.1						
LoB Width	98.0	1.3	2.7	16.0	0.0	UpB Width	98.0	5.4	15.0	150.0	0.0
LoB Height	98.0	0.6	1.1	8.0	0.0	UpB Height	98.0	1.8	1.4	10.0	0.3
LoB Slope	96.0	47.0	32.0	95.0	3.0	UpB Slope	98.0	35.3	25.8	90.0	5.0
Channel dimensions											
Width	49.0	19.4	22.9	164.7	3.4	Depth	49.0	3.6	2.5	14.9	1.0
Width/Dep	49.0	6.2	8.2	61.0	0.8	Av. Depth	49.0	3.4	2.5	14.9	1.0
C.Sect.Area	49	180	232	1395	16						
Channel dimensions at the Water Mark											
Width	49.0	8.7	7.1	32.1	0.7	Depth	49.0	1.3	1.1	6.7	0.2
Width/Dep	49.0	8.6	7.2	32.5	0.2	Av. Depth	49.0	1.1	1.1	6.7	0.2
C.Sect.Area	49	151	231	1365	1						
Channel dimensions at the Water's Surface											
Width	49.0	6.2	6.6	31.0	0.5	Depth	49.0	0.7	0.7	4.1	0.1
Width/Dep	49.0	12.3	14.0	95.0	1.7	Av. Depth	49.0	0.5	0.5	2.8	0.1
C.Sect.Area	49	6	18	120	0						

Flows m/s

****Rock Outcrops****

L/lower	R/lower	L/upper	R/upper	Bed	None
23	16	21	16	27	14

**** Substrates - particle diam. in mm ****

	num	mean	sem	cov(%)	max	min
Lower Banks	93	1.011	0.0879	100.0	316.228	0.010
Upper Banks	99	0.331	0.0589	100.0	316.228	0.010
Beds	490	37.697	0.0205	100.0	316.228	0.010

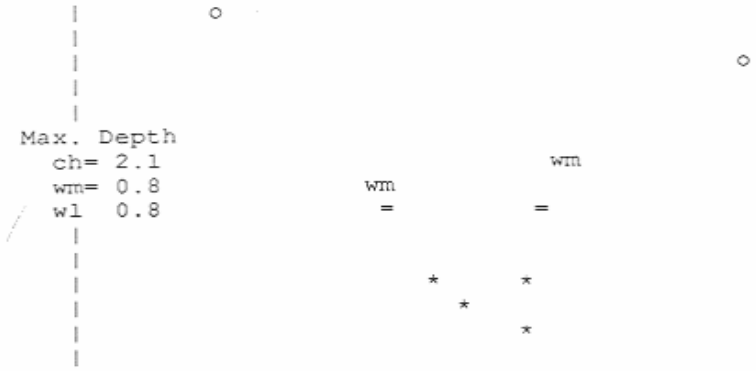
Organic Matter	num	mean	sem	max	min
Upper Bank	19.0	47.4	31.9	100.0	10.0
Lower Bank	17.0	35.6	30.5	95.0	5.0
Bed	722.0	54.7	35.6	90.0	5.0

*****Ratings Summary*****

	num	mean	sem	max	min		num	mean	sem	max	min
wm depth	49.0	16.6	13.1	67.0	2.0	pool sed	42.0	494.7	446.1	999.0	2.0
wm width	49.0	9.8	6.9	32.0	2.0	flow sed	30.0	373.4	438.2	999.0	1.0

