Northern Territory Government

DEPARTMENT OF
NATURAL RESOURCES, ENVIRONMENT, THE ARTS AND SPORT

TECHNICAL REPORT 01/2009D

WORKPLAN:

1:100,000 SCALE MAP OF THE NATIVE VEGETATION OF THE NORTHERN TERRITORY.

Implications and Indicative Costing

Peter Brocklehurst
Land and Vegetation Branch, Natural Resources Division
Department of Natural Resources, Environment, The Arts and Sport
PO Box 496
Palmerston NT 0831

Preface

This report is attached as an adjunct to the business plan/vegetation prospectus and provides cost figures for remapping all NT vegetation at a 1:100,000 scale. It includes the rationale for the cost calculations and includes a number of possible future scenarios. It also includes cost breakdowns for bio-regions and river catchments. The discourse has been kept to a minimum with most of the pertinent information contained in tables at the end of report. Theses tables can be used to determine the cost implications of different scenarios once they present themselves This report complements Technical Report 23/2008D *'Scoping Paper: A Finer Scale Vegetation Map for the Northern Territory'* produced previously.

Cover : Somewhere in Arnhemland - © P.Brocklehurst 2008

Contents

1. Objective

Develop the cost and implications for a re-mapping of NT native vegetation at the 1:100,000 scale for the whole Northern Territory and for river catchments and bio-regions. Costs will need to be viewed in light of habitat/landscape complexity as well as access constraints.

2. Preamble

The spatial scale of consistent and standardised vegetation mapping across much of the NT remains at a national level (predominantly at the 1:1million scale).

The extent of NT vegetation mapping at various scales is shown below.

Table 1 NT vegetation map scales

Scale	Area km^2	% coverage of NT	Applicability
≤ 1:50,000	7,662	0.6	local
100,000-250,000	100,898	7.5	regional
1,000,000	1,346,200	100	National/State

At this scale many smaller vegetation types are below the minimum map unit area and are not spatially represented. The original NT vegetation map (Wilson et al 1991) describes 113 vegetation types for the Northern Territory.

A comparison of scales and map units delineated was made utilising the original NT vegetation map and a number of more recent surveys (see table below).

Table 2 Mapping Units delineated for different scale surveys

Survey	Scale	Mapping Units by survey		Map units at 1:1 million scale
Gregory National Park	1:100,000	35		14
Mt Bundy Defence Training Ground	1:100,000	9		4
Stray Creek Vegetation	1:25,000/ 1:50,000	>30		7

The NVISver3 dataset currently recognises 174 spatially represented vegetation types for the Northern Territory. The NVISver3 dataset is the most up to date nationally accredited and consistent NT wide vegetation dataset and incorporates the original NT 1:1 million vegetation map and a number of finer scale vegetation surveys.

A recent inventory and analysis of vegetation information, both spatial and non-spatial revealed the existence of at least 470 unique vegetation types for the Northern Territory, many of which are not mapped (Brocklehurst & Gibbons 2003). An estimate of the total number of vegetation types for the Northern Territory would be in the order of 600+. These could increase in number if they are further refined on an environmental or ecosystem basis.

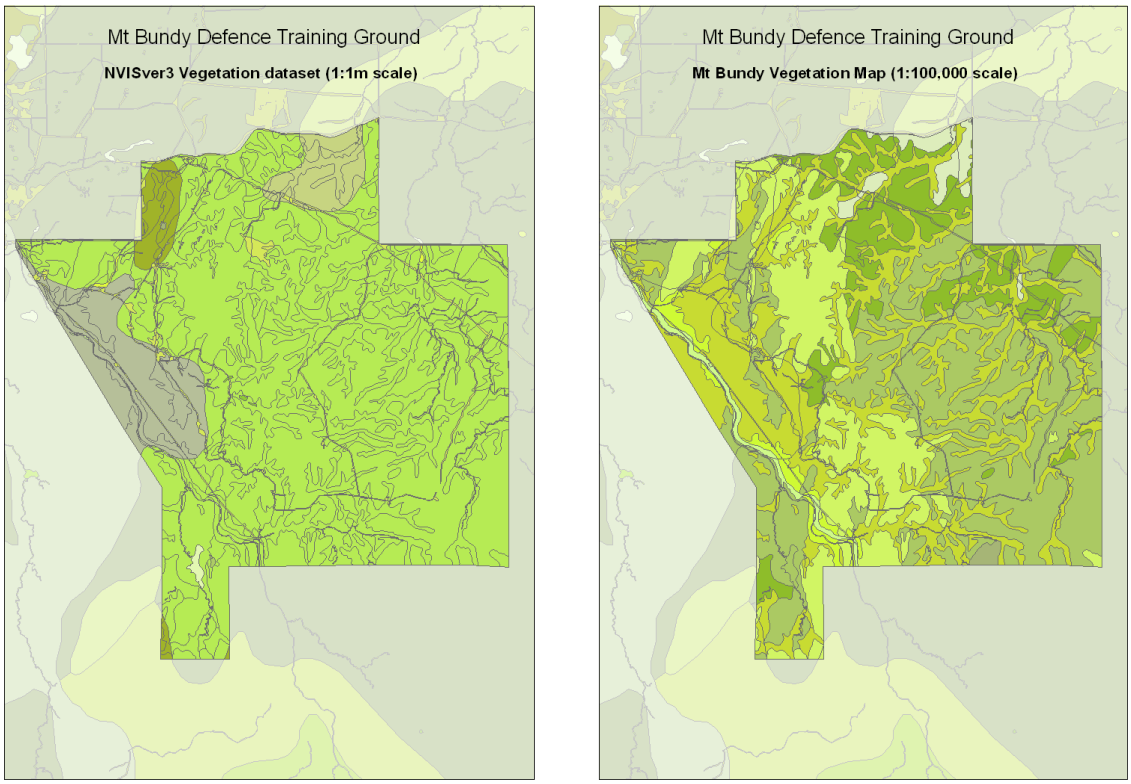


Figure 1 Scale comparison: 1:1m and 1:100k mapping of Mt Bundy

Approximately 80% of Australia's vegetation mapping is at scales finer than the NT.

Table 3 Scale of Mapping: States & Territories (current and past)

State	Predominant Scale of Coverage*	Extent	Significance	Predominant Type	% of Australia	Unique Veg types/DVT's
TAS	25k	100%	local	Pure vegetation	~ 0.8	152
VIC	25k-100k	100%	local	Ecosystems EVC	~ 3	?
ACT	25k	100%	local	Pure vegetation /eco systems	~ 0.039	?
QLD	100-50kk	85%	local/regional	Pure vegetation /eco systems	~ 22.5	3,201
NSW	100k- 250k	60%	regional/local	Pure vegetation /eco systems	~10.4	?
SA	100k-50k	87%	regional/local	Pure vegetation	~ 13	1,025
WA	250k	100%	regional	Pure vegetation /eco systems	~ 33	2,174
NT	≤ 1000k	100%	National/regional	Pure vegetation	~ 17.5	470+
* the mapping scale covering large areas of the State or Territory; other mapping may exist.						

The need for vegetation mapping at the 1:100,000 scale, for regional and local biodiversity planning and management issues, has been recognized for a number of years. This was acknowledged more recently in the NT NRM plan and the Parks Master Plan.

The spatial representation of 'ecological' communities within an environmental and landscape context also requires reasonably robust vegetation mapping, at scales finer than the landscape scales of most of the presently available vegetation mapping. Fine scale vegetation mapping would form an integral part of any future regional ecosystem and landscape mapping framework for the NT.

3. Approaches to Future mapping

Three possible approaches:

I. Progressive mapping of the whole NT, by one team. Current surveys were used to estimate costs for this approach. Figures are provided for an NT wide continuous mapping project (section 3.2.1)

II. Project based with a large vegetation group specifically tasked to complete the mapping of the whole NT within a certain time frame. This is the cheapest option in the long term but would require considerable up front funding. Costs are based on timelines required to achieve this and their salary and operational requirements (section 3.2.2).

III. Mapping of priority areas on a one off basis as required. No continuity between projects. Current surveys were used to estimate costs for this approach (appendix 5). This is the approach used to achieve RIS 2005/121 and RIS2007/167. This is the most expensive approach to mapping the whole NT (section 3.2.3).

Any future mapping will require prioritisation of areas based on development pressures, landscape complexity and costing implications.

Costing figures were reduced to an average cost per kilometre basis to enable extrapolation across the NT based on the real costs of recently completed surveys. Indicative timelines are also provided.

Costs and timelines are provided on an NT wide basis in section 3.2 and for bio-regions and river catchments in appendix 5. Cost breakdowns for bio-regions and river catchments are provided in the eventuality that only priority areas can be mapped in the immediate future. For bio-regions and river catchments, estimates based on per kilometre figures tended to overestimate costs/timelines for particularly large areas and under estimate for particularly small areas. A fixed cost for one off small area mapping was factored into the bio-region and river catchment cost figures. Figures can be further refined if funding opportunities become available.

3.1 Parameters

3.1.1 Method

Costing figures and timelines are based on the Eastern Finke bio-region survey and the McArthur River catchment survey, undertaken as part of RIS2007/167. Nominal scale for these surveys is at the 1:100,000 scale. Private enterprise costing figures are included for comparative purposes although they have not been explored in depth.

The eastern Finke was deemed suitable for determining costs for arid region vegetation for a survey with minimal travelling time to and from survey area. The McArthur River catchment was deemed suitable for determining costs for savanna vegetation which did involve a large amount of travelling time to and from the survey area. Mean figures from these two surveys,

combined with expert opinion, was deemed suitable as the basis for estimates which should account for the variation which would be encountered in a Territory wide survey.

Costing figures should be regarded as indicative and the overall final cost for a Territory wide map will vary depending on the approach taken and the composition of the mapping group.

3.1.2 Parameters

The following parameters were used to estimate the dollar cost for each survey.

Personnel

A team of three people including a permanent P2, permanent P1 and permanent T2
Salary costs for a team of three people with no overtime (circa 2009).

