APPENDIX G
SPECIALIST HYDROLOGICAL REPORT

HYDRAULIC ASSESSMENT REPORT
FOR THE
OMEGA SUBSTATION
(WESTERN CAPE)

NOVEMBER 2004

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1. BACKGROUND

Eskom are proposing the construction of a 765kV Substation on the farm Groot Oliphantskop, which is located approximately 5km east of Melkbosstrand in the Western Cape. This substation forms part of Eskom's Cape strengthening project, the details of which are covered in the environmental Scoping Report. The Groot Oliphantskop Farm is owned by Eskom.

2. LOCAL TOPOGRAPHY

The Farm is located on gently sloping land that is predominantly utilized for wheat farming. The farm is transected by the Old Main Road in a North-South direction, and by a number of Eskom transmission lines that cross the farm on route to Koeberg Power Station. The high point of the farm is located east of the Old Mamre Road at an elevation of 139m mean sea level (1: 50 000 topographical map), which coincides with the Oliphantskop Homestead. From this high point the farm slopes gently to the north towards the Sout Rivier and to the south towards the Diep Rivier.

3. HYDROLOGY

The farm is divided into two watersheds – with the bulk of the land sloping gently from the homestead towards the Sout Rivier in a northeasterley direction. There are three clearly defined natural watercourses draining from this farm to the Sout Rivier, two from area C and one from area A. Area B drains to the south. The watercourses from the farm, which drain north to the Sout Rivier all pass through a bordering farm located between Groot Oliphantskop and the Sout Rivier.

The watercourse from area A drains under the Old Mamre Road and railway line on route to the Sout Rivier. This drainage structure will be a critical point in terms of stormwater discharge.

The eastern boundary of Groot Oliphantskop forms a watershed between this property and the neighbouring Witdraai Farm and it is therefore unlikely that stormwater run-off will be directed onto the neighbouring farm.

