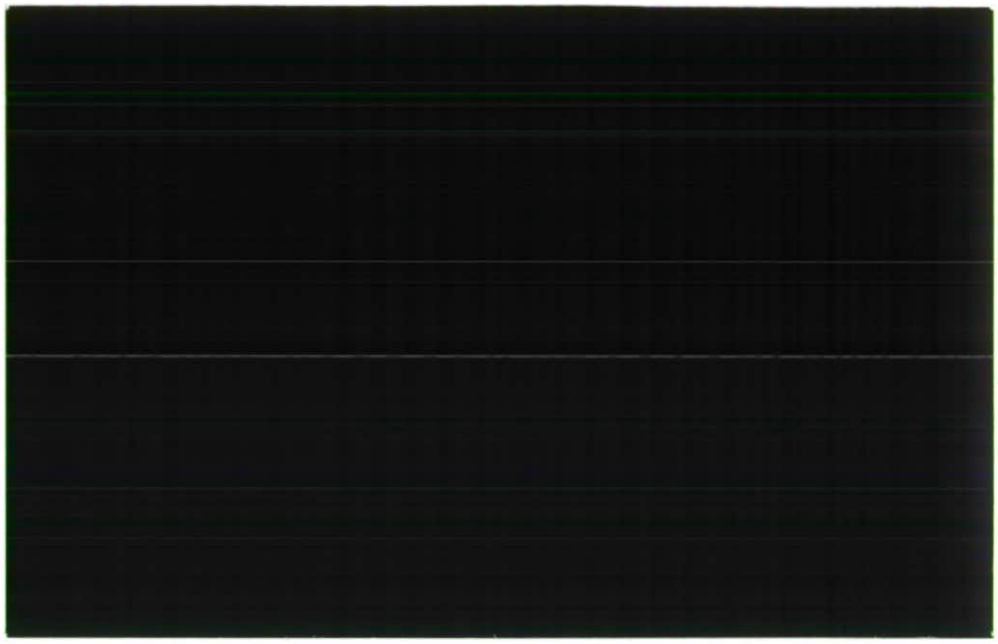
Institute of Hydrology



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COUNTRY ACTIVITY REPORTS,

DATA COLLECTION FOR

SOUTHERN AFRICA FRIEND.

FEBRUARY-AUGUST 1994

BY

A. Andrews and A. Bullock (Institute of Hydrology) in Association with the Hydrological Services of the SADC Countries.

Contents

Executive Summary

The aim of this report is to provide information regarding the acquisition of time series of river flow, rainfall and evaporation data; drawn catchment boundaries and accurate locations of the gauging stations to be used on the FRIEND project; collation of thematic maps and reports relevant to the FRIEND project. The data collection was carried out principally by Anthony Andrews and Andrew Bullock of the Institute of Hydrology with the full collaboration of the National Hydrological Services of the SADC region.

Each country report is written in distinct sections with generally the same sub-headings although neither author visited South Africa, the data being supplied directly by the Department of Water Affairs and Forestry and by Denis Hughes of The Institute for Water Research, Rhodes University.

The information contained in this report is specific to the FRIEND project and is is designed for reference only and NOT as a statement of the status of each country's hydrological service.

There are two appendices in the report. Appendix A contains a report presented to the Database Manager at the Coordination Centre, University of Dar-Es-Salaam who is responsible for the development, security and maintainance of the Southern Africa FRIEND HYDATA database. The report provides detailed information on the method and procedure for loading the data collated by the authors onto HYDATA. The report also shows the start date of the flow data series in each data file and the catchment number associated with the data file. This information is to be used in the validation of the transfer of the data from ASCII files onto HYDATA using HYTRAN.

Appendix B contains a preliminary list of the gauging stations to be used on the FRIEND project. However it must be emphasised that this is a PROVISIONAL list and is in no way final. The FRIEND code has been applied and is given alongside the local country code, the gauging station location and river name. The participating organisations are currently checking that the FRIEND numbering code has been applied correctly.

1. *SOUTHERN AFRICA FRIEND*
REPORT ON VISIT TO BOTSWANA - MAY 10th - MAY 22nd
Andy Bullock IH and Mr Kalaote Kalaote, DWA

DEPARTMENT OF WATER AFFAIRS, BOTSWANA

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Director, DWA; Mr. Khupe
Deputy Director, DWA, Mr. O.A. Masedi
Chief Hydrological Engineer; Mr. Isaac Muzila
Chief Water Resources Engineer; Mr. Jay
Senior Hydrological Engineer; Mr. Zibo Makosha
Senior Water Resources Engineer; Mr. Gaddi Ngirane-Katashaya
Hydrological Engineer; Mr. Kalaote Kalaote

Note that DWA will be moving office accommodation in August 1994 and Mr. Kalaote will inform FRIEND contacts of new address, telephone and fax numbers.

STATUS SUMMARY

There are 147 gauging sites in Botswana, which can be sub-divided by the frequency of level measurement. Many in the South-East and East possess daily flow data. Certain in the Okavango possess weekly or monthly levels only. Also included in the list is a fair proportion of stations which were planned and numbered but never opened or have yet to be opened.