Table 4 Salary

Level	Yearly cost		Monthly cost
	$k	$k + 30% on cost	$k
P2 –top level	78	101	8.5
P1- mid level	52	68	5.7
T2- mid level	49	64	5.3
		233	**19.5**

Computer Lease: $ 550 per month
Vehicle Hire (field season only): $1200 per month
Travelling allowance $ 87 per day

Imagery Costs

Landsat will be free from purchase costs in 2009. However download/procurement of imagery will cost money as well as pre-processing prior to analysis. Approximately 69 standard images are required for the whole NT. The Landsat purchase price has been removed from the calculations.

Processing by GEOimage $500 per scene
Download/procurement $50 per scene

Private Consultancy Cost

The following consultancy rates were used to determine the private enterprise cost of the McArthur River catchment survey. Costs were determined based on the time taken for each component. The office figures include all the analysis, map interpretation, data entry etc. The field component covers all aspects of the field survey including vehicle and personnel costs (ECOZ).

Office $1000 per day
Field $1500 per day

3.2 Indicative Costs

3.2.1 Summary of Costing: Approach 1: One Team of 3 Progressive mapping

A full cost breakdown for McArthur River catchment is provided as appendix 1. A full cost breakdown for the Eastern Finke Bio-region survey is provided as appendix 2.

Indicative costs are provided for an NT wide survey below. The mean figures per kilometre were used to estimate costs for remapping the whole NT and for each bio-region and river catchments (appendices 3-5). Timelines for surveys are provided. The addition of a soil survey component is also provided.

The figures are based on an operational team in place.

Table 5: NT wide Survey: Vegetation Only

			NT wide survey	
	$ Costs Per Km	Time days per km^2	$millions*[1]	Time*[2] years
Gulf Actual	8.6	0.020		
Gulf extended	9.5	0.020		
Eastern Finke	6.9	0.018		
Mean	**8.3**	**0.0193**		
			11.2	**45**
Private	22.6	**-**	**30.5**	**45**
*[1] **costs at 2008 levels**				
*[2] **one team of three**				

The addition of a soil component to the survey can be roughly factored in.
P1 soil scientist for 8 months (salary) + double field component (two vehicles) + equipment = $80k (see appendix 1).

Table 6: NT wide Survey: Vegetation and Soil Survey

			NT wide	
	$ Costs Per Km	Time days per km^2	$millions*[1]	Time*[2] years
Gulf actual	**12.6**	**0.0193**	**16.9**	**45**

Both surveys were also used to determine indicative task breakdowns. The most expensive component is the salary component.

Table 7: Budget breakdown by Task

Component	%budget expenditure			NT wide $millions
	Gulf	Eastern Finke	Mean	
Salaries	67	78	72.5	**8.12**
Field (non salary)	22	11.2	16.6	**1.86**
Equipment/Imagery	3.3	4.1	3.7	**0.41**
Vehicle hire (field only)	2.4	1.7	2.05	**0.23**
Computer lease	4.8	5	4.9	**0.55**
			total	**11.2**

Table 8: NT wide budget breakdown by Landsat scene and 250k map sheet.

	$ 000 Cost
Landsat scene	162

1:250k map (~81 sheets)	139

3.2.2 Summary of Costing: Approach 2 Vegetation Mapping Group

A group specifically tasked with the job with sufficient funds to complete the task –the best case scenario.

Costs based on estimated timeframe and salary requirements for this, within the current NTG infrastructure. Purchase of computer equipment to enable large data storage and processing may add to the costs. Also volatility of fuel prices may add to overall costs.

Length of project based on the time taken to process and classify images if these where done individually = 12 years by one P2. This would be the minimum time frame for one image analyst. .

Based on this the following cost and staffing figures were determined to achieve the task in 6 years.

Salaries assumed to be approximately 70% of the costs (based on task breakdown for Eastern Finke and McArthur River catchment).

P3 salary + on costs = $109/year

Table 9: Staff requirements

Task		level	Time years	$000 salary
Organizing/staff appointment/manager/ report		P3	6.5	708.5
General assistant; Edit /Enter/process new data		T2 (or P1)	6	384
Compile Existing Data		P1	2	136
Image analysis/map classification	Image preparation (1 month per image= 5.7 years)	P2@2)	3	606
Field Survey:	2 teams	(P1@2)x2	3	816
Data analysis		P2@2	2	404
Image analysis/map classification	Map classification (1.5 month per image=8.6 years)	P2@3	3	909
Report writing*	Ex field staff	P1@2	2	272
	Ex image analyst	P2	2	202
				4437.5
Those writing report should have undertaken field work: also includes P3 and advice from image analysis people				

Table 10: Yearly Cost and Timelines

		Time Frame (years)							
Task	level	-0.5	1	2	3	4	5	6	
Setup	P3	1							
Supervisor + T2	P3,T2		2	2	2	2	2	2	
Image preparation	P2		2	2	2				
Compile existing data	P1		1	1					
Field Survey	P1		4	4	4				

Data analysis	P2				2	2			
Map classification	P2				3	3	3		
Report/Map production	P1/P2						3	3	
Staff and funding requirements									
No of staff		1	9	9	13	7	8	5	
Salary cost		54.5	715	715	1152	678	712	409	**4435**
Salary cost + Operational (70% + 30%)		**77**	**1021**	**1645**	**2122**	**968**	**1017**	**584**	**6335**
Funding with 3% increase per year cumulative		77	1052	1743	2312	1084	1169	689	**8049**

3.2.3 Summary of Costing: Approach 3: Bio-regions and River catchments

Indicative costs are also provided for bio-regions and river catchments (appendix 5). There are 15 main bioregions in the Northern Territory. These are further divided into 60 sub-regions. There are 40 main river catchments in the NT. The cost figures provided were determined on the basis that each area was mapped as a separate project.

3.2.4 Habitat/landscape complexity/patterning

The cost of future surveys needs to be placed into the perspective of habitat and landscape complexity, as well as ease of field survey access. In order to get some indication as to patterning in the landscape, a number of spatial datasets were intersected with the IBRA sub-regions and river catchments. These were used to determine the number of patterns/units that could occur in each bio-region or river catchment. An estimate of habitat complexity and access constraints was also determined by subjective appraisal of a Landsat image of the NT combined with expert opinion.

Maximum likelihood classification

Iso-cluster analysis and maximum likelihood classification to provide terrain units based on an unsupervised classification of MSS Landsat (greenness), total count radio-metrics (soil/land characteristics) and elevation (position). This should reflect truer patterning within the landscape as interpreted by multi-spectral classification techniques (Appendix 6).

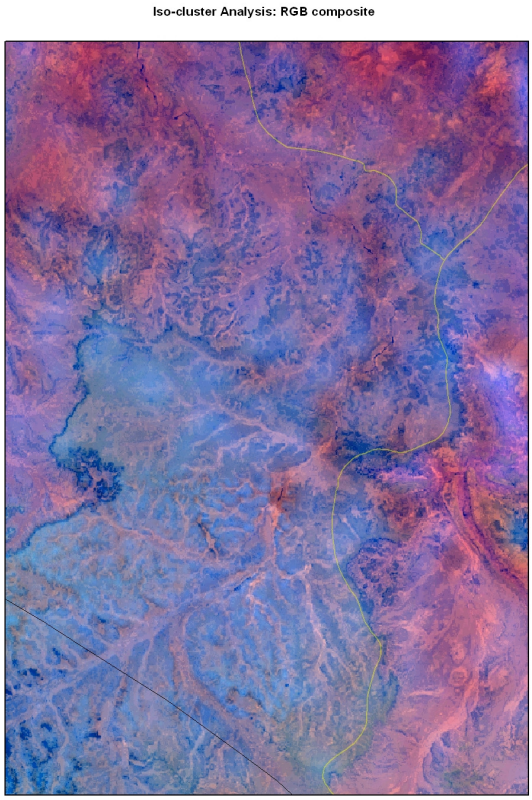


Figure 2 Combined Image

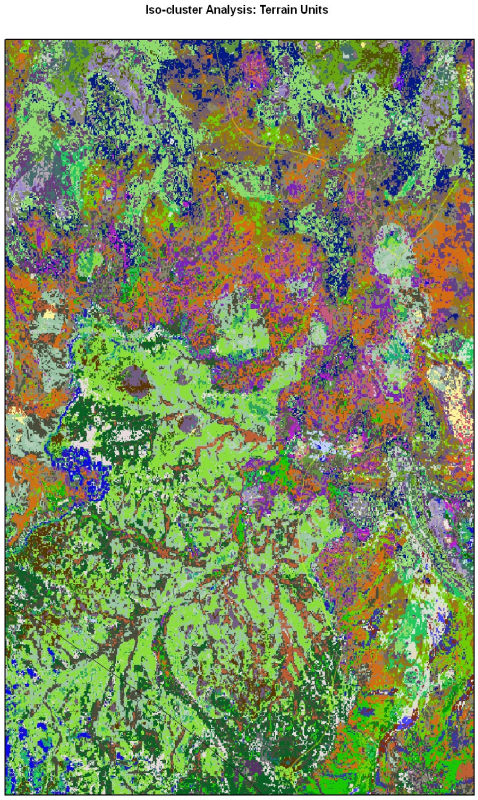


Figure 3 Terrain Units

Vehicle Access

Road network of the NT. Tends to indicate that pastoral regions have better access than Aboriginal owned lands. Only main roads and tracks shown in most instances. Appendix 6

Subjective Appraisal

Subjective appraisal of Landsat images and expert opinion to determine landscape complexity and access constraints.

The outcomes of the GIS analysis and the subjective appraisal are contained in appendix 6. These can be used for further reference when necessary.

It should be noted that complexity in terms of what a Landsat image 'sees' in much of the Top End will be pre-dominantly due to vegetation rather than edaphic/soil related factors. The reverse applies to the Arid region. Overall complexity of mapping at finer scales, using Landsat is not necessarily dependent on the degree of complexity and structuring of the vegetation.