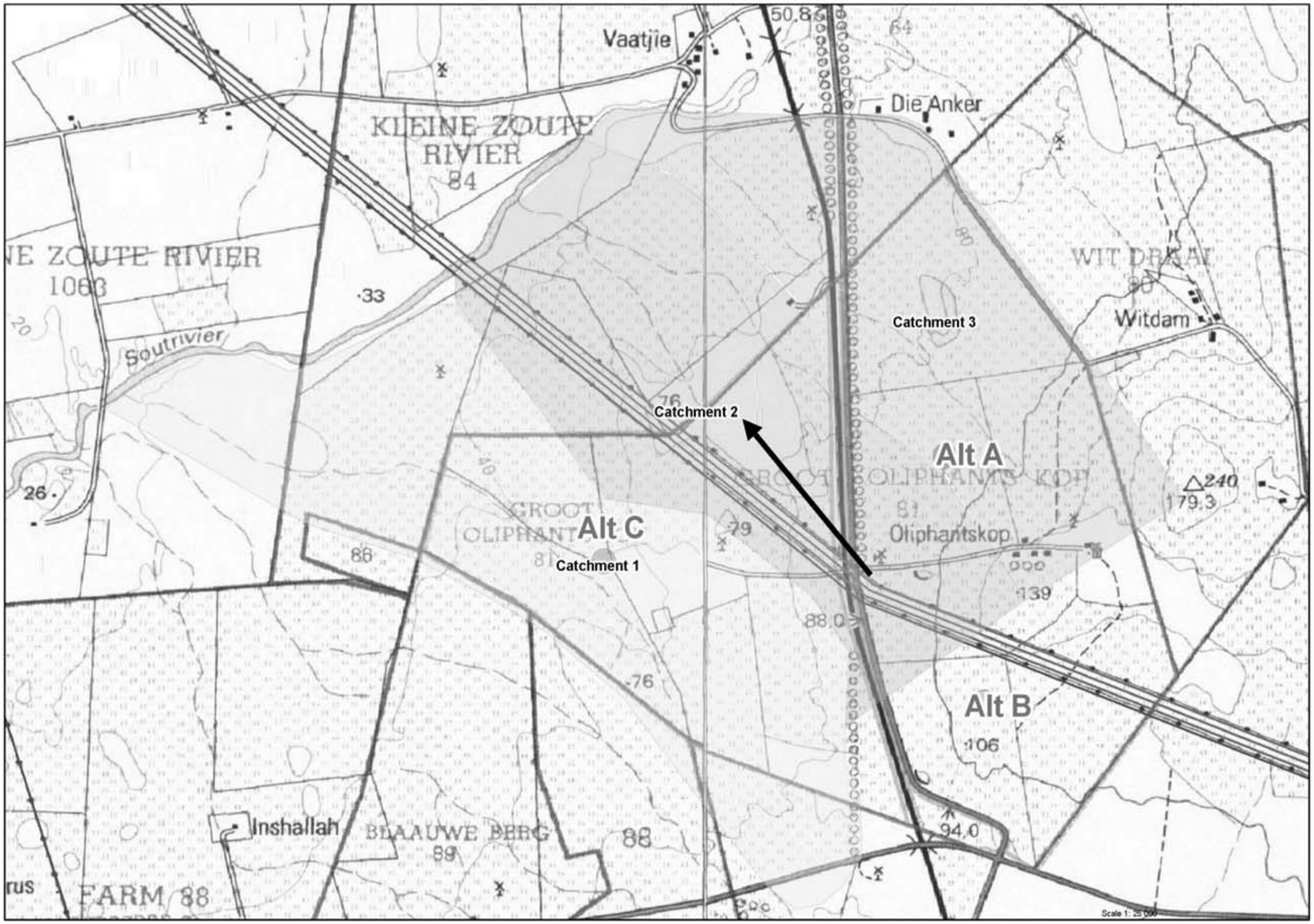


FIGURE 1 1: 50 000 MAP SHOWING STUDY AREA TOPOGRAPHY

4. CLIMATE AND RAINFALL

The area experiences a moderate Mediterranean climate in common with the rest of the South Western Cape. Rainfall is predominantly in winter and averages 380mm per annum. Rainfall intensity graphs were obtained from the Cape Town Municipality for various measuring stations in and around the City of Cape Town. The rainfall data from the Tygerberg Station has been used for this baseline study. The rainfall intensity graphs are included in Appendix A for reference.

5. DEVELOPMENT OF THE SITE FOR A SUBSTATION

The development of this site for a substation will require certain activities including large scale modifications to existing land levels to create flat terraces for heavy electrical equipment and removal of vegetation from the site. Substation yards are not hardened by the construction of an impermeable surface (such as asphalt or concrete) but are gravelled for aesthetics and erosion control. Both of these activities will affect the stormwater run-off characteristics of the land as follows:

a) Engineered flat ground results in more point specific discharge points, this tends to concentrate flow and increase its erosive potential;

b) Terracing will result in changes to the existing water discharge pathways.

c) The absence of vegetation will result in higher stormwater run-off as vegetation slows the flow of surface water run-off allowing it to infiltrate into the ground. The less vegetation on a site the higher the run-off coefficient will become i.e. a higher percentage of water will "run-off" the site rather than infiltrating into the ground.

d) Higher run-off coefficients mean that watercourses and man-made drainage structures have to carry more water – this can result in hydraulic capacity problems and flooding.

6. QUANTIFICATION OF STORMWATER IMPACT

In order to determine the impact of constructing a substation on the Groot Oliphantskop Farm the extent of change of run-off has been quantified. The Rational Method is the most commonly used method of computing run-off for stormwater systems. The formula used in this method is:

$$Q = \frac{C.I.A}{360} \text{ m}^3/\text{s}$$

Q = run-off volume of water
C = coefficient of run-off
I = average rainfall intensity (from Tygerberg measuring station)
A = area of catchment

For comparative purposes a run-off coefficient of 0.3 was assumed for the existing land and a coefficient of 0.7 once the site has been developed. A 50 year flood event was considered.