Deepest Cross-section @ wmark - Site--> 163 Section Type => All types

<-------------- Channel Width = 10.7 -------------->
Width @ wm = 3.6


Max. Depth
ch= 2.1
wm= 0.8
w1 0.8
wm
wm
=
=

Channel Dimension Pools No. Sites 30 Last Site 163 Last Sect 74

	num	mean	sem	max	min		num	mean	sem	max	min
Tp Length	30.0	28.3	22.4	100.0	3.0	Tp Width	30.0	8.4	7.0	31.0	0.5
Tp Depth	30.0	0.7	0.5	2.3	0.2						
LoB Width	60.0	0.5	1.2	9.0	0.0	UpB Width	60.0	6.2	18.9	150.0	0.0
LoB Height	60.0	0.4	0.2	1.0	0.0	UpB Height	60.0	1.8	1.0	5.0	0.3
LoB Slope	58.0	59.9	26.5	90.0	3.0	UpB Slope	60.0	41.9	27.8	90.0	5.0
Channel dimensions											
Width	30.0	22.6	28.3	164.7	4.1	Depth	30.0	3.5	1.5	6.8	1.6
Width/Dep	30.0	6.8	10.2	61.0	2.6	Av. Depth	30.0	3.2	1.4	6.3	1.5
C.Sect.Area	30	108	57	249	16						
Channel dimensions at the Water Mark											
Width	30.0	10.2	8.1	32.1	1.5	Depth	30.0	1.5	0.8	4.5	0.4
Width/Dep	30.0	6.8	3.9	18.5	2.8	Av. Depth	30.0	1.2	0.6	3.2	0.3
C.Sect.Area	30	75	46	187	1						
Channel dimensions at the Water's Surface											
Width	30.0	9.3	7.4	31.0	1.3	Depth	30.0	1.1	0.8	4.1	0.3
Width/Dep	30.0	9.1	5.9	28.1	3.1	Av. Depth	30.0	0.8	0.5	2.8	0.2
C.Sect.Area	30	10	22	120	0						
Flows m/s											

****Rock Outcrops****

L/lower	R/lower	L/upper	R/upper	Bed	None
15	10	14	12	18	8

**** Substrates - particle diam. in mm ****

	num	mean	sem	cov(%)	max	min
Lower Banks	58	0.311	0.0665	100.0	316.228	0.010
Upper Banks	61	0.134	0.0364	100.0	316.228	0.010
Beds	300	45.177	0.0186	100.0	316.228	0.010

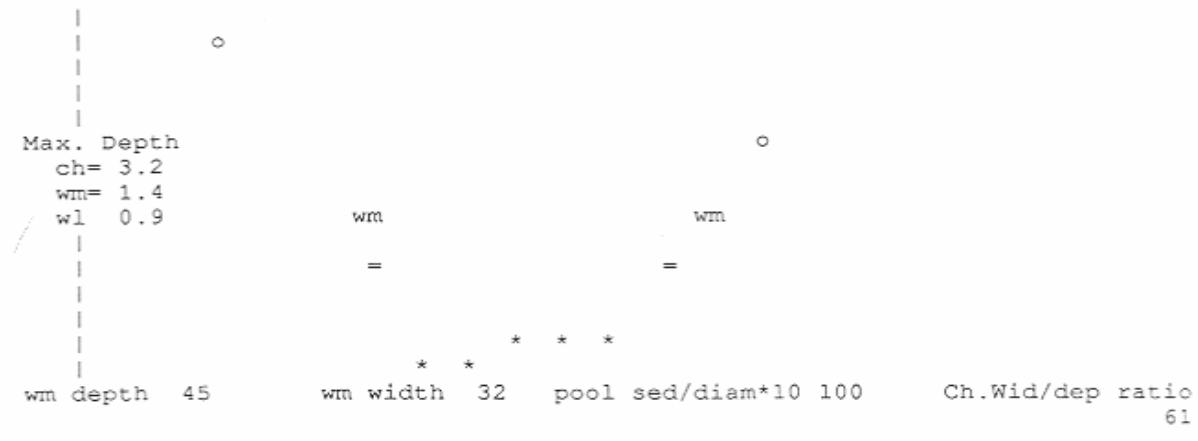
Organic Matter	num	mean	sem	max	min
Upper Bank	12.0	34.2	27.5	90.0	10.0
Lower Bank	11.0	26.8	26.3	80.0	5.0
Bed	272.0	58.2	33.0	90.0	5.0

*****Ratings Summary*****

	num	mean	sem	max	min		num	mean	sem	max	min
wm depth	30.0	17.1	13.0	67.0	4.0	pool sed	28.0	539.8	437.7	999.0	2.0
wm width	30.0	10.4	7.8	32.0	2.0	flow sed	14.0	328.7	419.2	999.0	1.0

Deepest Cross-section @ wmark - Site--> 161 Section Type => Pools

<---------- Channel Width = 10.9 ---------->
Width @ wm = 6.9


Max. Depth
ch= 3.2
wm= 1.4
wl 0.9
wm
wm
wm depth 45
wm width 32
pool sed/diam*10 100
Ch.Wid/dep ratio
61