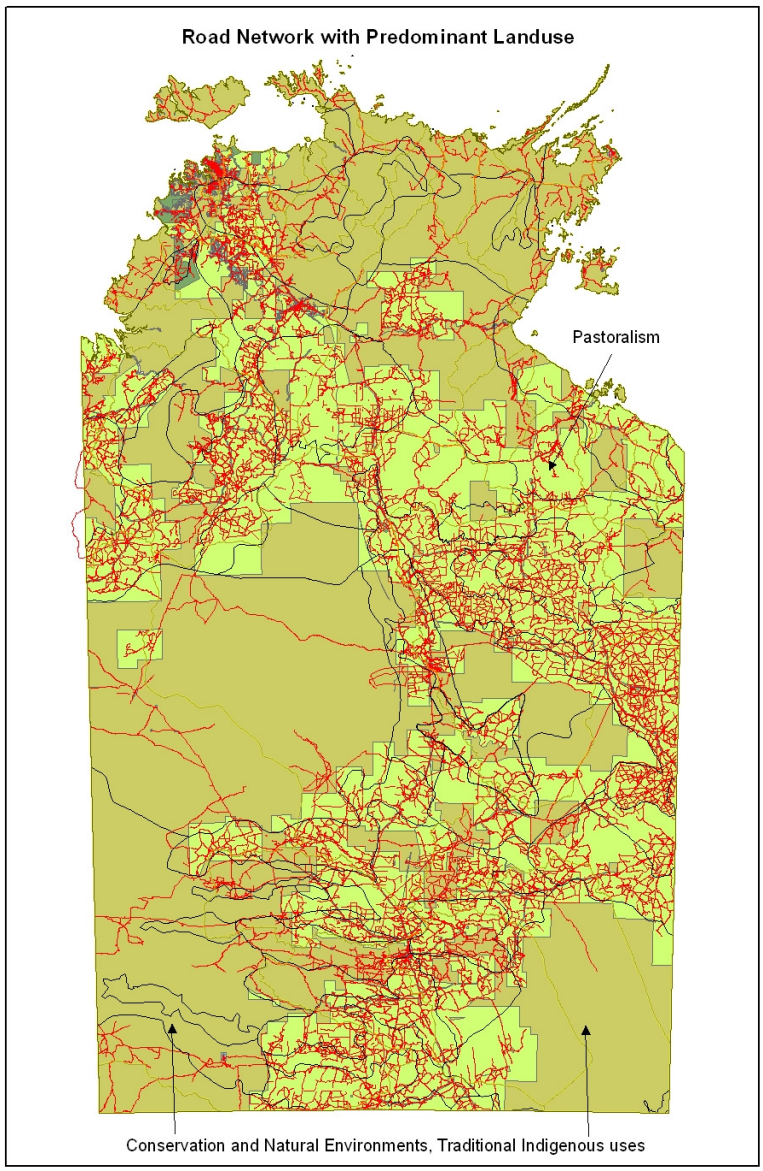


Figure 4 Main roads and Tracks

4 Workplan

It is difficult to provide a blue print or step by step procedure for future survey of all NT vegetation when funding sources, support with in the NT Government and possible collaborative partners are currently unknown. With this in mind the report was designed to provide the necessary information which can be used to determine the possible cost consequences and the implications of various scenarios once funding opportunities present themselves and vice versa. However a number of issues can be addressed.

4.1 Existing Data

A large amount of land resource mapping and information is available within Northern Territory Government agencies.

These include:

- Approximately 30,000 vegetation sites of various age, detail and accuracy of geo-referencing. Some but not all of this site data is digital or in a standardised format or in the one database.

- A large number of scientific and technical reports relating to vegetation and land resource surveys, floristic surveys, fauna studies etc. These have been summarised to some degree in the Definitive Vegetation Types of the NT database currently being developed.

- A large number of vegetation, land unit and lands system maps at various scales- Current holdings can be viewed on NRETAS maps rather than providing a full listing here: http://www.nt.gov.au/nreta/nretamaps/

- Baseline spatial datasets of environmental and cultural features such as geology, radiometrics, cadastre, river catchments etc

- NRETAS also holds a large amount of imagery including aerial photography, Landsat, Spot, Modis etc. **Archived** standard format Landsat images will be free of purchase price in 2009, although continuing availability of new imagery will depend on the satellite continuing operation and may incur a purchase cost.

Suffice it to say there is a large amount of existing data that can be used to inform and assist any future mapping exercise. This was not the case when the original NT vegetation mapping program was undertaken in 1986.

4.2 Prioritising Bio-Regions and River Catchments

Areas for future finer scale survey, irrespective of whether a part of an NT wide survey or undertaken on an individual basis, can be prioritised in terms of.

- Those most likely to undergo development and land use change. These are generally, though not necessarily, in the vicinity of larger population centres. This is possibly the most important immediate criteria.
- Those recognised under the Parks Master plan and NT INRM plan as important
- Those in line with AG COFC
- Those in line with NRETAS biodiversity targets
- ECOLINK corridor and NT Parks estate
- Those most likely to be impacted by climate change.
- Bio-regions currently being mapped and requiring completion

The following areas are designated as higher priority areas based on these criteria (Appendix 7-8). They are essentially the areas where most development is occurring or will occur. These areas should be mapped first. A brief costing exercise for the Darwin Region is provided in Appendix 9.

Table 11 Priorities for future mapping

IBRA sub-region	River Catchments
Darwin Coastal	Adelaide River
Pine Creek	Daly River*[1]
Daly Basin*[1]	Finniss / Elizabeth / Howard Rivers
Victoria Bonaparte P1	Mary River
Tiwi-Cobourg P2	Wildman River
Western Finke**[2]	Finke river NT

Sturt Plateau P3	Roper river
*Mapped RIS2005/121	
** To complete Finke bio-region .Eastern Finke mapped RIS2007/167	

4.3 Mapping Methodologies

The mapping techniques used for the individual surveys are explained in the reports produced for each vegetation survey. The merits of the different approaches are not discussed in detail here. However the primary or at least initially approach for future large area mapping will utilise Landsat as per the Eastern Finke method. This has advantages in terms of cost, economies of scale, is relatively simple and repeatable and can be undertaken with relative minimal skill set. Landsat also has the ability to deliver at the 1:100,000 scale although does not deliver community structure well, necessitating a large amount of site data.

Particular vegetation types (e.g. seasonally inundated floodplains) will require additional and/or different techniques. Technology is also evolving rapidly and multi time series approaches are becoming more practically available and may complement the current mapping technique in the future.

4.4 Staff resources

The number of staff required for any future mapping program will depend on the approach taken. The best case scenario approach would require a large number of experienced staff.

Four people have been contracted on RIS2005/121 and RIS2007/167 funding to produce the vegetation mapping of the Daly Basin catchment, McArthur River catchment and the Eastern Finke bio-region. Significant in kind support has also been provided by permanent staff within the NTG.

A significant amount of expertise has been built up during the life of both RIS projects. A number of new techniques have been trialled and proved successful. A notable degree of dedication has been shown by all staff involved with the project in order to meet the targets and timelines. At this point in time considerable expertise resides within the NT government, either as permanent employees or on contract for any future mapping exercise.

Those currently on contract will cease employment on 4th February 2009.

5. Conclusions

The overall conclusion is that the most efficient and cost effective way forward to produce a 1:100,000 scale map of vegetation communities of the whole NT, within a reasonable timeframe, is to set up vegetation group specifically tasked with the job, with sufficient funds to complete the task within 5 or 6 years.

Expertise currently resides within the NT government to achieve this although extra staff, funds and collaborative partnerships would need to be sort from external sources.

There is also a large amount of existing data that can be used to inform and assist any future mapping exercise.

6. References

Brocklehurst, P. Sparrow, B. Wilson, B. & Clark, M. (2008) *'Scoping Paper: A Finer Scale Vegetation Map for the Northern Territory'*). Technical Report 23/2008D Land and Vegetation Branch, NRETAS, Darwin NT.

Brocklehurst, P. & Gibbons, A. (2003) *The Northern Territory and Commonwealth of Australia National Vegetation Information and Analysis – NT Vegetation Compendium Project Report.* Department of Infrastructure Planning and Environment, Natural Systems Division, Palmerston, Northern Territory.

Cuff N, Thompson T, Sparrow B, Brocklehurst P.(2009), *Vegetation Survey and Mapping of the McArthur River Catchment*. Technical Report XXXXXD, Department of Natural Resources, Environment, The Arts and Sport, Northern Territory of Australia.

Sparrow B, Leitch E (2009), *Vegetation Survey and Mapping of the Eastern Finke Bio-Region.*. Technical Report XXXXXD, Department of Natural Resources, Environment, The Arts and Sport, Northern Territory of Australia.

Peel L (2009), *Daly Basin Vegetation survey*. Technical Report XXXXXD, Department of Natural Resources, Environment, The Arts and Sport, Northern Territory of Australia.

Richardson, K & Lynch, D (2008) *Native Vegetation Extent Baseline & Monitoring Project.* NT Department of Natural Resources Environment and the Arts (NRETA), Darwin NT

Wilson, B.A., Brocklehurst, P.S., Clark, M.J. and Dickinson, K.J.M. (1990*). Vegetation Survey of the Northern Territory, Australia.* Technical Report No. 49, Conservation Commission of the Northern Territory.

Appendix 1

Cost Breakdown: McArthur River Survey

Cost figures for the McArthur river survey were determined based on actual timelines as well as for an extended field component to bring it in line with the Finke survey methodology that requires a large number of field sites.

