POWER AND WATER AUTHORITY
WATER RESOURCES DIVISION

COOMALIE/LITCHFIELD
FLOODPLAIN MAPPING
Adelaide River Section

REPORT 106 / 93
JEROME PAIVA
DARWIN
JULY 1993
SYNOPSIS

This report describes the determination of the boundary of the land liable to flooding (on a 1:25,000 topographical map), within the Coomalie/Litchfield area on the Adelaide River floodplain, by a 1 in 100 AEP flood.

The 1 in 100 AEP flood discharge of the Adelaide River at Tortilla Flats was determined by applying the 100 year Annual Recurrence Interval (ARI) design rainfall hyetograph to the RORB model. The RORB model was calibrated using pluviometer and streamflow records at Tortilla Flats, for the flood events of February 1969, March 1974, March 1976 and March 1989. The flood level at Tortilla Flats, was then obtained from the rating curve.

The boundary of the land liable to flooding between Adelaide River Town and Tortilla Flats was obtained assuming a uniform flood slope between their respective 1 in 100 AEP flood levels. The boundary of the land liable to flooding downstream of Tortilla Flats was determined assuming the longitudinal profile of the 1 in 100 AEP flood, from Tortilla Flats to Beatrice Hill, to be parallel to that for the March 1977 flood. The March 1977 flood profile was obtained assuming uniform flood slopes, between the March 1977 flood peaks, from Tortilla Flats to Upper Marrakai Crossing, Upper Marrakai Crossing to Dirty Lagoon, and Dirty Lagoon to Beatrice Hill. From Beatrice Hill to the sea outfall, the 1 in 100 AEP flood profile was assumed to slope uniformly to the high tide level at the Adelaide River sea outfall.
# TABLE OF CONTENTS

SYNOPSIS ................................................. (i)

TABLE OF CONTENTS ........................................ (ii)-(iii)

LIST OF TABLES ........................................... (iv)

LIST OF FIGURES ........................................... (iv)

1. INTRODUCTION .......................................... 1

2. STUDY AREA ..............................................
   2.1 General ............................................. 2
   2.2 Climate ............................................. 4

3. ADELAIDE RIVER FLOOD MAPPING - EARLIER STUDIES 5

4. BASIC DATA .............................................
   4.1 Topographic Maps .................................... 6
   4.2 Streamflow Data ..................................... 6
   4.3 Pluviometer Records ................................ 9

5. COMPUTATION OF DESIGN FLOOD .........................
   5.1 General ............................................ 10
   5.2 Runoff Routing Model ............................... 11
   5.3 Calibration of the RORB Model ................... 12
   5.4 The 1 in 100 AEP Design Flood from the RORB Model 15
   5.5 The 1 in 100 AEP Design Flood Estimate ........ 17


6. FLOODPLAIN MAPPING

6.1 General .......................... 18
6.2 Flood Mapping .......................... 18
6.3 Flood Map .......................... 20

7. REFERENCES .......................... 22
LIST OF FIGURES

FIGURE 2.1 LOCATION MAP . . . . . . . .3

FIGURE 5.1 ADELAIDE RIVER AT TORTILLA FLATS
RORE MODEL CALIBRATION – $K_c$ VERSUS $m$ . 14

FIGURE 6.1 LONGITUDINAL PROFILE OF 1 IN 100 AEP FLOOD 21

FIGURE 6.2 COOMALIE/LITCHFIELD FLOOD MAP 24

LIST OF TABLES

TABLE 4.1 ADELAIDE RIVER ANNUAL PEAK DISCHARGES
AT TORTILLA FLATS G8170084 . . . 8

TABLE 5.1 RORE MODELLING OF 1 IN 100 AEP ADELAIDE
RIVER PEAK FLOW AT TORTILLA FLATS . . 16
1. INTRODUCTION

The Floodplain Management Policy of the Northern Territory Government (Northern Territory Department of Lands 1981) provides for the identification and mapping of land liable to flooding (including coastal surge zones) and sets out guidelines and requirements to allow development to proceed on such land. In accordance with the policy and at the direction of the Northern Territory Floodplain Management Committee, the Power and Water Authority (PAWA) has been carrying out flood estimation and mapping of several towns and areas in the Northern Territory.