The category of hydrometry is given by the last number of the four figure station number, as follows;

Category	Function
1	Continuous stage recording and frequent discharge measurements (n=26)
2	Regular stage recording and stream discharge measurements, the latter often used to define flows (n=15)

3	Regular stage recording at times of flow only, with stream discharge measurements to define rating curves (n=1)
4	Irregular stage readings (n=54)
5	Irregular stage and/or discharge measurements often made concurrently (n=51)

A thorough review of the hydrometry (incl. rating equations) was undertaken in the Botswana National Water Master Plan. DWA are in a good state regarding river flow archives, with the most recent data being 1990. For selected stations, DWA have undertaken to give priority to processing of the most recent data up to 1993.

ACTIVITIES

1. HYDATA

a) DWA possess two versions of HYDATA; Version 3.01 which is fully operational and is used as the principal national river flow archiving facility; and Version 3.1 provided by the FRIEND project. Unsuccessful attempts had been made to install the 3.1 during the past year. In an attempt to install this version, a fax was sent by AB on 11/5 to software section requesting advice on what seems to be a DOS environment problem.

b) Firesafe information provided by Software Section prior to departure was passed on to DWA.

2. MASTER REGISTER OF GAUGING STATIONS

Mr. Kalaote provided a revised Master Register of gauging stations, which is incorporated into BOTSWANA.XLS.

3. FRIEND STATION SELECTION PROCEDURE

Mr Kalaote had undertaken a large component of the recommended station selection procedure prior to the visit, and completed it during, resulting in the selection of 28 stations. The spreadsheet is entitled BOTQUEST.XLS.

4. *CATCHMENT BOUNDARIES*

Locations of all 149 gauging stations in Botawana were depicted on a full set of 1:250,000 map sheets (40) along with the boundaries of the 28 selected catchments, and the nine principal sub-basins (as defined by Motts in Sub-Saharan Hydrological Assessment Project). Two sets were produced - one to be returned to Wallingford, the second to reside in DWA. Given the absence of digitising facilities within DWA, DWA requested IH to digitise catchment boundaries for catchments contributed to the FRIEND project, and this will be undertaken at Wallingford. Upon future establishment of appropriate archiving facilities in Botswana, as identified by DWA, the digitised boundaries will be copied by IH.

5. *RAINFALL DATA*

A visit was made to the Meteorological Dept. on 16th May and a data request submitted for rainfall data for 45 stations comprising;

a) monthly time series for period of record
b) long-term monthly means
c) daily time series

The 45 stations were selected from the inventory in the Botswana National Water Master Plan to represent the period 1960 to date (to coincide with the new WMO standard period (1961-1990), with almost complete records (less than 5% missing) and to represent good national coverage. The start date and the continuity of record criteria were relaxed in certain cases to improve national coverage. Contact at the Dept. of Meteorological Services is Mr. Tim Ntabeni (Director is Ms. G.K. Ramothwa), Tel. 356281, Fax 356282. Diskettes were provided and data were set to be collected on 19th May. DMS operate CLICOM.

6. *EVAPORATION DATA*

Deptartment of Meteorlogical Services were also requested to supply monthly time series of monthly pan evaporation data. Additionally a photocopy was obtained of the Snowy Mountains Engineering Corporation (SMEC) 1987 report on "Study of open water evaporation in Botswana". Note that A. Rosema of EARS Ltd. (Remote Sensing Consultants, Delft, The Netherlands are investigating remote sensing applications for evaporation measurement in Botswana. One relevant publication is "Using

Meteosat for operational evapotranspiration and biomass monitoring in the Sahel region" in Remote Sensing Environment 45:1-25 (1993).

7. THEMATIC MAPS

During a previous visit to Botswana (May 1993) national maps of soil and vegetation were acquired by IH. Ministry of Agriculture staff are believed to archive these as ARCINFO data bases.

8. BOTSWANA INPUTS INTO RESEARCH PROGRAMMES

A meeting was held on Friday 13th May at the Environmental Sciences Department at the University of Botswana, attended by Francis Sefe (hydrologist), Sue Ringrose (vegetation) and Marty McFarlane (tropical geomorphologist) from UB and Mr. Kalaote Kalaote of DWA and Andy Bullock (IH). The background to the Southern African FRIEND project was presented, highlighting opportunities for involvement in the spatial data, floods, low flows and rainfall-runoff modelling projects. The Department expressed an initial interest in the rainfall-runoff modelling and low flows sub-projects, undertook to obtain further details through Mr. Kalaote (acopy of the Steering Committe report was obtained by UB), and to submit a written expression of interest and possible activities to the Coordination Centre at UDSM.

The Department has good GIS technology and expertise (PC-ARCINFO) and could act as a repository for FRIEND spatial data in Botswana.