Duration (mths)	8
Area (km2)	20000

Summary

Component	$ 000 Actual (%budget)	Extended field component	Mean	NT wide breakdown $m
Salaries	122 (70.6)	122 (63.5)	67.1	8.2
Field	32.8 (19)	49.1 (25.5)	22.3	2.7
Equipment/Imagery	6 (3.4)	6 (3.1)	3.3	0.40
Vehicle hire	3 (1.7)	6 (3.1)	2.4	0.298
Computer lease	8.8 (5)	8.8 (4.6)	4.8	0.594
	172.6 or $8.6 per km	**191.9 or $ 9.5 per km**	**6.9**	
Time days per km^2	0.02	0.02	0.02	
Total NT	11.6 million	12.9 million	**12.3 m**	
This buys one team of three salaries for 26 years time required about 30 years				

Salaries

Staff	task	Time (work days)	Salary NTG	Private (office)
P2 – 4 months :	data prep/analysis/admin	80	34	80 (P2 @ $1000/day)
P1- 8.0 months	Field/office/report	160	45.6	160 (P1 @ $800/day)
T2- 8.0 months	Map interpretation/report/field assistant	160	42.4	160 (P1 @ $800/day)
Total		400 man days	122	336
		soil scientist@8months	45.6	

Field component

Expense	Actual	extended field component	Private rate
TA (2xP1-2.5 months 133 days $85.1/day)	11318	22636	At $1500/day for 9.5 weeks
Fuel Diesel	8000	12000	Gulf actual
Repairs	2000	4000	
	21318 ($2244/week)	38636	99,750 ($10,500/week)
Helicopter	7000	10000	7000
Airfares	1000	0	1000
Traditional Owners	3500	3500	3500
Total	32818	49136	111.250
* Double field component: TA double but other figures estimated			
Soil scientist: 38636			

Equipment:

Sundries,PDAs etc	$2000
Imagery processing	$4000

Addition of Soil scientist = +$80,000

Staff	$
P1- 8.0 months salary	45600
TA (2xP1-2.5 months 133 days $85.1/day)	11318
Fuel Diesel	8000
Repairs	2000
Equipment	6000
Computer lease (@ $550 8 months)	4400
Vehicle lease (2.5 months)	3000
Total	**80318**
+$172k for team	**252k**

Appendix 2: Cost Breakdown: Eastern Finke bio-region Survey

Duration (mths)	11
Area (km2)	37740

Summary

	$k NTG		%budget
Salaries	203.9		79.1
Field (non salary)	27.37		10.6
Equipment/Imagery	10		3.9
Computer lease (2 @ 8months)	12.1		4.7
Vehicle lease (2.5 months)	4.2		1.7
TOTAL	**257.57**		**100**
Cost per km^2:	6.9		
Cost per month*:	23.41		
Work days per km^2	0.018		
Whole NT	**$9.2 million**		
*based on 11 months duration or 675 man days Landsat purchase price taken off			

Salary

Staff	task	Time (work days)	Salary NTG
P2 – 39 weeks /9.75 months	data prep/analysis/admin	195	82.9
P1- 48 weeks /11 months	Field/office/report	240	62.7
T2- 48 weeks /11 months	Map interpretation/report/field assistant	240	58.3
Total		**675 man days**	**203.9**

Field/ Equipment/Leasing

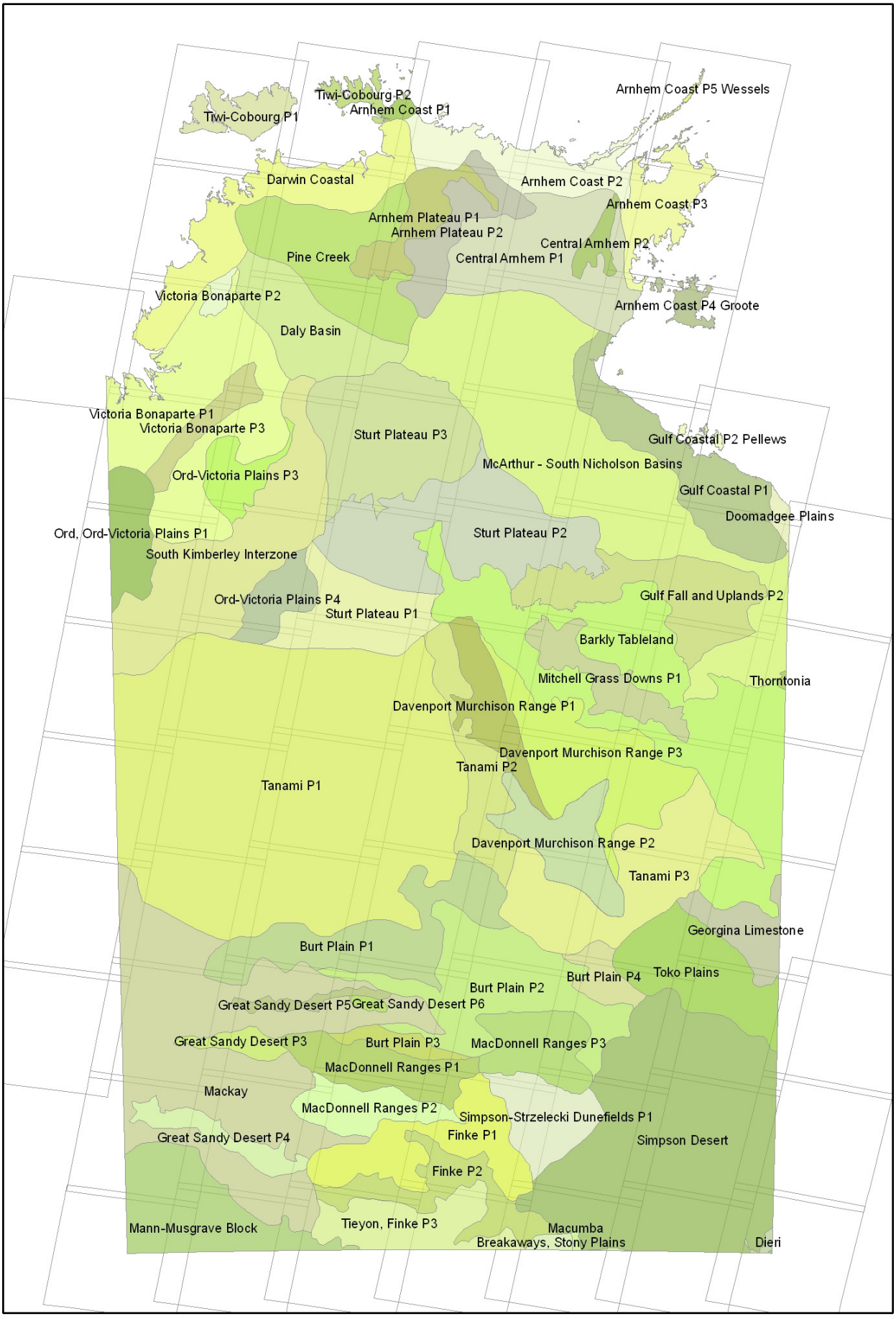
		$
Field	TA (P2/P1/T2) 200 days $86/day)	17620
	Fuel Diesel	3750
	Repairs	3000
	Traditional Owners	3000
Equipment	Field/survey Equipment	5000
	Sundries	2000
	Imagery (download/processing)	3000
	Leasing	
Leasing	Computer lease (2x11 months@ 550/mth)	12100
	Vehicle lease (3.5 months@ 1200/mth-field survey only	4200
	Total	**53670**

Task breakdown

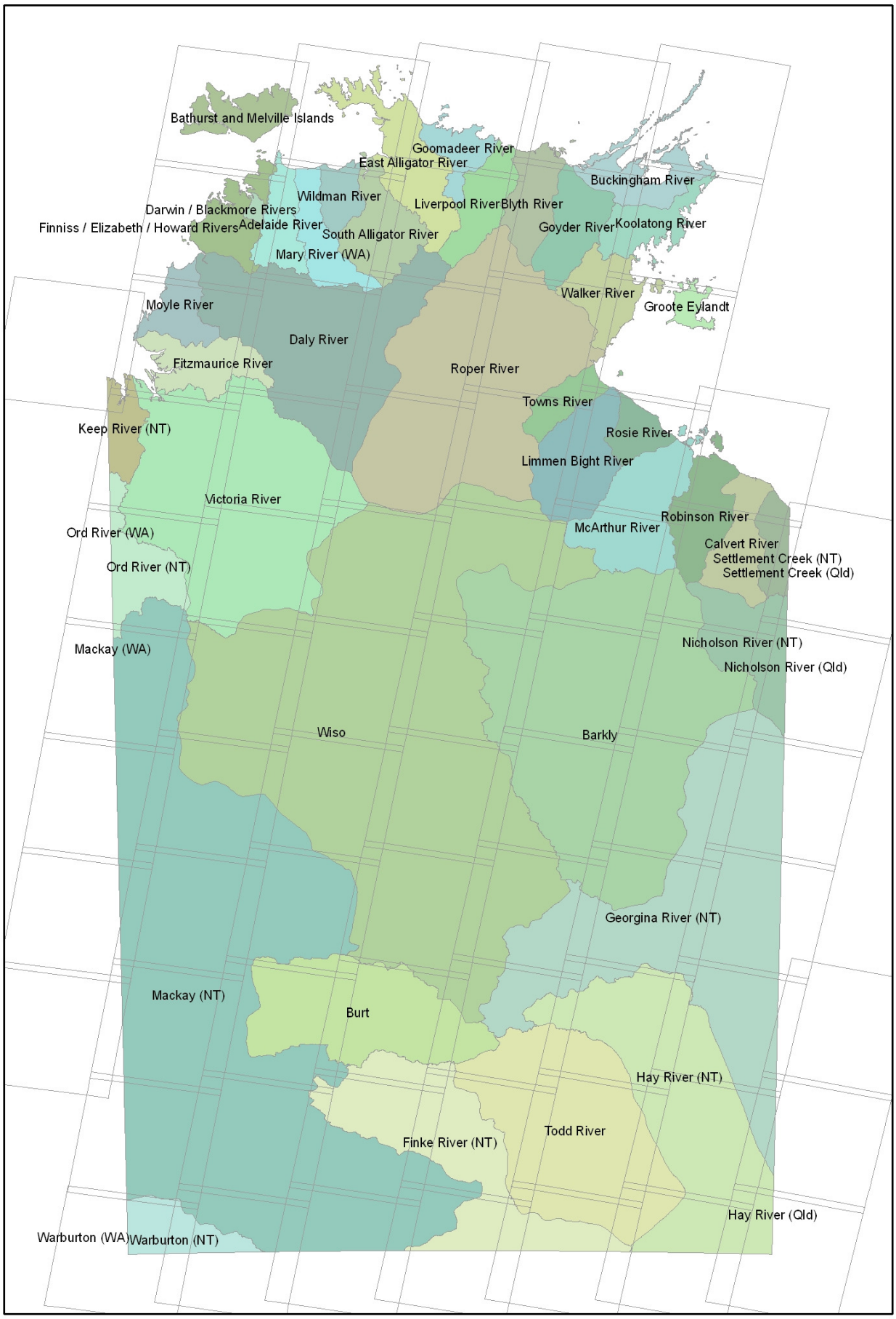
Figures in weeks	P2	P1	T2	sum	%time
Satelite imagery Preparation	3	0	0	3	2.22
Field Data Preparation	2		0	2	1.48
Field Work (includes prep, Cleanup and TOIL)	6	35	35	76	56.30
Data Entry	0	0	0	0	0.00
Data Polishing	3	2.5	2	7.5	5.56
Herbarium ID's	0	4	2	6	4.44

Data Analysis – Statistics	5			5	3.70
Map Classification	6			6	4.44
Final Map production	2			2	1.48
Report writing	5	1	3.5	9.5	7.04
Leave	4	5.5	5.5	15	11.11
Supervision	3			3	2.22
Totals	39	48	48	135	100.00

Appendix 3: IBRA sub-regions



Appendix 4 River Catchments



Appendix 5 Indicative Costs: Bio-regions and River Catchments

NOTE:

- Costings are 'indicative' and were produced to enable breakdown of the total Territory wide figure.
- Efficiencies/economies of scale should reduce the costs per kilometre in the larger areas (rather than costs shown here).
- Doing projects on an individual basis (e.g. one bio-region at a time) greatly increases overall costs.
- Any survey however small will entail a certain amount of fixed costs.

