internal report **305**

Dry and Wet season aerial reconnaissance of Magela Creek and East Alligator River, with brief notes on the geomorphology of the area

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October 1998

supervising scientist

Dry and Wet Season Aerial Reconnaissance of Magela Creek and East Alligator River, With Brief Notes on the Geomorphology of the Area

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ENVIRONMENTAL RESEARCH INSTITUTE OF THE SUPERVISING SCIENTIST

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1.0 Introduction

Between 24/5/97 and 8/6/97, Dr Wayne Erskine, University of New South Wales, visited the Erosion and Hydrology Group at ***eriss*** to investigate future research projects. The broad title of his project was originally listed as the "Quantification of Solute and Particulate Loads Discharged from Natural and Rehabilitated Landforms at Ranger Uranium Mine". However this was changed during the visit to "Assessment of the Off-Site Geomorphic Impacts of Uranium Mining on Magela Creek". A further investigation of the magnitude and frequency of large rainfall and flood events was incorporated into the project.

As part of the visit, an aerial reconnaissance of Magela Creek and the East Alligator River was undertaken using a Bell Jet-Ranger helicopter. A further visit was arranged between 14/2/98 and 28/2/98 to complete the collation of information for a supervising scientist report which proposes future research. A helicopter trip to follow the same route, as was flown during the dry season, was organised and flown. The two trips allow comparisons to be made of Dry and Wet season conditions.

This Internal Report describes both flights and comments on the photographs and slides that were taken. Notes on the geomorphology have been added to highlight particular landforms and their significance. The senior author was responsible for the photography.

2.0 Background

The Dry season flight departed from Jabiru Airport at approximately 0930 hours on Monday 2 June 1997. On board were
Wayne Erskine (UNSW),
Mike Saynor (***eriss***),
Ken Evans (***eriss***),
Dene Moliere (***eriss***), and
Ian Harris (Pilot - Rotor Services).

The flight lasted approximately 2 hours with the route shown in Figure 1. It involved circling the ERA Ranger Mine then a flight down Magela Creek to the East Alligator River, up the East Alligator River to the gorge country and then back to Jabiru via Magela Falls. The helicopter landed on a sand bar in the gorge section of the East Alligator River for approximately 15 minutes to inspect some slackwater deposits.

The Wet season flight departed from Jabiru Airport at approximately 1000 hours on Sunday 22 February 1998. On board were
Wayne Erskine (UNSW),
Mike Saynor (***eriss***),
Bernard Prendergast (***eriss***),
Garry Willgoose (The University Newcastle), and
Des Rose (Pilot - Rotor Services).

The flight lasted just under 2 hours with the route following a similar path to the earlier trip (Figure 1).

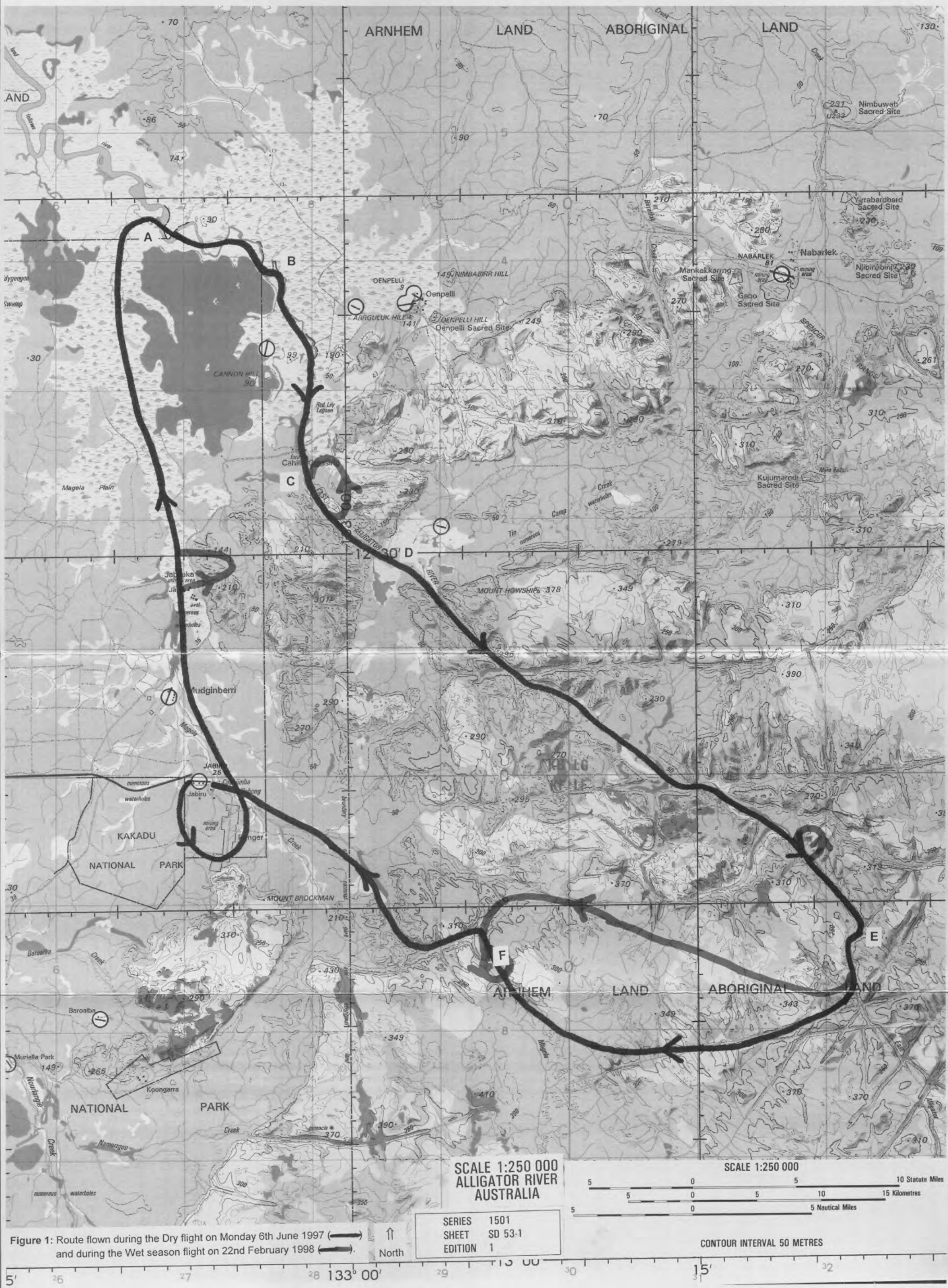

Figure 1: Route flown during the Dry flight on Monday 6th June 1997 (——) and during the Wet season flight on 22nd February 1998 (——).

3.0 Photographic Equipment used.

Dry season flight

One roll of slide film (36 x 100 ASA Fujichrome) was taken using a Cannon EOS 500 with a 28 to 80 mm lens. Unfortunately this was the only camera used and, as there were problems with the battery, only 1 roll of film was taken.

Wet season flight

Six rolls of slide film (24 x 200 ASA Kodak Elite) were taken using a Cannon EOS 500 with a 28 to 105 mm lens. Five rolls of print film (mainly 24 X 200 ASA Konica) were also taken using a Cannon EOS 500 with a 28 to 80 mm lens.

4.0 Flight Path Details

The flight was used to obtain information about the Geomorphology around the Energy Resources of Australia Ranger Mine (ERARM), Magela Creek and the East Alligator River.

The two helicopter flights followed similar flight paths (Figure 1).

4.1 Monday 6 June 1997

The flight plan is shown in Figure 1 (black line). After take off from Jabiru Airport at 0930 hours the helicopter flew to Gulungul Creek and followed its left bank (western bank), south towards the escarpment at Mt Brockman. Before reaching Mt Brockman, the helicopter circled around to the south of the uranium mine, past the tailings dam, pit 1 and the buildings associated with the processing of the uranium. Georgetown Creek was then followed down past Georgetown Billabong to Magela Creek.

On reaching Magela Creek, the right bank was followed downstream past the mine, Djalkmara Billabong (and an old water sampling site), Coonjimba Billabong (near the end of Jabiru Airstrip) to the gauging station on Magela Creek (8210009). The helicopter continued down Magela Creek over various billabongs, before flying out over the vast expanse of Magela Plains (Pickup et al 1987). A straight palaeochannel was clearly visible on the plains, between Jabiluka Billabong and the tidal section of Magela Creek. The Magela Plains were followed to the Magela Creek mouth (Point A, Fig. 1) where it debouches into the East Alligator River near Turkey Dreaming, (a large sandstone outcrop on the right bank of the East Alligator River).

The helicopter followed the East Alligator River upstream, towards Cahills Crossing. Several palaeochannels were clearly evident on the floodplain, including a cutoff in the vicinity of a contemporary cutoff that used to be known as the "switch-back" (Point B, Fig. 1). This bend was abandoned during the 1996/97 Wet season. The helicopter continued upstream to the causeway at Cahills Crossing which was visible with a small amount of water flowing over it. Cahills Crossing is located on a bedrock bar. We continued up river above Cahills Crossing towards the area where the East Alligator River debouches from the gorge in the Arnhem Land plateau country (Point C, Fig. 1). There are extensive sand deposits in this region, and also evidence of flood chutes (to accommodate the Wet season flood flows) and palaeochannels.

Once in the plateau country the river straightens to follow a well defined gorge until it opens out at the Meakin Valley (Point D, Fig. 1). Tin Camp Creek (a large tributary) also enters from the right bank at this site. The helicopter continued to follow the river which closed back into a sandstone confined channel that continued further into the plateau county. This bedrock channel is a good location for slackwater deposits and the determination of large prehistoric floods (Pickup et al 1987; Wohl 1988). The river was followed for some distance into the plateau and was a sand bed river until it reached the first bedrock waterfall. Further upstream, the river was a gravel and bedrock stream with many areas of marginal sand deposition. There is a gauging station located in this area but it was not seen on this flight.

The helicopter continued to fly upstream in the gorge country and over a sharp angled bend, before landing on a large sandy slackwater deposit. The landing area was a large unvegetated sand deposit some 10 metres above the river level (Point E, Fig. 1). There was a higher sand deposit which was approximately 6-8 metres above the bench on which we landed and had well established vegetation. This higher deposit was deposited by a catastrophic flood of unknown height, discharge and date. After spending approximately 15 minutes on the ground, the helicopter took off and continued upstream for about 0.5 km before turning west and heading towards Magela Falls across the plateau country.

Magela Creek was located on the plateau above Magela Falls and the helicopter flew down Magela Creek until the falls were located (Point F, Fig. 1). The falls were dry but were nevertheless an impressive sight. The helicopter then followed Magela Creek down through the escarpment to the open woodlands and then continued downstream to land at Jabiru airport at approximately 1210 hours.

4.2 Sunday 22 February 1998

The flight plan is shown in Figure 1 (red additions to the black line). After take off from Jabiru Airport at 1000 hours the helicopter flew to Gulungul Creek and followed its left bank (western bank), south towards the escarpment at Mt Brockman. Before reaching Mt Brockman, the helicopter circled around to the south of the uranium mine, past the tailings dam, pit 1 and the buildings associated with the processing of the uranium. Georgetown Creek was followed down past Georgetown Billabong to Magela Creek.