The effect of this change can be tabulated as follows:

Area	**Run-off coeff.**	**Q_{50} (Stormflow m^3/s)**	**Increase**
A	0.3	2.67	239%
	0.7	6.39	
C	0.3	1.86	233%
	0.7	4.34	

TABLE 1. **COMPARISION OF SITE A AND C**

These values are a bit misleading in that the engineered site will be flatter and hence will result in slower run-off velocities and more seepage or infiltration of water into the ground.

The important result of this exercise is that:
A development of this size will substantially alter the characteristics of the stormwater run-off, resulting in concomitant increased stormwater run-off, in the order of magnitude indicated in the above table.

Downstream infrastructure could be placed under pressure by the increase in run-off volumes.

Site B was not evaluated as the topography of this site is far steeper than the others, which will result in excessive earthworks volumes and it does not for this reason appear viable.

7. PREFERRED SITE

Neither site A nor C presents themselves as a better choice from a hydrological perspective. Site C has a more defined watercourse and hence substantial land remodelling will be more detrimental to the ecology of the site. Site C also accepts stormwater from a neighbouring farm to the south (Blaauwberg), which would have to be accommodated by way of a stormwater culvert or canalisation of some sort. The head of the catchment of site A is within the Groot Oliphantskop farm and hence there would not need to be any specific accommodation of flows from a neighbouring landowner.

Site C does however drain to a stormwater control structure, which takes the watercourse under the Old Mamre Road and railway line. This will limit the acceptable flow that can be allowed from a development on Site C.

8. RECOMMENDATIONS AND MITIGATION

Neither site A nor Site C is a “no-go area” from a hydrological perspective.

We recommend that mitigation measures be adopted to reduce run-off from the site, such as avoiding point source discharge points, encouraging slower path velocities by grassing stormwater channels rather than having concrete lined drains to increase infiltration. Use vegetation rather than “hard” surfaces – grassing wherever possible.

A detention facility should be constructed to ensure that peak flow leaving the site after the development has been completed, does not exceed the peak flows prior to development. Once the extent of the work is defined an Engineer should be appointed to design a detention facility of suitable capacity.