Costs determined on an area basis as well as a time basis. Fields contained in the following tables include

Estimates on per km basis (straight calculation)
Costings based on $/kilometre ($8.3/km)and time/kilometre (0.0193) basis, using values calculated from Gulf and Finke surveys as per parameters section 3.1.2. Straight calculation based on area (km^2)

This method tends to underestimate small areas and over estimate the larger areas. A fixed cost for the smaller area mapping was incorporated in the figures to address the small areas. Large areas are still over estimates.

Estimated cost including fixed costs and formulae		
Area	Time	Salary + Operational
1-2000	3 months	80,00
2001-10000	6 months	161
10,000 +	An equation was then used to determine figures for areas greater than 10,000 km^2. Cost minimum (per km based) = ((area-10000xcost per kilometre)+ fixed cost) Cost maximum: (time based) = ((area-10000xtimedays per kilometre)+ fixed cost)	

Estimated maximum and minimum cost for each bio-region and river catchment have been determined. True costs should fall within this range. Costing based on an established operating team. These **two fields** are the main fields to use in the following tables.

Summary Table: Total costs for NT wide vegetation survey using all cost breakdowns:

Area	How	$ million	
		minimum	maximum
NT Wide	Tasked Vegetation Mapping Group	6.3+	
	Progressive mapping 1 team	$ 11.2 m	
Individual regions-one off projects	IBRA bio-regions	13.2	19.4
	IBRA sub-regions	16.7	23.7
	River Basins	14.8	20

IBRA bio-regions

IBRA_Region	Area	Landsat		Estimates on per km basis (straight calculation)				Estimated cost including fixed costs and formulae ($000)		Subjective Estimate Time	
		Lsno	Lscost	$000cost/km (area @ 8.3) + landsat cost	workdays Man work days (area@0.019)	calendar calendar months (team)		**Cost minimum** $costs by area +fixed cost*	**Cost maximum** $costs by time + fixed cost	months Team of three	years
Arnhem Coast	33317.81	7	3850	276.53	643.03	14.25		354.54	544.38	18.00	1.5
Arnhem Plateau	23060.23	5	2750	191.39	445.06	9.87		269.40	426.35	12.00	1.0
Burt Plain	73797.18	9	4950	612.51	1424.29	31.57		690.52	1010.17	30.00	2.5
Central Arnhem	34623.71	5	2750	287.37	668.24	14.81		365.38	559.41	18.00	1.5
Central Ranges	25806.55	5	2750	214.19	498.07	11.04		292.19	457.95	15.00	1.3
Channel Country	23277.34	4	2200	193.20	449.25	9.96		271.20	428.85	12.00	1.0
Daly Basin	20922.29	4	2200	173.65	403.80	8.95		251.66	401.75	12.00	1.0
Darwin Coastal	28423.81	6	3300	235.91	548.58	12.16		313.92	488.07	15.00	1.3
Davenport Murchison Ranges	58051.09	7	3850	481.82	1120.39	24.84		559.82	828.98	26.00	2.2
Finke	54257.65	6	3300	450.33	1047.17	23.21		528.34	785.33	24.00	2.0
Great Sandy Desert	99854.92	10	5500	828.79	1927.20	42.72		906.80	1310.01	48.00	4.0
Gulf Coastal	27105.20	5	2750	224.97	523.13	11.60		302.97	472.89	15.00	1.3
Gulf Fall and Uplands	112587.09	8	4400	934.47	2172.93	48.17		1012.47	1456.52	44.00	3.7
Gulf Plains	1471.23	2	1100	12.21	28.39	0.63		161.00	161.00	6.00	0.5
MacDonnell Ranges	39294.45	8	4400	326.143	758.38	16.81		404.14	613.15	18.00	1.5
Mitchell Grass Downs	93073.49	2	1100	772.51	1796.32	39.82		850.51	1231.98	36.00	3.0
Mount Isa Inlier	225.82	1	550	1.87	4.36	0.10		80.00	80.00	3.00	0.3
Ord Victoria Plain	70428.19	6	3300	584.55	1359.26	30.13		662.55	971.40	30.00	2.5
Pine Creek	28517.76	5	2750	236.69	550.39	12.20		314.70	489.15	15.00	1.3
Simpson Strzelecki Dunefields	105342.79	10	5500	874.34	2033.12	45.07		952.35	1373.16	48.00	4.0
Stony Plains	1696.91	1	550	14.08	32.75	0.73		161.00	161.00	6.00	0.5
Sturt Plateau	98575.33	10	5500	818.17	1902.50	42.17		896.18	1295.29	36.00	3.0
Tanami	229811.43	17	9350	1907.43	4435.36	98.32		1985.43	2805.39	48.00	4.0
Tiwi Cobourg	10104.42	2	1100	83.86	195.02	4.32		161.87	277.27	8.00	0.7
Victoria Bonaparte	54097.61	7	3850	449.01	1044.08	23.14		527.01	783.49	24.00	2.0
Total	**1347724.30**	152.00	83600.00	**11186.11**	26011.08	576.58		**13275.94**	**19412.93**	567.00	**47.3**

IBRA sub-regions

River basin	Area (km^2)	Landsat		Estimates on per km basis (straight calculation)				Estimated cost including fixed costs and formulae ($000)		Subjective Estimate Time years	
		number	$cost	$ 0000 Cost (area @ 8.3) + landsat cost	Time required Man work days (area@0.019)	Time required calendar months (team)		**Cost minimum** $costs by area +fixed cost*	**Cost maximum** $costs by time + fixed cost	team of three	
Arnhem Coast P1	1128	1	550	9.92	21.4	0.48		161.00	161.00	6	0.5
Arnhem Coast P5 Wessels	519	1	550	4.86	9.9	0.22		80.00	80.00	3	0.3
Arnhem Coast P4 Groote	2664	2	1100	23.21	50.6	1.12		161.00	161.00	6	0.5
Arnhem Coast P3	11582	2	1100	97.23	220.1	4.88		174.13	292.21	7	0.6
Arnhem Coast P2	17424	4	2200	146.82	331.1	7.34		222.62	358.38	9	0.8
Arnhem Plateau P1	10386	3	1650	87.86	197.3	4.37		164.21	278.65	7	0.6
Arnhem Plateau P2	12674	4	2200	107.39	240.8	5.34		183.19	304.57	7	0.6
Burt Plain P1	29311	7	3850	247.13	556.9	12.34		321.28	493.03	18	1.5
Burt Plain P3	3910	2	1100	33.55	74.3	1.65		161.00	161.00	6	0.5
Burt Plain P4	5266	2	1100	44.80	100.0	2.22		161.00	161.00	6	0.5
Burt Plain P2	35311	5	2750	295.83	670.9	14.87		371.08	561.00	18	1.5
Central Arnhem P1	31379	4	2200	262.65	596.2	13.22		338.45	516.46	18	1.5
Central Arnhem P2	3245	1	550	27.48	61.6	1.37		161.00	161.00	6	0.5
Mann-Musgrave Block	25807	5	2750	216.94	490.3	10.87		292.19	453.33	15	1.3
Toko Plains	23277	4	2200	195.40	442.3	9.80		271.20	424.68	13	1.1
Daly Basin	20922	4	2200	175.86	397.5	8.81		251.66	398.01	12	1.0
Darwin Coastal	28424	6	3300	239.22	540.1	11.97		313.92	482.98	15	1.3
Davenport Murchison Range P1	12186	3	1650	102.80	231.5	5.13		179.15	299.05	7	0.6
Davenport Murchison Range P2	15896	3	1650	133.59	302.0	6.69		209.94	341.07	8	0.7
Davenport Murchison Range P3	29969	5	2750	251.49	569.4	12.62		326.74	500.49	18	1.5
Finke P1	22571	3	1650	188.99	428.8	9.51		265.34	416.68	12	1.0
Finke P2	15203	5	2750	128.93	288.9	6.40		204.18	333.22	8	0.7
Tieyon, Finke P3	16484	3	1650	138.47	313.2	6.94		214.82	347.73	8	0.7
Great Sandy Desert P3	3757	3	1650	32.83	71.4	1.58		161.00	161.00	6	0.5
Mackay	85145	10	5500	712.20	1,617.8	35.86		784.70	1125.52	36	3.0
Great Sandy Desert P6	829	1	550	7.43	15.8	0.35		80.00	80.00	3	0.3
Great Sandy Desert P5	2895	2	1100	25.13	55.0	1.22		161.00	161.00	6	0.5