On reaching Magela Creek, the right bank was followed downstream past the mine, Djalkmara Billabong (and an old water sampling site), Coonjimba Billabong (near the end of Jabiru Airstrip) to the gauging station on Magela Creek (8210009). From the gauging station, the helicopter flew over Gulungul and Corndorl billabongs (to the west of Magela Creek) before returning to Magela Creek to follow it down to Mudginberri Billabong. A boat was sighted on the billabong. The flight continued down Magela Creek over various billabongs, (including Y-shaped and Island billabongs) before reaching the vast expanse of Magela Plains. The Magela floodplain was followed down to Mine Valley Billabong (generally in a northerly direction) where the helicopter turned to fly east up Mine Valley and over the Jabiluka outlier. A tight circle was flown just east of the Jabiluka outlier, over the headworks of the proposed Jabiluka mine, before flying back over the sandstone escarpment of Jabiluka to the Magela floodplain.

Once back over Magela Plains, the helicopter turned north and continued to track downstream until Magela Creek debouched into the East Alligator River (Point A, Fig. 1) near Turkey Dreaming, (a large sandstone outcrop on the right bank). Just upstream of the tidal section of Magela Creek, the water was clear and relatively slow moving. However, in the tidal section the water flowed quicker and the turbidity increased markedly until it matched the muddy water

in the East Alligator River. The tide at the time (approximately 1030 hours) that we flew over the Magela Creek entrance was low, corresponding to a low of 2.83m in Darwin, according to the tide charts. There was still an ocean-directed flow from rains during the Wet season although flow was not as high as in previous weeks when monsoons dumped large amounts of rain in the catchment of the East Alligator. As a result of the low tide, there were many sand or mud bars visible in the river and sand splays on the floodplain.

The helicopter followed the East Alligator River upstream to Cahills Crossing, passing over the sinuous tidal channel. The slides and photographs indicate that the recent cutoff (Point B, Fig. 1) at the "switchback" had experienced substantial infilling since abandonment during the 1996/97 Wet season. The helicopter continued upstream passing vast floodplains on each side of the river, some with still water, others with dense vegetation. The causeway at Cahills Crossing was not visible due to the high flow passing over it, although the approach roads could be seen. In the photographs it looks as though there has been some deposition of sediment in the car park at Cahills Crossing and the downstream boat ramp.

We continued upstream above Cahills Crossing towards the area where the East Alligator River debouches from the gorge in the plateau country (Point C, Fig. 1). There were extensive sand deposits in this region, as well as flood chutes (to accommodate the Wet season flood flows) and palaeochannels. A large clockwise circle was flown in this area to enable film to be changed and provided a good opportunity for detailed inspection. Once in the plateau country the river straightens to follow a well defined gorge until it opens out at Meakin Valley (Point D, Fig. 1). The helicopter continued to follow the river which closed back into a sandstone-confined channel that continued further into the Arnhem Land plateau county.

The river was followed for some distance into the plateau and was a sand bed river until it reached the first bedrock waterfall. Further upstream, the river was a gravel and bedrock stream with many areas of marginal sand deposition. Upstream of the first group of bedrock cascades or small waterfalls, there is a gauge called East Alligator River At 12 Deg 43 Min South (G28210010). The gauge is located on the right bank downstream of a small tributary. The helicopter circled around the gauge before continuing upstream over a sharp bend to fly over the large sand deposit on which the helicopter landed in June 1997 (Point E, Fig. 1). The helicopter continued upstream for about 0.5 km before turning west and heading towards Magela Falls across the Arnhem Land plateau.

Magela Creek was joined in the gorge country downstream of Magela Falls, so the helicopter flew up Magela Creek to the falls (Point F, Fig. 1). There was water falling over the falls, unlike on the Dry season flight. The helicopter than descended in a tight circle to fly down the creek in the gorge well below the top of the cliffs. This low flying was continued downstream through the complete gorge of Magela Creek until it opened out onto the woodland areas upstream of ERARM. A gauge on the left bank was flown over at the downstream end of the Magela gorge (Bowerbird Gorge), (Point G, Fig. 1). Magela Creek was then followed downstream to the mine which was circled in a clockwise direction. An aerial shot of the buildings at ***eriss*** was taken before landing at Jabiru airport at approximately 1150 hours.

5.0 Photographic images of the flights.

This section contains some of the images taken during both flights. Slides were only taken during the first flight (Dry season) and both prints and slides during the second flight (Wet season). The slides (n=32) from the first flight have been catalogued and are stored in slide pouches in a ring binder. A unique number, the date and the photographer has been written on the border of each slide. Descriptions of the slides are not only contained at the beginning of the ring binder but also in Appendix 1.

The prints (n=108) have been catalogued with a sequential numbering system. A caption label, containing the number of the print, a short description, the date and photographer, has been stuck on the back of the photograph. The prints have been stored in pouches in a ring binder. The negatives have been placed in the pouches behind the starting photograph for each roll. A copy of the captions is contained in Appendix 2.

A total of 168 slides were taken during the second flight (Wet season). These have also been catalogued with a sequential numbering system and are stored in slide pouches in a ring binder. A unique number, the date and the photographer has been written on the border of each slide. Descriptions of the slides are not only contained at the beginning of the ring binder but also in Appendix 3.

A selection of slides and photographs are contained in Plates 1 to 36, inclusive.

Photographs were taken during each flight and, where possible, comparative photographs to show differences (if any) between the Dry and Wet seasons are included as Plates 1 to 36, inclusive. The plates have been scanned from slides and printed out on a colour bubble jet printer or colour photocopied from photographs (Plates 1 to 36, inclusive). Brief notes on the geomorphology of each plate are included in the captions and the regional geomorphology is described in Section 6.

Plate 1: View of the tailings dam and Retention Pond 1 at Ranger Uranium Mine showing the Mt Brockman Escarpment in the background. Slide No 1: Mike Saynor, 2/6/97.

Plate 2: Georgetown Billabong, near Magela Creek, upstream of the mine. This is a backflow billabong or blocked valley lake (see Blake and Oliver, 1971; Hart & McGregor, 1980) formed by the damming of the outlet of Georgetown Creek by Magela creek deposits (Nanson et al 1993) The extensive lowland surrounding the billabong is the Tertiary Koolpinyah Surface of Hayes (1967). The soils of the area in the top left are described by Chartres et al (1991). Slide No 3: Mike Saynor, 2/6/97.

Plate 3: Georgetown Billabong near ERA Ranger Mine. Note higher water level than in Plate 2. Print No. 15 Mike Saynor, 22/2/98.

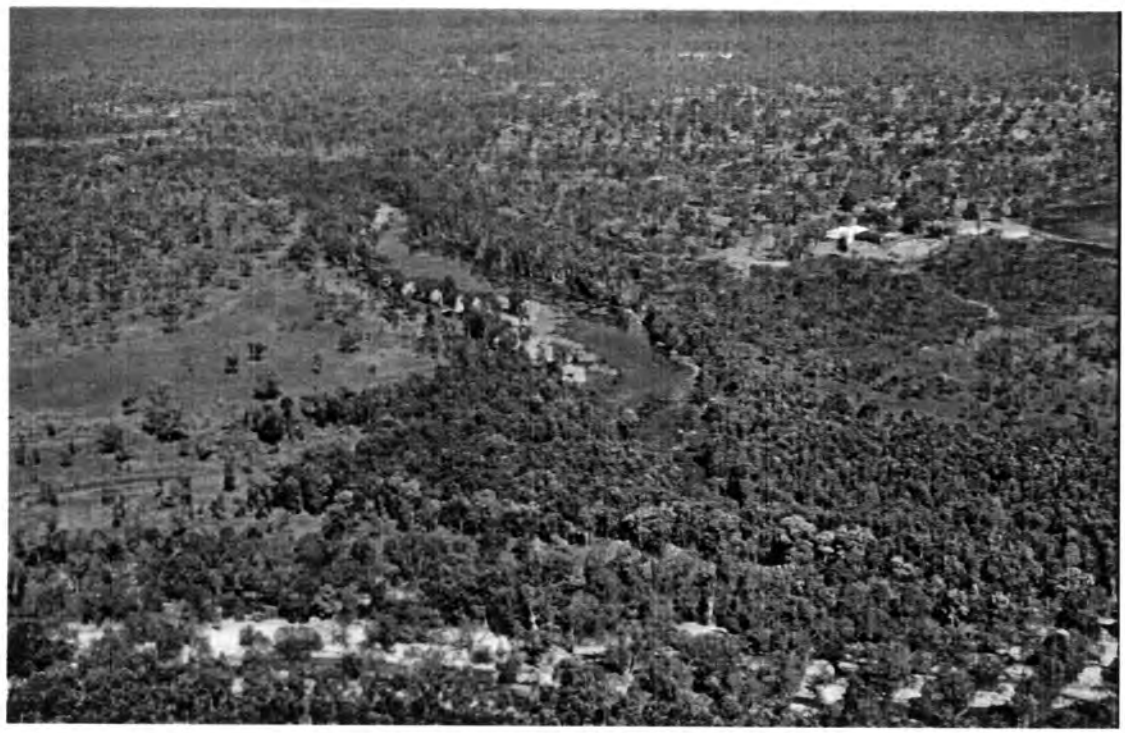

Plate 4: Coonjimba Billabong, and, to the right, buildings near the end of Jabiru Airstrip. This is another backflow billabong impounded by Magela Creek and surrounded by the Koolpinyah Surface. Slide No 6: Mike Saynor, 2/6/97.

Plate 5: Gauging station 8210009 on Magela Creek. Magela Creek is a sand-bed anastomosing channel here. The individual channels are separated by vegetated, sandy islands. Many sediment transport measurements have been made here. Print No. 23 Mike Saynor, 22/2/98.

Plate 6: Gulungul Billabong to the west of Magela Creek. This is another backflow billabong downstream of the mine site. The sand in the bottom left of the image is part of a reverse delta extending from Magela Creek billabong. Slide No. 17 Mike Saynor, 22/2/98.

Plate 7: Corndorl Billabong to the west of Magela Creek. This is another backflow billabong occupying a shallow valley cut into the Koolpinyah surface. Slide No. 18 Mike Saynor, 22/2/98.

Plate 8: Sand delta at upstream end of Mudginberri Billabong. This marks the present downstream limit of the sand anastomosing zone of Magela Creek. The buildings are located on the Koolpinyah Surface. Slide No. 8 Mike Saynor, 2/6/97.

Plate 9: Sand anastomosing section of Magela Creek terminating at the upstream end of Mudginberri Billabong. The billabong will be eventually infilled with sand but the sedimentation rates are low (Roberts 1991). Slide No. 22 Mike Saynor, 22/2/98.

Plate 10: Palaeochannel on Magela floodplain to the west of Jabiluka Billabong. This channel is a remnant of the former tidal channel that functioned during the mid Holocene (Wasson 1992).
Slide No. 13 Mike Saynor, 2/6/97.