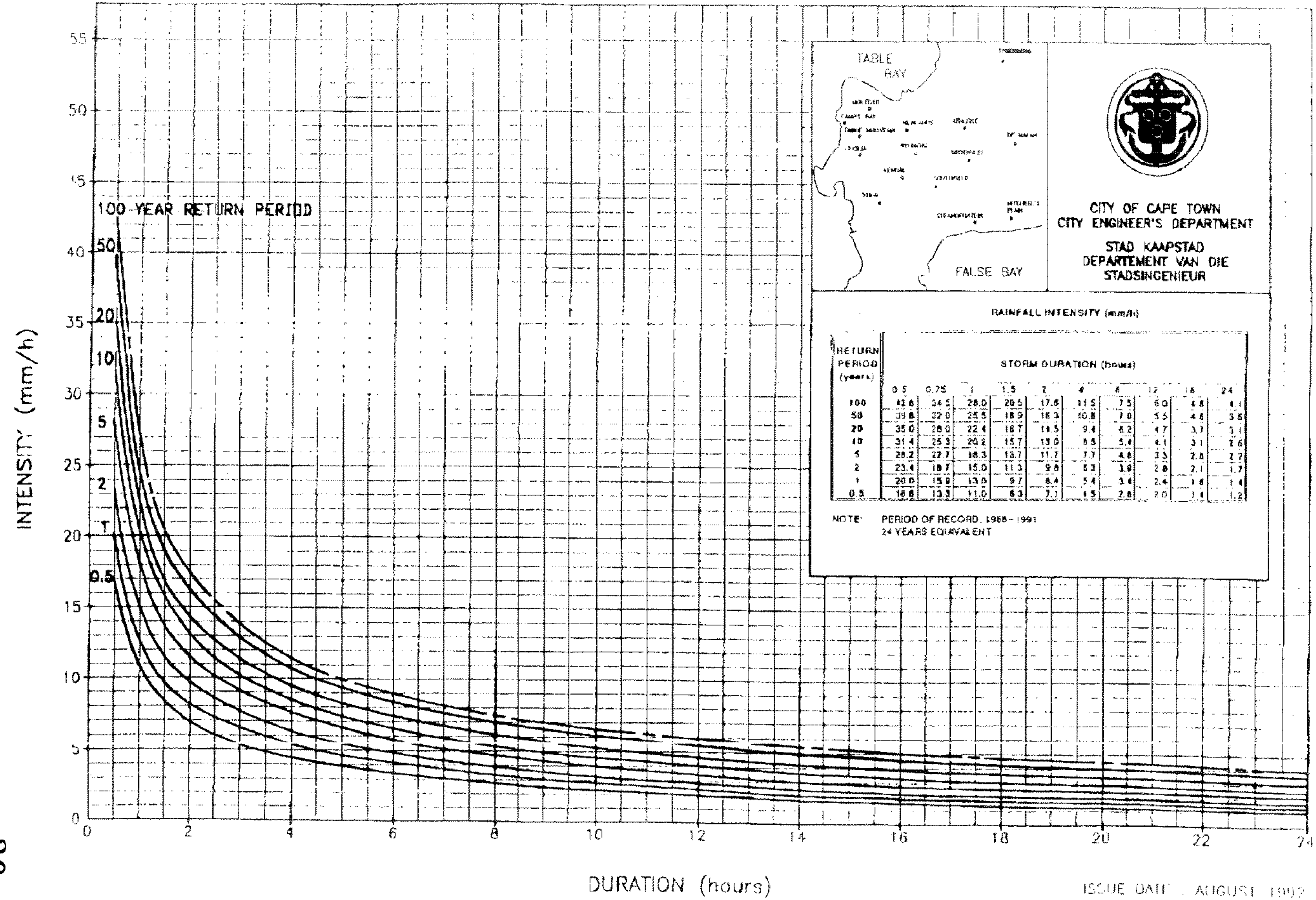
Earthworks should be carefully planned to ensure that there are no inter-catchment disturbances i.e. transfer of flow from one catchment to another due to the amendment of natural ground levels.

Erosion protection and grit traps should be constructed during construction to prevent erosion of sands and subsequent silting of downstream watercourses.