Channel Dimension All non pools No. Sites 20 Last Site 163 Last Sect 74

	num	mean	sem	max	min		num	mean	sem	max	min
Tp Length	20.0	25.2	29.0	100.0	1.0	Tp Width	20.0	3.2	4.4	20.0	0.5
Tp Depth	20.0	0.3	0.5	2.2	0.1						
LoB Width	40.0	2.4	3.6	16.0	0.0	UpB Width	40.0	4.0	2.9	15.0	0.7
LoB Height	40.0	0.9	1.7	8.0	0.1	UpB Height	40.0	1.9	1.8	10.0	0.4
LoB Slope	40.0	28.2	28.9	95.0	3.0	UpB Slope	40.0	24.5	17.5	60.0	5.0
Channel dimensions											
Width	20.0	15.2	7.4	31.3	3.4	Depth	20.0	3.8	3.4	14.9	1.0
Width/Dep	20.0	5.4	2.8	11.3	0.8	Av. Depth	20.0	3.8	3.4	14.9	1.0
C.Sect.Area	20	98	112	469	15						
Channel dimensions at the Water Mark											
Width	20.0	7.1	5.3	22.8	0.7	Depth	20.0	1.2	1.5	6.7	0.2
Width/Dep	20.0	11.4	9.5	32.5	0.2	Av. Depth	20.0	1.1	1.5	6.7	0.2
C.Sect.Area	20	73	108	440	10						
Channel dimensions at the Water's Surface											
Width	20.0	2.3	2.2	9.6	0.5	Depth	20.0	0.2	0.4	1.7	0.1
Width/Dep	20.0	16.9	19.8	95.0	1.7	Av. Depth	20.0	0.2	0.3	1.6	0.1
C.Sect.Area	20	1	2	8	0						
Flows m/s											

****Rock Outcrops****

L/lower	R/lower	L/upper	R/upper	Bed	None
9	7	8	5	10	6

**** Substrates - particle diam. in mm ****

	num	mean	sem	cov(%)	max	min
Lower Banks	38	8.427	0.0678	100.0	316.228	0.010
Upper Banks	40	1.572	0.0813	100.0	316.228	0.010
Beds	200	31.783	0.0224	100.0	316.228	0.010

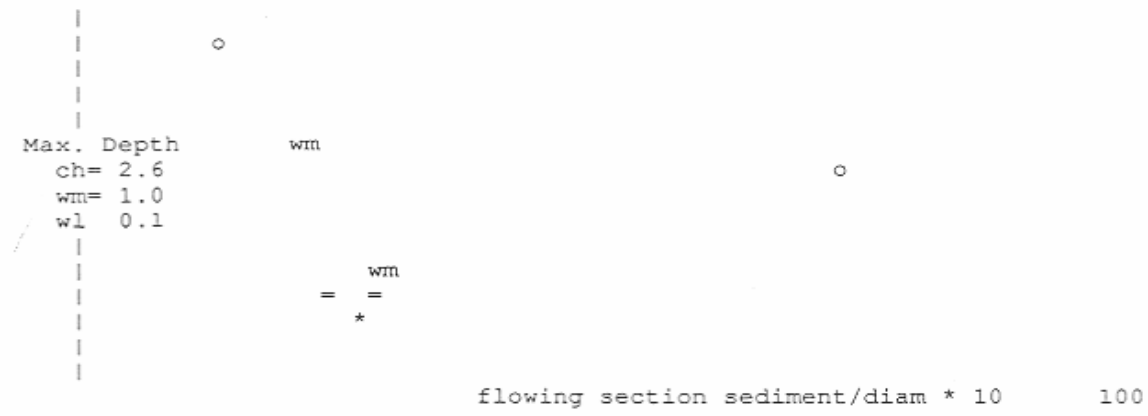
Organic Matter	num	mean	sem	max	min
Upper Bank	7.0	70.0	25.6	100.0	30.0
Lower Bank	6.0	51.7	31.2	95.0	15.0
Bed	119.0	49.0	38.7	90.0	5.0

*****Ratings Summary*****

	num	mean	sem	max	min		num	mean	sem	max	min
wm depth	20.0	17.0	13.9	67.0	2.0	pool sed	15.0	444.2	458.4	999.0	2.0
wm width	20.0	9.1	5.2	23.0	2.0	flow sed	16.0	412.5	450.5	999.0	1.0