This report describes the analysis of the extent of flooding by a 1 in 100 Annual Exceedence Probability (AEP) flood and flood mapping of the Adelaide River section of the Coomalie/Litchfield area.
2. STUDY AREA

2.1 General

The study area (Figure 1.1) lies on the western floodplain of the Adelaide River, downstream of Adelaide River Town, and is bounded to the north by the Arnhem Highway and the Cox Peninsula Road. The area is generally flat and gently undulating.

Land use in the study area consists of rural residential, farming and pastoral activity.

The proposed land uses for the area are set out in the Darwin Regional Land Use Structure Plan 1990 (Northern Territory Department of Lands and Housing 1990) and the Litchfield Land Use Structure Plan 1990 (Northern Territory Department of Lands and Housing 1990). Generally, the area has been set aside for rural residential and agricultural/horticultural purposes.

The purpose of this study is to define the land liable to flooding within the study area and, if possible, to produce flood maps showing the severity of flooding. This would greatly assist in the development of the Coomalie/Litchfield area.

---

1 Land liable to flooding is defined as land that would be inundated as a result of a flood event that has a statistical chance of 1% of being equalled or exceeded during any one year. This flood event is one which has a 50% chance of being experienced at least once in an average life span and has been generally adopted for planning purposes.
Figure 1.1

Coomalie/Litchfield Flood Mapping Location Map
2.2 Climate

The Adelaide River catchment falls within the climate zone classified as 'Summer Rainfall - Tropical' (Bureau of Meteorology 1986). This zone is characterized by heavy periodic rains (heavier in coastal areas), generally hot, and humid in coastal areas during the summer (November - March). The winter months (May - September) are generally rainless, mild to warm and dry. The months of April and October represent transition periods of change from one season to the other.

The rainfall is seasonal and 80 - 90% of the annual rainfall occurs in the four months from December to March. Although a substantial portion of the rainfall is caused by thunderstorm activity, flood producing rainfalls in the catchment mainly result from monsoonal depressions or cyclonic activity.
3. ADELAIDE RIVER FLOOD MAPPING - EARLIER STUDIES

A flood map of Adelaide River Town was produced in 1980 by the Water Division of the Department of Mines and Energy (1988). The flood levels were determined from a one dimensional backwater analysis which matched the 1 in 100 AEP flood discharge obtained by frequency analysis of 26 years of recorded annual flood maxima at G8170002. The frequency analysis was based on a Log Pearson Type 3 distribution with zero skew.

The above analysis was reassessed in August 1985 (Department of Mines and Energy 1988) using 31 years of record and again using a Log Pearson Type 3 distribution, but with non zero skew. Flood levels computed were found to be 0.7 m to 1 m lower than those obtained from the previous analysis.

A floodplain map of Adelaide River Town and environs was prepared (Paiva 1989) using the hydraulic model PL2DFLOW\(^1\) (Chang and Lesleightner 1984). The model was calibrated and verified, using stage and streamflow records at G8170002 for the flood events of March 1977 and February 1968, respectively. The 1 in 100 AEP flood for input to the model was obtained using frequency analysis of 35 years (1953 - 1987) of annual recorded maximum flood discharges at G8170002.

---

\(^1\) PL2DFLOW model is a 2 dimensional gradually varied flow finite difference model. It is operated by considering the potential flood zone study area as a number of cells with the boundaries generally following the contours where possible, and the flow is analysed at successive time steps in the 2 - D model over the whole area. The model is established using geometrical (topographical) data and cell boundary flow control data.
4. BASIC DATA

4.1 Topographic Mapping

The study area (Figure 1.1) is covered by 1:100,000 with 20 m contours, 1:250,000 scale maps with 20 m contours and 1:25,000 scale maps with 5 m contours.

4.2 Streamflow Data

Within and near the study area, the Adelaide River is continuously gauged at Adelaide River/Stuart Highway Crossing G8170002, Tortilla Flats G8170084, Upper Marakkai Crossing G8170005 and at Dirty Lagoon G8170020. The river level is also continuously recorded (and some discharge measurements have been taken) at Beatrice Hill G8170021, which is a tidal gauging station.