APPENDIX A

RAINFALL INTENSITY/DURATION CURVES

RAINFALL INTENSITY – DURATION – FREQUENCY CURVES
TYGERBERG



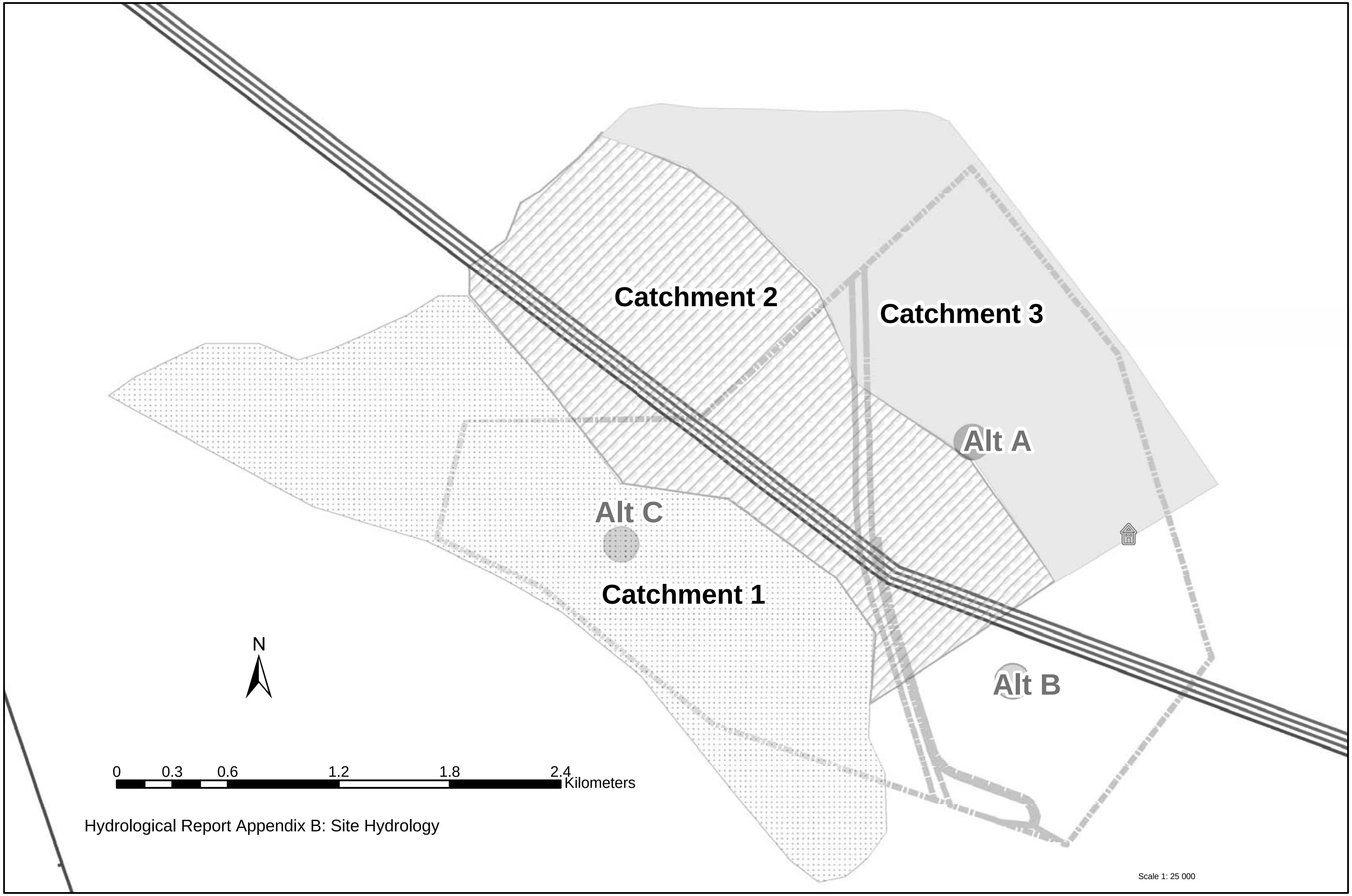
RAINFALL INTENSITY (mm/h)

RETURN PERIOD (years)	STORM DURATION (hours) 0.5	0.75	1	1.5	2	4	8	12	18	24
100	42.6	34.5	28.0	20.5	17.6	11.5	7.5	6.0	4.8	4.1
50	39.8	32.0	25.5	18.9	16.3	10.8	7.0	5.5	4.6	3.5
20	35.0	28.0	22.4	18.7	14.5	9.4	6.2	4.7	3.7	3.1
10	31.4	25.3	20.2	15.7	13.0	8.5	5.4	4.1	3.1	2.6
5	28.2	22.7	18.3	13.7	11.7	7.7	4.8	3.3	2.8	2.2
2	23.4	18.7	15.0	11.3	9.8	6.3	3.9	2.8	2.1	1.7
1	20.0	15.9	13.0	9.7	8.4	5.4	3.4	2.4	1.8	1.4
0.5	16.8	13.3	11.0	8.3	7.1	4.5	2.8	2.0	1.4	1.2

NOTE: PERIOD OF RECORD: 1968 – 1991
24 YEARS EQUIVALENT

ISSUE DATE : AUGUST 1992

APPENDIX B
SITE HYDROLOGY



Hydrological Report Appendix B: Site Hydrology