Deepest Cross-section @ wmark - Site--> 160 Section Type => All non pools

<---------- Channel Width = 6.5 ----------> Width @ wm = 0.7


Max. Depth
ch= 2.6
wm= 1.0
wl 0.1
wm
wm
flowing section sediment/diam * 10
100

Channel Dimension Riffles No. Sites 11 Last Site 162 Last Sect 72

	num	mean	sem	max	min		num	mean	sem	max	min
Tp Length	11.0	14.7	12.1	40.0	1.0	Tp Width	11.0	1.7	1.1	4.5	0.5
Tp Depth	11.0	0.3	0.6	2.2	0.1						
LoB Width	22.0	2.5	3.7	16.0	0.0	UpB Width	22.0	4.2	3.4	15.0	0.7
LoB Height	22.0	0.4	0.3	1.5	0.1	UpB Height	22.0	1.8	2.1	10.0	0.4
LoB Slope	22.0	21.8	22.6	90.0	5.0	UpB Slope	22.0	25.9	17.8	60.0	5.0
Channel dimensions											
Width	11.0	15.0	8.9	31.3	3.4	Depth	11.0	2.9	2.5	10.2	1.1
Width/Dep	11.0	5.8	2.6	11.3	2.5	Av. Depth	11.0	2.9	2.5	10.2	1.1
C.Sect.Area	11	47	36	141	8						
Channel dimensions at the Water Mark											
Width	11.0	6.6	6.0	22.8	0.7	Depth	11.0	0.6	0.2	1.0	0.2
Width/Dep	11.0	12.9	10.4	32.5	0.7	Av. Depth	11.0	0.6	0.2	1.0	0.2
C.Sect.Area	11	20	15	58	6						
Channel dimensions at the Water's Surface											
Width	11.0	1.6	0.8	3.0	0.5	Depth	11.0	0.1	0.1	0.3	0.1
Width/Dep	11.0	14.3	8.8	29.7	1.7	Av. Depth	11.0	0.1	0.1	0.3	0.1
C.Sect.Area	11	0	0	0	0						

Flows m/s

****Rock Outcrops****

L/lower	R/lower	L/upper	R/upper	Bed	None
4	3	4	2	6	3

**** Substrates - particle diam. in mm ****

	num	mean	sem	cov(%)	max	min
Lower Banks	22	6.855	0.0606	100.0	316.228	0.010
Upper Banks	22	0.559	0.0629	100.0	316.228	0.010
Beds	110	23.269	0.0169	100.0	316.228	0.010

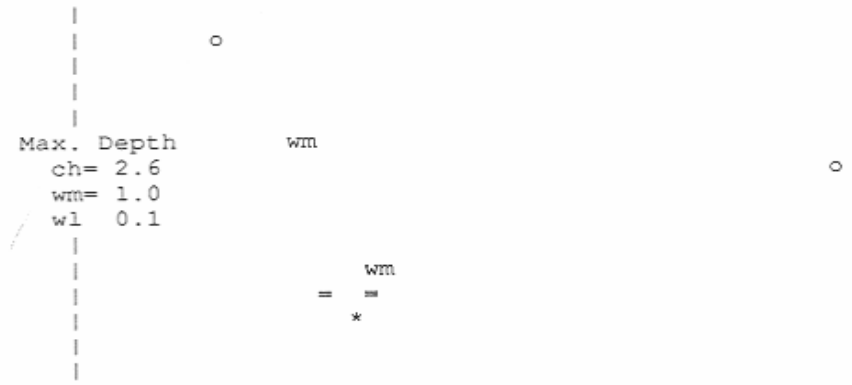
Organic Matter	num	mean	sem	max	min
Upper Bank	4.0	55.0	21.8	90.0	30.0
Lower Bank	2.0	92.5	2.5	95.0	90.0
Bed					

*****Ratings Summary*****

	num	mean	sem	max	min		num	mean	sem	max	min
wm depth	11.0	13.1	6.3	28.0	2.0	pool sed	9.0	406.0	426.1	999.0	2.0
wm width	11.0	8.5	5.7	23.0	2.0	flow sed	10.0	274.8	388.3	999.0	1.0

