2. RAINFALL

2.1. OVERVIEW

Rainfall data for the study area were acquired from the Ministry of Natural Resources (Department of Metrology) as well as the South African Weather Bureau. There is a significant coverage of rainfall gauges, particularly around the border areas (as is shown in **Figure A.4** in **Annexure A**), however, there is a scarcity of rainfall data in the interior of Lesotho. In particular, the lack of rain gauges in the higher lying areas of the Study Area may lead to an under-estimation of catchment rainfall.

Rainfall data were required for two purposes in this assignment, namely for the simulation of catchment runoff using the WRSM 2000 model and for the simulation of rainfall on the surface of impoundments using the WRYM model. The process of producing such rainfall data was as follows :

1. Preliminary screening and evaluation of rainfall data;
2. Grouping and patching of rain gauges;
3. Final screening and evaluation of rainfall data; and
4. Creation of catchment rainfall files.

The following sections discuss each of these steps in more detail.

2.2. PRELIMINARY SCREENING

A preliminary evaluation of the rainfall data was undertaken and this screening exercise indicated that much of the rainfall data are poor and not fit for use in a hydrological study such as this. Inspection of these data revealed that many of the rainfall records were neither long enough nor reliable enough to simulate streamflow. In addition, the locations of many of the rain gauges are too remote to be representative of the rainfall at the various points of interest in the Study Area. A total of 57 rain gauges were selected for use in the subsequent patching exercise, and 15 rain gauges were used for the streamflow generation.

Listings of the raw observed rainfall records of those gauges finally selected for streamflow simulation purposes are provided in **Annexure B**. Part of the screening exercise was to generate cumulative mass plots of the annual rainfall totals to check for stationarity of the data. The mass plots of the final selected gauges are provided in **Annexure C**.

2.3. PATCHING

The rainfall records selected after preliminary screening were patched and extended to create complete monthly data sets from 1935 to 1999. Ideally, a longer record would have been preferable, however, only a few of the observed records extended back to 1920 and patching with such a dearth of data would have created unreliable results. In addition, the last two years of the records had to be discarded since the streamflow simulation model (WRSM2000) does not accept data after 1999 in the current format. Rather than reformat the entire rainfall database, it was decided to utilise the slightly shorter records. This still provides 65 years of records, which is deemed acceptable for stochastic streamflow modelling.

Table 2.1 presents the various groups of rain gauges that were used for the patching process. The gauges indicated in bold are those that were eventually selected for use in this assignment. Those rainfall records that were used for patching but that were not used in the assignment are fit for use but were considered to be too remote to be representative of the rainfall on the three

catchments considered. Listings of the patched rainfall records of those gauges used for streamflow generation are provided in **Annexure D**.

Table 2.1 : Grouping of rain gauges used for patching purposes.

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
297-337	*298-244*	*265-875*	265-039	263-888	235-110	204-392
297-401	298-301	*266-001*	*297-082*	264-022	235-183	204-486
297-436	298-481	266-370	*297-388*	264-039	235-243	204-515
297-519	298-512	266-437		264-042	*264-715*	204-518
297-544	298-545	266-931		264-110	*264-836*	204-640
297-612	298-638	266-646		264-235		204-819
297-721	298-791	267-126		264-291		*233-775*
297-825	298-818	267-107		*264-417*		*234-150*
298-031	298-871			264-459		*234-170*
298-194	299-008			264-473		
298-481	332-834			264-735		

Note : Gauges in bold italics were those selected for streamflow generation.

2.4. FINAL SELECTION OF RAINFALL GAUGES

The patched rainfall records for those gauges considered fit for use were then selected according to their geographical location relative to the catchments and their length of record. **Table 2.2** provides a list of the rain gauges that were eventually selected for the purposes of simulating catchment runoff. The rainfall records were combined to generate the aerial rainfall over the three catchments of interest using the HDYP08 model. Listings of the catchment rainfall files are provided in **Annexure E**.

Table 2.2 : Details of rain gauges used in this assignment.

Gauge number	Gauge name	Start date	End date	Length of record (years)	Elevation (m.a.s.l.)	Latitude (S)	Longitude (E)
Ngoajane/Hololo Catchment :							
297436	Butha-Buthe	1930	2002	72	1768	28º 46'	28º 15'
297612	Hololo	1964	2002	58	1640	28º 43'	28º 21'
297825	St Peters	1964	2002	58	1860	28º 45'	28º 28'
298194	Ox Bow	1957	2002	45	2591	28º 43'	28º 37'
298244	Caledonia	1921	1982	61	1951	28º 34'	28º 39'
Hlotse Catchment :							
265875	Pelaneng	1932	1979	47	2040	29º 05'	28º 30'
266001	Rampai	1970	1995	25	2901	29º 01'	28º 30'
297082	Leribe	1930	2002	72	1666	28º 53'	28º 03'
297388	Pitseng	1937	2002	65	1780	28º 57'	28º 13'
Makhaleng Catchment :							
233775	Thabana Morena	1936	2002	66	1676	29º 57'	27º 25'
234150	Mpharane/Mt Carmel	1925	2002	77	1752	30º00'	27º 35'
234170	Malealea	1954	2002	48	1966	29º 51'	27º 34'
264417	Roma	1935	2001	66	1646	29º 27'	27º 44'
264715	Molimo Nthuse	1962	2002	40	2040	29º 25'	27º 54'
264836	Thaba Putsoa	1962	2002	40	2600	29º 26'	27º 58'