G8170002 was opened in May 1952 and continuous stage recording commenced in June 1959. Current meter measurements are also carried out at this station and since 1952, 464 discharge measurements have been made. The current meter measurements are sufficient to derive a stage discharge relationship up to a discharge of 1080 m$^3$/s (highest discharge measurement) at the gauge height of 11.85 m. The gauge height of the highest stage recorded, to date, is 12.41 m (in March 1977). The rating curve was extended up to the 1 in 100 AEP flood level of 52.2 m AHD (at 1480 m$^3$/s, gauge height 12.78 m), using the results of the 2D floodplain modelling of Adelaide River Town (Paiva 1989).

1 Dirty Lagoon and Beatrice Hill stations are under tidal influence. The tidal limit is Marakkai Crossing which is 4 km downstream of G8 8170005.
G8170084 at Tortilla Flats was opened in June 1963 and continuous stage recording is carried out at this station. Current meter measurements are also being taken at G8170084 and up to now 217 discharge measurements are available. The current meter measurements are sufficient to derive a rating curve at G8170084 up to a discharge of 451 m³/s (highest discharge measurement) at the gauge height of 5.93 m. The maximum stage recorded was 6.52 m. The rating curve beyond was extended logarithmically up to the gauge height of 6.52 m. The available digitized stage records (1963 - 1992) were processed using the extended rating curve and the discharges (1963 - 1992) obtained. The annual maximum discharges at Tortilla Flats are shown in Table 4.1.

G8170005 at Upper Marrakai Crossing was opened in July 1956 and continuous stage recording is carried out at the station. The highest stage recorded to date was 9.67 m in March 1977. Up to now 194 discharge measurements have been taken at G8170005. These discharge measurements are sufficient to derive a rating curve up to a discharge of 80.7 m³/s (highest discharge measurement) at the stage height of 4.86 m. The rating curve has been extended by use of the AR₁/₂ method and regression analysis of flow gaugings, and is reliable up to the gauge height of 7.77 m (Paiva 1991).

G8170020 at Dirty Lagoon was opened in November 1962 and the stage was continuously recorded until October 1986. The highest stage recorded to date was in March 1977, and that was 10.81 m AHD. Up to now, only 23 current meter measurements have been taken. The largest discharge measurement taken had a height of 8.04 m AHD. A rating curve with an extension up to 13.5 m has been derived for Dirty Lagoon G8170020 (Paiva 1991).
### TABLE 4.1

**ANNUAL PEAK DISCHARGES AT TORTILLA FLATS G8170084**

<table>
<thead>
<tr>
<th>Water Year</th>
<th>Discharge (m$^3$/s)</th>
<th>Flood Level (m AELD)</th>
<th>Water Year</th>
<th>Discharge (m$^3$/s)</th>
<th>Flood Level (m AELD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1963/64</td>
<td>268</td>
<td>5.49</td>
<td>1978/79</td>
<td>104</td>
<td>4.38</td>
</tr>
<tr>
<td>1964/65</td>
<td>545</td>
<td>6.31</td>
<td>1979/80</td>
<td>nr*</td>
<td>nr</td>
</tr>
<tr>
<td>1965/66</td>
<td>417</td>
<td>6.00</td>
<td>1980/81</td>
<td>311</td>
<td>5.33</td>
</tr>
<tr>
<td>1966/67</td>
<td>252</td>
<td>5.24</td>
<td>1981/82</td>
<td>446</td>
<td>6.08</td>
</tr>
<tr>
<td>1967/68</td>
<td>611</td>
<td>6.45</td>
<td>1982/83</td>
<td>313</td>
<td>5.54</td>
</tr>
<tr>
<td>1968/69</td>
<td>648</td>
<td>6.52</td>
<td>1983/84</td>
<td>417</td>
<td>6.00</td>
</tr>
<tr>
<td>1969/70</td>
<td>89</td>
<td>2.95</td>
<td>1984/85</td>
<td>218</td>
<td>4.74</td>
</tr>
<tr>
<td>1970/71</td>
<td>237</td>
<td>5.07</td>
<td>1985/86</td>
<td>215</td>
<td>4.71</td>
</tr>
<tr>
<td>1971/72</td>
<td>528</td>
<td>6.27</td>
<td>1986/87</td>
<td>nr</td>
<td>nr</td>
</tr>
<tr>
<td>1972/73</td>
<td>549</td>
<td>6.32</td>
<td>1987/88</td>
<td>nr</td>
<td>nr</td>
</tr>
<tr>
<td>1974/75</td>
<td>345</td>
<td>5.78</td>
<td>1989/90</td>
<td>112</td>
<td>3.34</td>
</tr>
<tr>
<td>1975/76</td>
<td>559</td>
<td>6.34</td>
<td>1990/91</td>
<td>479</td>
<td>6.16</td>
</tr>
<tr>
<td>1976/77</td>
<td>606</td>
<td>6.44</td>
<td>1991/92</td>
<td>nr</td>
<td>nr</td>
</tr>
<tr>
<td>1977/78</td>
<td>296</td>
<td>5.42</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* nr denotes missing records
### 4.3 Pluviometer Records

