national centre for tropical wetland research

Australian Government
Land & Water Australia

Natural Heritage Trust
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An Australian Government Initiative

LWA/NHT Project DET18

Australia's tropical rivers – an integrated data assessment and analysis

Milestone Report 4

Progress report for sub-projects 1 (Inventory & mapping) and 2 (Assessment of the major pressures on aquatic ecosystems)

August 2005

Contents

Project summary

Sustainable management of Australia's tropical rivers and wetlands requires an integrated information base for assessment of their ecological character (including benchmarking their status) and the development of policy, especially for environmental flows and potential uses of water. This project is establishing an information base for assessing status and change of Land and Water Australia's tropical rivers study area, and, using the information base, is undertaking several case studies of ecological risk assessments of major pressures for various focus catchments.

The information base is being built on consultation, analysis of existing information, and, in the future, will include specific investigations to provide further data. It is anticipated that the final integrated information base will be used as a reference for assessing change to the river/wetland habitats and their species, and the ecosystem services they provide. As reference conditions for assessing change and environmental flows cannot be provided for all localities or species, it is expected that surrogates will be determined and responses to key pressures assessed through structured and quantitative frameworks and linked with the provision of ecosystem services. These analyses will extend analyses being done through other initiatives in tropical Australia.

Project details

Project Reference Number: DET18

Project Title: Australia's tropical rivers – an integrated data assessment and analysis.

Contracted Research Organisation: Environmental Research Institute of the Supervising Scientist (ERISS) on behalf of the National Centre for Tropical Wetland Research (NCTWR).

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Project duration: July 2004 – September 2006.

Milestone number: 4

Due date: 31 August 2005

Project objectives

The project will provide an information base for determining and applying management priorities and land use practices of relevance to stakeholders, including local and indigenous people, private sectors and governmental agents. Specific objectives are to:

1. undertake a multiple-scale inventory of the habitats and biota of the rivers and wetlands of tropical Australia, where necessary developing and/or ensuring consistency with other suitable typologies based on hydrological and landform features;
2. undertake risk assessments of the major pressures on the habitats and biota of the rivers and wetlands of selected focus catchments in tropical Australia; and
3. provide a framework for analysis of the ecosystem services (e.g. provision of water for multiple uses), provided by the habitats and biota of the rivers and wetlands of northern Australia.

These objectives each relate to one of the three sub-projects that make up the Tropical Rivers Project:

Sub-project 1 – Inventory of the biological, chemical and physical features of aquatic ecosystems;

Sub-project 2 – Assessment of the major pressures on aquatic ecosystems; and

Sub-project 3 – Development of a framework for the analysis of ecosystem services provided by aquatic ecosystems.

Milestone 4 and Achievement Criteria

This Report (Milestone Report 4) reports against the following milestones:

Sub-project 1 – Report on progress towards multiple-scale maps of aquatic ecosystems; typology of aquatic habitats; and a description and database of information on biological, chemical and physical features of aquatic habitats;

Sub-project 2 – Report on progress towards specific analyses of major pressures (eg. weeds, feral animals, infrastructure, water pollution) for selected major catchments; and

Sub-project 3 – Final report that includes a framework and initial database for analysing ecosystem services provided by the aquatic ecosystems.

Below we have summarised our progress to date for Sub-projects 1 and 2 as well the key consultation and communication activities since the project's commencement. Additionally, any administrative, human resource and technical issues are identified, and their consequences on the project and milestone schedules discussed. More detailed information for Sub-projects 1 and 2 is provided in Attachment 1. The final draft report for Sub-project 3 has been provided separately, and is not addressed as part of this report.

The Achievement Criterion for Milestone 4 is the receipt and acceptance of this report by Land &Water Australia.

Progress for Sub-project 1

Inventory of the biological, chemical and physical features of aquatic ecosystems

Description

The major purpose of this Sub-project is to undertake a multiple-scale inventory of the habitats and biota of the rivers, floodplains and estuaries within Land & Water Australia's program area for the Tropical Rivers funding program. The project will integrate information from the previous Land & Water Australia data collation project and additional published

sources to make an initial assessment of the diversity, status and ecological value of aquatic ecosystems across the region. This will be undertaken using the multiple-scale model for inventory supported by the Ramsar Wetlands Convention and being applied in the Alligators Rivers Region. The core data will cover information necessary for describing the biological, chemical and physical character of an aquatic ecosystem.

Status

A summary is provided in table 1 of progress against the key activities that occurred, and/or were scheduled to occur, between February and August 2005 (ie. 6 month period; see Attachment 2 of Milestone 2 Report for work plan details). Overall, progress on various activities and the overall Sub-project was delayed due to ongoing discussions regarding the final form of a geomorphic classification of rivers. This issue, which is now resolved, is discussed below, although not in great detail because LWA were aware of the issues and associated delays they caused.

Table 1 Summary of progress for key activities for Sub-project 1 (Inventory and mapping).

Activity	Progress/status
Data and metadata standards	The spatial data and structure continues to be regularly backed up onto DVD, with copies of the data maintained offsite as an added security measure. Metadata for databases / datasets is being progressively created / updated as required to ANZLIC-2 standard.
Compile existing GIS datasets at 2.5M, 250K and other scales	Data collation is increasingly focussing on datasets that could be used to support risk assessment activities within the focus catchments. Such datasets include the distribution of feral animals, rare and threatened species, ground water divisions, land use and land cover, and land tenure. Negotiation and liaison with the custodians of detailed and focus-catchment scale (1:100,000) data sets (principally state agencies) to access additional data is ongoing. The 3-second digital elevation model (DEM) of Australia was acquired, and a request has been submitted through DEH for the purchase from Defence of the 1-second DEM.
Identify and collate additional reach attributes	National (eg AUSRIVAS, OZCAM, BirdsAtlas) and State/Territory faunal and floral databases are being progressively accessed and data extracted to identify the distribution of specific species at catchment and focus catchment scale. Additionally, new spatial datasets are being created for hydrological, geomorphological and water quality attributes.
Develop geomorphic classification/typology	This activity dominated the reporting period for this Sub-project. Discussions were held with Dr Andrew Brooks (Griffith University) and LWA to align the TRIAP with Dr Brooks' project studying the geomorphology of the Gulf of Carpentaria Rivers. A mini-workshop was held in July to finalise the issue. Following this, an approach for the geomorphic classification component of the TRIAP was agreed upon and accepted by LWA.
Trial and apply skeletal typology	Given the dependency of this activity on the finalisation of the geomorphic classification, there was no progress. However, the project timeline was extended to reflect this delay (see *Variations to future Milestones*).
Estuary classification review	Data collection has included information on tidal character and non-tidal processes, cyclone paths and land crossing, climate change and variability projections and estuarine classification systems.
Field sampling	No field sampling was undertaken during the reporting period. Discussions will be held in late 2005 regarding targeted field sampling activities for 2006.
Ongoing consultation and awareness	See *Communications achievements*.

Progress for Sub-project 2

Assessment of the major pressures on aquatic ecosystems

Description

The objective of this Sub-project is to develop a risk assessment framework applicable to the key focus catchments and significant locations that meet stakeholder needs, within the region of the TRIAP. In developing the risk assessment framework, semi-quantitative and quantitative risk analysis will be undertaken where possible, for selected threats. The focus will be on three catchments: the Daly River (Northern Territory), Flinders River (Queensland) and Fitzroy River (Western Australia). In addition, there will be a broad overview of the major pressures on tropical Australia's aquatic ecosystems, based on data gathered during this Sub-project and Sub-project 1. Throughout this Sub-project stakeholders will provide input and feedback.

Status

Sub-project 2 commenced in April 2005 and a detailed work plan was submitted to Land & Water Australia in July 2005 (representing Milestone Report 3; see Attachment 2). A summary is provided in table 2 of progress against the key activities scheduled between the project's commencement and August 2005 (ie. 8 month period). Overall, progress to date has been hampered by the lack of availability of key staff members. However, as discussed below and in Attachment 1, this has been rectified and good progress from this point is expected.

Table 2 Summary of progress for key activities for Sub-project 2 (Assessment of pressures).

Activity	Progress/status
Draft risk assessment framework	A draft framework for the risk assessments has been drafted although not yet finalised and circulated. The risk assessment process is outlined in the detailed workplan (see Attachment 2) and will follow the approach recently used by ERISS for the Alligator Rivers Region
Select focus catchments	The following focus catchments were agreed upon: • Fitzroy River (WA) • Daly River (NT) • Flinders River (Qld) This list was refined from previous versions for logistical and resourcing reasons.
Identify key stakeholders	Key stakeholders have been identified for the Fitzroy River and Daly River. Many have been contacted. To date, less attention has been paid to the Flinders River, although ACTFR has a sound knowledge of stakeholders in the catchment. Work is ongoing on this activity.
Identify, acquire data for, and describe key assets & threats	Data acquisition has been occurring for several months, again, mostly for the Fitzroy and Daly Rivers. Key synthesis documents have been obtained for both catchments and the relevant information within these is currently being extracted and synthesised.
Compile new GIS layers/ datasets & maintain metadata	Where possible, spatial data for key assets and threats have been acquired or are currently being acquired through the relevant State, Territory or Commonwealth agencies. This activity is advanced for the Daly River and in ongoing discussions with CALM and WWF for the Fitzroy River. To date, little attention has been paid to the Flinders River.
Develop conceptual models	At the time of this Milestone Report, this activity was yet to commence. Given the upcoming increase in staff resources for this Sub-project, solid progress is expected over the next reporting period.

Variations to future milestones

Project delays due to ongoing technical discussions and human resource issues resulted in delays to both Sub-projects 1 and 2. However, ongoing discussions with LWA, particularly regarding Sub-project 1, resulted in an agreement to amend future milestone timelines. The current schedule as agreed by ***eriss*** and LWA is set out table 3. At this point in time no additional variations to future milestones are requested.

Table 3 Currently agreed schedule for Milestone reporting, from Milestone 3 onwards.

Milestone	Current due date
3. Detailed work plan for Sub-project 2	10 June 2005
4. (a) Progress report for Sub-projects 1 and 2	31 August 2005
(b) Final report for Sub-project 3	
Financial Report, 2004-05	30 September 2005
5. (a) Final report for Sub-project 1	31 March 2006
(b) Progress report for Sub-project 2	31 March 2006
6. (a) Final report for Sub-project 2	30 September 2006
Final financial report	31 October 2006

Human resource issues

The key human resource issues during the reporting period are summarised below:

- Dr Rick van Dam replaced Dr Max Finlayson as Principal Investigator of the project, following Dr Finlayson's departure from ***eriss*** to the International Water Management Institute (IWMI). Given Dr Finlayson's heavy involvement in the development and early management of the project, we have secured his services to continue in a technical advisory role, through a sub-contract to IWMI.
- We have secured the services of Maria Bellio to complete the birds component of Sub-project 1, which she commenced before departing ***eriss*** for Sri Lanka. A plan to complete the task has been developed, although a sub-contract, probably through IWMI, still needs to be drafted. Maria will be in Darwin in September, when further discussions will be held.
- Tida Nou, the theme leader for the frog component of Sub-project 1, left ***eriss*** at the end of May. The collation of the remainder of the frog inventory data is currently being undertaken using existing staffing resources within ***eriss***.
- Since the commencement of Sub-project 2 (April 2005), there has been a general lack of availability of staff to allocate time to the activities, although some progress has been made (see summary above and Attachment 1). To overcome this, it is likely that ***eriss*** will appoint a half-time position for a scientist to manage and undertake the sub-project, with assistance from other relevant staff where necessary. In addition, ***eriss*** has secured the services of a DEH graduate placement for three months from September to November to assist with Sub-project 2. These measures should see solid progress on this Sub-project in the next reporting period.

Communications achievements

Communication and consultation activities have continued to take place since the last reporting period. To date, over 170 stakeholder consultations have taken place, with efforts concentrated on building linkages for sub-project 2. A significant stakeholder communication activity was the visit of the LWA Board to Darwin in May. Board members were briefed on the project and given a demonstration of the GIS under development. An informal mini-workshop was held in Darwin on July 12 to discuss approaches for geomorphic classification of Australia's northern rivers. This workshop included stakeholders from James Cook University, Northern Territory Government, academics from various institutions and a Western Australia representative.

Following the first edition of the project newsletter a second edition was distributed to all stakeholders in July (Attachment 4). Distribution of the newsletter to stakeholders is an important tool to identify stakeholders who have not been engaged previously. In July, the project was re-badged as the *Tropical Rivers Inventory and Assessment Project* (TRIAP), in order to resolve confusion with the broader LWA's program called the *Tropical Rivers Program*. In conjunction with this re-badging, a logo has been developed for use in newsletters, presentations and posters.

Communication activities in the last quarter have focused on raising awareness of the TRIAP amongst relevant groups. In July, an exhibition booth featuring the TRIAP was at the North Australian Remote Sensing and GIS Conference (NARGIS). This enabled the project to be presented to representatives of the major stakeholders across north Australia. The project was also featured in the RipRap edition on tropical rivers. Conference papers reporting on the project have been, or will soon be, presented at national conferences including RiverSymposium and the Spatial Sciences Conferences. Further details of communication activities are presented in Attachment 3.