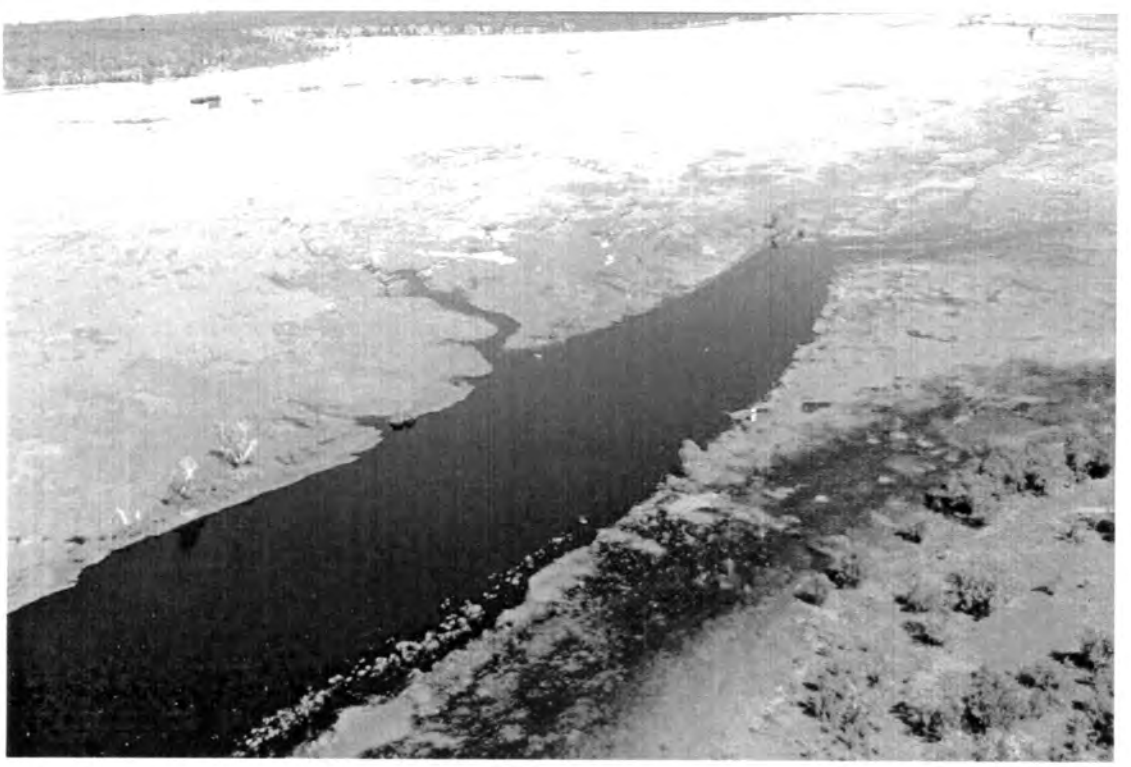

Plate 11: Downstream end of Jabiluka Billabong on Magela floodplain. A discontinuous channel is visible on the western side of the floodplain A gauging station is located on the right bank of the billabong. Print No. 37 Mike Saynor, 22/2/98.

Plate 12: Palaeochannel on Magela floodplain between Jabiluka Billabong and the tidal section of Magela Creek. This infilled channel is a remnant of the former tidal channel that functioned during the mid Holocene (Wasson, 1992). It is now located in an extensive area of freshwater wetlands.
Slide No. 14 Mike Saynor, 2/6/97.

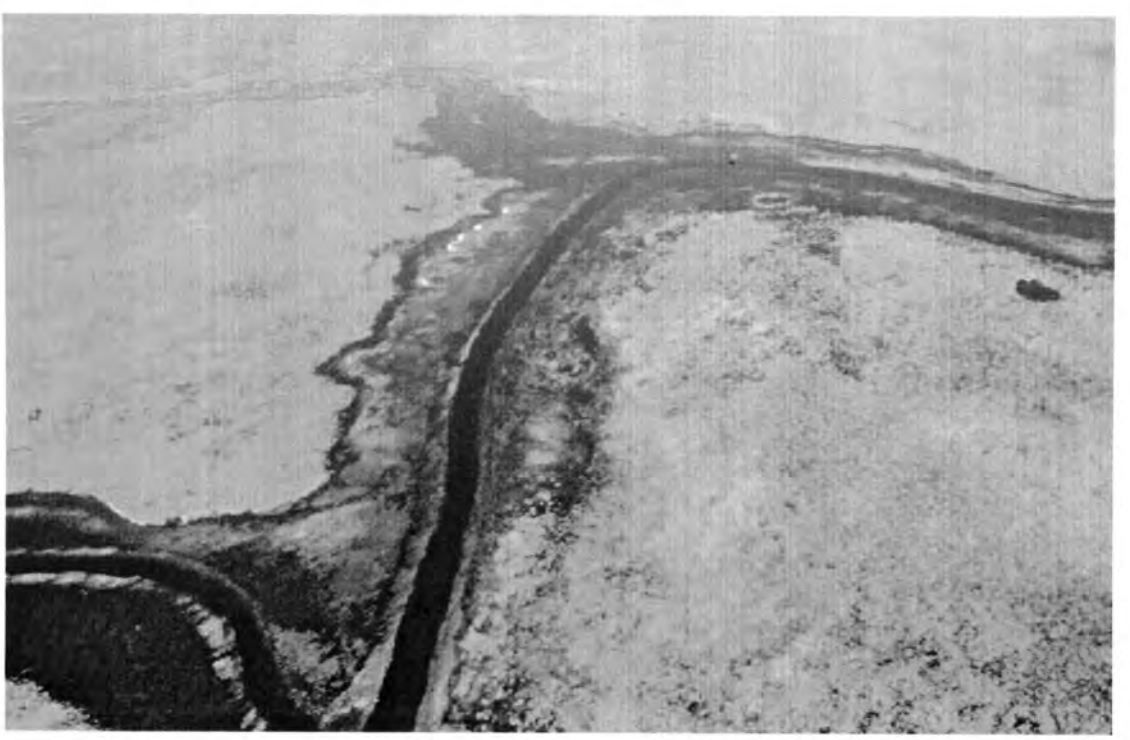

Plate 13: Channels flooded with clear water just upstream of the tidal section of Magela Creek. Clear, sediment-free water is discharging from the wetlands back into the outlet channel. Mangroves are present on the downstream section of channel. Slide No. 39 Mike Saynor, 22/2/98.

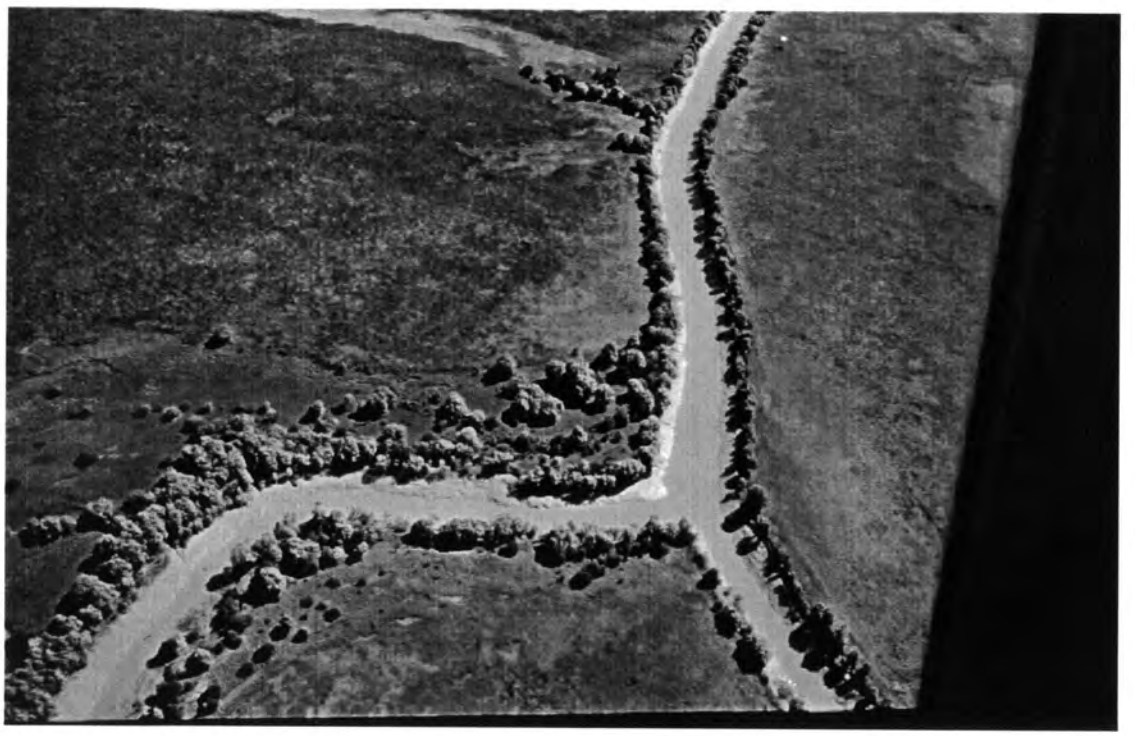

Plate 14: Mangrove-lined tidal section of Magela Creek. Note the high turbidity of the macrotidal estuary during the Dry season. Slide No. 15 Mike Saynor, 2/6/97.

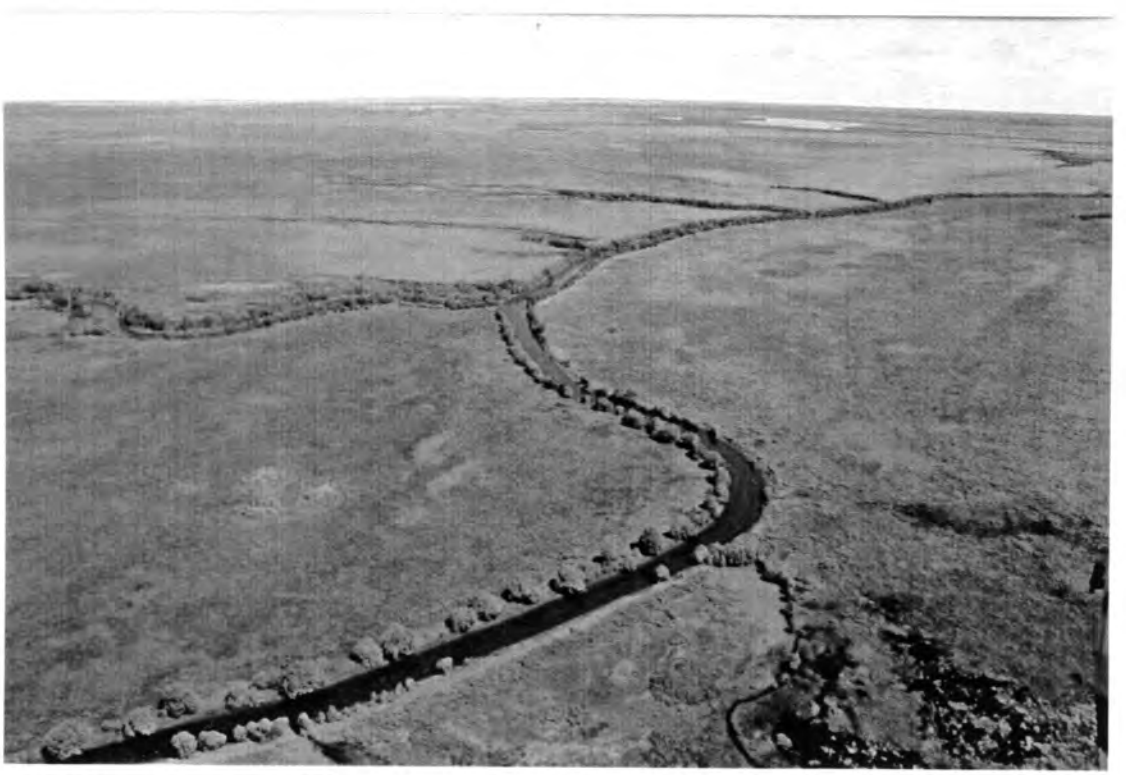

Plate 15: Similar section of Magela Creek. The water is clearer and the vegetation greener than in Plate 14. Clear freshwater from the wetlands has flushed the upper estuary.
Print No. 40 Mike Saynor, 22/2/98.