Within and near the Adelaide River catchment at Tortilla Flats, pluviometers have been operated for different periods as follows.

<table>
<thead>
<tr>
<th>STATION NO.</th>
<th>STATION NAME</th>
<th>LAT.</th>
<th>LONG.</th>
<th>PERIOD OF RECORD</th>
</tr>
</thead>
<tbody>
<tr>
<td>R8170002</td>
<td>Adelaide River</td>
<td>1318</td>
<td>13104</td>
<td>10.1965 - present</td>
</tr>
<tr>
<td>R8170008</td>
<td>&quot;</td>
<td>1325</td>
<td>13105</td>
<td>07.1985 - present</td>
</tr>
<tr>
<td>R8170009</td>
<td>&quot;</td>
<td>1315</td>
<td>13107</td>
<td>11.1955 - 02 1962</td>
</tr>
<tr>
<td>R8170010</td>
<td>&quot;</td>
<td>1319</td>
<td>13058</td>
<td>10.1960 - 12.1981*</td>
</tr>
<tr>
<td>R8170084</td>
<td>&quot;</td>
<td>1305</td>
<td>13114</td>
<td>11.1958 - 08 1973</td>
</tr>
<tr>
<td>R8170236</td>
<td>&quot;</td>
<td>1326</td>
<td>13103</td>
<td>11 1965 - 07 1985</td>
</tr>
<tr>
<td>R8170007</td>
<td>Red Bank Creek</td>
<td>1322</td>
<td>13058</td>
<td>12 1981 - 11 1986</td>
</tr>
<tr>
<td>R8170014</td>
<td>60 Mile Creek</td>
<td>1305</td>
<td>13106</td>
<td>12 1954 - 05 1960</td>
</tr>
<tr>
<td>R8170089</td>
<td>Snake Creek</td>
<td>1314</td>
<td>13105</td>
<td>12 1960 - 03 1962</td>
</tr>
<tr>
<td>R8170301</td>
<td>Stapleton Creek</td>
<td>1311</td>
<td>13104</td>
<td>10 1978 - 06 1981</td>
</tr>
<tr>
<td>R8170302</td>
<td>&quot;</td>
<td>1312</td>
<td>13100</td>
<td>10 1978 - 06 1981</td>
</tr>
<tr>
<td>R8170303</td>
<td>&quot;</td>
<td>1307</td>
<td>13105</td>
<td>08 1973 - 06 1981</td>
</tr>
</tbody>
</table>

* There were no pluviometer records for the period 21.06 1963 - 13.10.1965
5. COMPUTATION OF DESIGN FLOOD

5.1 General

Design floods can be derived from flood frequency analysis of discharge records or from a rainfall runoff model. Where flood frequency analysis is used, the required peak flow is found from a frequency distribution of recorded annual flood maxima. Rainfall runoff based methods, usually, use either a runoff routing model or a unit hydrograph and give a complete hydrograph of the design flood.

The extent to which a flood frequency analysis can be extrapolated before an alternative rainfall based method becomes preferable depends on the accuracy of the latter method and the characteristics of the design rainfall data (IE Aust. 1987). In addition, it depends on the length of the flood record (N) in years, the standard deviation (S) and coefficient of skew (g) of the logarithms of the flood values (IE Aust. 1987).