Summary

Sub-project 1, *Inventory of the biological, chemical and physical features of aquatic ecosystems*, continued during the reporting period, with a large amount of existing data for catchment/river biophysical attributes being updated and in some cases finalised. The most significant activity was the ongoing discussion about the geomorphic classification, which led to the overall delay of certain aspects of the project by about 2-3 months. The geomorphic classification will provide the basis of the ecological typology, and now it is finalised, the typology can be progressed. Another significant outcome during the reporting period was the finalisation of the approach to mapping the drainage base, with the mapping for the focus catchments utilising a combination of the 1:250,000 topographic data and the 3-second DEM.

Sub-project 2, *Assessment of the major pressures on aquatic ecosystems*, commenced during the reporting period. Whilst reasonable progress has been made, human resource constraints prevented the project from continuing on-track. However, this issue will soon be rectified, and substantial activity and strong progress is expected over the next reporting period.

Sub-project 3, *Development of a framework for the analysis of ecosystem services provided by aquatic ecosystems*, has been completed. Dr Dolf de Groot and the six Masters students from the University of Wageninen have prepared a comprehensive synthesis report from the six student theses. This report, which at present is in semi-final draft stage, was submitted to LWA on 9 September.

Communications activities continued during the reporting period according to the communications strategy. Key activities during the period included the visit by and presentation to the LWA Board, the mini-workshop on geomorphic classification, and the presentation and promotion of the TRIAP and various scientific fora. Stakeholder consultation focused on the risk assessment activities for the Daly and Fitzroy Rivers. Consultations and formal communications activities (eg. project newsletter, conference attendance, web page updates) will continue to occur and be recorded.

Listing of Attachments

Attachment 1	*Detailed progress report for Sub-projects 1 and 2*.
Attachment 2	*Detailed work plan for Sub-project 2*.
Attachment 3	*Detailed progress report for communication and consultation*
Attachment 4	*Tropical Rivers Project Newsletter July 2005*

Attachment 1 Detailed progress report for Sub-projects 1 & 2

Detailed Progress Report for Sub-project 1

Inventory of the biological, chemical and physical features of aquatic ecosystems

Project description and objectives

The major purpose of this project is to undertake a multiple-scale inventory of the habitats and biota of the rivers, floodplains and estuaries of northern Australia within Land & Water Australia's (LWA) geographic scope for the Tropical Rivers funding program. The project will integrate information from the previous data collation project and additional published sources to make an initial assessment of the diversity, status and ecological value of aquatic ecosystems across the region. This will be undertaken using the multiple-scale model for inventory supported by the Ramsar Wetlands Convention and being applied in the Alligators Rivers Region. The core data will cover information necessary for describing the biological, chemical and physical character of an aquatic ecosystem.

The inventory data will be used to illustrate known areas of biodiversity importance and gaps in information. The data will be linked to a river/wetland typology, which will provide a framework for predicting the possible occurrence of specific biota and habitats within previously unsurveyed areas. The inventory will provide information for policy and management implementation at multiple-scales (eg. regional, catchment, or individual habitat). This will be possible through the use of GIS data layers and presentation of information at appropriate scales.

Data collection/collation

During the reporting period, the scope of the data collection task was more clearly defined, such that all theme leaders had clear guidance on the extent and type of data to search for and the details of accompanying descriptive/interpretive text.

Extent of data acquisition

The extent of data acquisition needs to be considered within the context of adopting the hierarchical approach to inventory and mapping, hence addressing scale and data issues concomitantly (eg. coarser data at coarser scales, more detailed data at finer scales). Based on this, the following approach is being adopted.

- *Across the whole study area* - utilise all available national datasets (eg. AUSRIVAS, OZCAM, Birds Atlas, AUSLIG 1:250K topographical data, etc.) as well as State/Territory datasets that cover all or a significant portion of the State/Territory (eg. NT Parks & Wildlife datasets).
- *For the focus catchments* - utilise the above datasets, but also all other relevant spatial datasets that exist for that catchment (eg. floodplain vegetation, wetlands, specific fauna surveys, etc.). It may be, that for some attributes, additional focus catchment level data do not exist. Such data gaps will be identified in the text.

There may also be a need to acquire key non-spatial datasets, at least in the form of the publications that describe them. This effort will be targeted towards key studies and reviews

that describe broad features of the attributes (eg. species distributions, habitat requirements, etc.). Highly specific papers/reports focusing on particular species (or physical processes) in geographically small areas (eg. a billabong or dam or creek channel) are less critical, unless it is the only place the species is known to occur or the location is within a focus catchment.

Details of narrative to accompany data

There are three key components to the data narrative:

- *Approach to the data acquisition* – What was the methodology? What criteria or rules were applied for selecting data, and why? What datasets were accessed?
- *General description of the data* – description of the number and types of species, and which are listed as threatened, vulnerable, endangered, or protected under relevant Treaties/Conventions; broad patterns of species distribution, including species that have restricted ranges or are listed; comparison of species information with key texts/reports – ie. do the spatial data concur with existing descriptions; data gaps – our ability to characterise the biophysical status of the northern rivers?
- *Evaluation of datasets against the geomorphic classification* – This component equates to the 'typology' that will be developed. The geomorphic river reach classification will be used as the basic planning unit for the other biophysical attributes. The key aim is to overlay the biophysical attribute data on the geomorphic classification, and look for and describe relationships/patterns (eg. do certain types/groups of species consistently occur in particular river reaches?) Groupings could relate to any number of relevant biophysical characteristics (eg. for birds – feeding guilds or migratory zones; fish – feeding guilds or salinity tolerance). Ultimately, it is the decision of each theme leader to decide how they are going to represent their attribute (ie. expert opinion will be important). This component is mostly an hypothesis-generating exercise, not a definitive description of where and why species/species groupings occur, and it needs to acknowledge the level of confidence in the data.

Progress on the data collection and mapping of the selected biophysical attributes of the northern rivers is detailed below. It is evident that progress has varied across the attributes, which is a reflection of the existing project commitments to date of the various team members leading the data collation exercise.

Geomorphology

Most project activity during the reporting period was focused on agreeing on a geomorphic classification scheme for the northern rivers. The Geomorphology section of the Milestone 2 Report (www.nctwr.org.au/publications/tropical-rivers-reports.html) provides useful contextual information on this issue. In addition to agreeing internally on a classification, there were several teleconferences and much e-mail correspondence with Dr Andrew Brooks from Griffith University, who is undertaking a project to develop a geomorphic classification of the Gulf of Carpentaria rivers. These discussions culminated in a mini-workshop in Darwin on 12 July, which brought together the relevant technical experts and sought to resolve the issue. The attendees and aims of the mini-workshop are detailed in Attachment 3 (Detailed communications and consultation progress report).

Based on the mini-workshop discussions, and also considering project-related resourcing and timeline issues, a framework for two geomorphic classifications schemes (one to be applied at the continental scale, one at the focus catchment scale) was agreed to and subsequently

supported by LWA. Importantly, the classes applied at the focal catchment scale are subcomponents of the broader classes developed for the whole of the project area. The two classifications thus fit within the overall hierarchical framework of the project. Table 1 lists the geomorphic classes that have been developed for the broad and focus catchment scales. In general, they are modifications of the classifications of Erskine et al (2005) and Brennan & Gardiner (2004), which were described in the Milestone 2 report. Importantly, the focus catchment scheme is, at this stage, consistent with the 3rd Order classification proposed to be applied at a similar scale by Dr Brooks (see summary of Brooks' project in RipRap, Ed. 28, June 2005; www.rivers.gov.au/publicat/riprap/riprap28.htm). Thus, we have committed to work with Dr Brooks to ensure that our parameters/criteria for defining each geomorphic class are the same or as similar as possible. In this way, we feel that the geomorphic component of our project is sufficiently aligned with Dr Brooks' project and we are still able to maintain our current scope and timeline.

The classifications described in table 1 will be applied to their respective broad scale and focus catchment datasets through the integration, querying and analysis of the geomorphic, geological, landform landsystem, vegetation and elevation datasets, which have been previously collated at the different relevant spatial scales within a GIS environment. This task is further elaborated upon below in the section *GIS and mapping*.

Table 1 Broad scale and focus catchment geomorphic classes.

Broad scale classification	Focus-catchment scale classification
Bedrock channel	Bedrock channel
Bedrock confined	Bedrock-confined
Alluvial	Low sinuosity rivers
	Meandering rivers
	Floodouts
	Multiple channel rivers
	Wandering channel rivers
Lake / swamp	Non-channelised
	Swamp / waterbody dominated zone
Estuarine	Tidal

Water quality

We used the software program that we developed (described in Milestone 2 Report) to analyse Queensland state HYDSYS data available for rivers in the Mitchell, Gilbert, Staaten and Norman catchments. The raw data were provided in spreadsheet format comprising >10,000 rows of data in 65 columns of data. The software program reformatted and merged these to create a consolidated sheet containing 4,190 rows of data.

These data were then censored by removing values that were unequivocally erroneous, although the number of cases that failed validation tests was too high for it to be feasible to remove all potentially suspect data. For example, in more than 55% of cases where both TSS and turbidity data were available, the TSS result deviated from the values predicted from turbidity by more than 50%. That suggests that at least one of the two parameters was suspect but there was no means of telling which, and therefore no justification for deletion. Accordingly, most of the data provide only qualitative or semi-quantitative indications of

water clarity. Thus, they could not be used for detecting trends but they could still be potentially useful for developing conceptual models that provide an indication of the processes that drive water quality, provided that sampling replication was adequate to encompass key variations in environmental factors such as flow, hydrographic state and season. Unfortunately, there were very few instances where this proviso was met. Although there are 4,190 rows in the existing database, they represent discrete samples collected over 42 years from 101 sites in 53 streams, yielding very low levels of replication for most sites. However, sampling frequency is far from evenly distributed through the dataset. In general, there were very few places where sampling replication was adequate to even begin to describe spatio-temporal variability and only a few instances where more intensive monitoring has been conducted at selected sites for periods ranging from a few weeks to a few years.

Under conditions of low flow, ambient water quality is driven by instream biophysical factors such as bathymetry, instream biomass, riparian condition and substrate type, each of which are too parochial and variable to be readily predicted. None of the available data are supported by information indicative of these key drivers so it is impossible to interpret the meaning of the water quality data recorded during the periods of low flow that are so typical of the monsoonal dry season. Thus, the data do not provide a basis for predicting the ambient water quality expectations for any other stream for which no data are available. It would be inadvisable to pose conceptual models for these streams.

Even though there are thousands of turbidity data points, there is no basis for predicting water clarity patterns as there are no sites for which there are sufficient data to understand any of the underlying causative agents and therefore no basis for predicting turbidity regimes in other streams. There are only a few individual sites for which one could guess whether the stream was chronically, episodically, periodically or seasonally turbid.

Fortunately, the factors which drive the dynamics of water quality during major flow events are more predictable, so useful insights can be gleaned from water quality data collected at such times, as long as it is accompanied by flow data or an acceptable surrogate such as stream level. Within the existing datasheet, there are four instances where data of this kind are available. Preliminary analysis of these cases indicates strong parallels between these rivers, which are flowing north and west of the Great Divide, and many of the streams flowing to the east coast (outside the study area) that we are more familiar with and for which there is much greater data availability.

Preliminary indications are that data for the remaining Queensland sections of the study area will be no better than what we have obtained to date and that the data available for the rest of the study area will be very limited, with none available at all for many catchments. It would be productive to search the other databases to see if they contain intensive case studies that can be used to aid conceptualisation, but it is doubtful that this project has the time or resources to pursue this line too far. It would also be worthwhile accessing some of the data that are not available in publicly held datasets. For example, JCU has a reasonably extensive database for the Lawn Hill section of the Gregory River and from other commercial clients.

Accordingly, it may prove more productive to apply professional judgement than hard data (ie. a hypothesis for testing) and to this end we are currently attempting to determine if there is sufficient physiographic information available (eg. topography, rainfall regime, etc.) to be able to identify stream types that would reasonably be expected to parallel the types of streams that have been better studied. That is, we would examine physiographic data to see if there is enough background information to make educated guesses about what rivers match with the conceptual models already generated.

Hydrology

Introduction

The primary aim of this component of the project is to establish hydrological characteristics for streams within the tropical rivers region. It has been shown in other studies that some streamflow characteristics such as mean annual runoff and, in particular, inter-annual variation, are important variables as they can be linked to stream biota.

A previous Milestone report presented flow characteristics (mean annual flow and coefficient of variation) determined for long-term stations within two of the focus catchments – Fitzroy River and Flinders River. In this report, streamflow data and flow characteristics for stations within the Daly river catchment are presented.

Daly River catchment data

Gauging stations within the Daly River catchment are operated and maintained by the Department of Infrastructure, Planning and Environment (DIPE) and data collected at these stations are stored within a Hydstra database. According to the DIPE database, there are 70 gauging stations that have been operated or are still currently operating within the Daly river catchment. Stage data (stream level in metres) have been collected at all of these stations. Of these 70 stations, 31 have an associated rating curve to convert stage data to discharge data. In other words, streamflow data are available at less than half of the stations within the catchment. The streamflow data collected at these 31 stations were copied from the DIPE database and added to the ***eriss*** database for analysis.