Plate 16: Tidal creek entering the East Alligator River, upstream of Turkey Dreaming and the Magela Creek mouth. Note the high turbidity of the estuary during the Dry season.
Slide No. 16 Mike Saynor, 2/6/97.

Plate 17: Meandering section of Magela Creek entering the East Alligator River (Point A, Fig 1). Note the lower turbidity of the estuary during the Wet Season. Slide No. 44 Mike Saynor, 22/2/98.

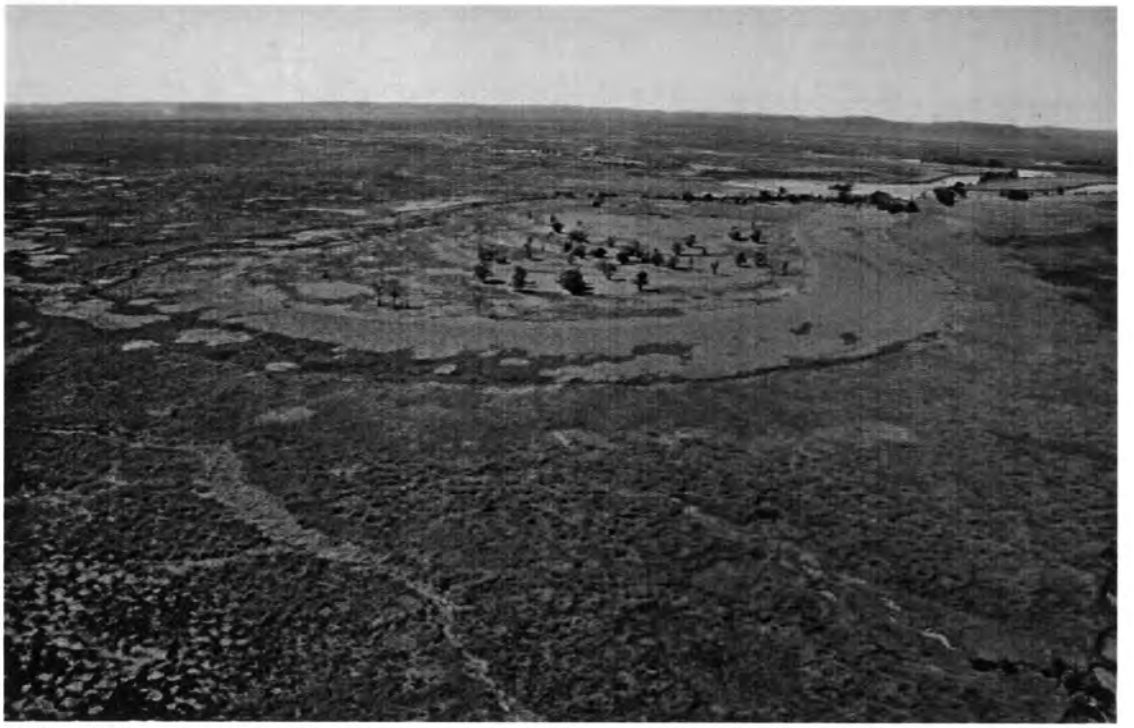

Plate 18: Palaeocutoff at "The Switchback", East Alligator River during the Dry Season. Location shown as Point B in Figure 1. This is a neck cutoff of Erskine and Melville (1982). Convex ridges in the meander core were formed by lateral migration and subsequent point bar formation.
Slide No. 18 Mike Saynor , 2/6/97.

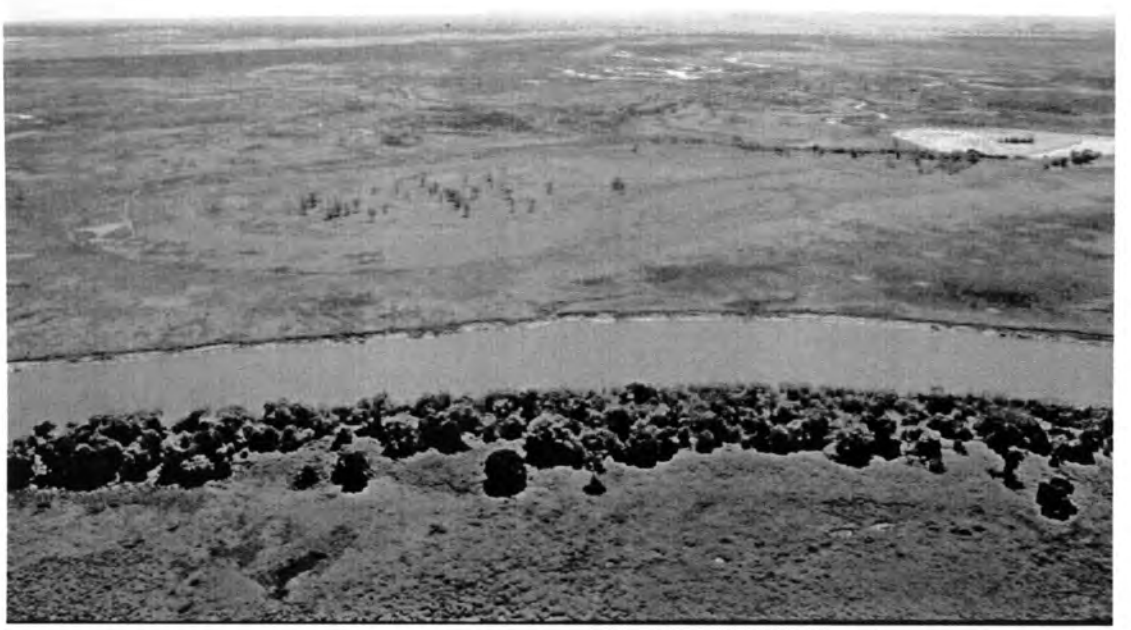

Plate 19: Palaeocutoff at "The Switchback", East Alligator River during the Wet Season . Location shown as Point B in Figure 1. Same neck cuttoff as in Plate 18. Slide No. 52 Mike Saynor, 22/2/98.

Plate 20: Dry Season view of the 1996/97 cutoff (formerly called "The swtichback"). This is also a neck cutoff of Erskine and Melville (1982). Location shown as Point B in Figure 1.
Slide No. 19 Mike Saynor, 2/6/97.

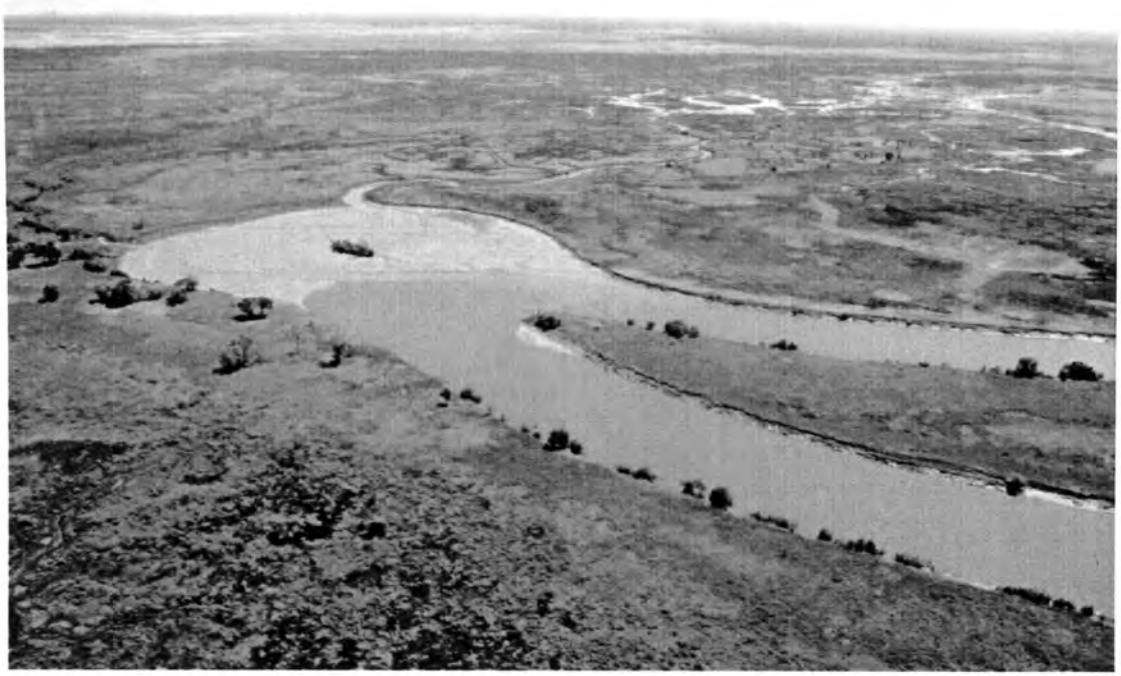

Plate 21: Wet Season view of the 1996/97 cutoff, (formerly called "The swtichback"). The entrance to the cutoff has been entirely closed by sedimentation but an outlet has been maintained through the downstream end because of the tributary which discharges into the cutoff. Note that a small point bar is present on the inside bank of the bend only downstream of the bend apex. Slide No. 53 Mike Saynor, 22/2/98.

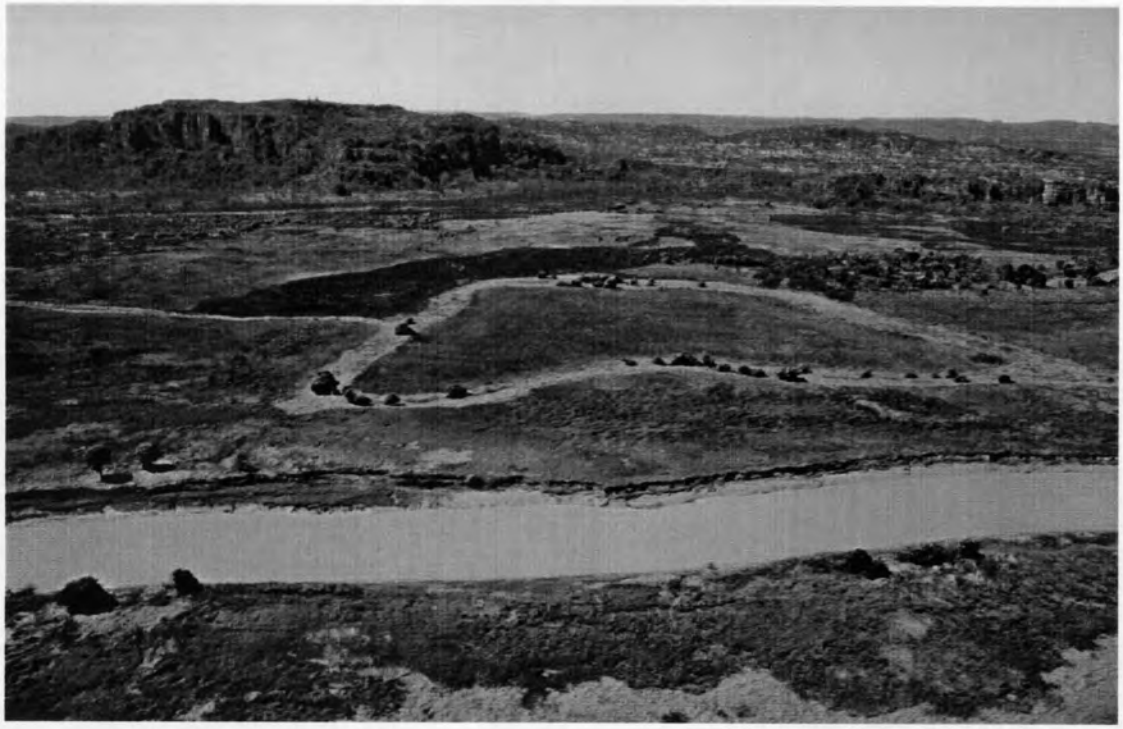

Plate 22: Palaeochannel on the right bank of the East Alligator River upstream of Point B in Figure 1. This is another neck cutoff on the palaeochannel. Slide No. 20 Mike Saynor, 2/6/97.