Great Sandy Desert P4	7228	2	1100	61.10	137.3	3.04		161.00	161.00	6	0.5
Gulf Coastal P1	26419	4	2200	221.48	502.0	11.13		297.28	460.27	15	1.3
Gulf Coastal P2 Pellews	686	2	1100	6.80	13.0	0.29		80.00	80.00	3	0.3
Gulf Fall and Uplands P2	25170	4	2200	211.11	478.2	10.60		286.91	446.12	14	1.2
McArthur – South Nicholson Basins	87417	8	4400	729.96	1,660.9	36.82		803.56	1151.26	36	3.0
Doomadgee Plains	1471	2	1100	13.31	28.0	0.62		161.00	161.00	6	0.5
MacDonnell Ranges P1	14840	5	2750	125.92	282.0	6.25		201.17	329.10	8	0.7
MacDonnell Ranges P2	10928	4	2200	92.90	207.6	4.60		168.70	284.79	7	0.6
MacDonnell Ranges P3	13527	3	1650	113.92	257.0	5.70		190.27	314.23	7	0.6
Georgina Limestone	9090	2	1100	76.55	172.7	3.83		161.00	161.00	6	0.5
Mitchell Grass Downs P1	11533	2	1100	96.82	219.1	4.86		173.72	291.64	7	0.6
Barkly Tableland	72451	2	1100	602.44	1,376.6	30.51		679.34	981.72	27	2.3
Thorntonia	226	1	550	2.42	4.3	0.10		80.00	80.00	3	0.3
Ord-Victoria Plains P3	7498	3	1650	63.89	142.5	3.16		161.00	161.00	6	0.5
South Kimberley Interzone	43947	6	3300	368.06	835.0	18.51		442.76	658.83	24	2.0
Ord-Victoria Plains P4	8287	2	1100	69.88	157.5	3.49		161.00	161.00	6	0.5
Ord, Ord-Victoria Plains P1	10696	2	1100	89.88	203.2	4.50		166.78	282.16	7	0.6
Pine Creek	28518	5	2750	239.45	541.8	12.01		314.70	484.05	18	1.5
Dieri	461	1	550	4.38	8.8	0.19		80.00	80.00	3	0.3
Simpson-Strzelecki Dunefields P1	13552	3	1650	114.13	257.5	5.71		190.48	314.52	7	0.6
Simpson Desert	91330	8	4400	762.44	1,735.3	38.47		836.04	1195.58	36	3.0
Macumba	386	1	550	3.75	7.3	0.16		80.00	80.00	3	0.3
Breakaways, Stony Plains	1311	1	550	11.43	24.9	0.55		161.00	161.00	6	0.5
Sturt Plateau P1	19390	5	2750	163.68	368.4	8.17		238.93	380.64	9	0.8
Sturt Plateau P3	35847	5	2750	300.28	681.1	15.10		375.53	567.08	21	1.8
Sturt Plateau P2	43338	5	2750	362.46	823.4	18.25		437.71	651.93	22	1.8
Tanami P1	177530	11	6050	1479.55	3,373.1	74.77		1551.50	2172.05	36	3.0
Tanami P2	16009	4	2200	135.07	304.2	6.74		210.87	342.35	8	0.7
Tanami P3	36272	5	2750	303.81	689.2	15.28		379.06	571.89	21	1.8
Tiwi-Cobourg P1	7487	1	550	62.69	142.2	3.15		161.00	161.00	6	0.5
Tiwi-Cobourg P2	2618	1	550	22.28	49.7	1.10		161.00	161.00	6	0.5
Victoria Bonaparte P1	45501	6	3300	380.96	864.5	19.16		455.66	676.43	24	2.0
Victoria Bonaparte P2	1706	2	1100	15.26	32.4	0.72		161.00	161.00	6	0.5
Victoria Bonaparte P3	6890	4	2200	59.39	130.9	2.90		161.00	161.00	6	0.5
	1347724	217	119350	**11305**	25606	567.62		**16706.77**	**23700.69**	710	**59**

River Catchments

River catchment	Area (km^2)	Landsat		Estimates on per km basis (straight calculation)				**Estimated cost including fixed costs and formulae ($000)**		Subjective Estimate Time years
		number	$cost	$ 0000 Cost (area @ 8.3) + landsat cost	Time required Man work days (area@0.019)	calendar months (team)		**Cost minimum** $costs by area +fixed cost*	**Cost maximum** $costs by time + fixed cost	team of three
Darwin / Blackmore Rivers	816.18	1	550	7	15.5	0.34		**161.00**	**161.00**	0.50
Groote Eylandt	2361.22	1	550	20	44.9	0.97		**161.00**	**161.00**	0.50
Wildman River	4818.11	2	1100	41	91.5	1.98		**161.00**	**161.00**	0.50
Rosie River	5044.26	1	550	42	95.8	2.08		**161.00**	**161.00**	0.50
Towns River	5432.07	3	1650	47	103.2	2.24		**161.00**	**161.00**	0.50
Settlement Creek (NT)	5493.43	2	1100	47	104.4	2.26		**161.00**	**161.00**	0.50
Goomadeer River	5683.33	2	1100	48	108.0	2.34		**161.00**	**161.00**	0.50
Keep River (NT)	6002.90	2	1100	51	114.1	2.47		**161.00**	**161.00**	0.50
Moyle River	7084.49	2	1100	60	134.6	2.92		**161.00**	**161.00**	0.50
Adelaide River	7461.69	2	1100	63	141.8	3.07		**161.00**	**161.00**	0.50
Bathurst and Melville Islands	7483.67	1	550	63	142.2	3.08		**161.00**	**161.00**	0.50
Koolatong River	7912.03	2	1100	67	150.3	3.26		**161.00**	**161.00**	0.50
Mary River	8073.54	2	1100	68	153.4	3.32		**161.00**	**161.00**	0.50
Finniss / Elizabeth / Howard Rivers	8671.05	2	1100	73	164.7	3.57		**161.00**	**161.00**	0.50
Liverpool River	8944.72	2	1100	75	169.9	3.68		**161.00**	**161.00**	0.50
Blyth River	9215.79	2	1100	78	175.1	3.79		**161.00**	**161.00**	0.50
Buckingham River	9597.60	4	2200	82	182.4	3.95		**161.00**	**161.00**	0.50
Warburton (NT)	9645.96	2	1100	81	183.3	3.97		**161.00**	**161.00**	0.50
Walker River	9730.37	4	2200	83	184.9	4.01		**161.00**	**161.00**	0.50
Calvert River	10032.69	2	1100	84	190.6	4.13		**161.27**	**272.86**	0.60
Fitzmaurice River	10373.91	2	1100	87	197.1	4.27		**164.10**	**276.66**	0.60
Goyder River	10390.54	1	550	87	197.4	4.28		**164.24**	**276.85**	0.60
Ord River (NT)	11355.49	2	1100	95	215.8	4.67		**172.25**	**287.61**	0.60
Robinson River	11369.10	2	1100	95	216.0	4.68		**172.36**	**287.76**	0.60
South Alligator River	11916.42	3	1650	101	226.4	4.91		**176.91**	**293.86**	0.60
Nicholson River (NT)	15773.11	3	1650	133	299.7	6.49		**208.92**	**336.86**	0.80
East Alligator River	15873.85	4	2200	134	301.6	6.53		**209.75**	**337.98**	0.80
Limmen Bight River	15938.24	3	1650	134	302.8	6.56		**210.29**	**338.70**	0.80
McArthur River	20021.23	2	1100	167	380.4	8.24		244.18	384.22	0.90

Burt	38823.46	4	2200	324	737.6	15.98		**400.23**	**593.85**	1.50
Finke River (NT)	43881.60	5	2750	367	833.8	18.06		**442.22**	**650.25**	1.70
Daly River	53197.09	8	4400	446	1010.7	21.90		**519.54**	**754.11**	2.00
Todd River	59636.39	7	3850	499	1133.1	24.55		**572.98**	**825.90**	2.00
Hay River (NT)	62770.65	8	4400	525	1192.6	25.84		**599.00**	**860.85**	2.20
Victoria River	78143.64	6	3300	652	1484.7	32.17		**726.59**	**<1032.25**	2.90
Roper River	79617.15	6	3300	664	1512.7	32.78		**738.82**	**<1048.68**	2.90
Georgina River (NT)	99840.90	10	5500	834	1897.0	41.10		**906.68**	**<1274.16**	4.00
Barkly	123999.69	9	4950	1034	2356.0	51.05		**1107.20**	**<1543.51**	4.00+
Mackay (NT)	215956.85	17	9350	1802	4103.2	88.90		**1870.44**	**<2568.77**	4.00+
Wiso	229310.76	15	8250	1912	4356.9	94.40		**1981.28**	**<2717.66**	4.00+
TOTAL	**1347695.17**	158.00	86900.00	**11272.77**	25606.21	554.80		**14808.25**	**<20022.34**	**47.60**
calendar months team	(Workdays/60)x1.33									
$costs by area +fixed cost*	Fixed cost of 6 months for areas 10,000km or less= (yearly slary/2)/salary component= (233/2)/.72)=161k									
	Areas greater than 10000km= (area-10000x8.3)+ 161(e.g. fixed cost)									
Costs components approximately 72.5% salary/ 27.5% operational										
20 work days a month										