Streamflow characteristics are generally only derived for long-term stations. Table 1 shows that there are 23 and 15 stations (of the 31 stations) with a period of record at least 20 y and 30 y respectively. However, as mentioned in the previous Milestone report, many stations throughout the tropical rivers region have significant periods of missing data. Only complete years of data can be used to determine the mean annual runoff and coefficient of variation at a station. Within the Daly river catchment, all but one (G8140151) of the 31 stations had years with missing data.

Missing data

A number of stations had years where relatively minor gaps in the runoff record occurred during low flow periods. It is likely that runoff data were not recorded during these minor gaps because (1) flow had dropped below instrument height, or (2) the equipment was removed for maintenance for a period during the Dry season. Where these gaps occurred, runoff was infilled by either (1) interpolating the runoff across the gap, or (2) assuming a discharge value of zero at the midpoint of the gap. (These adjustments were not made within the original database at DIPE.) As a result, these years where minor gaps were infilled were considered reliable for statistical analysis of the annual series. However, in general, most of the gaps in the runoff record either occurred over significant time periods or during periods of high flow. Annual hydrographs that included these major gaps were not used for analysis.

Table 2 shows that there are 13 stations (of the 31 stations) with at least 20 y of complete annual runoff data and only 6 stations with at least 30 y of complete annual runoff data.

Table 2 Long-term gauging stations in the Daly river catchment

	No. of gauging stations	
	Period of record	**Complete data**
> 20 y	23	13
> 30 y	15	6

Data quality

The accuracy of the runoff data is influenced by the quality of the rating curve fitted for the station. The reliability of the curve is not only dependent on the number of gaugings taken at the site, but also the range of flows at which gaugings were conducted. For example, more than 200 gaugings have been conducted at some of the long-term stations within the Daly river catchment over almost the entire range of flows (ie. G8140001, G8140040 and G8140063). It is considered that at these stations, runoff data is relatively accurate for most flow conditions. However, at stations such as G8140044 and G8140151, only relatively few gaugings have been conducted at these sites at only relatively low flows. At these stations, the accuracy of the runoff data, particularly at high flows, is expected to be low. The flow statistics derived for these stations may have significant errors. It is considered that perhaps only stations with accurate long-term data should be used to determine flow characteristics for a catchment. (However, in this report, all of the long-term stations, irrespective of data quality, were used to determine mean annual runoff and inter-annual variability.)

Streamflow characteristics

Figure 1 shows the mean annual runoff and the coefficient of variation at stations within the Daly river catchment with at least 20 y of complete annual data. There are three stations with data clearly different to that collected at the other stations (figure 1). Stations G8140151, G8140011 and G8140068 have a mean annual runoff well below 50 mm with a high inter-annual variability. The other stations all have a mean annual runoff greater than 150 mm with a relatively low inter-annual variability.

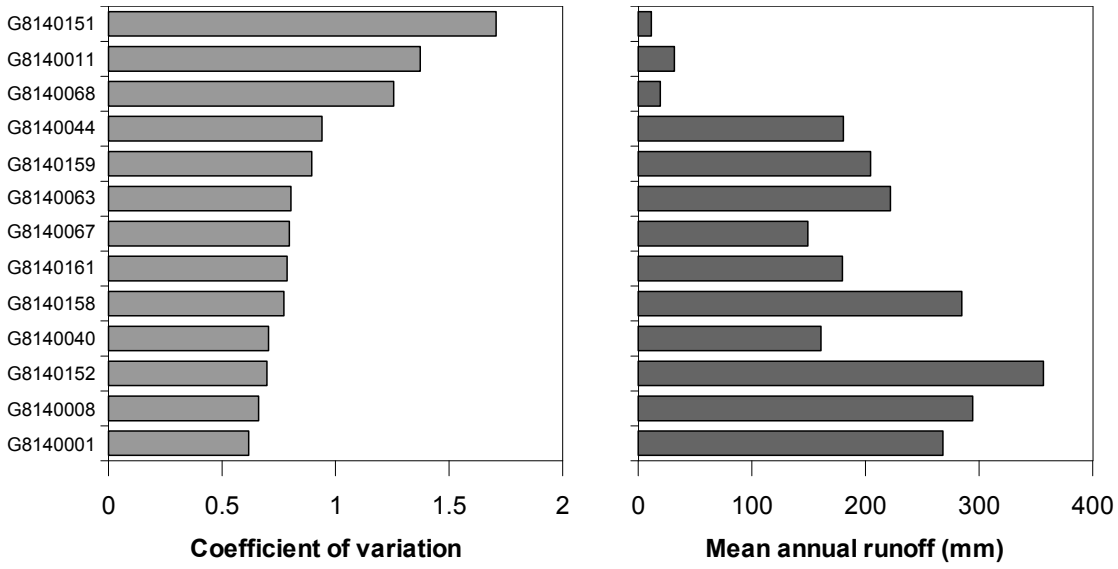

Figure 1 Inter-annual variability of runoff (Left) and mean annual runoff (Right) of the streams within the Daly river catchment area.

It is interesting to note that the catchment areas upstream of these three stations (G8140011, G8140068 and G8140151) are in the southern part of the Daly river catchment area (figure 2) which suggests that these flow characteristics could reflect the rainfall conditions for the region. For example, mean annual rainfall in the south-eastern part of the Daly river catchment is approximately 700 mm compared to 1200 mm in the northern part.

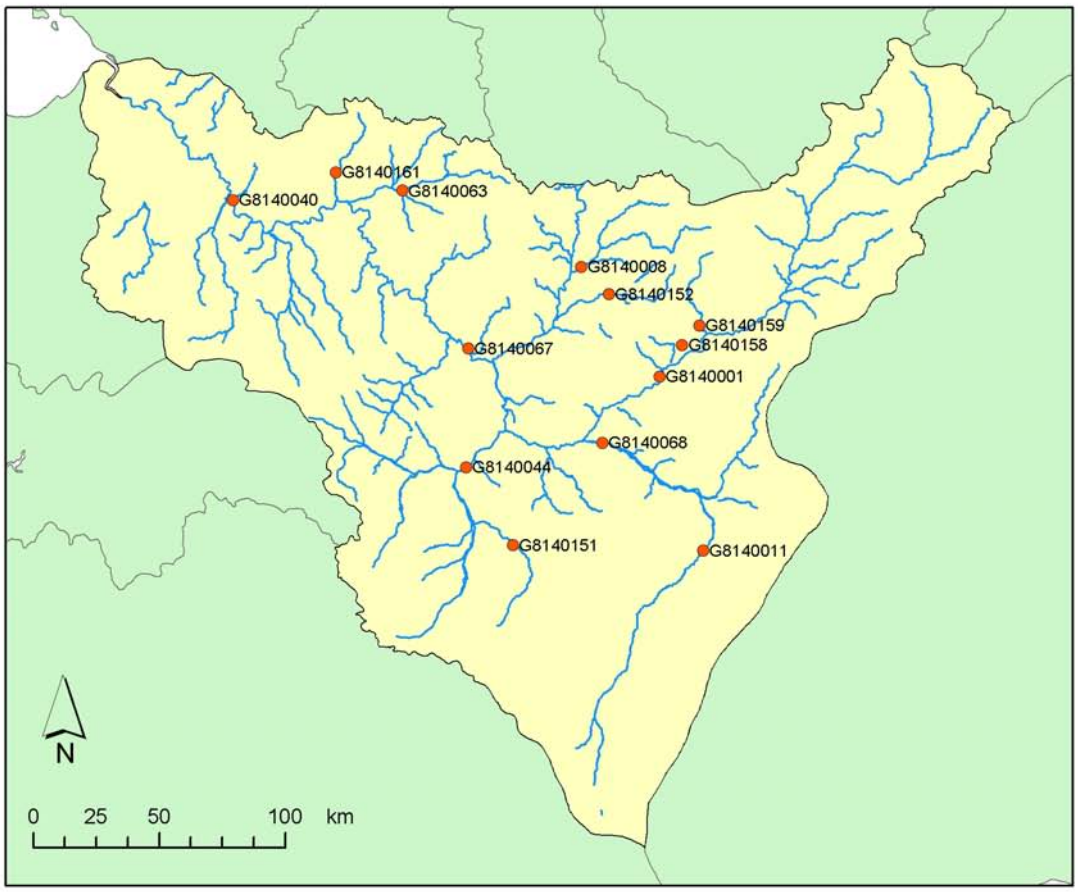

Figure 2 Location of gauging stations within the Daly river catchment with at least 20 y of complete annual flow data.

Study area

To determine the flow characteristics for the entire tropical rivers region, it is important that the type of data analysis undertaken for stations within the Daly river catchment is also conducted for the project area. In other words, it is necessary to determine which stations within the project area have at least 20 y of complete annual flow data. As discussed in the previous Milestone report, more than 600 stations have operated or are still currently operating in the entire tropical rivers region. Of these, 241 stations have a period of record greater than or equal to 20 y (figure 3). It is understood that stage data have been collected at all of these stations but it is not yet known how many of these stations have an associated rating curve to convert stage data to discharge data. Using station data from the Daly river catchment as a rough guide, almost half of the 241 stations may not have an associated rating curve and a further half of these stations may have significant periods of missing data. It is estimated that there could be less than 100 stations (of the original 600 plus stations) across the entire project area with 20 y of complete streamflow data.

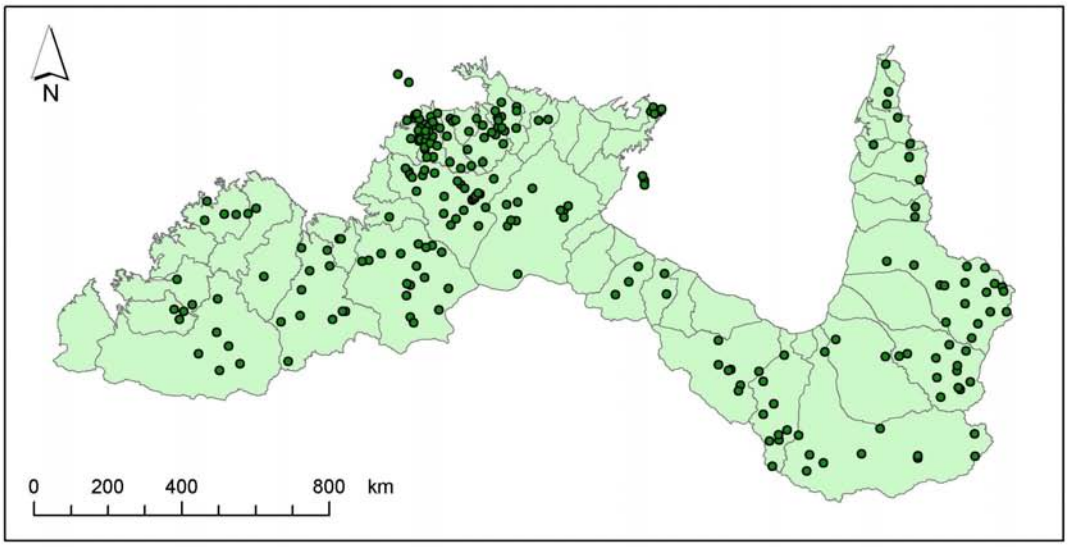

Figure 3 Location of gauging stations throughout the project area with a period of record at least 20 y.

Summary

Flow characteristics of mean annual runoff and inter-annual variability have been determined for the long-term stations within the three focus catchments. Runoff data for stations within the Daly river catchment have been copied from the DIPE database and added to the ***eriss*** database, which has provided an opportunity to analyse the data in some detail (such as infill minor gaps in data and make preliminary assessments on the actual quality of the data). Such analysis has not yet been conducted on the runoff data collected at stations within the Fitzroy and Flinders catchments. Flow statistics were established from monthly volume data available on the DNRM and DoE (WA) websites. It is recommended that runoff data is obtained from the above agencies for stations within the Fitzroy and Flinders River catchments for data assessment and analysis similar to that done for the Daly River catchment.

Further analysis of the long-term gauging stations within the three focus catchments could include the derivation of other important flow characteristics (identified by other studies) such as the analysis of flood frequency and low flow periods.

Vegetation

Following the identification of obligate riparian plant species[1] that occur in the Tropical Rivers study area, as reported in Milestone Report February 2005, 24 species (table 3) were selected as prime indicators of riparian distribution. Distributional data were sought and obtained from the following ten sources:

1. Australian Centre for Tropical Freshwater Research (ACTFR)
2. Australian National Botanic Garden Herbarium (CANB)
3. CSIRO Herbarium, Atherton (QRS)
4. National Herbarium of New South Wales (NSW)
5. National Herbarium of Victoria (MEL)
6. Northern Territory Herbarium (DNA)
7. Queensland Herbarium (BRI)
8. South Australian Herbarium (AD)

9. Tropical Biology Herbarium, James Cook University (JCT)
10. Western Australian Herbarium (PERTH)

Almost 5,800 herbarium accessions were processed, analysed and distribution maps were jointly prepared by John Dowe and Mirjam Alewijnse at ACTFR. Data were received in various forms, and most had to be converted to uniform entries before mapping. Data were converted to degrees and decimalised minutes. Some data were received without precise geographical location, and an estimate of location was made from the available information. It is anticipated that the plant distribution maps will be overlaid with climate, soil and geology maps, when they become available, to ascertain relations between the distribution of plants species and environmental factors.