Based on the above considerations, Australian Rainfall and Runoff (ARR) (IE Aust. 1987) has set out three empirical equations for finding Y (for a flood of AEP of 1 in Y), one for catchments greater than 150 km$^2$ where Meteorological Bureau design rainfalls (in ARR) are based on daily data, and the other two for catchments smaller than 100 km$^2$ where the design rainfalls were based on pluviometer records.

1 The Log Pearson Type III (LP111) distribution is used as a standard in Australia and lends itself well to flood data which tend to have a lower limit but no upper limit.
The annual exceedence probability (AEP) at which the rainfall based method becomes more accurate than flood frequency analysis (for a catchment area greater than 150 km$^2$), is denoted by 1 in $Y_1$ for a rainfall - runoff method calibrated "on site" (and 1 in $3Y_1$ for a rainfall runoff method using regional parameters).

On the above basis, it was found that a calibrated rainfall runoff model would produce more accurate estimates of the 1 in 100 AEP flood Tortilla Flats G8170084, than frequency analysis.

5.2 Runoff Routing Model

The rainfall runoff model used was the RORB runoff routing model version 4 developed by Laurenson and Mein (1988). The model computes the flood hydrograph from rainfall and other channel inputs by subtracting the losses from rainfall and routing the rainfall excess through each subcatchment storage. The model is non linear and accounts for temporal and areal variation of rainfall and losses.

The key parameters in the model are the dimensionless exponent $m$, a measure of the nonlinearity of the catchment (usually, $0.6 \leq m \leq 1.0$), and the empirical coefficient $K_c$, a dimensionless measure of the storage delay time of the whole catchment.

$Y_1 = F N^{0.5} \exp(0.02N)$ where $F$ depends on the values of $S$ and $q$ and is taken from Table 12.2 in ARR.
Subcatchment storages are assumed to be governed by a storage-discharge equation of the form

\[ S = 3600 K_c K_r Q^m \]

where

- \( S \) = storage \((m^3)\)
- \( Q \) = outflow discharge \((m^3/s)\)
- \( m \) = dimensionless exponent
- \( K_c \) = empirical coefficient applicable to the whole catchment and stream network
- \( K_r \) = dimensionless ratio called the relative delay time applicable to individual reach storages.

### 5.3 Calibration of the RORB Model

For G8170184 at Tortilla Flats, the RORB model was calibrated for all flood events with pluviometer and discharge records (February 1969, March 1974, March 1976 and March 1989). Base flow contributions to the peak flows were insignificant (about 2% of the peak flows). Week's procedure (Weeks 1980) was used to obtain an optimum combination of \( m \) and \( K_c \). For each of the flood events, a range of \( m \) values was used. For each \( m \) value, \( K_c \) was varied until the best fit with that \( m \) value was obtained. Graphs of \( K_c \) versus \( m \).
for the flood events were then plotted (Figures 5.1 and 5.2). The graphs indicated the optimal combination of \( m \) and \( K_c \) to be 0.86 and 55.0.

The results of the calibrations were as follows.

### RORB Calibration at Tortilla Flats

<table>
<thead>
<tr>
<th>Event</th>
<th>Peak Loss (m³/s)</th>
<th>Initial Loss (mm)</th>
<th>Continuing Loss (mm/hr)</th>
<th>( K_c )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( m )</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
<td>0.9</td>
</tr>
<tr>
<td>1968/69</td>
<td>648</td>
<td>0.0</td>
<td>2.97</td>
<td>243.6</td>
</tr>
<tr>
<td>1973/74</td>
<td>523</td>
<td>0.0</td>
<td>1.17</td>
<td>173.2</td>
</tr>
<tr>
<td>1975/76</td>
<td>559</td>
<td>0.0</td>
<td>3.84</td>
<td>280.8</td>
</tr>
<tr>
<td>1988/89</td>
<td>368</td>
<td>0.0</td>
<td>1.05</td>
<td>268.2</td>
</tr>
</tbody>
</table>
ADELAIDE RIVER AT TORTILLA FLATS
RORB MODEL CALIBRATION - Kc v's m

Figure 5.1
The RORB model parameter $K_c$ (for $m = 0.8$) was also obtained from the RORB regional relationship\(^1\) for the humid region of the Northern Territory (IE Aust. 1987). $K_c$ (for $m = 0.8$) was computed to be 101.5 for Tortilla Flats.