Deepest Cross-section @ wmark - Site--> 160 Section Type => Riffles

<---------- Channel Width = 6.5 ---------->
Width @ wm = 0.7


Max. Depth
ch= 2.6
wm= 1.0
wl 0.1
wm
wm

Channel Dimension Runs No. Sites 2 Last Site 75 Last Sect 104

	num	mean	sem	max	min		num	mean	sem	max	min
Tp Length	2.0	52.5	47.5	100.0	5.0	Tp Width	2.0	4.8	2.7	7.5	2.0
Tp Depth	2.0	1.0	0.6	1.6	0.4						
LoB Width	4.0	0.5	0.1	0.7	0.4	UpB Width	4.0	3.8	2.6	8.0	1.6
LoB Height	4.0	0.4	0.2	0.5	0.1	UpB Height	4.0	1.8	0.7	3.0	1.2
LoB Slope	4.0	53.8	17.1	70.0	30.0	UpB Slope	4.0	42.5	19.2	60.0	10.0
Channel dimensions											
Width	2.0	13.7	2.2	15.9	11.5	Depth	2.0	3.7	0.4	4.1	3.3
Width/Dep	2.0	3.7	0.2	3.9	3.5	Av. Depth	2.0	3.6	0.4	3.9	3.2
C.Sect.Area	2	26	4	30	22						
Channel dimensions at the Water Mark											
Width	2.0	6.1	2.2	8.3	3.9	Depth	2.0	1.5	0.5	2.0	1.1
Width/Dep	2.0	4.0	0.3	4.3	3.7	Av. Depth	2.0	1.4	0.5	1.8	0.9
C.Sect.Area	2	8	2	10	6						
Channel dimensions at the Water's Surface											
Width	2.0	5.1	2.5	7.5	2.6	Depth	2.0	1.2	0.5	1.7	0.6
Width/Dep	2.0	4.4	0.0	4.4	4.3	Av. Depth	2.0	1.0	0.6	1.6	0.4
C.Sect.Area	2	4	3	8	1						
Flows m/s											

****Rock Outcrops****

L/lower	R/lower	L/upper	R/upper	Bed	None
0	0	0	0	0	2

**** Substrates - particle diam. in mm ****

	num	mean	sem	cov(%)	max	min
Lower Banks	4	0.018	0.0027	41.3	0.100	0.010
Upper Banks	4	0.020	0.0029	41.4	0.100	0.010
Beds	20	0.141	0.0144	100.0	3.162	0.010

Organic Matter	num	mean	sem	max	min
Upper Bank	1.0	70.0	0.0	70.0	70.0
Lower Bank	2.0	45.0	5.0	50.0	40.0
Bed	5.0	74.0	19.6	90.0	50.0

*****Ratings Summary*****

	num	mean	sem	max	min		num	mean	sem	max	min
wm depth	2.0	17.0	3.0	20.0	14.0	pool sed					
wm width	2.0	6.5	1.5	8.0	5.0	flow sed					

Deepest Cross-section @ wmark - Site--> 60 Section Type => Runs

<---------- Channel Width = 11.5 ----------> Width @ wm = 8.3


Max. Depth
ch= 3.3
wm= 2.0
wl 1.7
wm
wm

Channel Dimension Cascades No. Sites 6 Last Site 163 Last Sect 74

	num	mean	sem	max	min		num	mean	sem	max	min
Tp Length	6.0	36.8	34.4	100.0	2.0	Tp Width	6.0	2.5	2.7	8.0	0.5
Tp Depth	6.0	0.1	0.1	0.3	0.1						
LoB Width	12.0	2.2	2.9	9.8	0.0	UpB Width	12.0	3.5	1.8	6.4	1.0
LoB Height	12.0	1.5	2.3	8.0	0.2	UpB Height	12.0	2.2	1.6	6.7	0.6
LoB Slope	12.0	28.2	33.1	95.0	3.0	UpB Slope	12.0	17.5	11.8	45.0	5.0
Channel dimensions											
Width	6.0	14.3	3.7	22.1	11.1	Depth	6.0	4.7	4.7	14.9	1.0
Width/Dep	6.0	5.7	3.3	11.1	0.8	Av. Depth	6.0	4.7	4.7	14.9	1.0
C.Sect.Area	6	66	70	215	9						
Channel dimensions at the Water Mark											
Width	6.0	7.2	3.8	13.1	1.2	Depth	6.0	1.7	2.3	6.7	0.4
Width/Dep	6.0	12.5	8.3	23.8	0.2	Av. Depth	6.0	1.7	2.3	6.7	0.4
C.Sect.Area	6	43	65	186	2						
Channel dimensions at the Water's Surface											
Width	6.0	2.8	3.2	9.6	0.5	Depth	6.0	0.1	0.0	0.2	0.1
Width/Dep	6.0	26.8	31.6	95.0	2.5	Av. Depth	6.0	0.1	0.0	0.2	0.1
C.Sect.Area	6	0	0	1	0						
Flows m/s											