Table 3 Obligate riparian plant species[1] that were mapped from herbarium accession data

Aeschynomone indica	*Livistona rigida*
Asteromyrtus symphyocarpa	*Lophostemon grandiflorus*
Callistemon viminalis	*Melaleuca argentea*
Calycopeplus casuarinoides	*Melaleuca bracteata*
Casuarina cunninghamiana	*Melaleuca fluviatilis*
Cathormion umbellatum	*Melaleuca leucadendra*
Chrysopogon oblongatus	*Melaleuca stenostachya*
Corymbia bella	*Melaleuca trichostachya*
Cyperus difformis	*Persicaria attenuata*
Eucalyptus camalduelnsis	*Sesbania cannabina*
Flueggea virosa	*Sesbania erubescens*
Goodenia strangfordii	*Vitex acuminata*

[1]***obligate riparian plant species***: plants that occur exclusively in the riparian zones associated with creeks, rivers, lakes or lagoons.

Invertebrates

In TRP Milestone 2 report, consultations and a framework for employing aquatic macroinvertebrates in a multi-scalar, inventory and assessment tropical rivers study were presented. The framework considered (i) broad-scale, rapid assessment using AUSRIVAS, and (ii) assessments at specific sites and/or for conservation & biodiversity importance. The rationale for this dual approach was provided in the TRIAP Milestone 2 report.

For (i), broad-scale, rapid assessment, family-level data were to be acquired from State and Territory agencies through ERIN. One application of these AUSRIVAS data was to seek a (multivariate) classification across the tropical rivers region that could potentially lead to improved precision and resolution of AUSRIVAS models. (Currently models have been developed for separate states and territory.) For (ii), assessments at specific sites and/or for conservation & biodiversity importance, species-level data were to be acquired from the several wet-dry tropical streams for which such information is available, while other taxonomic information was to be acquired from specialists and national databases.

Progress for both components (i) and (ii) is not as advanced as would be hoped. Three issues have impeded progress:

1. Staff availability: Two key ***eriss*** staff members were largely unavailable to contribute to the project in the past 6 months.
2. It was found that the ERIN AUSRIVAS database was incomplete in some areas, including recent years of data.
3. It was noted that similar, and potentially complementary, work was being conducted by other workers in the north.

These issues are currently being resolved. Regarding staff availability, time has now been allocated to the work programs of two key ***eriss*** staff members. Regarding data deficiencies in the ERIN AUSRIVAS database, ***eriss*** has contacted (Qld) or will contact (NT, WA) state/territory agencies directly to acquire missing data.

In relation to the third item above (ie. similar, and potentially complementary, work being conducted by other workers in the north), we have been made aware of similar inventory and assessment studies being conducted for the Kimberley region by or through Tanya Vernes, Kimberley Wetlands Project Officer for WWF Australia. To avoid duplication of effort for northern WA, we are coordinating with Tanya Vernes a common approach to data collection for both AUSRIVAS and from other national repositories of invertebrate data.

Similar data inventory and assessment projects are also being conducted in the (mainly) Wet tropics. One such project being coordinated by Niall Connolly of the Australian Centre for Tropical Freshwater Research (James Cook University), aims to develop a species level interactive atlas of macroinvertebrates in the Wet Tropics that is proposed to be expanded into other bioregions. We have approached Niall Connolly with a recommendation that we value add to the current project and use his template to populate with information acquired for the Wet-Dry tropics. Key taxa that would be incorporated in such an atlas are Ephemeroptera, Trichoptera, Odonata, Diptera: Chironomidae, Crustacea: Decapoda and Mollusca.

Fish

Compilation of Distributional Data on Freshwater Fish

We have continued to acquire literature on the distribution of freshwater fish across the study area to add to our already substantial collection. We have begun extracting the relevant data from these reports for inclusion in our database and onto GIS platforms. In conjunction with colleagues from Griffith University, ACTFR are contributing to the development of an atlas of freshwater fish across northern Australia. Currently this is being trialled in the Wet Tropics via other funding and includes an interactive GIS portal as well as a database. Users can click on to a location and it will, from the linked database, bring up the data known from that location. Site information will be provided and users can request information on particular species or particular geographic areas. We are now working toward incorporating the data collected as part of this Tropical Rivers program into a similar database format so that it will be compatible to that GIS atlas format. It is our intention to finish the database for this project. The development of the interactive atlas will have to come from additional funds (see below).

Further Development of Freshwater Fish Research in Northern Australia

We have been successful in obtaining NHT funding for a project "A Comprehensive Analysis of Freshwater Fish and Their Key Management Issues Across Northern Australia". This three-year project aims to undertake extensive field survey from Cape York to Kimberley to fill in the distributional survey gaps identified through this project of the Tropical Rivers program. It is thus a significant addendum to this project. The understanding of the tropical

rivers freshwater fish fauna and the distribution of where field surveys has previously occurred, generated much of our ability to successfully argue for this further funding. The two projects complement each other as the Tropical Rivers project covers the gathering of all existing survey effort and distributional knowledge and the NHT project funds the filling of the gaps identified in the Tropical Rivers project. The new NHT project is being led by NCTWR member – ACTFR, with co-proponent being Dr Brad Pusey from Griffith University and with ERISS also as project partners. Dr Pusey is the fish biodiversity member of the Northern Rivers Consortium, a group funded through the LWA Tropical Rivers mini-call last year to recommend research and development directions for the LWA Tropical Rivers program. Thus, our new collaboration now brings these aspects of these two programs together.

Amphibians

Due to the departure from ***eriss*** of the theme leader (Tida Nou), little additional progress has been made for amphibians. However, a replacement theme leader has now been chosen and the acquisition of all remaining available data will occur within the next reporting period. To date, all available data from OZCAM and the Parks and Wildlife Commission of the Northern Territory database have been extracted and entered into GIS format. Enquiries are ongoing regarding data from Queensland, through the Queensland Parks and Wildlife Service's WildNet database.

Reptiles

A total of 13,098 records of reptiles are now in the Tropical Rivers Project database. These comprise a total of 1,750 records extracted from the OZCAM database updated at the end of June 2005, which compares to 1,613 records from the previous extraction in January 2005 and 11,352 records from the Parks and Wildlife Commission of the Northern Territory database from which information was received on 16th June 2005. These data cover 28 catchments in the NT. Of these, 9,330 records were from crocodile surveys.

A breakdown of the number of records and number of species for each catchment is shown in Table 4. Table 5 is a species breakdown of the three focus catchments (Fitzroy, Daly and Flinders).

Data are still very deficient in many of the catchments, a good example being the Flinders, one of the three focus catchments, for which there are four records covering two species; these being one record of the goanna *Varanus mertensi* and three records of the Freshwater snake *Tropidonophis mairii.* One catchment (Morning Inlet) contains no records at all while nineteen catchments have twenty records or less. Thirty four catchments or sixty seven percent have fifty records or less spread across a maximum of thirty species. To date most records (12,648) have been found in the Northern Territory catchments, while only approximately 200 records are from the Western Australian catchments and 250 records from the Queensland catchments. Efforts to date have failed find any other data from Western Australian and Queensland catchments, although enquiries are still being made. For example, Queensland Parks and Wildlife Service maintains the WildNet database.

All data points have been entered into GIS format, which will be overlain onto the geomorphic mapping (when completed). However, the lack of information at present will make any meaningful analysis very difficult.

Table 4 Summary of reptile records for each catchment.

Catchment	Total Records	No of Species	Catchment	Total Records	No of Species
Cape Levique Coast (OZ)	9	3	Buchingham (OZ)	9	6
Fitzroy (OZ)	40	10	Buchingham (DI)	659	11
Lennard (OZ)	7	4	Koolatong (OZ)	1	1
Isdell (OZ)	58	7	Koolatong (DI)	39	6
Prince Regent (OZ)	13	6	Walker (OZ)	8	3
King Edward (OZ)	47	13	Walker (DI)	11	4
Drysdale (OZ)	15	10	Roper (OZ)	46	15
Pentecost (OZ)	5	2	Roper (DI)	435	16
Ord (OZ)	81	9	Towns (OZ)	0	0
Ord (DI)	15	6	Towns (DI)	1	1
Keep (OZ)	9	3	Limmen Bight (OZ)	3	3
Keep (DI)	17	7	Limmen Bight (DI)	23	8
Victoria (OZ)	112	10	Rosie (OZ)	0	0
Victoria (DI)	453	9	Rosie (DI)	2	1
Daly (OZ)	194	18	McArthur (OZ)	21	10
Daly (DI)	729	19	McArthur (DI)	46	12
Fitzmaurice (OZ)	8	4	Robinson (OZ)	0	0
Fitzmaurice (DI)	36	7	Robinson (DI)	5	5
Moyle (OZ)	4	2	Calvert (OZ)	7	2
Moyle (DI)	112	5	Calvert (DI)	11	6
Finnis (OZ)	316	17	Settlement Ck (OZ)	17	5
Finnis (DI)	2698	19	Settlement Ck (DI)	18	6
Adelaide (OZ)	168	15	Nicholson (OZ)	78	13
Adelaide (DI)	2677	17	Nicholson (DI)	5	2
Mary (OZ)	21	10	Leichhardt (OZ)	26	5
Mary (DI)	1045	15	Morning Inlet (OZ)	0	0
Wildman (OZ)	17	6	Flinders (OZ)	4	2
Wildman (DI)	29	7	Norman (OZ)	15	9
Sth Alligator (OZ)	34	10	Gilbert (OZ)	20	7
Sth Alligator (DI)	226	16	Staaten (OZ)	1	1
East Alligator (OZ)	84	13	Mitchell (OZ)	59	12
East Alligator (DI)	113	15	Coleman (OZ)	21	11
Goomadeer (OZ)	3	1	Holroyd (OZ)	3	3
Goomadeer (DI)	84	6	Archer (OZ)	48	9
Liverpool (OZ)	5	2	Watson (OZ)	12	7
Liverpool (DI)	717	16	Embley (OZ)	5	4
Blyth (OZ)	37	11	Wenlock (OZ)	22	3
Blyth (DI)	672	10	Ducie (OZ)	9	6
Goyder (OZ)	13	3	Jardine (OZ)	11	6
Goyder (DI)	474	11			

(OZ) = OZCAM Record (DI) =DIPE Record Flinders = Focus Catchment

Table 5 Summary of reptile records for the focus catchments.

Genus	Species	Fitzroy (OZCAM)	Daly (OZCAM)	Daly (DIPE)	Flinders (OZCAM)
Crocodylus	*johnstoni*	3	12	165	
Crocodylus	*porosus*		2	341	
Carettochelys	*insculpta*		5	7	
Chelodina	*canni*				
Chelodina	*rugosa*	9	11	7	
Chelodina	*novaeguineae*				
Chelodina	*kuchlingi*				
Chelodina	*burrungandjii*		3	2	
Elseya	*dentata*		42	31	
Elseya	*lavarackorum*				
Elseya	*latisternum*		1	1	
Emydura	*australis*	8	2		
Emydura	*subglobosa*		16	6	
Emydura	*tanybaraga*		18	20	
Emydura	*victoriae*	6	4	11	
Emydura	*worrelli*			4	
Varanus	*indicus*				
Varanus	*mertensi*	2	24	39	1
Varanus	*mitchelli*	1	9	24	
Varanus	*panoptes*	4	2	14	
Varanus	*semiremex*				
Acrochordus	*arafurae*				
Acrochordus	*granulatus*				
Liasis	*fuscus*		3	9	
Cerberus	*rynchops*				
Enhydris	*polylepis*			1	
Fordonia	*leucobalia*	4	1	1	
Myron	*richardsonii*	1			
Stegonotus	*cucullatus*		1	4	
Tropidonophis	*mairii*	2	38	42	3
TOTAL		**40**	**194**	**729**	**4**

Birds

Due to the departure from ***eriss*** of the theme leader (Maria Bellio), little additional progress has been made for birds. However, we have since re-secured the services of Maria Bellio to complete the acquisition and description of the birds data. A plan to complete the task has been developed, although a sub-contract, probably through IWMI, still needs to be drafted. Maria will be in Darwin in September, when further discussions will be held.

Estuaries

Data Collection

Selected long-term tide gauge records have been obtained across the study region from DIPE (NT), EPA (Qld), DPI (WA). Analysis of tidal character and non-tidal processes is underway, particularly for cyclone impacts. Wind records have been obtained from the Bureau of Meteorology. This information is being used in the assessment of non-tidal water level fluctuations. Some long-term rainfall records have been obtained for the study region. Further data needs to be collected, particularly from Queensland.