Appendix 6: Landscape complexity and access constraints

	Landscape complexity					
IBRA_sub regions	Subjective Ranking*	Pattern analysis#	Vehicle access*	aircraft requirement*	ferry time*	road length(km) per km^2
Arnhem Coast P5 Wessels	1	1	poor	high	high	0.00
Dieri	1	1	poor	high	high	0.00
Macumba	1	1	medium-poor	nil	nil	0.14
Thorntonia	1	2	medium	nil	nil	0.19
Great Sandy Desert P6	1	1	good medium	nil	nil	0.02
Arnhem Coast P3	1	2	medium	low	low	0.09
Arnhem Coast P4 Groote	1	2	medium	low		0.12
Breakaways, Stony Plains	1	2	medium	nil	nil	0.15
Doomadgee Plains	1	1	good	nil	nil	0.08
Great Sandy Desert P3	1	1	medium-poor	low	low	0.05
Great Sandy Desert P4	1	1	medium-poor	low	low	0.00
Georgina Limestone	1	2	medium	nil	nil	0.15
Victoria Bonaparte P2	1	1	good	nil	nil	0.22
Arnhem Coast P1	2	1	medium-poor	low	low	0.15
Burt Plain P3	2	1	good medium	nil	nil	0.28
Great Sandy Desert P5	2	2	good medium	nil	nil	0.13
Gulf Coastal P2 Pellews	2	1	poor	high	medium	0.00
Mitchell Grass Downs P1	2	2	medium	nil	nil	0.19
Burt Plain P4	2	3	medium	nil	nil	0.18
Central Arnhem P2	2	3	medium-poor	high	medium	0.05
Davenport Murchison Range P3	2	4	medium	high	medium	0.07
Ord-Victoria Plains P3	2	4	medium-poor	high	medium	0.11
Ord-Victoria Plains P4	2	3	good	nil	nil	0.11
Sturt Plateau P1	2	2	medium	high	high	0.01
Tiwi-Cobourg P1	2	2	medium	low	low	0.07
Tiwi-Cobourg P2	2	1	medium-poor	low	low	0.11
Mann-Musgrave Block	2	2	medium-poor	low	medium	0.05
Victoria Bonaparte P3	2	4	medium	low	medium	0.12
Arnhem Coast P2	3	3	medium	low	medium	0.08
Burt Plain P1	3	2	good medium	nil	nil	0.15
Daly Basin	3	3	medium-poor	low	low	0.17
MacDonnell Ranges P2	3	2	medium-poor	low	low	0.09
MacDonnell Ranges P3	3	3	medium	low	low	0.17
Sturt Plateau P3	3	3	medium	low	medium	0.11
Tanami P3	3	4	medium-poor	high	medium	0.08
Tieyon, Finke P3	3	4	good medium	nil	nil	0.16
Gulf Fall and Uplands P2	3	3	medium-poor	low	low	0.11
Toko Plains	3	4	good medium poor	nil	nil	0.14
Barkly Tableland	3	3	good	nil	nil	0.24
Central Arnhem P1	3	4	medium-poor	high	medium	0.04
MacDonnell Ranges P1	3	3	medium-poor	low	medium	0.15
Simpson-Strzelecki Dunefields P1	3	4	medium-poor	low	medium	0.12
Arnhem Plateau P1	3	3	poor	high	medium	0.03
Arnhem Plateau P2	3	3	poor	high	medium	0.03
Davenport Murchison Range P1	3	3	medium	low	low	0.23
Davenport Murchison Range P2	3	4	medium	low		0.12
Tanami P2	3	4	medium-poor	high	high	0.12
Finke P2	3	4	medium	nil	nil	0.21
Mackay	3	3	medium	high	medium	0.04
Ord, Ord-Victoria Plains P1	3	4	good	low	low	0.14

Sturt Plateau P2	3	3	medium	low	low	0.08
Finke P1	3	3	medium	nil	nil	0.19
Gulf Coastal P1	3	3	good medium	high	medium	0.08
Pine Creek	4	4	medium	low	medium	0.15
South Kimberley Interzone	4	5	medium	low	low	0.18
Burt Plain P2	4	3	good medium	nil	nil	0.18
Tanami P1	4	4	poor	high	high	0.02
Simpson Desert	4	5	poor	high	high	0.02
Darwin Coastal	4	4	medium	low	low	0.14
McArthur – South Nicholson Basins	5	5	poor	high	high	0.08
Victoria Bonaparte P1	5	5	medium-poor	low	low	0.05
* based on subjective judgement and expert opinion: NOTE: Ranked out of 5 although rank 5 is not 5 times more difficult than 1. Rankings can also be used to determine regions of similar complexity						
# Maximum likelihood classification of Landsat, radiometrics and elevation bands						

River Basins

	Landscape complexity					
River catchment	Subjective Ranking*	Pattern analysis#	Vehicle access*	aircraft requirement*	ferry time*	road length(km) per km^2
Buckingham River	1	1	good	low	low	0.09
Groote Eylandt	1	1	medium	low	low	0.14
Koolatong River	1	1	medium	low	low	0.08
Blyth River	2	2	medium	low-high	medium	0.05
Darwin / Blackmore Rivers	2	1	good	nil	nil	0.43
Goyder River	2	2	medium poor	high	medium	0.04
Keep River (NT)	2	2	good	low	low	0.18
Liverpool River	2	2	good medium	high	medium	0.04
Moyle River	2	2	good medium	low	low	0.09
Rosie River	2	2	medium	low-high	low	0.05
Towns River	2	2	medium	low	medium	0.01
Walker River	2	1	medium	high	low	0.05
Warburton (NT)	2	2	medium poor	low-high	low	0.02
Wildman River	2	2	good	nil	nil	0.06
Goomadeer River	2	1	medium	low	low	0.03
Hay River (NT)	2	2	medium poor	low-high	high	0.05
Bathurst and Melville Islands	2	1	medium	low	low	0.08
Calvert River	2	2	medium	low	low	0.08
Fitzmaurice River	2	2	poor	high	low	0.02
Mary River	2	2	good	low	low	0.19
Ord River (NT)	2	2	good	low	low	0.14
Settlement Creek (NT)	2	2	medium	low	medium	0.09
Adelaide River	3	2	good	nil	nil	0.28
Burt	3	3	medium	low	low	0.13
East Alligator River	3	3	medium	low	medium	0.06
Finniss / Elizabeth / Howard Rivers	3	3	good	low	low	0.33
Limmen Bight River	3	3	medium poor	high	low	0.09
McArthur River	3	3	medium	low	medium	0.13
Nicholson River (NT)	3	3	medium	low	low	0.07
Robinson River	3	3	medium	low	low	0.06
South Alligator River	3	3	good medium	low	low	0.05
Georgina River (NT)	3	3	medium poor	low-high	low	0.16
Roper River	3	4	medium	low	medium	0.10
Todd River	3	3	medium	low-high	high	0.11
Daly River	4	4	medium	low	medium	0.12

Victoria River	4	4	good medium	low	medium	0.12
Barkly	4	4	good medium	low	low	0.15
Finke River (NT)	4	4	medium	low-high	low	0.15
Wiso	4	5	poor	high	high	0.06
Mackay (NT)	5	5	poor	high	high	0.05
* based on subjective judgement and expert opinion: NOTE: Ranked out of 5 although rank 5 is not 5 times more difficult than 1. Rankings can also be used to determine regions of similar complexity						
# Maximum likelihood classification of landsat, radiometrics and elevation bands						

Appendix 7: Priority Areas

IBRA sub-regions

River Catchment	Development Potential	Climate change	INRM Plan Parks Masterplan AG	Bushfires Council	Ecolink corridor	NT parks estate	total
Darwin Coastal	2	1	1	0	1	1	6
Pine Creek	2	0	1	0	1	1	5
Daly Basin	2	1	1	0	1	0	5
Victoria Bonaparte P1	0	1	1	0	1	1	4
Tiwi-Cobourg P2	0	1	1	0	1	1	4
Tanami P1	2	0	1	0	1	0	4
Gulf Coastal P1	0	1	1	1	0	1	4
Arnhem Coast P3	0	1	1	1	1	0	4
Arnhem Coast P2	0	1	1	1	1	0	4
Sturt Plateau P3	2	0	1	0	0	0	3
McArthur – South Nicholson Basins	0	0	1	1	0	1	3
MacDonnell Ranges P2	0	0	1	0	1	1	3
Doomadgee Plains	0	1	1	1	0	0	3
Central Arnhem P2	0	0	1	1	1	0	3
Central Arnhem P1	0	0	1	1	1	0	3
Arnhem Plateau P1	0	0	1	1	0	1	3
Arnhem Coast P1	0	1	1	0	1	0	3
Tiwi-Cobourg P1	0	1	1	0	0	0	2
South Kimberley Interzone	0	0	1	0	1	0	2
Ord-Victoria Plains P4	0	0	1	0	1	0	2
MacDonnell Ranges P1	0	0	1	0	0	1	2
Gulf Coastal P2 Pellews	0	1	1	0	0	0	2
Great Sandy Desert P6	0	0	1	0	1	0	2
Great Sandy Desert P5	0	0	1	0	1	0	2
Finke P1	0	0	1	0	1	0	2
Davenport Murchison Range P2	0	0	1	0	0	1	2
Burt Plain P2	0	0	1	0	1	0	2
Burt Plain P1	0	0	1	0	1	0	2
Arnhem Plateau P2	0	0	1	1	0	0	2
Arnhem Coast P5 Wessels	0	1	1	0	0	0	2
Arnhem Coast P4 Groote	0	1	1	0	0	0	2
Victoria Bonaparte P3	0	0	1	0	0	0	1
Victoria Bonaparte P2	0	0	1	0	0	0	1
Toko Plains	0	0	1	0	0	0	1
Tieyon, Finke P3	0	0	1	0	0	0	1
Thorntonia	0	0	1	0	0	0	1
Tanami P3	0	0	1	0	0	0	1
Tanami P2	0	0	1	0	0	0	1
Sturt Plateau P2	0	0	1	0	0	0	1
Sturt Plateau P1	0	0	1	0	0	0	1
Simpson-Strzelecki Dunefields P1	0	0	1	0	0	0	1
Simpson Desert	0	0	1	0	0	0	1
Ord-Victoria Plains P3	0	0	1	0	0	0	1
Ord, Ord-Victoria Plains P1	0	0	1	0	0	0	1
Mitchell Grass Downs P1	0	0	1	0	0	0	1
Mann-Musgrave Block	0	0	1	0	0	0	1
Macumba	0	0	1	0	0	0	1
Mackay	0	0	1	0	0	0	1
MacDonnell Ranges P3	0	0	1	0	0	0	1

Gulf Fall and Uplands P2	0	0	1	0	0	0	1
Great Sandy Desert P4	0	0	1	0	0	0	1
Great Sandy Desert P3	0	0	1	0	0	0	1
Georgina Limestone	0	0	1	0	0	0	1
Finke P2	0	0	1	0	0	0	1
Dieri	0	0	1	0	0	0	1
Davenport Murchison Range P3	0	0	1	0	0	0	1
Davenport Murchison Range P1	0	0	1	0	0	0	1
Burt Plain P4	0	0	1	0	0	0	1
Burt Plain P3	0	0	1	0	0	0	1
Breakaways, Stony Plains	0	0	1	0	0	0	1
Barkly Tableland	0	0	1	0	0	0	1