Plate 23: Palaeochannel in foreground and wetlands in the background on the right bank of the East Alligator River upstream of Point B in Figure 1. Slide No. 59 Mike Saynor, 22/2/98.

Plate 24: Cahills Crossing, East Alligator River during the dry season. Note that the crossing has been built on a foundation of bedrock and acts as a weir during the lower part of the tidal cycle. Slide No. 21 Mike Saynor, 2/6/97.

Plate 25: Cahills Crossing, East Alligator River during the Wet season, 22/2/98. Slide No. 65 Mike Saynor.

Plate 26: Dry season Gorge country, East Alligator River. Sand-bed anastomosing river confined between the sandstone valley sides. Vegetated sand islands are present between the individual channels. Slide No. 24 Mike Saynor, 2/6/97.

Plate 27: Sand bar and chute on the right bank of the East Alligator River (Point C, Fig 1). This is a palaeochannel which is still activated by current flood flows. Slide No. 68 Mike Saynor, 22/2/98.

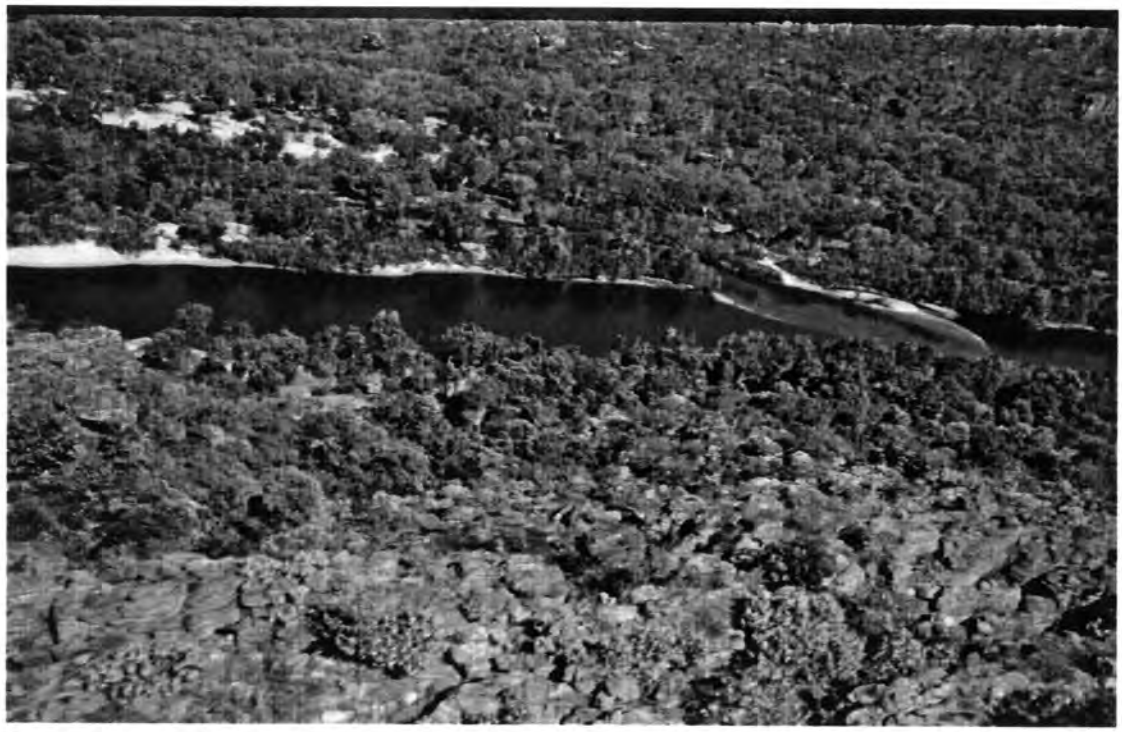

Plate 28: Sand delta at confluence of anastomosing channels in the gorge section of East Alligator River. Sand-bed, anastomosing river confined between the Sandstone valley sides. View from right bank. Slide No. 25 Mike Saynor, 2/6/97.

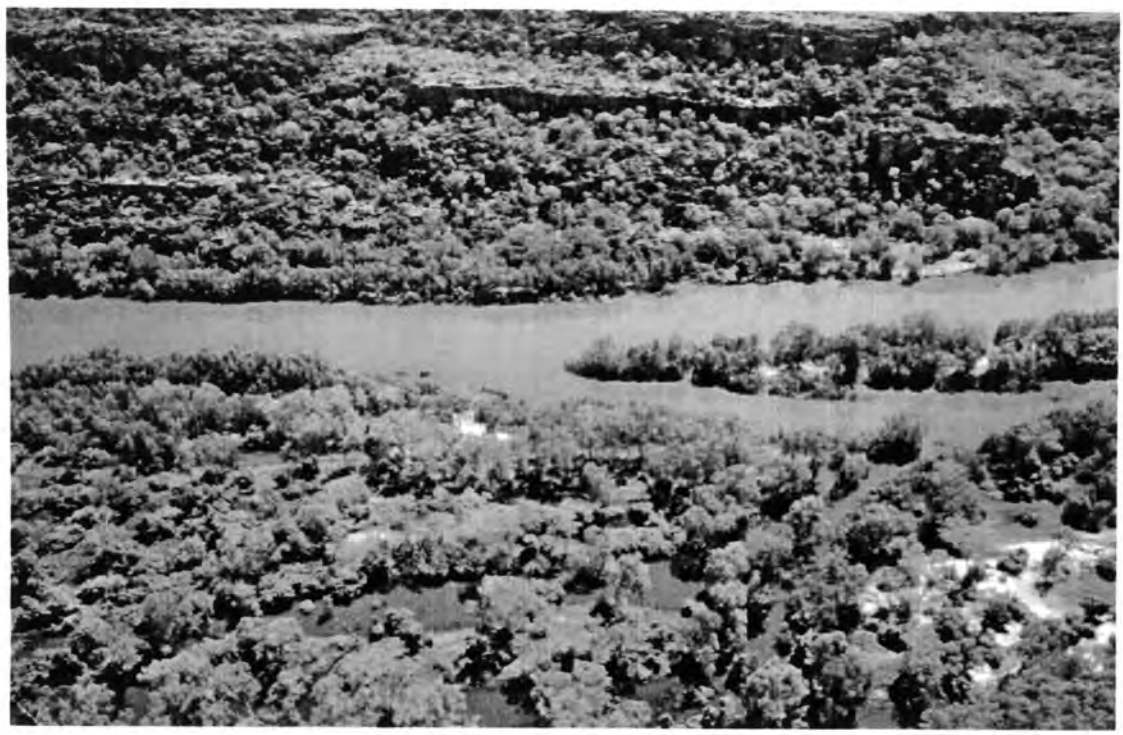

Plate 29: Same channel confluence as in Plate 28 in the gorge section of East Alligator River. No delta visible. View from left bank. Slide No. 75 Mike Saynor, 22/2/98.

Plate 30: Sandy bedforms (large scale ripples) in the bed of the East Alligator River. Slide No. 29 Mike Saynor, 2/6/97.

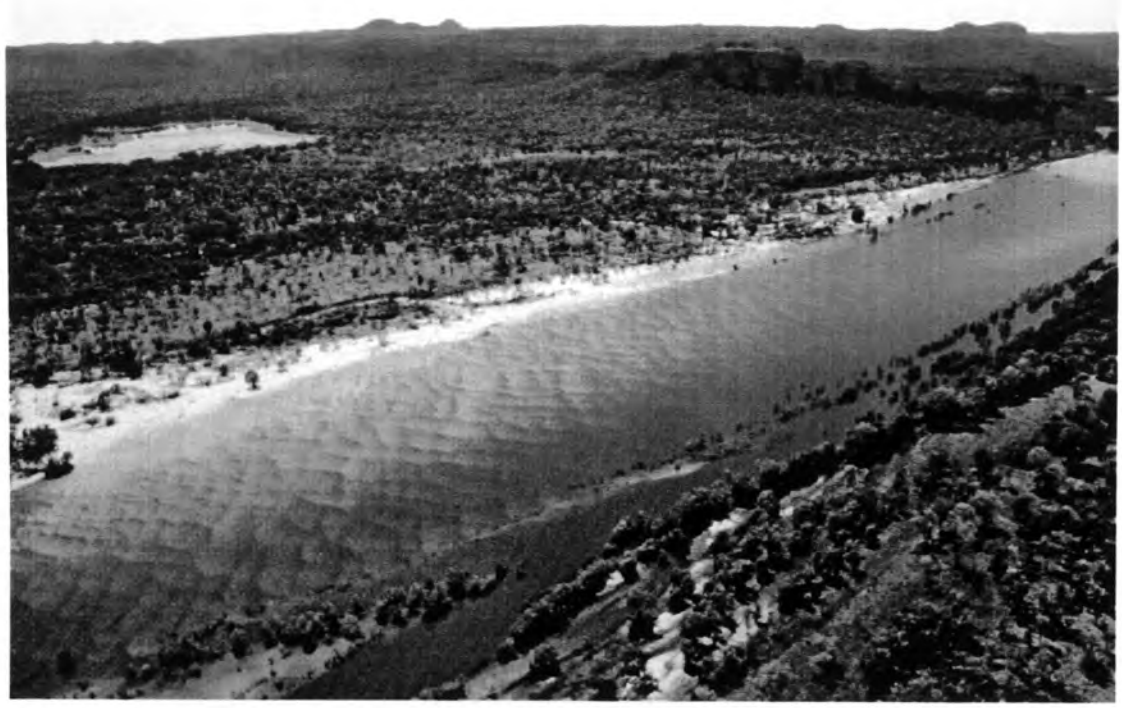

Plate 31: Sandy bedforms (large scale ripples) in the bed of the East Alligator River. Slide No. 83 Mike Saynor, 22/2/98.

Plate 32: Gorge section of the East Alligator River showing the first bedrock cascade or waterfall upstream of the sand zone. The Channel is cut into sandstones of the Kombolgie Formation. Slide No. 30 Mike Saynor, 2/6/97.

Plate 33: Gorge with bedrock cascades and sandy marginal deposits in the East Alligator River. Slide No. 110 Mike Saynor, 22/2/98.

Plate 34: Sandy slackwater deposits in a flood chute across the inside of the bed (Point E, Fig. 1) that the helicopter landed on in the gorge section of the East Alligator River. Slide No. 31 Mike Saynor, 2/6/97.

Plate 35: Aerial shot of the sandy chute and slackwater deposits, that the helicopter landed on in June 1997. East Alligator River. The inside of valley bends are favoured sites for slackwater deposition. Slide No. 128 Mike Saynor, 22/2/98.