Cyclone Paths & Landcrossing

The Bureau of Meteorology tropical cyclone database has been obtained and tools for its interrogation developed. This allows rapid identification of relevant tropical cyclone paths affecting particular sites. It is important to note that the relative scale of cyclonic impact requires investigation at a local rather than regional level. It is likely that these data will be incorporated as a threat in the risk assessments in Sub-project 2.

Climate Change & Variability Projections

Reports outlining projected climate change projections have been obtained, including IPCC (2001), AGO (2003). Protocols for the application of climate change information to coastal and estuarine systems are available from NCCOE (2004). Similar to the cyclone data, it is likely that these data will be incorporated as a threat in the risk assessments in Sub-project 2.

Estuarine System Classifications

A range of available classification systems has been obtained, including those used by Ozestuaries and SERM. Information regarding estuarine health and environmental flow requirements from the National River Health Initiative will be included in the review.

GIS and mapping

Data collation

Data collation and compilation has continued, as additional data sources are identified and assessed (as described above for the individual attributes). Data collation is increasingly focussing on those datasets which could be used to support risk assessment activities within the three focus catchments. Datasets that fall into this category include the distribution of feral animals, rare and threatened species, ground water divisions, land use and landcover, and land tenure. Negotiation and liaison with the custodians of detailed and focus-catchment scale (1:100,000) data sets (principally state agencies) to access additional data is ongoing. In the intervening period since the last milestone, the latest versions of several datasets that have a temporal element – specifically, those representing the recorded observations of fauna and flora – have been acquired from national databases. Several state agencies have also supplied additional datasets on faunal distribution, which complement existing national datasets.

A significant acquisition at the continental scale has been the three-second digital elevation model (DEM) of Australia. Originally captured by the NASA SRTM (Shuttle Radar

Topographic Mapping) program, the extent of the project area has been extracted from the national dataset, and is now being used to complement and enhance existing information on the topographic, landform and drainage features at a consistent scale across the project area .

Copies of data layers continue to be supplied to team members to enable them to compile and produce maps for their respective themes, once they have been checked to ensure that the datasets are in a consistent format and datum.

Data management and structure

The spatial data and structure continues to be regularly backed up onto DVD, with copies of the data maintained offsite as an added security measure. Metadata for databases / datasets is being progressively created / updated as required to ANZLIC-2 standard.

Modelling and analysis

The three-second DEM has been used to generate drainage networks for the focus catchments, providing a detailed hydrological base dataset at the focus catchment scale. The framework and specifications for the base drainage datasets at both the continental scale. It is planned that the 'base' continental drainage dataset will consist of the drainage features from the 1:250,000 topographic data that are attributed as being a named or major river. At the focus catchment scale, it is planned that these data will be merged with stream-ordered drainage data derived from the 3-second DEM in areas of significant relief, to provide an enhanced drainage network. Optical imagery (Landsat 7) is being used to validate the position and integrity of the drainage networks.

As described above in the *Geomorphology* section, continental and focus catchment geomorphic classifications were finalised, and the task being undertaken at present is to apply the classifications at the relevant scale through the integration, querying and analysis of the geomorphic, geological, landform landsystem, vegetation and elevation datasets which had been previously collated within a GIS environment. The slope and topographic attributes of the 3-second DEM are also being integrated with existing geological, pedological, landform, landsystem, topographic and vegetation data to help delineate the proposed geomorphic classifications. Examples of the spatial parameters used to delineate geomorphic classes are listed in table 6. An example of how the classification may be attributed to the drainage features in a catchment is shown in figure 4, for the Leichhardt River.

Table 6 Spatial parameters used to delineate geomorphic classes.

Sample geomorphic type - Focus Catchment	Features used for delineation
Bedrock rivers (upland channels & gorges)	Elevation and slope from DEM , landform, soils / geology attributes
Bedrock confined rivers	Elevation, slope, contours from DEM; geology/ soils attribute
Meandering rivers	Topographic data; drainage from DEM
Straight rivers	Topographic data; drainage from DEM
Floodouts	Drainage data from DEM and topographic sources
Island & anabranching rivers	Drainage data from topographic sources; imagery
Mud-braided & anabranching rivers	Drainage data from topographic sources; imagery
Freshwater wetlands and billabongs	Waterbody features from topographic data; waterlogging characteristics of land systems and soils data; vegetation data

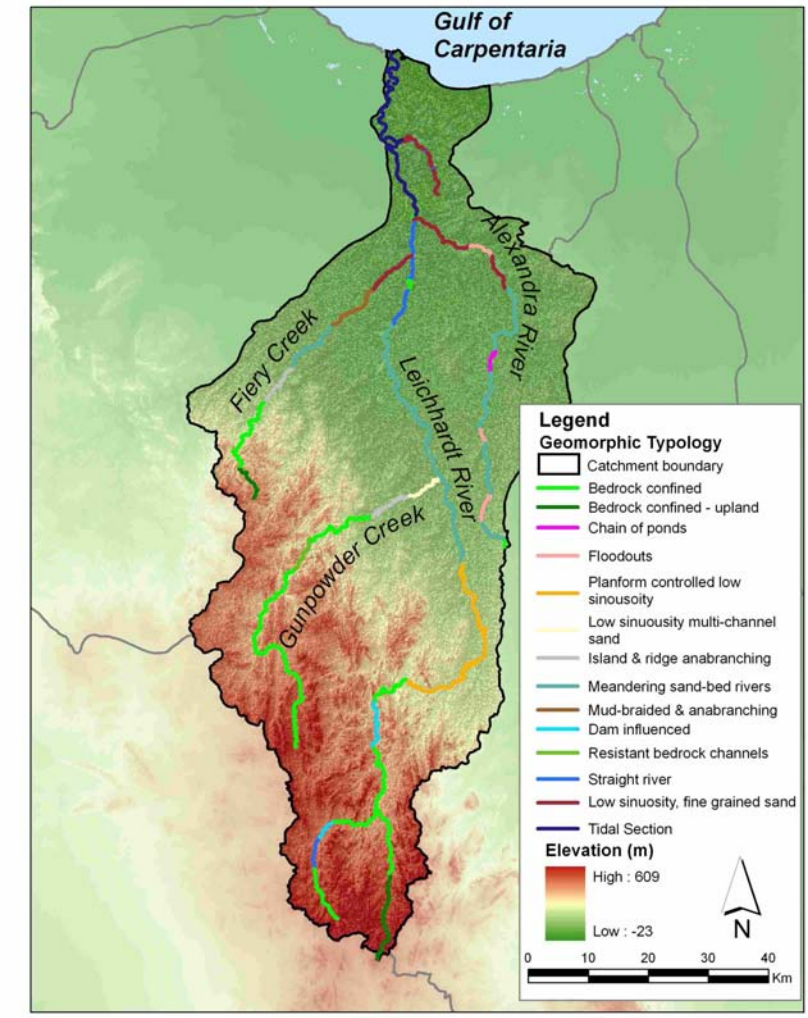

Figure 4 Geomorphic classification of the Leichhardt River catchment.

With the geomorphic typology of the different reaches in the drainage datasets established, it is proposed that the ecological character of the rivers may be determined by overlaying the faunal and floral datasets collated earlier, that occur within a prescribed distance (eg 2 km) of the different geomorphic typologies represented along a watercourse. Figure 5 illustrates how the different datasets, such as vegetation may be overlayed, to identify the spatial distribution of key species relative to the different geomorphic types.

Issues and constraints

In addition to the delays caused due to the geomorphic classification, delays have occurred in the collection and compilation of inventory data due to the need to ensure that the data being compiled complements datasets being created in other projects supported by LWA. The planned purchase of the 1-second DEM, which will be used to provide more detailed topographic and drainage data within the focus catchments is currently awaiting final approval by the Department of Environment and Heritage in Canberra.

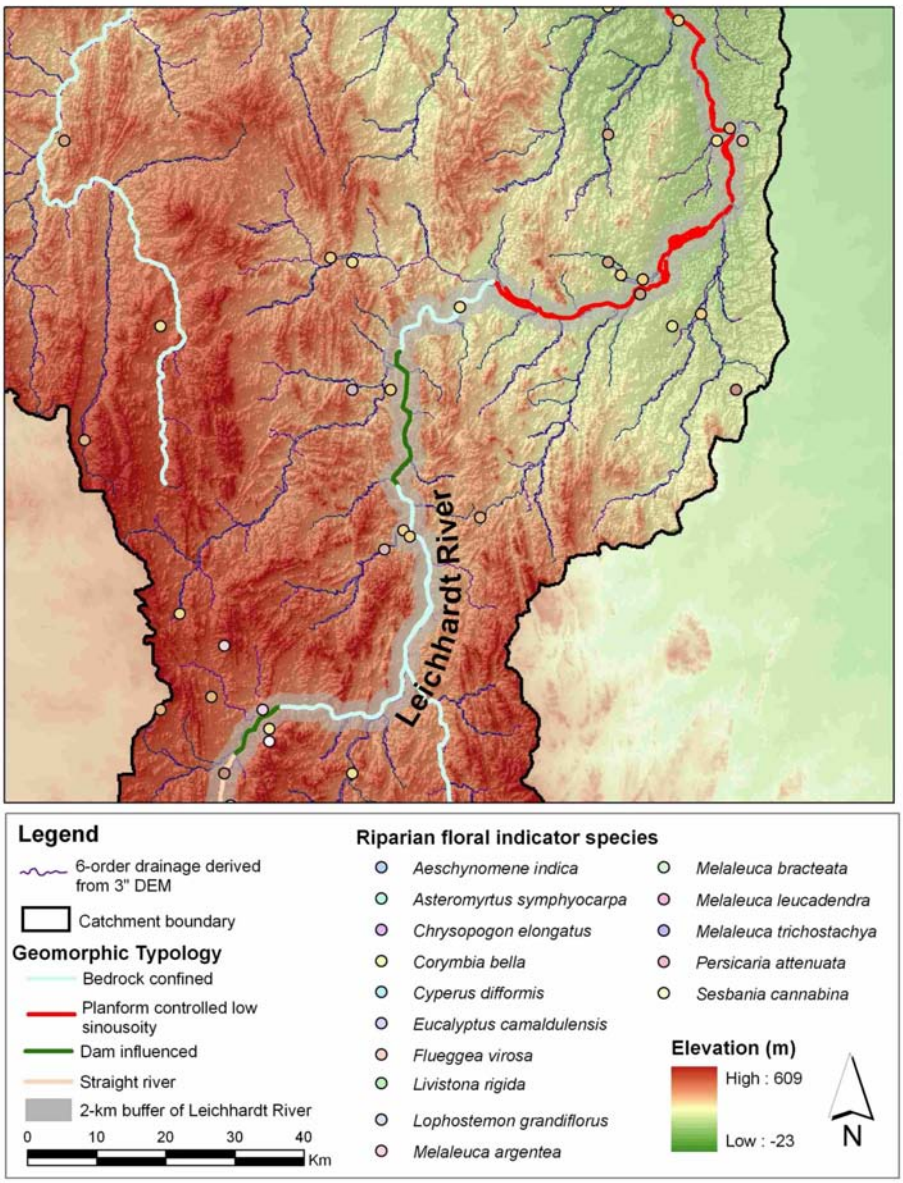

Figure 5 Integration of floral data with the base geomorphic typology.

Planned activities

Data acquisition and integration will continue, on a reduced basis, as individual / specific datasets required for inventory are identified. Most of data collection/ compilation will be of those datasets required for risk assessment activities in the focus catchment. The key focus will be on completing the generation of the base drainage datasets at the continental scale, and for the focus catchments, and the application of the geomorphic classifications to these datasets. Once done, attention will focus on overlaying, integrating and analysing datasets, which could be used to establish the ecological character of the rivers.

Communication and consultation

The relevant activities are described in the separate report at Attachment 3 of the Milestone Report.

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Detailed Progress Report for Sub-project 2

Assessment of the major pressures on aquatic ecosystems

Project description and objectives

The tropical rivers of northern Australia are under increasing pressure due to environmental threats and human activities. The objective of this sub-project is to develop a risk assessment framework applicable to the key focus catchments and significant locations that meet stakeholder needs, within the region of the TRIAP. As well as providing a broad overview of the major pressures on tropical Australia's aquatic ecosystems, the key component of this study is more detailed risk assessments for the focus catchments, being the Daly River (NT), Flinders River (Qld) and Fitzroy River (WA). Throughout this sub-project, stakeholders will be involved in providing input and feedback.

There a number of key elements in developing the risk assessment framework that will be addressed. Firstly, identification of assets and threats within the focus catchments will be undertaken through a combination of consultations with stakeholders and a review of existing reports and management plans. Both spatial and aspatial data related to assets and threats will also be collated. The spatial data will then be compiled in a GIS, and linked to the inventory. Secondly, conceptual models for each of the focus catchments will be developed, focussing on the interactions between key assets and threats. Finally, both semi-quantitative and quantitative risk analysis will be conducted on selected threats.