River Basins

River basin	Development Potential	Climate change	INRM Plan Parks Masterplan AG	Bushfires Council	Ecolink corridor	NT parks estate	total
Adelaide River	2	1	1	0	1	1	6
Daly River	2	1	1	0	1	1	6
Finniss / Elizabeth / Howard Rivers	2	1	1	0	1	1	6
Mary River	2	1	1	0	1	1	6
Wildman River	2	1	1	0	1	1	6
East Alligator River	0	1	1	1	1	1	5
Bathurst and Melville Islands	2	1	1	0	0	0	4
Blyth River	0	1	1	1	1	0	4
Darwin / Blackmore Rivers	2	1	1	0	0	0	4
Keep River (NT)	0	1	1	0	1	1	4
Limmen Bight River	0	1	1	1	0	1	4
Roper River	0	1	1	1	1	0	4
Victoria River	0	1	1	1	1	0	4
Buckingham River	0	1	1	1	0	0	3
Finke River (NT)	0	0	1	0	1	1	3
Goyder River	0	1	1	0	1	0	3
Koolatong River	0	1	1	1	0	0	3
Liverpool River	0	1	1	1	0	0	3
Mackay (NT)	0	0	1	0	1	1	3
Settlement Creek (NT)	0	1	1	1	0	0	3
South Alligator River	0	1	1	0	0	1	3
Towns River	0	1	1	0	0	1	3
Barkly	0	0	1	0	0	1	2
Burt	0	0	1	0	1	0	2
Calvert River	0	0	1	1	0	0	2
Fitzmaurice River	0	1	1	0	0	0	2
Goomadeer River	0	1	1	0	0	0	2
Groote Eylandt	0	1	1	0	0	0	2
McArthur River	0	1	1	0	0	0	2
Moyle River	0	1	1	0	0	0	2
Nicholson River (NT)	0	0	1	1	0	0	2
Robinson River	0	1	1	0	0	0	2
Rosie River	0	1	1	0	0	0	2
Walker River	0	1	1	0	0	0	2
Georgina River (NT)	0	0	1	0	0	0	1
Hay River (NT)	0	0	1	0	0	0	1
Ord River (NT)	0	0	1	0	0	0	1
Todd River	0	0	1	0	0	0	1
Warburton (NT)	0	0	1	0	0	0	1
Wiso	0	0	1	0	0	0	1

Appendix 8 Pre-dominant Land-use and remaining native vegetation extent (circa 2004)

IBRA sub-regions

Bio-region	Predominant Land-use	%native*
Daly Basin	Horticulture, Pastoralism, Conservation and Natural Environments, Traditional Indigenous Uses	**88.8**
Sturt Plateau	Pastoralism, Conservation and Natural Environments,Traditional Indigenous Uses	**88.8**
Darwin Coastal	Horticulture, Pastoralism, Conservation and Natural Environments, Traditional Indigenous Uses	**93.9**
Pine Creek	Pastoralism, Conservation and Natural Environments,Traditional Indigenous Uses	**97**
Tiwi Cobourg	Conservation and Natural Environments, Traditional Indigenous Uses	**98**
Victoria Bonaparte	Pastoralism, Conservation and Natural Environments, Traditional Indigenous Uses	99.1
Burt Plain	Pastoralism, Conservation and Natural Environments, Traditional Indigenous Uses	99.4
Finke	Pastoralism	99.4
Gulf Coastal	Conservation and Natural Environments, Traditional Indigenous Uses, Pastoralism	99.4
Gulf Coastal	Pastoralism	99.4
Arnhem Coast	Conservation and Natural Environments, Traditional Indigenous Uses	99.5
MacDonnell Ranges	Conservation and Natural Environments, Traditional Indigenous Uses, Pastoralism	99.5
Stony Plains	Pastoralism	99.5
Ord Victoria Plain	Pastoralism, Conservation and Natural Environments,Traditional Indigenous Uses	99.7
Channel Country	Conservation and Natural Environments, Traditional Indigenous Uses, Pastoralism	99.8
Davenport Murchison Ranges	Pastoralism, Conservation and Natural Environments,Traditional Indigenous Uses	99.8
Arnhem Plateau	Conservation and Natural Environments, Traditional Indigenous Uses	99.9
Central Arnhem	Conservation and Natural Environments, Traditional Indigenous Uses	99.9
Central Ranges	Conservation and Natural Environments, Traditional Indigenous Uses	99.9
Gulf Fall and Uplands	Conservation and Natural Environments, Traditional Indigenous Uses, Pastoralism	99.9
Mitchell Grass Downs	Pastoralism	99.9
Simpson Strzelecki Dunefields	Pastoralism	99.9
Tanami	Conservation and Natural Environments, Traditional Indigenous Uses	99.9
Great Sandy Desert	Conservation and Natural Environments, Traditional Indigenous Uses, Pastoralism	100
Gulf Plains	Pastoralism	100
Mount Isa Inlier	Pastoralism	100
*Richardson & Lynch (2008)		

River Basins

River catchment	Predominant Landuse	%Native*
Darwin / Blackmore Rivers	Intensive Uses-urban,residential,infrastructure etc/Agriculture, Horticulture, Plantations	**77.50%**
Finniss / Elizabeth / Howard Rivers	Intensive Uses-urban,residential,infrastructure etc/Agriculture, Horticulture, Plantations	**88.60%**
Adelaide River	Intensive uses, Horticulture/Pastoralism/Conservation and Natural Environments,Traditional Indigenous Uses	**92.50%**
Daly River	Intensive uses, Horticulture/Pastoralism/Conservation and Natural Environments,Traditional Indigenous Uses	**94.20%**
Mary River	Intensive uses, Horticulture/Pastoralism/Conservation and Natural Environments,Traditional Indigenous Uses	**96.40%**
Bathurst and Melville Islands	Conservation and Natural Environments,Traditional Indigenous Uses/Agriculture, Horticulture, Plantations	**97.30%**
Wildman River	Intensive uses, Horticulture/Pastoralism/Conservation and Natural Environments,Traditional Indigenous Uses	**98.40%**
Groote Eylandt	Conservation and Natural Environments,Traditional Indigenous Uses	**98.80%**
Moyle River	Conservation and Natural Environments,Traditional Indigenous Uses/Pastoralism	99.00%
Buckingham River	Conservation and Natural Environments,Traditional Indigenous Uses	99.20%
Finke River (NT)	Intensive uses, Horticulture/Pastoralism/Conservation and Natural Environments,Traditional Indigenous Uses	99.30%
Roper River	Conservation and Natural Environments,Traditional Indigenous Uses/Pastoralism	99.40%
South Alligator River	Conservation and Natural Environments,Traditional Indigenous Uses	99.40%
Keep River (NT)	Conservation and Natural Environments,Traditional Indigenous Uses/ Pastoralism	99.50%
East Alligator River	Conservation and Natural Environments,Traditional Indigenous Uses	99.60%
Todd River	Intensive uses, Horticulture/Pastoralism/Conservation and Natural Environments,Traditional Indigenous Uses	99.60%

Victoria River	Pastoralism/Conservation and Natural Environments,Traditional Indigenous Uses	99.60%
Hay River (NT)	Pastoralism/Conservation and Natural Environments,Traditional Indigenous Uses	99.70%
Limmen Bight River	Conservation and Natural Environments,Traditional Indigenous Uses	99.70%
McArthur River	Pastoralism/Conservation and Natural Environments,Traditional Indigenous Uses	99.70%
Ord River (NT)	Pastoralism/Conservation and Natural Environments,Traditional Indigenous Uses	99.70%
Robinson River	Conservation and Natural Environments,Traditional Indigenous Uses/Pastoralism	99.70%
Blyth River	Conservation and Natural Environments,Traditional Indigenous Uses	99.80%
Burt	Conservation and Natural Environments,Traditional Indigenous Uses/Pastoralism	99.80%
Calvert River	Conservation and Natural Environments,Traditional Indigenous Uses/Pastoralism	99.80%
Fitzmaurice River	Conservation and Natural Environments,Traditional Indigenous Uses	99.80%
Georgina River (NT)	Intensive uses, Horticulture/Pastoralism/Conservation and Natural Environments,Traditional Indigenous Uses	99.80%
Goomadeer River	Conservation and Natural Environments,Traditional Indigenous Uses	99.80%
Goyder River	Conservation and Natural Environments,Traditional Indigenous Uses	99.80%
Koolatong River	Conservation and Natural Environments,Traditional Indigenous Uses	99.80%
Liverpool River	Conservation and Natural Environments,Traditional Indigenous Uses	99.80%
Walker River	Conservation and Natural Environments,Traditional Indigenous Uses	99.80%
Wiso	Conservation and Natural Environments,Traditional Indigenous Uses/Pastoralism	99.80%
Barkly	Pastoralism/Conservation and Natural Environments,Traditional Indigenous Uses	99.90%
Mackay (NT)	Conservation and Natural Environments,Traditional Indigenous Uses/ Pastoralism	99.90%
Nicholson River (NT)	Conservation and Natural Environments,Traditional Indigenous Uses/Pastoralism	99.90%
Rosie River	Conservation and Natural Environments,Traditional Indigenous Uses/Pastoralism	99.90%
Towns River	Conservation and Natural Environments,Traditional Indigenous Uses	99.90%
Settlement Creek (NT)	Pastoralism	100.00%
Warburton (NT)	Conservation and Natural Environments,Traditional Indigenous Uses	100.00%
*Richardson & Lynch (2008)		

Appendix 9 Darwin Regional Survey: Indicative Costs

A large amount of mapping and descriptive information already exists over this region. Essentially the process would be to compile and re-interpret all the information to the one map base-one classification. It would probably not require a great deal of field work. The GIS component would probably by significant.

Costs based on NTG doing the job.

Area & Costing

Area	Km^2
Adelaide River	7462
Darwin / Blackmore Rivers	816
Finniss / Elizabeth / Howard Rivers	8671
Mary River	8074
Wildman River	4818
Total	**29841**
Staff	$ 000
P2	151.00
P1	102.00
P1	102.00
Operational	
Field TA	7.20
computer	19.80
vehicle (field only)	2.00
equipment	3.00
	387.00
Timeframe	Years
	1.5

Work Flow

Task	Timeframe (months)					
	1-3	3-6	6-9	9-12	12-15	15-18
Setup						
Image preparation						
Compile existing descriptive data						
Compile existing GIS data						
Field Survey						
Data analysis						
Map classification/standardisation						
Report/Map production						