Plate 36 : Magela Falls on Magela Creek. Significant plunge pool at the base of the waterfall. Waterfall retreats by basal undercutting followed by toppling of the more coherent caprock. Slide No. 139 Mike Saynor, 22/2/98.

6.0 Regional Geomorphology

The geomorphology of the Alligator Rivers Region has been outlined by Williams (1969a; 1991), Galloway (1976), Russell-Smith et al (1995) and East (1996), among others. They have described the main landforms relevant to this report as the Arnhem Land plateau, the Arnhem escarpment, the Koolpinyah erosion surface, the alluvial plains and the deltaic estuarine floodplains. Each of the above landforms is briefly described below and some examples have been shown in the plates and appendices.

The *Arnhem Land plateau* is an exhumed, essentially bedrock, tabular upland, which constitutes the upper catchment of most major rivers. It is formed predominantly of resistant, horizontally bedded, vertically jointed, quartz sandstone of the Middle Proterozoic Kombolgie Formation and produces low sediment yields of predominantly sandy material (Roberts, 1991). A deeply incised, trellised drainage pattern has developed along the closely spaced joints and faults (see Plates 26 and 27). Williams (1991) emphasised that the sandstones have long operated as a very effective caprock, protecting the underlying rocks from later erosion. Outliers of sandstone form isolated massifs, such as Mt Brockman, at varying distances from the main plateau.

The *Arnhem escarpment* is the most striking scenic feature of Kakadu National Park and marks the edge of the plateau. It varies from about 30 to 330 m high and exhibits a range of different forms depending on the underlying geologic structure (Galloway, 1976). Quartz sandstone of the Kombolgie Formation outcrops in the scarp, which retreats episodically by collapses of large sandstone blocks, followed by centuries of near stability. Galloway (1976) speculated that the rate of scarp retreat may be of the order of 1 m/1000 years but Roberts (1991) calculated rates of only 0.02-0.2 m/1000 years. Rivers exiting the plateau either flow over the scarp as spectacular waterfalls (Magela Falls, Plate 36) or dissect the scarp by relatively long, narrow, deep bedrock gorges, which follow joints and faults (East Alligator River, Plates 26, 30, 32, 33 and 34). Near the escarpment, Roberts (1991) found that sand fans began to accumulate at 230-220 and 120-100 ka, which coincide with the start of the penultimate and last interglacials, respectively. Roberts et al (1990) reported the then oldest dates of human occupation in Australia (50-60 ka) based on thermoluminescence dating of these sandy footslope deposits, which contained Aboriginal artifacts.

The extensive undulating lowlands between the Arnhem Land escarpment and plateau, and the floodplains of the major rivers in the Alligator Rivers Region have been called the *Koolpinyah Surface* (Hays, 1967). It was originally believed to be a Tertiary lateritised palaeoplain (Hays, 1967; Williams, 1969a; 1991; East et al 1993). However, Nott (1995) concluded that the Koolpinyah Surface is an exhumed Proterozoic surface extending below the Arnhem Land plateau. Nevertheless, thorium-uranium disequilibrium dating of iron pisoliths from the same shallow soil horizon below the Koolpinyah Surface yielded ages of 135 to 202 ka, with a mean of 176 ka (Short et al 1989). Short et al (1989) interpreted this result to mean that there was a second phase of lateritisation of the Koolpinyah Surface in the late Quaternary following the earlier main Tertiary phase. Williams (1969b) concluded that this surface had a complex and polygenetic history. Chartres et al (1991) investigated in detail the soils formed on a small area of the Koolpinyah Surface near ERARM. They found that the soils are generally shallow and gravelly, and overlie weathered, ferruginised schist of the Cahill Formation at relatively shallow depths. Clay and organic matter contents are low, cation exchange capacity is extremely low and the clays are low activity clay minerals, with kaolinite dominating. This is

consistent with Williams' (1969a) findings that, near the East Alligator River, very little of the original Koolpinyah Surface remains because it has been extensively eroded. Nevertheless, the Koolpinyah Surface is an extremely old landscape and appears to be very stable (Galloway, 1976; East et al 1993; East, 1996). East et al (1993) recommended that rehabilitated mine structures associated with ERARM should be sited on this surface, as indeed they have been (Plate 1).

Rivers crossing the Koolpinyah Surface have cut shallow trenches, which are occupied by sandy river channels, wetlands, floodplains, river terraces and palaeochannels (Galloway, 1976; Pickup et al 1987; Nanson et al 1990; 1993). This suite of landforms is called the *alluvial plains*. Multiple Pleistocene terraces and palaeochannels of clayey, silty and sandy sediments flank the contemporary sandy anastomosing channels below the Arnhem escarpment (Nanson et al 1990; 1993). Many are currently flooded during the wet season. The present channel of Magela Creek started aggrading with sand about 5-7 ka and largely infilled the trench excavated during the low sea level of the last glacial maximum. This sand is progressively prograding downstream and burying flood basins, billabongs and wetlands (Plates 8 and 9). Extensive flood basins of Holocene organic clay sediments lie between the upstream sandy alluvial plain and the downstream deltaic estuarine plain (Plates 10, 11, 12, and 13). The flood basin sediments often stratigraphically overlie estuarine sediments (Woodroffe et al 1986; Clark et al 1992a; 1992b).

Extensive *deltaic estuarine floodplains* are present on the lower South Alligator, West Alligator and East Alligator Rivers. These estuaries exhibit four distinct channel types, which, in upstream sequence are the estuarine funnel, sinuous reach (Plate 17), cuspate reach and the upstream reach (Woodroffe et al 1986; 1989). Each channel type is also associated with a distinctive stratigraphy (Woodroffe et al 1986; 1989). The deltaic estuarine plain developed in three major phases over the last 8 ka as sea level rose from about -14 m AHD to its present level after 5.8 ka BP (Woodroffe et al 1986; 1987; 1989). The "transgressive phase" (8-6.8 ka BP) marked the final marine flooding of the prior valley and the development of mangrove forests. Then the "big swamp phase" (6.8-5.3 ka BP) occurred as sea level stabilised around its present level and mangrove forests became established over most of the present floodplain. The "sinuous/cuspate phase" began about 5.3 ka BP and was characterised by the establishment of a meandering estuarine channel flanked by a marginal zone of mangroves. Freshwater swamps developed and overbank deposits were laid down on the floodplain surface over the last 4-1.5 ka BP. The Holocene depositional history of the deltaic estuarine plain on Magela Creek is discussed in detail by Clark et al (1992b). While there is a coastal plain fronting van Diemen Gulf (East, 1996; Bayliss et al 1997), it is not relevant to the present discussion.

7.0 References.

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Appendix 1 – Slides taken on 6 June 1997

Pouch One

Photographer Mike Saynor. No. 1 to No. 20 taken 2/6/98.
No. 1 Aerial view of ERA Ranger Mine (tailings dam) showing Mt Brockman in the background (Plate 1).
No. 2 Tailings dam at ERA Ranger Mine.
No. 3 Georgetown Billabong, near Magela Creek, upstream of the mine (Plate 2).
No. 4 Pit 3 ERA Ranger Mine.
No. 5 Pit 3 ERA Ranger Mine.
No. 6 Coonjimba Billabong, and to the right buildings near the end of Jabiru Airstrip (Plate 4).
No. 7 Gulungul (small round) and Corndorl (larger and longer) billabongs to the west of Magela Creek.
No. 8 Sand delta at upstream end of Mudginberri Billabong, (Plate 8).
No. 9 Small billabong to the west of Mudginberri Billabong near to the Oenpelli Road.
No. 10 Magela Floodplain.
No. 11 Magela Floodplain showing buffalo swim channels (straight lines).
No. 12 Magela Floodplain looking back towards Jabiluka escarpment and Jabiluka Billabong.
No. 13 Palaeochannel on Magela floodplain (Plate 10).
No. 14 Palaeochannel on Magela floodplain between Jabiluka Billabong and the tidal section of Magela Creek. (Plate 12).
No. 15 Tidal section of Magela Creek (Plate 14).
No. 16 Creek entering the East Alligator River, upstream from Turkey Dreaming (right bank) and the Magela Creek mouth (left bank), (Plate 16).
No. 17 Point bar in the cuspate section of the East Alligator River upstream from the Magela Creek mouth.
No. 18 Palaeocutoff near the Switchback, East Alligator River (Plate 18).
No. 19 Contemporary cutoff, (formerly called the swtichback) formed during the 1996/97 Wet Season (Plate 20).
No. 20 Palaeochannel on the right bank of the East Alligator River (Plate 22).

Pouch Two

Photographer Mike Saynor. No. 21 to No. 32 taken 2/6/98.
No. 21 Cahills Crossing, East Alligator River (Plate 24).
No. 22 Sand rocks and water on the right bank of the East Alligator River, Wet season flood chute.
No. 23 Sand bar on the East Alligator River, about 4 km upstream of Cahills Crossing.
No. 24 Gorge country, East Alligator River (Plate 26).
No. 25 Sand delta in the gorge section of East Alligator River (Plate 28).
No. 26 Sand bed section of the East Alligator River.
No. 27 Sand bed section of the East Alligator River.
No. 28 Sand bed section of East Alligator River with some eroded banks.
No. 29 Sandy bedforms, East Alligator River (Plate 30).
No. 30 Gorge section of the East Alligator River, first bedrock cascade or waterfall travelling upstream (Plate 32).
No. 31 Sandy slackwater deposits (Plate 34) in the gorge section of the East Alligator River, on which the helicopter landed.
No. 32 Sandy slackwater deposits in the gorge section of the East Alligator River, on which the helicopter landed.

Appendix 2 – Prints taken on 22 February 1998

Gulungul Creek, there appears to be two channels, a clear unincised channel and an incised sandy channel.
No. 1 Mike Saynor 22/2/98

Gulungul Creek, sandy channel. The tailings dam at Ranger can be seen in the background.
No. 2 Mike Saynor 22/2/98

Gulungul Creek. Single channel appears to split into two channels.
No. 3 Mike Saynor 22/2/98

Sandy point bar on Gulungul Creek.
No. 4 Mike Saynor 22/2/98

Gulungul Creek, sandy channel. Tailings dam and Mt Brockman in the background.
No. 5 Mike Saynor 22/2/98

Looking up Gulungul Creek towards Mt Brockman.
No. 6 Mike Saynor 22/2/98

Looking back down Gulungul Creek, two channels visible.
No. 7 Mike Saynor 22/2/98

View of the tailings dam whilst flying over Gulungul Creek.
No. 8 Mike Saynor 22/2/98

Tailings dam at Ranger looking northward towards the Jabiluka escarpment in the distance.
No. 9 Mike Saynor 22/2/98

Tailings dam at Ranger looking northward towards the Jabiluka escarpment in the distance.
No. 10 Mike Saynor 22/2/98

Pit 1 Ranger Mine.
No. 11 Mike Saynor 22/2/98

Pit 1 Ranger Mine.
No. 12 Mike Saynor 22/2/98

Pit 1 Ranger Mine.
No. 13 Mike Saynor 22/2/98

Buildings at Ranger.
No. 14 Mike Saynor 22/2/98

Georgetown Billabong near Ranger Mine. (Plate 3)
No. 15 Mike Saynor 22/2/98

Magela Creek downstream of Georgetown Billabong near Ranger Mine.
No. 16 Mike Saynor 22/2/98

Magela Creek looking across to buildings and Pit 3 Ranger Mine.
No. 17 Mike Saynor 22/2/98