The tasks for the semi-quantitative risk analysis are:

- *Effects/consequence analysis* – collate data/information on documented effects of key threats to key assets (possibly applying a semi-quantitative 'consequences' ranking scheme), and document the associated level of confidence in the data/information.
- *Exposure/likelihood analysis* – integrate relevant GIS layers to determine extent or likelihood of exposure of key assets to key threats, and document the associated level of confidence in the data.
- *Risk characterisation* – integrate outcomes of effects and exposure analyses to estimate risks of threats to assets. Outputs include: identification of relative risks (and, therefore, highest risk threats); assets least/most under risk; initial indication of cumulative risks; and articulation of uncertainty.
- Describe applications of semi-quantitative risk outputs to catchment management and NRM bodies – ie. how do they inform risk management/risk reduction?.

The quantitative risk assessment will follow on from the semi-quantitative risk analysis. Based on outcomes of semi-quantitative risk analyses and stakeholder views, **one** threat/issue will be selected for quantitative risk analysis, and the conceptual model for this threat/issue will be reaffirmed/revised accordingly.

Major outputs within selected major catchments and at important sites will include: specific analyses of major pressures (e.g. weeds, feral animals, infrastructure, water pollution); recommendations for risk reduction/management steps and monitoring; and a database of available information.

Development of risk assessment framework

A risk assessment framework has been constructed that will act as a template for the focus catchment assessments. The workplan tasks (see Attachment 2) reflect this framework. The generic paradigm for ecological risk assessment is shown in figure 6, and is the basis for the framework developed for this project. Whilst the risk assessment approach has been presented in a number of presentations to date, it has not been fully documented. This needs to occur in the early stages of the next reporting period. Briefly, the risk assessments will adopt an *assets and threats*[1] approach, with the key ecological assets and threats to these assets being described and inter-linked through conceptual models. Thus, data collation will focus on the key assets and threats (NB – the assets data will be derived largely from Sub-project 1, whilst the threats data are being collated as part of Sub-project 2 – see below). Where possible, spatial data will be used to underpin the risk assessments, although non-spatial data will also need to be accessed and included. A pictorial example of the approach using spatial data for multiple assets and threats is shown in figure 7. This is the approach that has been adopted by ERISS for its ecological risk assessment of the Magela Floodplain in Kakadu National Park. However, it is stressed that data quantity and quality for the focus catchments will determine the detail/resolution at which the risk assessments can be undertaken; it is unlikely that the level of detail applied to the Magela Floodplain assessment will be possible in this study for the focus catchments.

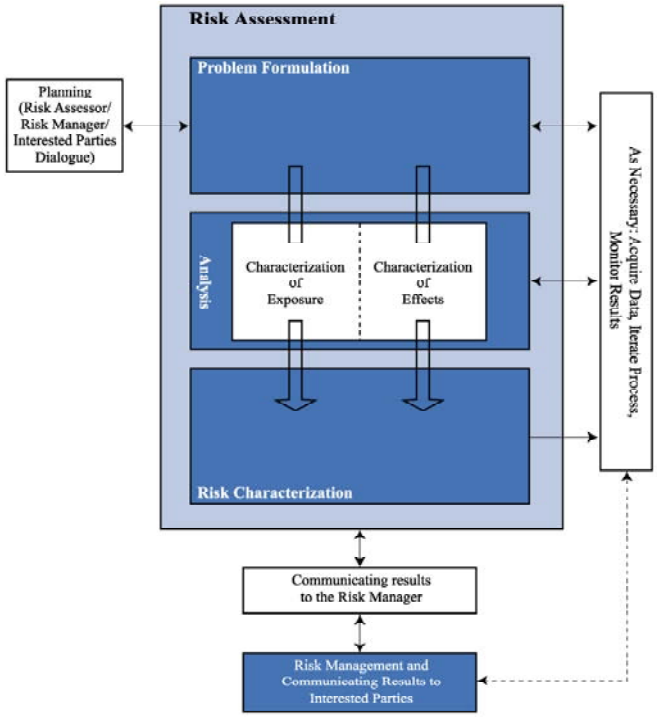


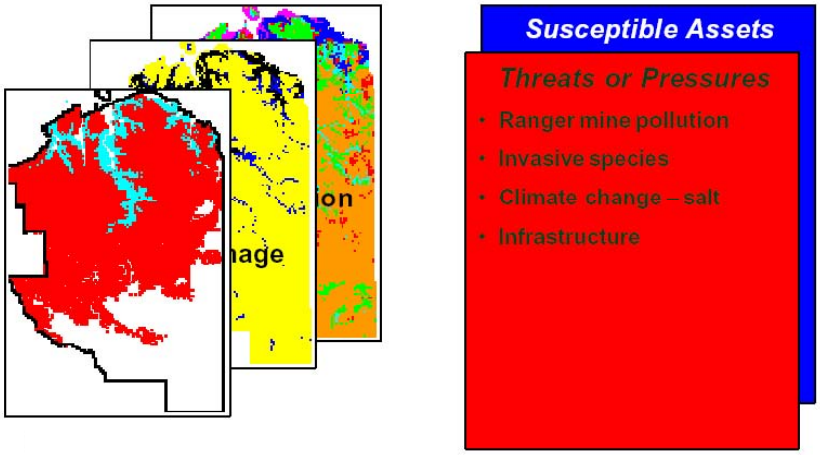
Figure 6 General framework for ecological risk assessment (modified from US EPA 1998).

[1] The terms *assets* and *threats* are synonymous with *values* and *pressures*, respectively, and can be used interchangeably.

A.

ASSETS	THREATS OR PRESSURES				
	U-mine	Infrastructure	Invasive species weeds & pigs	Climate change saltwater	Fire
World Heritage values					
Landscape heterogeneity					
Biodiversity					
Endemnism					
Species richness					
Species abundance					
Cultural significance					
Spiritual values					
Bush foods					
Ramsar wetlands					
Freshwater wetlands/waterways					
Mangroves/saline wetlands					
Biophysical					
Geomorphic landforms					
Geology, hydrology, soils					
Floodplain vegetation					
Invertebrates (macro)					
Fish					
Waterbirds					

B.



C.

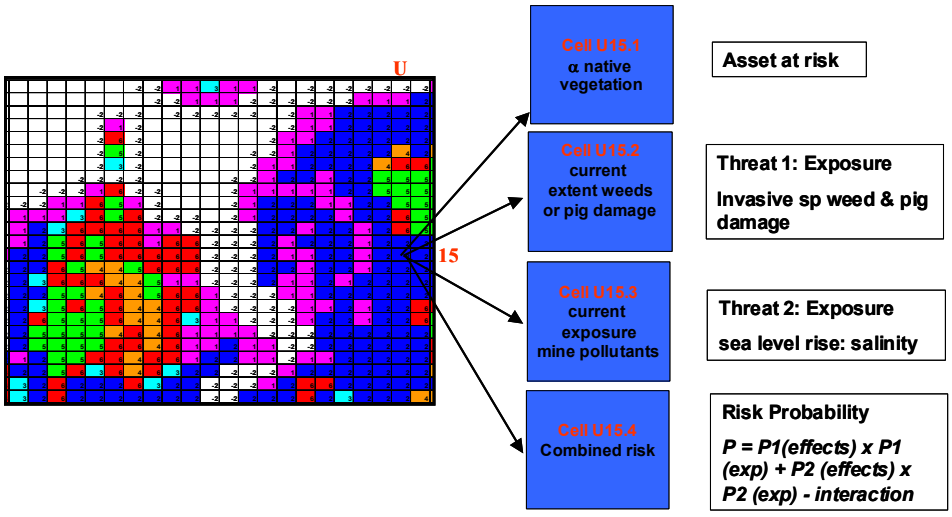


Figure 7 Pictorial representation of spatial risk assessment of key threats to key assets – A. matrix of assets and threats; B. Overlaying of multiple assets and threats spatial data layers; C. quantitative risk assessment using multiple asset and threat data layers at 1 km^2 cellular resolution (Bayliss et al. 2004).

Problem definition/hazard identification

This phase of the risk assessment captures the activities that were scheduled during the reporting period. Problem definition/hazard identification (termed *problem formulation* in figure 6) attempts to build a picture of the nature of the issue that is being investigated, using all available existing information. Thus, the key aim of this phase is to identify and describe (i) the key assets (mostly ecological, but capturing a number of overlapping values of socio-cultural and economic importance) and threats to the aquatic ecosystems of three focus catchments, and (ii) the interactions between the ecological assets and threats. This information will then be used to construct conceptual models for each focus catchment of the interactions between key assets and threats. The final form of the models is yet to be determined, but for practical reasons, may involve disaggregation of the complex systems into a series of simpler, more useable sub-models. The conceptual models will drive the risk assessments. A critical issue here is that risk assessments are only as adequate and appropriate as the conceptual models on which they are based (Burgman 2005). Consequently, significant attention is being placed on this aspect of the project.

To date, consultations with stakeholders from the Daly and Fitzroy Rivers have strongly indicated that there is unlikely to be a need for up-front stakeholder workshops to identify and agree on key assets and threats, as this process has occurred in both catchments for various purposes over the last few years. Consequently, it is considered appropriate to utilise the information produced from these previous efforts, as long as the key stakeholders are kept abreast of progress and utilised to verify/confirm the appropriate usage and interpretation of data/information. Numerous key documents for the Daly and Fitzroy Rivers have been obtained, including:

Daly River

- Daly River Community Reference Group Draft Report, November 2004.
- Draft Conservation Plan for the Daly Basin Region, August 2003 (NT DIPE).
- Environmental Water Requirements of the Daly River, July 2004 (NT DIPE).
- Aquatic Conservation Values of the Daly River Catchment, Northern Territory, Draft Report, May 2004 (WWF, ECNT).
- Social Values of the Daly Region, May 2004 (CDU).
- Preliminary Report on Aboriginal perspectives on land-use and water management in the Daly River Region, Northern Territory, May 2004, (CSIRO).
- Inventory and risk assessment of water dependent ecosystems in the Daly basin, Northern Territory, 2001 (ERISS).
- Integrated Natural Resource Management Plan for the Northern Territory, March 2005 (NT DIPE, Landcare Council of NT).

Fitzroy River

- Fitzroy River System: Environmental Values, July 2001 (UWA, ECU).
- Draft NRM Strategy – Rangelands Region of WA, 2004 (Rangelands NRM Coordinating Group).
- Kimberley Natural Resource Management Plan, December 2004 (Rangelands NRM Coordinating Group).

- Fitzroy Valley indigenous cultural values study: a preliminary assessment, 2001 (UWA).

At the time of submission of this report, information on the assets and threats of the two river systems was being extracted from the above-listed documents. The initial output will be a matrix of assets and threats that will be used as the basis for (i) constructing the conceptual models and (ii) focusing data/information searches.

Spatial data acquisition

As mentioned previously, the majority of ecological assets data will have been collected for Sub-project 1. Whilst a limited amount of threats data also has been incorporated in Sub-project 1 (eg. land tenure), the majority will be collected as part of this Sub-project.

Daly River

Data acquisition is most advanced for the Daly River. Ongoing liaison with relevant staff of the Departments of Natural Resources, Environment and the Arts (NRETA; formerly Department of Infrastructure, Planning and Environment) and Primary Industry, Fisheries & Mines (DPIFM) has resulted in the acquisition of numerous datasets for the Daly River (table 7). An important aspect to note for these data is that the metadata are often poor or lacking. In addition to the threats datasets, some additional assets datasets have been identified and are being acquired. Most notably, long-term fisheries catch data for barramundi, jewfish and mud crabs are being supplied by DPIFM, and will be used as indicators of production as well as recreational fishing value.

Fitzroy River

The identification and acquisition of spatial data for the Fitzroy River is being done in conjunction with the Kimberley Wetlands Project being coordinated by WWF and the WA Department of Conservation & Land Management (CALM). Related to this, the Kimberley Regional Fire Project has a database of existing spatial datasets for the Kimberley, for which we are seeking access. Numerous possible datasets have been identified, but need to be investigated further because the metadata are often inadequate. Some of the threats datasets that have been earmarked for acquisition include:

Table 7 Summary of 'threats' spatial datasets identified to date for the Daly River.

Dataset & description		Acquired? (Y/N)
Daly_historicweeds_g94	Points representing the historical location of weeds pre 1998 clipped to the Daly River Catchment	Y
Daly_point_220801_g94	Points representing weed locations collected from 1999 to 2003 clipped to the Daly River Catchment	Y
Daly_mimosa_survey_g9	Points representing the track file collected during a mimosa aerial survey 2003 clipped to the Daly River Catchment. Each of the points represents the characteristics of the area preceding it.	Y
Land use mapping		Y
Land tenure/cadastre		Y
Roads	1:50,000	Y
Pastoral lease infrastructure		N
Communities		N
Fire mapping		N

- West Kimberley Erosion and Range Condition Report - Survey of land use, fauna, geomorphology, vegetation, soil properties and erosion status to compile a resource inventory for evaluation of land use planning, erosion hazard evaluation and an evaluation of grazing;
- Gillnet and Barramundi Kimberley - Polygon coverage of the Fisheries licence area for the Kimberley Gillnet and Barramundi Managed Fishery; and
- Location of Communities.