\(^1\) For the humid region of the Northern Territory

\[ K_c = 1.8 \left( \frac{A}{S^{0.5}} \right)^{0.55} \]

where $A$ is the catchment area in km\(^2\)

$S$ is the equal area slope of the catchment in m/km.

5.4 The 1 in 100 AEP Design Flood from the RORB Model

To obtain the 1 in 100 AEP design flood, the 100 year Average Recurrence Interval (ARI) design rainfall from ARR (IE Aust. 1987) together with the 100 year ARI rainfall temporal patterns (IE Aust. 1987) were applied to the RORB model. The rainfall hyetograph for input to the model was derived by first applying an areal reduction factor (IE Aust. 1987) to the 1 in 100 year AEP point rainfall. Storm durations of 12, 24, 36 and 48 hours were used.

The results of the modelling of the 1 in 100 AEP flood for Tortilla Flats are shown in Table 5.1, respectively.
Table 5.1

RORB MODELLING
OF
1 IN 100 AEP
ADELAIDE RIVER PEAK FLOW AT TORTILLA FLATS

<table>
<thead>
<tr>
<th>Storm Duration (Hours)</th>
<th>Areal Reduction Factor</th>
<th>Total Rainfall (mm)</th>
<th>Peak Flow (m³/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point</td>
<td>Catchment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>0.88</td>
<td>204</td>
<td>180</td>
</tr>
<tr>
<td>24</td>
<td>0.91</td>
<td>293</td>
<td>265</td>
</tr>
<tr>
<td>36</td>
<td>0.91</td>
<td>376</td>
<td>342</td>
</tr>
<tr>
<td>48</td>
<td>0.91</td>
<td>411</td>
<td>374</td>
</tr>
</tbody>
</table>

Note: Ko, m, - RORB parameters, il - initial loss, cl - continuing loss

*The regional value of Ko is 101.5
5.5 The 1 in 100 AEP Design Flood Estimate

The 1 in 100 AEP flood peaks obtained by RORB modelling using calibrated and regional parameters, are 2230 (m$^3$/s) and 2030 (m$^3$/s), respectively.

The average error of estimate from a calibrated rainfall runoff model is 14%, whilst that from a rainfall runoff model using a regional parameter is 25 - 70% (IE Aust. 1987).

The 1 in 100 AEP flood peak (2230 m$^3$/s) at Tortilla Flats, obtained from the calibrated RORB model, was therefore taken to be the 1 in 100 AEP design flood estimate, for flood mapping.
6. FLOODPLAIN MAPPING

6.1 General

The scale of the topographical maps available for the study area was 1 : 25,000 with 5 m contours. The accuracy of the topographical maps did not permit the use of either a 1 - D or 2 - D gradually varied flow finite difference model, for simulating the flood flow.

With the available information it was not possible to determine flood contours, severities of flooding etc. Only the approximate boundary of the area liable to flooding was determined.

6.2 Flood Mapping

At Tortilla Flats G8170084, the 1 in 100 AEP flood level was found to be 32.46 m AHD (gauge height 8.24 m).

From the 1 in 100 AEP flood hydrograph at Tortilla Flats it was found that the flood discharge would exceed 90 % of its peak (2230 m$^3$/s) for a period of 16 hours. It is very likely therefore that a high tide would obtain at the Adelaide River outfall during this period. The high tide level at the Adelaide River outfall was

---

1 The error in interpolating levels from 5 m contour maps is about ± 1.5 m
The boundary of the land liable to flooding for the Coomalie/Litchfield area between Adelaide River Town and Tortilla Flats was determined by assuming a uniform slope from the 1 in 100 AEP flood level at Adelaide River Town / Stuart Highway Crossing\(^2\) (52.20 m AHD) to the 1 in 100 AEP flood level at Tortilla Flats (32.46 m AHD). This slope was 0.00071.

The 1 in 100 AEP longitudinal flood profile, downstream of Tortilla Flats, was assumed to be parallel to that of March 1977. For the March 1977 flood, uniform slopes were assumed between the flood peak levels at Tortilla Flats G8170184 and Upper Marakkai Crossing G8170005, Upper Marakkai Crossing G8170005 and Dirty Lagoon G8170020, and Dirty Lagoon G8170020 and Beatrice Hill G8170021. Downstream of Beatrice Hill (excluding the coastal area\(^1\)), an uniform slope to the high tide level at the Adelaide River sea outfall was assumed.