Pit 3 Ranger Mine with what is left of Djalkmara Billabong after the new access road was built.
No. 18 Mike Saynor 22/2/98

Sand formations and bedforms in Magela just downstream from Djalkmara Billabong. Old water sampling site.
No. 19 Mike Saynor 22/2/98

Magela Creek at the end of Jabiru Airstrip.
No. 20 Mike Saynor 22/2/98

Coonjimba Billabong, near the end of Jabiru Airstrip.
No. 21 Mike Saynor 22/2/98

Gauging station 8210009 on Magela Creek.
No. 22 Mike Saynor 22/2/98

Gauging station 8210009 on Magela Creek (Plate 5).
No. 23 Mike Saynor 22/2/98

Gulungul (small round) and Corndorl (larger and longer) Billabongs to the west of Magela Creek.
No. 24 Mike Saynor 22/2/98

Gulungul Billabong to the west of Magela Creek (Slide 17)
No. 25 Mike Saynor 22/2/98

Corndorl Billabong to the west of Magela Creek. (Slide 18)
No. 26 Mike Saynor 22/2/98

Looking down Magela Creel towards Mudginberri Billabong and the Magela floodplain.
No. 27 Mike Saynor 22/2/98

Y-shaped Billabong with the Oenpelli Road just visible at bottom of the photo.
No. 28 Mike Saynor 22/2/98

Magela floodplain (airboat track visible) looking towards Djarr Djarr Billabong.
No. 29 Mike Saynor 22/2/98

The end of Djarr Djarr Billabon on the Magela floodplain.
No. 30 Mike Saynor 22/2/98

Mine Valley Billabong with a gauge on it.
No. 31 Mike Saynor 22/2/98

Flying up Mine Valley and over the Jabiluka escarpment.
No. 32 Mike Saynor 22/2/98

Flying over the Jabiluka escarpment.
No. 33 Mike Saynor 22/2/98

The orange paint (speck) mid photo is the location of the shaft for Jabiluka mine.
No. 34 Mike Saynor 22/2/98

Downstream end of Jabiluka Billabong on Magela floodplain.
No. 35 Mike Saynor 22/2/98

Downstream end of Jabiluka Billabong on Magela floodplain.
No. 36 Mike Saynor 22/2/98

Downstream end of Jabiluka Billabong on Magela floodplain with the gauging tower visible Plate 11)
No. 37 Mike Saynor 22/2/98

Channel or billabong section of Magela floodplain to the west of Jabiluka Billabong.
No. 38 Mike Saynor 22/2/98

Clear water just up stream of the tidal section of Magela Creek (Plate 13).
No. 39 Mike Saynor 22/2/98

Moving towards the tidal section of Magela Creek, clear water in the channels (Plate 15)
No. 40 Mike Saynor 22/2/98

Magela Creek channel passes near to the East Alligator River where a large bar can be seen.
No. 41 Mike Saynor 22/2/98

Magela Creek enters the East Alligator River.
No. 42 Mike Saynor 22/2/98

Closer view of Magela Creek as it enters the East Alligator River.
No. 43 Mike Saynor 22/2/98

East Alligator River and Turkey Dreaming.
No. 44 Mike Saynor 22/2/98

Looking upstream on the East Alligator River from near Turkey Dreaming.
No. 45 Mike Saynor 22/2/98

Mud or sand splays on the East Alligator River.
No. 46 Mike Saynor 22/2/98

Mud or sand splays and creeks entering the East Alligator River.
No. 47 Mike Saynor 22/2/98

East Alligator River looking towards the palaeocutoff and the more recent cutoff (96/97 Wet season).
No. 48 Mike Saynor 22/2/98

Palaeocutoff on the East Alligator River.
No. 49 Mike Saynor 22/2/98

Recent cutoff on the East Alligator River, which occurred during the 1996/97 Wet season.
No. 50 Mike Saynor 22/2/98

Recent cutoff on the East Alligator River, which occurred during the 1996/97 Wet season.
No. 51 Mike Saynor 22/2/98

Right bank flood plain on the East Alligator River. Various palaeochannels can be seen.
No. 52 Mike Saynor 22/2/98

Right bank flood plain on the East Alligator River, not far downstream from Cahills Crossing.
No. 53 Mike Saynor 22/2/98

Cahills crossing, East Alligator River, also downstream boat Ramp at bottom of picture.
No. 54 Mike Saynor 22/2/98

Cahills Crossing, East Alligator River, also downstream boat ramp at bottom of picture.
No. 55 Mike Saynor 22/2/98

Main channel of the East Alligator, looking across to a flooded right bank.
No. 56 Mike Saynor 22/2/98

Sandy outflow section debouching from the gorge country, East Alligator River.
No. 57 Mike Saynor 22/2/98

Sandy outflow section from the gorge country, East Alligator River, and the flooded right bank,.
No. 58 Mike Saynor 22/2/98

East Alligator main channels and The Rockhole to the left of the photo.
No. 59 Mike Saynor 22/2/98

Looking downstream from the gorge country to a large sand splay. East Alligator River.
No. 60 Mike Saynor 22/2/98

Looking downstream from the gorge country, East Alligator River. The Rockhole is just visible on the left.
No. 61 Mike Saynor 22/2/98

Looking downstream from the gorge country, East Alligator River. The Rockhole is just visible on the left.
No. 62 Mike Saynor 22/2/98

Close up of the sandy outflow section East Alligator River.
No. 63 Mike Saynor 22/2/98

Two channels become one in the gorge country, East Alligator River.
No. 64 Mike Saynor 22/2/98

East Alligator River in the Meakin Valley with Tin Camp Creek coming in on the left.
No. 65 Mike Saynor 22/2/98

Bedforms in the East Alligator River, upstream of the Meakin Valley.
No. 66 Mike Saynor 22/2/98

The East Alligator River passing Through the gorge and plataeu Country.
No. 67 Mike Saynor 22/2/98

The East Alligator River and an incoming valley, opposite Ellen Wohl's slackwater deposit site, we believe.
No. 68 Mike Saynor 22/2/98

The East Alligator River passing through the gorge and plataeu country.
No. 69 Mike Saynor 22/2/98

The East Alligator River passing Through the gorge and plataeu country.
No. 70 Mike Saynor 22/2/98

Close up of some bedforms on the East Alligator River as it passes through the Gorge and plateau country
No. 71 Mike Saynor 22/2/98

Cascades on the East Alligator River just downstream of the gauge.
No. 72 Mike Saynor 22/2/98

Cascades on the East Alligator River just downstream of the gauge.
No. 73 Mike Saynor 22/2/98

Control and gauge pool for the gauge located on the right bank. Gauge shed can just be seen mid-photo.
No. 74 Mike Saynor 22/2/98

Control and gauge pool for the gauge located on the right bank. Shed can just be seen.
No. 75 Mike Saynor 22/2/98

Pool riffle sequence on the East Alligator River upstream of the gauge. Gravel and sand bed stream.
No. 76 Mike Saynor 22/2/98

Sandy point bar deposit, that the helicopter landed on in June 1997 flight. A higher bench can also be seen. East Alligator River.
No. 77 Mike Saynor 22/2/98

Sandy point bar deposit, that the Helicopter landed on in June 1997 flight. A higher bench can also be seen. East Alligator River.
No. 78 Mike Saynor 22/2/98

Looking up the East Alligator River above the sandy point bar shown in photos 77 and 78.
No. 79 Mike Saynor 22/2/98

Looking back downstream to the sandy point bar shown in photos 77 and 78. East Alligator River
No. 80 Mike Saynor 22/2/98

Escarpment country flying from the East Alligator River towards Magela Falls.
No. 81 Mike Saynor 22/2/98

Escarpment country flying from the East Alligator River towards Magela Falls.
No. 82 Mike Saynor 22/2/98

Escarpment country flying from the East Alligator River towards Magela Falls.
No. 83 Mike Saynor 22/2/98

Escarpment country flying from the East Alligator River towards Magela Falls.
No. 84 Mike Saynor 22/2/98

One of the branches of Magela Creek in the escarpment country.
No. 85 Mike Saynor 22/2/98

Escarpment country around Magela Creek.
No. 86 Mike Saynor 22/2/98

Magela Falls coming into view, Magela Creek.
No. 87 Mike Saynor 22/2/98

Magela Falls coming into view, Magela Creek.
No. 88 Mike Saynor 22/2/98

Magela Falls on Magela Creek.
No. 89 Mike Saynor 22/2/98

Magela Falls on Magela Creek.
No. 88 Mike Saynor 22/2/98

Magela Falls on Magela Creek.
No. 91 Mike Saynor 22/2/98

Magela Falls on Magela Creek.
No. 92 Mike Saynor 22/2/98

Magela Falls on Magela Creek.
No. 93 Mike Saynor 22/2/98

Magela Falls on Magela Creek.
No. 94 Mike Saynor 22/2/98

Looking down Magela Creek from above Magela Falls.
No. 95 Mike Saynor 22/2/98

Side of gorge in Magela Creek downstream from Magela Falls.
No. 96 Mike Saynor 22/2/98

Looking down Magela Creek from above Magela Falls.
No. 97 Mike Saynor 22/2/98

Magela Falls on Magela Creek.
No. 98 Mike Saynor 22/2/98

Magela Falls on Magela Creek.
No. 99 Mike Saynor 22/2/98

Magela Falls on Magela Creek.
No. 100 Mike Saynor 22/2/98

Magela Falls on Magela Creek.
No. 101 Mike Saynor 22/2/98

Magela Creek in gorge country downstream from Magela Falls.
No. 102 Mike Saynor 22/2/98

Magela Creek in gorge country downstream from Magela Falls.
No. 103 Mike Saynor 22/2/98

Looking down Magela Creek as the gorge begins to open up.
No. 104 Mike Saynor 22/2/98

Narrow side gorge enters Magela Creek upstream of gauge, possible slackwater site.
No. 105 Mike Saynor 31/1/98

Magela Creek looking toward where the most upstream gauge is located.
No. 106 Mike Saynor 22/2/98

Escarpment country near Magela Creek near where the most upstream gauge is located.
No. 107 Mike Saynor 22/2/98

Escarpment country near Magela Creek near where the most upstream gauge is located.
No. 108 Mike Saynor 22/2/98

Appendix 3 – Slides taken on 22 February 1998

Pouch One

Photographer Mike Saynor. No. 1 to No. 20 taken 22/2/98.
No. 1 Gulungul Creek.
No. 2 Water amongst the trees near Gulungul Creek.
No. 3 Sandy channel of Gulungul Creek.
No. 4 Sandy channel of Gulungul Creek with the tailings dam at Ranger in the background.
No 5 Looking up Gulungul Creek towards Mt Brockman.
No 6 View of the tailings dam whilst flying over Gulungul Creek.
No 7 Tailings dam at Ranger looking northward towards the Jabiluka escarpment in the distance.
No 8 Tailings dam at Ranger looking northward towards the Jabiluka escarpment in the distance.
No 9 Pit 1 Ranger Mine.
No 10 Looking back up Georgetown Billabong towards Mt Brockman.
No 11 Georgetown Billabong near Ranger Mine.
No 12 Magela Creek downstream of Georgetown Billabong near Ranger Mine.
No 13 Sand formations and bedforms in Magela just downstream from Djalkmara Billabong. Old water sampling site.
No 14 Magela Creek at the end of Jabiru Airstrip.
No 15 Flying downstream towards the gauging station 8210009 on Magela Creek.
No 16 Gulungul (small round) and Corndorl (larger and longer) Billabongs to the west of Magela Creek.
No 17 Gulungul Billabong to the west of Magela Creek (Plate 6).
No 18 Corndorl Billabong to the west of Magela Creek (Plate 7.
No 19 Looking down Magela Creek towards Mudginberri Billabong and the Magela floodplain.
No 20 Looking down Magela Creek towards Mudginberri Billabong and the Magela floodplain.