Issues and constraints

The main constraint to progress of this Sub-project has been a general lack of availability of staff to allocate time to the activities, although some progress has been made, as described above. To overcome this, ***eriss*** will be appointing a half-time position for a scientist to manage and undertake the sub-project, with assistance from other relevant staff where necessary. In addition, ***eriss*** has secured the services of a DEH graduate placement for three months from September to November to assist with this Sub-project. These measures should see solid progress on this Sub-project in the next reporting period.

Planned activities

The focus over the next reporting period will be several-fold, as follows:

- Continue to identify and acquire relevant threats and assets data for the focus catchments, and, where the data are spatial, enter them into the GIS;
- Continue to extract relevant information on assets and threats in order to build a picture of their nature and inter-relationships and, from this, construct conceptual models for the Daly and Fitzroy Rivers;
- Commence qualitative and/or semi-quantitative risk assessments for the Daly and Fitzroy Rivers; and
- Continue to liaise with key stakeholders to seek additional information and ongoing feedback, and to ensure the study is useful to their needs.

References

Bayliss P, Finlayson M & van Dam R 2004. *Progress and review of the ISP Landscape Program (2002–2004) in the Alligators Rivers Region: ARRTC Key Knowledge Need 5.1 – Landscape scale analysis of impacts.* Internal Report 492, October, Supervising Scientist, Darwin. Unpublished paper.

Burgman M 2005. Risks and decisions for conservation and environmental management. Cambridge University Press (Ecology, Biodiversity and Conservation), Cambridge, UK, 488 pp.

US EPA 1998. *Guidelines for ecological risk assessment.* EPA/630/R-95/002F, Risk Assessment Forum, Washington, DC.

Attachment 2 Detailed work plan for Sub-project 2

National Rivers Consortium (Tropical Rivers)

Australia's tropical rivers – an integrated data assessment and analysis

Detailed Work Plan for Sub-Project 2

Assessment of the major pressures on aquatic ecosystems

Duration

2 person equivalents at each of ERISS and ACTFR for 16.5 months each (Years 1 and 2)

Description

The tropical rivers of northern Australia are under increasing pressure due to environmental threats and human activities. The objective of this sub-project is to develop a risk assessment framework applicable to the key focus catchments and significant locations that meet stakeholder needs, within the region of the Tropical Rivers Project. In developing the risk assessment framework, semi-quantitative and quantitative risk analysis will be undertaken where possible, for selected threats. The key focus catchments that will be assessed are: the Daly River Catchment (Northern Territory); Flinders (Queensland); and Fitzroy River Catchment (Western Australia). Throughout this sub-project stakeholders will provide input and feedback.

There a number of key elements in developing the risk assessment framework that will be addressed. Firstly, identification of assets and threats within the focus catchments will be undertaken through a combination of consultations with stakeholders and a review of existing reports and management plans. Both spatial and non-spatial data related to assets and threats will also be collated. Spatial data will then be compiled in a GIS. Secondly, conceptual models for each of the focus catchments will be developed, focussing on the links between key assets and threats. Finally, both semi-quantitative and quantitative risk analysis will be conducted on selected threats.

Responsibilities

Database development and quantitative ecological risk assessments will be led by ERISS. Collation of information on pressures will be led by ACTFR with assistance from ERISS.

Outputs

Within selected major catchments and at important sites: specific analyses of major pressures (eg. weeds, feral animals, infrastructure, water pollution); recommendations for risk reduction/ management steps and monitoring; and a database of available information.

Work Plan & Schedule

The project tasks and associated task leads and timeframes are detailed below.

1. Develop risk assessment framework and describe methodology

1.1 Prepare internal paper describing the risk assessment framework and proposed methodology, including clarification of terminology (eg. threat v. stressor v. hazard).

2. Problem definition/hazard identification

2.1 Agree on risk assessment focus catchments (most likely Fitzroy – WA, Daly – NT, Flinders – Qld) and, in liaison with State/Territory Govts, NRM bodies and TRP Steering Committee, determine need for stakeholder workshops.

2.2 Identify key stakeholders (eg. Commonwealth/State/Territory/Local Govts, NRM bodies, industry groups, community groups, environment groups) for each catchment.

2.3 Liaise with key stakeholders to identify key catchment assets and threats (may involve workshops).

NB – perceptions of assets and threats will depend on stakeholders' interests. This issue will be clearly articulated, with a possibility of defining assets and threats based on 2–3 generic stakeholder types (eg. biodiversity conservation, agricultural development).

2.4 Acquisition of relevant spatial and non-spatial data/information on assets and threats.

- most of the 'assets' data will already have been collected as part of sub-projects 1 and 3. Most of the 'threats' data will need to be collected as part of this sub-project.
- A second search/request for new data will be made during the last half of the project.

2.5 Compile new GIS data layers based on spatial assets and threats data additional to those acquired in sub-project 1 (and ensure consistency/compatibility with existing GIS datasets).

2.6 Recording/creation and updating of metadata and evaluation of data/information quality.

** *Most of Task 2 will be undertaken in parallel for each focus catchment* **

3. Development of conceptual models

3.1 Describe the key ecological assets (ecological values) and threats, and their inter-relationships (focus is on conceptualising which assets are potentially at risk from which threats).

3.2 Use the above information to develop conceptual models of the interactions between key assets and threats for each focus catchment (the final form of the models is yet to be determined, but for practical reasons, may involve disaggregation of the complex systems into a series of simpler, more useable sub-models).

3.3 Seek feedback and confirmation on the models from key stakeholders, and iterate/finalise models as required (may involve workshops).

3.4 Agree on scope of semi-quantitative and quantitative risk analyses with respect to the threats and assets being assessed (agreement to be reached internally and with key stakeholders).

** *Focus catchments will be assessed sequentially, thereby focusing resources on one catchment at a time* **

4. Semi-quantitative risk analysis

4.1 *Effects/consequence analysis* – collate data/information on documented effects of key threats to key assets (possibly apply a semi-quantitative 'consequences' ranking scheme), and document the associated level of confidence in the data/information.

4.2 *Exposure/likelihood analysis* – integrate relevant GIS layers to determine extent or likelihood of exposure of key assets to key threats, and document the associated level of confidence in the data.

4.3 *Risk characterisation* – integrate outcomes of effects and exposure analyses to estimate risks of threats to assets. Outputs include: identification of relative risks (and, therefore, highest risk threats); assets least/most under risk; initial indication of cumulative risks; and articulation of uncertainty.

4.4 Describe applications of semi-quantitative risk outputs to catchment management and NRM – ie. how do they inform risk management/risk reduction?.

** *Focus catchments will be assessed sequentially, thereby focusing resources on one catchment at a time* **

5. Quantitative risk analysis

5.1 Based on outcomes of semi-quantitative risk analyses and stakeholder views, select one threat/issue for quantitative risk analysis, and reaffirm/revise the conceptual model for this threat/issue.

NB – for the selected threat, there may exist numerous hazards for which the risks need to be estimated.

At this stage it is not possible to be prescriptive about the quantitative risk assessment methodology to be adopted, and the associated work plan. The decision on this will depend on numerous factors including the nature of the threats that are selected for quantitative analysis, the type, quantity and quality of available data, and linkages to other research projects (eg. NAIF). Nevertheless, some broad boundaries can already be set. For example, where adequate and appropriate empirical data exist, frequentist approaches will be used; where there is combined reliance on empirical data and expert opinion/knowledge, Bayesian networks may be employed. Moreover, where possible, the spatial nature of the assets and threats datasets will be utilised within the risk analysis phase. Depending on data availability (ie. data coverage & level of spatial resolution), it may be possible to do the quantitative ERA at multiple scales if there is a clear benefit in doing so. This could range from the whole catchment, broad ecosystems (eg. rivers, coast, wetlands, etc.), river reaches, down to raster cells of small size. Finally, the risk analysis approach will be consistent with the most recent national and international risk assessment guidance documents and texts (eg. US EPA 1998, 2003; AS/NZS 2004; Burgman 2005)[2].

[2] AS/NZS 2004. Risk management. Standards Australia/Standards New Zealand (AS/NZS) 4360:2004, Strathfield, NSW, Australia.

Burgman MA 2005. Risks and decisions for conservation and environmental management. Cambridge University Press (Ecology, Biodiversity and Conservation), Cambridge, UK.

US EPA 1998. Guidelines for ecological risk assessment. EPA/630/R-95/002F, Risk Assessment Forum, Washington, DC.

Additional details on the approach and tasks for the quantitative risk analyses will be provided to LWA when available.

6. Communication and consultation

6.1 Establish contact with agencies, boards and representative panels in WA, Qld & NT to notify of the commencement of the project, reiterate its objectives and links to the other two sub-projects, and seek collaboration and support and access to information.

6.2 Establish schedule and purpose for continued consultation, including ongoing exchange of information, collaboration and reporting and demonstrating initial analyses and outcomes.

NB – consultation tasks are embedded in all the tasks described for this sub-project

7. Reporting

7.1 Coordinated final draft risk assessment report.

US EPA 2003. Framework for cumulative risk assessment. EPA/630/P-02/001F, Risk Assessment Forum, Washington, DC.

Timeline for tasks

Task	04-05			05-06												06-07		
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1.1 Risk assessment framework																		
2.1 Select focus catchments																		
2.2 Identify key stakeholders																		
2.3 Identify key assets & threats																		
2.4 Data acquisition																		
2.5 Compile new GIS layers/datasets																		
2.6 Metadata & data quality																		
3.1 Describe assets & threats																		
3.2 Develop conceptual models																		
3.3 Incorporate stakeholder feedback																		
3.4 Agree on scope of risk analyses																		
4.1 Semi-quant. effects analysis																		
4.2 Semi-quant. exposure analysis																		
4.3 Semi-quant. risk characterisation																		
4.4 Describe application of outputs																		
5.1 Select threat & reaffirm conceptual model																		
Quantitative risk analyses*																		
6.1 Initial consultation																		
6.2 Ongoing comunication and consultation																		
7.1 Reporting (interim and final milestones)																		
Risk assessment workshops	To be advised																	

* details to be provided following completion of the semi-quantitative risk assessments.

Attachment 3 Detailed communication and consultation progress report

Detailed communication and consultation progress report

Change in project name

Until July, our LWA funded project, *Australia's tropical rivers – an integrated data assessment and analysis*, has been referred to simply as the *Tropical Rivers Project* or *TRP*. However, this often results in confusion amongst stakeholders between our project and the broader LWA funding program, which is called the *Tropical Rivers Program*. Thus, we have had to look at alternative suitable titles. The project is now referred to as the *Tropical Rivers Inventory and Assessment Project* or *TRIAP*. A logo has also been developed to use in newsletters, presentations and posters.

Communication and consultation activities since March 2005

Numerous and varied communication and consultation activities were undertaken during the reporting period, with the main aspects being described in table 1. Several key activities are described below in greater detail.

Land & Water Australia Board visit

On Wednesday 1 June, the Land and Water Australia (LWA) Board conducted a site visit in Darwin to be briefed on the Tropical Rivers Inventory and Assessment Project. Rick van Dam and Renee Bartolo met the Board at the erosion mitigation area at Rapid Creek. Rick gave the Board a briefing on the project and a summary on the potential impacts of cane toads (they were particularly interested in cane toad impacts). The group were then taken to the Supervising Scientist Division where John Lowry demonstrated the GIS developed under sub-project 1. The Board members were quite interested in the work done to date and the capacity for such work to be conducted in northern Australia.

Mini-workshop on approaches for geomorphic classification of Australia's northern rivers

On 12 July, an informal mini-workshop was held in Darwin to discuss approaches for classifying Australia's northern rivers. About a dozen technical experts attended the meeting, including Andrew Brooks (Griffith Uni), Wayne Erskine (University of Newcastle, Australia), Clare Taylor (NRM Facilitator, WA), Damien Burrows (JCU), Michael Doulgas (CDU), Peter Jolly, Steve Tickell and Ursula Zaar (NT Govt), and TRIAP team members from ***eriss***.

Across the north, geomorphic river classification is currently being addressed by two separate projects; it represents a small but important component of the TRIAP project, whilst it is the key objective for a project that is focused on the rivers draining into the Gulf of Carpentaria. The purpose of the workshop was to bring together the two projects so that the approaches could be discussed and, if necessary, aligned as best as possible in the context of the projects' respective scopes, objectives and time scales. The aims were to:

1. Understand the scope of the two projects and their respective approaches to the geomorphic classification (including details of classification, data and method of application);

Table 1 Description of TRIAP key communication and consultation activities undertaken since March 2005.