---

\(^1\) There is a decrease in tidal range from west to east along the open coast of the top end of the Northern Territory. Using Darwin Harbour as the basis of prediction for all other sites, Blain, Bremner and Williams (1983) obtained a tidal range ratio (TDR) of 0.79 for Point Stephens situated near the Adelaide River outfall. Using the tidal planes at Darwin Harbour of MSL 4.1 m, HAT 7.9 m, LAT 0.1 m, AED 3.962 m, and an assumed TDR of 0.79 at the Adelaide River outfall, the high tide level at the Adelaide River outfall was estimated to be 3.2 m AHD.

\(^2\) 1 in 100 AEP flood level at the Adelaide River/Stuart Highway Crossing is 52.2 AHD (Paiva 1989).

\(^1\) For the coastal area the boundary of the land liable to flooding would be determined by the design storm tide level. The storm tide level is experienced during the passage of a tropical cyclone and is made up of the astronomical tide level, the cyclone storm surge and the effect of wave action on the surge level at the coast. Design storm tide levels with risks of 1% to 0.1% per annum have been considered acceptable for coastal townships around Darwin.
The longitudinal profile of the 1 in 100 AEP flood from Adelaide River Town to the sea outfall is shown in Figure 6.1. Also shown in Figure 6.1 is the longitudinal profile for the March 1977 flood.

6.3 Flood Map

The flood inundation map of the study area for a 1 in 100 AEP flood event is shown on the 1 : 25,000 scale topographical maps (with 5 m contours) (Figure 6.2).

Only the extent of flooding in a 1 in 100 AEP flood event has been shown. Due to the error (± 1.5 m) in interpolating levels from 5 m contour maps it was not possible to show the flood contours and the hazardous floodway areas on the topographical map.

The flood map produced (Figure 6.2) is only indicative and shows the approximate extent of inundation by a 1 in 100 AEP flood.

2 Hazardous floodway is defined as an area where the depth of flooding is greater than 2 m, or where the product of depth in metres and velocity in m/s exceeds one.
LONGITUDINAL PROFILE OF 1 IN 100 AEP FLOOD

<table>
<thead>
<tr>
<th>Location</th>
<th>MARCH 1977</th>
<th>1 IN 100 AEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>GS 8170002</td>
<td>51.83 (m AHD)</td>
<td>52.20 (m AHD)</td>
</tr>
<tr>
<td>GS 8170184</td>
<td>30.66 (m AHD)</td>
<td>32.46 (m AHD)</td>
</tr>
<tr>
<td>GS 8170005</td>
<td>12.42 (m AHD)</td>
<td>14.22 (m AHD)</td>
</tr>
<tr>
<td>GS 8170020</td>
<td>10.81 (m AHD)</td>
<td>12.61 (m AHD)</td>
</tr>
<tr>
<td>GS 8170021</td>
<td>3.68 (m AHD)</td>
<td>5.48 (m AHD)</td>
</tr>
</tbody>
</table>

Figure 6.1
7. REFERENCES


Department of Civil Engineering, Monash University, Victoria.

NORTHERN TERRITORY DEPARTMENT OF LANDS AND HOUSING (1981)  
Land Use in Floodplains  
Northern Territory Department of Lands, Darwin.

NORTHERN TERRITORY DEPARTMENT OF LANDS AND HOUSING (1990)  
Litchfield Land Use Structure Plan 1990  
Northern Territory Department of Lands and Housing, Darwin.

NORTHERN TERRITORY DEPARTMENT OF LANDS AND HOUSING (1990)  
Darwin Regional Land Use Structure Plan 1990  
Northern Territory Department of Lands and Housing, Darwin.

PAIVA, J. (1989)  
Adelaide River Town Floodplain Mapping  

PAIVA, J. (1991)  
Marrakai Dam Yield Study  

23
Figure 6.2

COOMALIE/LITCHFIELD FLOOD MAP
ADELAIDE RIVER SECTION
Scale 1 : 25,000