****Rock Outcrops****

L/lower	R/lower	L/upper	R/upper	Bed	None
4	3	3	2	3	1

**** Substrates - particle diam. in mm ****

	num	mean	sem	cov(%)	max	min
Lower Banks	11	74.561	0.0154	7.8	316.228	0.010
Upper Banks	13	26.469	0.0338	100.0	316.228	0.010
Beds	60	237.980	0.0019	0.1	316.228	3.162

Organic Matter	num	mean	sem	max	min
Upper Bank	2.0	100.0	0.0	100.0	100.0
Lower Bank	2.0	17.5	2.5	20.0	15.0
Bed	8.0	5.0	0.0	5.0	5.0

*****Ratings Summary*****

	num	mean	sem	max	min		num	mean	sem	max	min
wm depth	6.0	20.2	21.1	67.0	8.0	pool sed	5.0	402.0	487.5	999.0	2.0
wm width	6.0	10.0	4.5	18.0	4.0	flow sed	6.0	642.0	453.4	999.0	5.0

Deepest Cross-section @ wmark - Site--> 85 Section Type => Cascades

<---------- Channel Width = 12.2 ---------->
Width @ wm = 1.2


Max. Depth
ch=14.9
wm= 6.7
wl 0.2
wm
wm

Channel Dimension Rapids No. Sites 1 Last Site 89 Last Sect 98

	num	mean	sem	max	min		num	mean	sem	max	min
Tp Length	1.0	15.0	0.0	15.0	15.0	Tp Width	1.0	20.0	0.0	20.0	20.0
Tp Depth	1.0	0.2	0.0	0.2	0.2						
LoB Width	2.0	6.5	6.0	12.5	0.5	UpB Width	2.0	5.5	1.6	7.0	3.9
LoB Height	2.0	3.8	3.2	7.0	0.5	UpB Height	2.0	1.5	0.0	1.5	1.5
LoB Slope	2.0	47.5	42.5	90.0	5.0	UpB Slope	2.0	15.0	0.0	15.0	15.0
Channel dimensions											
Width	1.0	25.9	0.0	25.9	25.9	Depth	1.0	8.7	0.0	8.7	8.7
Width/Dep	1.0	3.0	0.0	3.0	3.0	Av. Depth	1.0	8.7	0.0	8.7	8.7
C.Sect.Area											
	1	63		63	63						
Channel dimensions at the Water Mark											
Width	1.0	15.0	0.0	15.0	15.0	Depth	1.0	4.0	0.0	4.0	4.0
Width/Dep	1.0	3.8	0.0	3.8	3.8	Av. Depth	1.0	4.0	0.0	4.0	4.0
C.Sect.Area											
	1	32		32	32						
Channel dimensions at the Water's Surface											
Width	1.0	2.0	0.0	2.0	2.0	Depth	1.0	0.2	0.0	0.2	0.2
Width/Dep	1.0	10.0	0.0	10.0	10.0	Av. Depth	1.0	0.2	0.0	0.2	0.2
C.Sect.Area											
	1	0		0	0						
Flows m/s											

****Rock Outcrops****

L/lower	R/lower	L/upper	R/upper	Bed	None
1	1	1	1	1	0

**** Substrates - particle diam. in mm ****

	num	mean	sem	cov(%)	max	min
Lower Banks	2	298.538	0.0013	0.0	316.228	100.000
Upper Banks	1	316.228	0.0010	0.0	316.228	316.228
Beds	10	281.838	0.0014	0.0	316.228	100.000

Organic Matter	num	mean	sem	max	min
Upper Bank					
Lower Bank					
Bed					

*****Ratings Summary*****

	num	mean	sem	max	min		num	mean	sem	max	min
wm depth	1.0	40.0	0.0	40.0	40.0	pool sed	1.0	999.0	0.0	999.0	999.0
wm width	1.0	15.0	0.0	15.0	15.0	flow sed					

Deepest Cross-section @ wmark - Site--> 89 Section Type => Rapids

<---------- Channel Width = 25.9 ---------->
Width @ wm = 15.0