Type of communication	Date	Outcome
Stakeholder-consultations	June 04 – present	To date 170 consultations with stakeholders have taken place. The consultation details are stored in a consultation record, which includes contact details, response and follow-up requirements.
Stakeholder – communications-newsletter	First edition released in March	The newsletter provided stakeholders with a summary of the workshop held on 12/11/04 and details TRIAP representation at upcoming events. A major outcome was that many people requested to be added to the distribution list.
Stakeholder-communications-project summary	Project summary for LWA Board Visit May 2005	A TRIAP project summary was collated and distributed to LWA Board members prior to their visit to Darwin in June.
Stakeholder – communications-newsletter	Second edition released in July	The newsletter provided stakeholders with a summary on the LWA Board visit to Darwin and the mini-workshop on geomorphic classification. Other features included an announcement on changing the project's name, an update on progress on the sub-projects, a graphic conceptual depiction of the GIS output from sub-projects 1 and details of TRIAP representation at upcoming events. Newsletters are scheduled for quarterly release.
Stakeholder and wider scientific community-communications-conference exhibition booth	4-7 July NARGIS Darwin	There was a TRIAP exhibition booth at the North Australian Remote Sensing and GIS Conference (NARGIS) in Darwin. This was a good opportunity to showcase the TRIAP to people from across northern Australia. The booth feature a 3-D fly-through of the project area running on a laptop and handouts including newsletters and relevant articles published on the project. A number of people signed up to be included on the contact database to receive further information.
Stakeholder and wider scientific community-communications-magazine article	RipRap Edition 28, July 2005	An article was published in the July special edition of RipRap on Tropical Rivers. The article was titled 'Australia's tropical rivers: an integrated data assessment and analysis'. Fifty copies of the magazine were made available for distribution at NARGIS.
Stakeholder – communications – project scope document	Released 02.09.2005	The objective of this document is to communicate the scope of the TRIAP to all stakeholders and interested parties in the context of the allocated resources available for the project. The TRIAP team are unable to undertake work outside of the scope outlined in this document. The scope has been produced from the detailed work plans developed for each of the three sub-projects.
Internal communications- SSD-Newsbrief	2005	2 articles on the TRIAP in the Newsbrief

2. In the context of the scope of both projects, agree on the best elements of the information/approaches presented (including details of classification, data and method of application);
3. Agree on the approach to be used for the Tropical Rivers Inventory & Assessment Project; and
4. Discuss options for completing the task of the geomorphic classification for the Tropical Rivers Inventory and Assessment Project.

The final outcomes are presented in the *Geomorphology* section of Attachment 1.

Ongoing interaction with Kimberley Wetlands Project

Running in parallel to the TRIAP, WWF (Tanya Vernes) and the WA Department of Conservation & Land Management (CALM; Michael Coote and Andrew Moore) are coordinating the Kimberley Wetlands Project, a NAP-funded project to develop a GIS-based inventory of the biological attributes of the region's wetlands. Given the overlapping objectives of the two projects, we have been working closely with WWF and CALM in identifying relevant datasets and determining a process to maximise efficiencies and benefits in data acquisition and analysis for both projects. This interaction has resulted in a strong awareness in the Kimberley region of the TRIAP project.

Other activities

Society of Wetland Scientists 26th Annual International Wetlands Meeting, 5-10 June 2005 in Charleston, South Carolina, USA

George Lukacs presented a paper titled "Inventory & typology development for northern Australia's tropical river systems".

The North Australian Remote Sensing and GIS Conference (NARGIS), 4-7 July 2005 in Darwin

John Lowry presented a paper titled "Integration of data for inventory and assessment of Australia's northern rivers", which summarised sub-project 1.

www.nargis05.cdu.edu.au

International Rivers Symposium, 6-9 September 2005 in Brisbane

Max Finlayson will be presenting a paper titled "Benchmarking Northern Australia's Rivers Before Further Degradation – Practical Approaches and Constraints".

www.riverfestival.com.au/symposium

Spatial Sciences Conference 2005, 12-16 September 2005 in Melbourne

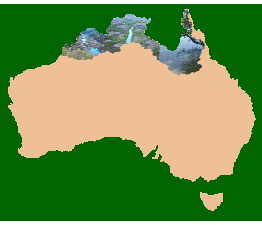
Renee Bartolo will be presenting a paper on behalf of John Lowry titled "Integration of spatial data for inventory and assessment of Australia's northern rivers".

www.ssc2005.com

Attachment 4 Tropical Rivers Project Newsletter July 2005

TROPICAL RIVERS INVENTORY & ASSESSMENT PROJECT NEWSLETTER

July 2005



CONTENTS

Mitchell River, WA

For comment or suggestions on this newsletter, please contact:

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Tropical Rivers Inventory and Assessment Project

A project funded under Land & Water Australia's Tropical Rivers Program

Australia's tropical river systems are unique and form one of the last great river networks in less-impacted condition in the world today; together, they are an internationally significant asset. Although these systems are considered public resources, they are increasingly subject to degradation, restrictions on access, and claims for development. For the vision of sustainable development in northern Australia to be effectively realised, a better understanding of the tropical river systems is required. A first step in the process to achieve this is to integrate existing data and information for the biophysical and socio-economic characteristics of the tropical rivers. To address this, the Australian Government (Land & Water Australia and The Natural Heritage Trust 2) has funded a National Rivers Consortium project titled '*Australia's tropical rivers - an integrated data assessment and analysis'*. The project is being conducted over two years (2004-2006) by the National Centre for Tropical Wetland Research (NCTWR), and will:

- establish an information base for assessing status and change;
- undertake ecological risk assessments of major pressures; and
- trial a framework for the evaluation of goods and services provided by wetlands.

national centre for tropical wetland research

Australian Government
Land & Water Australia

Natural Heritage Trust
Helping Communities Helping Australia
An Australian Government Initiative

Change in project name

Until now, our LWA funded project, *Australia's tropical rivers – an integrated data assessment and analysis*, has been referred to simply as the *Tropical Rivers Project* or *TRP*. However, this often results in confusion amongst stakeholders between our project and the broader LWA funding program, which is called the *Tropical Rivers Program*. Thus, we have had to look at alternative suitable titles. The project is now referred to as the *Tropical Rivers Inventory and Assessment Project* or *TRIAP*.

Land & Water Australia Board visit, 1 June 2005 Darwin

On Wednesday 1 June, the Land and Water Australia (LWA) Board conducted a site visit in Darwin to be briefed on the Tropical Rivers Inventory and Assessment Project (formerly referred to as the Tropical Rivers Project-TRP). The Board had a day of field visits with various researchers around Darwin. Rick VanDam and Renee Bartolo met the Board at the erosion mitigation area at Rapid Creek. Rick gave the Board a briefing on the project and a summary on the potential impacts of cane toads (they were particularly interested in cane toad impacts).

Rick briefing LWA Board members at Rapid Creek

The group were then taken to the Supervising Scientist Division where John Lowry demonstrated the GIS developed under sub-project 1. The Board members were quite interested in the work done to date and the capacity for such work to be conducted in northern Australia. Feedback from LWA was very positive, with the discussion and project GIS demonstration being being very well received and appreciated.

John Lowry demonstrating the GIS being developed under sub-project 1

Representation at Upcoming Events

RipRap Article

The July RipRap is a special edition on Tropical Rivers. There will be an article on the TRIAP summarising the project. This will be available on-line at:

www.rivers.gov.au

Society of Wetland Scientists 26th Annual International Wetlands Meeting

5-10 June 2005 in Charleston, South Carolina, USA

George Lukacs presented a paper tiltled “Inventory & typology development for northern Australia's tropical river systems”.

The North Australian Remote Sensing and GIS Conference (NARGIS)

4-7 July 2005 in Darwin

John Lowry will be presenting a paper titled “Integration of data for inventory and assessment of Australia’s northern rivers”.

Dene Moliere will be presenting a paper titled “A GIS analysis of stream lag-times in Northern Australia”.

We will have an exhibition booth at the conference which is a good opportunity to showcase the TRIAP to local stakeholders. Further details on the conference and the conference program are available at:

www.nargis05.cdu.edu.au

International River*symposium*

6-9 September 2005 in Brisbane

Max Finlayson will be presenting a paper titled “Benchmarking Northern Australia’s Rivers Before Further Degradation – Practical Approaches and Constraints”.

Further details on the symposium can be found at:

www.riverfestival.com.au/symposium

Spatial Sciences Conference 2005

12-16 September 2005 in Melbourne

John Lowry will be presenting a paper titled “Integration of spatial data for inventory and assessment of Australia’s northern rivers”.

The Spatial Sciences Conference is the national biennial Spatial Sciences Institute conference. Further information can be found at:

www.ssc2005.com

Mini-workshop on approaches for geomorphic classification of Australia’s northern rivers

On 12 July, an informal mini-workshop was held in Darwin to discuss approaches for classifying Australia’s northern rivers. About a dozen technical experts attended the meeting, including Andrew Brooks (Griffith Uni), Wayne Erskine (UNSW), Clare Taylor (NRM Facilitator, WA), Damien Burrows (JCU), Michael Doulgas (CDU), Peter Jolly, Steve Tickell and Ursula Zaar (NT Govt), and a swag of TRIAP team members from ***eriss***.

Discussion session

Across the north, geomorphic river classification is currently being addressed by two separate projects; it represents a small but important component of the TRIAP project, whilst it is the key objective for a project that is focused on the rivers draining into the Gulf of Carpentaria.

The latter project, being undertaken by Dr Andrew Brooks of Griffith University, has recently been summarised in LWA’s latest edition of Rip Rap (Edition 28; Brooks et al., pp. 5-10), and aims to develop a rigorous, geomorphic-based, hierarchical river classification scheme for the Gulf rivers. Our project, as one of its numerous components, is attempting to develop a similar scheme applicable to the entire Tropical Rivers study area. Thus, the purpose of the workshop was to bring together the two projects so that the approaches could be discussed and, if necessary, aligned as best as possible in the context of the projects’ respective scopes, objectives and time scales. The aims were to:

1. understand the scope of the two projects and their respective approaches to the geomorphic classification (including details of classification, data and method of application);
2. in the context of the scope of both projects, agree on the best elements of the information/approaches presented (including details of classification, data and method of application);
3. agree on the approach to be used for the Tropical Rivers Inventory & Assessment Project; and

4. discuss options for completing the task of the geomorphic classification for the Tropical Rivers Inventory and Assessment Project.

It is fair to say that, on the day, not all the aims were achieved, but that considerable forward progress was made. Given the recency of the meeting, the outcomes are still being finalised and decisions still under discussion. However, when completed, a summary report will be made available on the TRIAP web page.\

Update on TRP sub-projects

Sub-project 1: Inventory of the biological, chemical and physical features of aquatic ecosystems

The project team are currently working on developing two drainage datasets. The first is at the continental scale and is based on the 1:250 000 topographic data available from Geoscience Australia. Remote sensing data and Digital Elevation Models (DEMs) will be used to validate gaps. The second dataset is being developed for the focus catchments at a scale of 1:100 000 also using the 1:250 000 topographic data. Drainage in the highland areas will be enhanced using DEMs, while drainage in the lowlands will be enhanced using remote sensing data. These methods are being applied only to high order streams (the major perennial waterways).

In terms of the other components of sub-project 1, progress continues with ongoing data collation.

On July 12, a workshop examining approaches for geomorphic classification of Australia's northern rivers will be held at the Supervising Scientist Division, Darwin. The workshop will involve TRIAP members, Andrew Brooks who is working on the Gulf Rivers Project and Peter Jolly from NT DIPE. The broad aims of the workshop include:

- Discussion of the approaches to geomorphic classification being developed for the two projects (TRIAP and Gulf Rivers).
- Determining the most suitable approach for the geomorphic classification for the TRIAP.

Sub-project 2: Assessment of the major pressures on aquatic ecosystems

Sub-project 2 has commenced. The objective of this sub-project is to develop a risk assessment framework applicable to the key focus catchments and significant locations that meet stakeholder needs, within the region of the TRIAP. In developing the risk assessment framework, semi-quantitative and quantitative risk analysis will be undertaken where possible, for selected threats. Three key focus catchments will be assessed (one form each State/Territory within the project area). Work has commenced on assessing assets and threats in the Daly River in the Northern Territory and discussions are underway to initiate the process for the Fitzroy River in Western Australia. Throughout this sub-project stakeholders will be involved in providing input and feedback.

There a number of key elements in developing the risk assessment framework that will be addressed. Firstly, identification of assets and threats within the focus catachments will be

underatekn through a combination of consultations with stakeholders and a review of existing reports and management plans. Both spatial and aspatial data related to assets and threats will also be collated. The spatial data will then be compiled in a GIS. Secondly, conceptual models for each of the focus catchments will be developed, focussing on the interactions between key assets and threats. Finally, both semi-quantitative and quantitative risk analysis will be conducted on selected threats.

Project team members met with key NT DIPE staff in early June to discuss how we might work together and undertake the risk assessment. Amongst other things, a key outcome was that the risk assessment complements other processes underway in the Daly River (eg: the Northern Australian Irrigation Futures Project) and is consistent with the recommendations of the Community Reference Group Report. As such, DIPE are very supportive of the project as well as being an integral part of the project, and this is critical to its ultimate success. Consultation with other key stakeholders will occur over the next 2-3 months.

Sub-project 3: Development of a framework for the analysis of ecosystem services provided by aquatic ecosystems

A final report for this project will be completed by the end of July. Max Finlayson from the International Water Management Institute and Dolf deGroot from the Univeristy of Wageningen are currently compiling six Masters theses into a synthesis report. The catchments selected for developing the ecosystem services framework were the Mary River and Douglas-Daly catchments, Northern Territory. The students collated existing information and consulted with the many stakeholders within these catchments. Some of the framework has been populated with specific information.