Pouch Two

Photographer Mike Saynor. No. 21 to No. 40 taken 22/2/98.
No 21 Magela Creek just upstream of Mudginberri Billabong
No 22 Mudginberri Billabong and the adjacent buildings (Plate 9).
No 23 Flooded Oenpelli Road near the S-Bends on Magela Creek.
No 24 Y-shaped Billabong and also Oenpelli Road.
No 25 Magela floodplain looking towards Djarr Djarr Billabong.
No 26 The end of Djarr Djarr Billabong on the Magela floodplain.
No 27 Looking down Magela floodplain from the downstream end of Djarr Djarr Billabong.
No 28 Flying over woodland area near the Jabiluka escarpment country.
No 29 The orange paint (speck) mid photo is the location of the shaft for Jabiluka mine.
No 30 Flying over the Jabiluka escarpment.
No 31 Flying over the Jabiluka escarpment.
No 32 Flying over the Jabiluka escarpment with Magela floodplain visible.
No 33 Jabiluka Billabong on Magela floodplain.
No 34 Downstream end of Jabiluka Billabong on Magela floodplain.
No 35 Looking down Magela floodplain.
No 36 Channel or billabong section of Magela floodplain to the west of Jabiluka Billabong.

No 37 Looking down Magela floodplain.
No 38 Looking down Magela floodplain.
No 39 Approaching the channels of the tidal section of Magela Creek.
No 40 The channelled section of the tidal section of Magela Creek (Plate 13).

Pouch Three

Photographer Mike Saynor. No. 41 to No. 60 taken 22/2/98.
No 41 The channelled tidal section of Magela Creek.
No 42 Magela Creek channel passes near to the East Alligator River where a large bar can be seen.
No 43 Channel of Magela Creek.
No 44 Magela Creek where it enters the East Alligator River (Plate 17).
No 45 Closer view of Magela Creek where it enters the East Alligator River.
No 46 East Alligator River and Turkey Dreaming.
No 47 Looking upstream on the East Alligator River from near Turkey Dreaming.
No 48 Looking back towards Turkey Dreaming.
No 49 Point bar on the East Alligator River.
No 50 Palaeocutoff on the East Alligator River.
No 51 Palaeocutoff on the East Alligator River.
No 52 Recent cutoff on the East Alligator River, occurred during the 1996/97 Wet Season (Plate 19).
No 53 Recent cutoff on the East Alligator River, occurred during the 1996/97 Wet Season (Plate 21).
No 54 Floodplain of the East Alligator River upstream of the cutoff.
No 55 Closeup of the floodplain of the East Alligator River upstream of the cutoff.
No 56 Palaeochannel and flood waters on the right bank of the East Alligator River.
No 57 Right bank flood plain on the East Alligator River. Various palaeochannels can be seen.
No 58 Right bank flood plain on the East Alligator River. Various palaeochannels can be seen.
No 59 Right bank flood plain on the East Alligator River. Various palaeochannels can be seen (Plate 23).
No 60 Right bank flood plain on the East Alligator River, with lots of water.

Pouch Four

Photographer Mike Saynor. No. 61 to No. 80 taken 22/2/98.
No 61 Right bank flood plain on the East Alligator River, not far downstream from Cahills Crossing.
No 62 Right bank flood plain on the East Alligator River, not far downstream from Cahills Crossing.
No 63 Right bank flood plain on the East Alligator River, not far downstream from Cahills Crossing.
No 64 East Alligator River, looking upstream towards Cahills Crossing.
No 65 Cahills Crossing, East Alligator River (Plate 25).
No 66 Upstream boat ramp, East Alligator River.
No 67 Wet season flood chute, right bank East Alligator River just downstream of the gorge country.

No 68 Sand bar on the right bank of the East Alligator River and Wet season flood chute (Plate 27).
No 69 Looking back to the sand bar in No. 68.
No 70 East Alligator River main channels and The Rockhole to the right of the photo.
No 71 East Alligator River main channels and The Rockhole to the left of the photo.
No 72 Sandstone gorge country on the East Alligator River.
No 73 Sandy outflow section from the gorge country, East Alligator River, and the flooded right bank floodplain.
No 74 Looking upstream to the gorge country of the East Alligator River.
No 75 Two channels become one in the gorge country, East Alligator River (Plate 29).
No 76 The gorge country of the East Alligator River.
No 77 Colour change in the river flowing through the gorge country of the East Alligator River.
No 78 Main channel of the East Alligator River in the gorge country.
No 79 East Alligator River in the Meakin Valley with Tin Camp Creek coming in on the left.
No 80 East Alligator River in the Meakin Valley with Tin Camp Creek coming in on the left.

Pouch Five

Photographer Mike Saynor. No. 81 to No. 100 taken 22/2/98.
No 81 East Alligator River in the Meakin Valley with Tin Camp Creek coming in on the left.
No 82 Sandy Channel section on the East Alligator River.
No 83 Close up of some bedforms on the East Alligator River (Plate 31).
No 84 East Alligator River bedforms.
No 85 East Alligator River.
No 86 Exposed sand bar on the East Alligator River.
No 87 Looking back to the sand bar in No 86.
No 88 Looking back to the sand bar in No 86.
No 89 Another exposed sand bar on the East Alligator River, contains some vegetation.
No 90 Another exposed sand bar on the East Alligator River, contains some vegetation.
No 91 East Alligator River in the gorge section.
No 92 East Alligator River in the gorge section.
No 93 Sandstone cliffs above the East Alligator River.
No 94 East Alligator River continues through the gorge country.
No 95 East Alligator River continues through the gorge country.
No 96 Close up of the sandstone cliffs above the East Alligator River.
No 97 Close up of the sandy channel section of the East Alligator River.
No 98 Sweeping bend on the East Alligator River.
No 99 Sweeping bend on the East Alligator River.
No 100 Several channels on the East Alligator River

Pouch Six

Photographer Mike Saynor. No. 101 to No. 120 taken 22/2/98.
No 101 Close up sandy channel section of the East Alligator River.
No 102 East Alligator River and an incoming valley, opposite Ellen Wohl's slackwater deposit site, we believe.
No 103 Bedforms visible in the East Alligator River channel.
No 104 Several sandy deltas and other bedforms in the East Alligator River.

No 105 Several sandy deltas and other bedforms in the East Alligator River.
No 106 Shallow sandy channel next to a deeper channel, East Alligator River.
No 107 Tributary entering the East Alligator River on the right bank.
No 108 Cascades on the East Alligator River just downstream of the gauge.
No 109 Cascades on the East Alligator River just downstream of the gauge.
No 110 Cascades on the East Alligator River just downstream of the gauge (Plate 33).
No 111 Close up of the cascades.
No 112 Pool on the East Alligator River upstream of the cascades.
No 113 Cascades and pools on the East Alligator River.
No 114 Control and gauge pool for the gauge located on the right bank of the East Alligator River upstream of the cascades.
No 115 Control and gauge pool for the gauge located on the right bank of the East Alligator River upstream of the cascades.
No 116 Looking up the East Alligator River from above the gauge.
No 117 Looking up the East Alligator River from above the gauge.
No 118 Gauge pool and a tributary entering it (left of slide) just upstream of the gauge.
No 119 East Alligator River in the gorge country around the gauge.
No 120 Control and gauge pool for the gauge located on the right bank. Building can just be seen mid-photo. Also the tributary that enters the gauge pool.

Pouch Seven

Photographer Mike Saynor. No. 121 to No. 140 taken 22/2/98.
No 121 Pool riffle sequence approaching a sharp bend in the gorge section of the East Alligator River.
No 122 Pool riffle sequence approaching a sharp bend in the gorge section of the East Alligator River.
No 123 Approaching the sharp bend in the gorge section of the East Alligator River.
No 124 Close up of cliffs and a cascade in the gorge section of the East Alligator River.
No 125 Closer picture of the sharp bend in the gorge section of the East Alligator River.
No 126 Sandy point bar deposit that the helicopter landed on in June 1997 flight. A higher bench can also be seen. East Alligator River.
No 127 Sandy point bar deposit that the helicopter landed on in June 1997 flight. A higher bench can also be seen. East Alligator River.
No 128 Sandy point bar deposit that the helicopter landed on in June 1997 flight. A higher bench can also be seen. East Alligator River (Plate 35).
No 129 Looking back to the sandy point bar that the helicopter landed on in June 1997.
No 130 Gravel point bar on the East Alligator River in the escarpment country, just before the helicopter turned to head for Magela Falls.
No 131 Flowing water (cascade) in a tributary of the East Alligator River.
No 132 Escarpment country flying from the East Alligator River towards Magela Falls.
No 133 Magela Falls on Magela Creek.
No 134 Magela Falls on Magela Creek.
No 135 Magela Falls on Magela Creek.
No 136 Magela Falls on Magela Creek.
No 137 Looking down Magela Creek gorge from above Magela Falls.
No 138 Magela Falls on Magela Creek.
No 139 Magela Falls on Magela Creek (Plate 36).
No 140 Magela Falls on Magela Creek.

Pouch Eight

Photographer Mike Saynor. No. 141 to No. 160 taken 22/2/98.
No 141 Looking straight down Magela Falls as the helicopter flies over them.
No 142 Side of gorge and Magela Creek downstream from Magela Falls.
No 143 Flying down Magela Creek gorge.
No 144 Flying down Magela Creek gorge.
No 145 Looking down Magela Creek as the gorge begins to open up.
No 146 Cliffs and waterfalls in Magela Creek gorge.
No 147 Close up of the cliffs in Magela Creek gorge.
No 148 Close up of the cliffs in Magela Creek gorge.
No 149 Magela Creek still just in the gorge section.
No 150 Close up of the cliffs in Magela Creek gorge.
No 151 Magela Creek on the wooded lowland surface before flowing towards Ranger Mine.
No 152 Magela Creek sandy channel on the wooded lowland surface.
No 153 Looking back upstream towards the gorge country of Magela Creek.
No 154 Magela Creek sandy channel on the wooded lowland surface.
No 155 Magela Creek sandy channel on the wooded lowland surface.
No 156 Magela Creek sandy channel on the wooded lowland surface.
No 157 Magela Creek sandy channel on the wooded lowland surface.
No 158 Magela Creek sandy channel on the wooded lowland surface.
No 159 Mt Brockman sandstone escarpment.
No 160 Tailings dam at Ranger Mine.

Pouch Nine

Photographer Mike Saynor. No. 161 to No. 168 taken 22/2/98.
No 161 Retention Pond 1, Ranger Mine.
No 162 Coonjimba Billabong and Magela Creek, near the end of Jabiru Airstrip.
No 163 Sandy section of Magela Creek near the Ranger Mine site.
No 164 Looking back upstream on Magela Creek towards Georgetown Billabong.
No 165 Ranger Mine site including Pit No. 3.
No 166 Magela Creek flows along the Ranger Mine site, close to Pit No. 3.
No 167 Magela Creek flows along the Ranger Mine site, close to Pit No. 3.
No 168 Sandy bedforms in Magela Creek just downstream of the Ranger Mine site.