PROGRAMME OF DWA ACTION POINTS

1. DATA PROCESSING AND QUALITY CONTROL

For the set of stations identified by the station selection procedure, process water levels to flows for the period 1990-1993, and apply appropriate quality control procedures.

2. DATA EXCHANGE AGREEMENT

Ensure that the data exchange agreement document, distributed by the University of Dar Es Salaam is returned with the category of data conditions identified.

3. *RIVER FLOW DATA SERIES PROVISION*

By the end of July, despatch in computer format (ideally, but not necessarily HYDATA) time series of river flow data for the period 1990-1993 to IH at Wallingford, to enable them to transfer data to UDSM. This should be arrive at Wallingford by the end of June 1994.

4. *MANUAL DERIVATION OF CATCHMENT CHARACTERISTICS*

Using gauging station locations and drawn catchment boundaries, DWA should develop a LOTUS database of the following catchment characteristics for selected gauging stations only, (with supply of the data base directly to Dar Es Salaam);

a) AREA in sq.km. as measured by digital planimeter. These should be compared against pre-published values on the Master Register and any discrepancies (that is differences are greater than 5%) should be resolved. If as a result of this exercise it is dicovered that the location of the gauging station on the 1:250,000 maps is incorrect, then IH should be informed so they can correct the digitised boundary. This correction should be achieved by posting a photocopy of the relevant portion of the map showing both the new and old positions, clearly illustrated.

b) Main stream length, measured in km from the gauging station to the source of the main river. This is best achieved with a pair of dividers.

c) Catchment slope, defined as S1085, being the slope (difference in altitude in metres divided by the distance in metres) over the length of river between a point 10% of mainstream length upstream from the gauging station and a point 85% of mainstream length upstream from the gauging station).

d) Gauging station altitude in metres

e) Maximum catchment altitude in metres

f) If possible, and I suspect that it won't be, mean annual catchment maximum 1-day (or 2-day) rainfall.

5. *COORDINATION OF BOTSWANA RESEARCH INPUTS*

To coordinate Botswana inputs into the FRIEND research activities, informing the Coordination Centre and additionally the concerned research projects of staff availability, accompanied if necessary by detailed requests for financial support (travel, subsistence and other possible costs to be incurred but not met by Government).

6. *PROVISION OF CAPACITY BULIIDING REQUIREMENTS IN DATA PROCESSING*

To provide to the Coordination Centre, and copied to IH, a statement supported by financial components of requirements for technical assistance, training, hardware and software to upgrade data processing facilities and/or research capacity within DWA.

2. *SOUTHERN AFRICA FRIEND*
REPORT ON VISIT TO LESOTHO - MAY 16th - MAY 30th
Tony Andrews IH and Mrs Nteso, DWA

DEPARTMENT OF WATER AFFAIRS, LESOTHO

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STAFF

Director, DWA;	Mr. S. Makhoalibe
Acting Senior Hydrologist;	Mrs 'M'ammutsoe Nteso
Hydrometry Hydrologists;	Mr Edward Mokuoane, Mr Ndamase Matshikiza
Data processing staff;	Ms Jeminah Mohasisa, Ms Anna Mokoena, Ms 'M'alillo Malefane
Hydrometry Technicians;	Mr Khatleli, Mr Chekane, Mr Thabaneng
Meteorology Division	
Senior Meteorologist;	Mr B.T. Sekoli

NATIONAL HYDROLOGY

The entire country is drained by tributaries of the Orange River (Senqu). The tributaries form three main catchments within Lesotho: Senqu catchment covering 20,710 Km^2, the Makhaleng draining 3,050 Km^2 and the Mohokare (Caledon) River which forms the north-western border with RSA and has a catchment area of 6,950 Km^2 within Lesotho.

The Senqu River rises in the Maluti/Drakensberg mountains at elevations over 3000m and flows through deeply incised valleys and gorges in a generally southerly and south-westerly direction. The mean annual runoff is estimated at 3,625 million m^3 (~ 180 mm).

The Makhaleng River is the smallest of the three principal rivers in Lesotho and rises in the western foothills of the Maluti mountains and flows in a south-westerly direction parallel to the Caledon River. The confluence of the Makhaleng with the Senqu is situated across the border in RSA. From South African records

collected close to the border with Lesotho, the mean annual runoff is 627 million m^3 (~ 208 mm). The less pronounced rainshadow effects are less pronounced in the Makhaleng basin than in the Senqu which accounts for the higher runoff.

Forming the north-western border with RSA and only the eastern tributaries rise in Lesotho is the Mohakare or Caledon River. At the extreme south-westerly tip of Lesotho the catchment area is 13,421 Km^2, approximately half of which is in Lesotho. The mean annual runoff recorded at the furthest downstream station in Lesotho is 1000 million m^3 (~ 140 mm) whereas the first South African gauging station indicates 1,109 million m^3 (~ 83 mm).

STATUS SUMMARY

Studies and proposals to exploit the water resources of the Upper Senqu (Orange River when it enters South Africa) have been the major driving force behind the development of the river gauging network in Lesotho. A consequence of this policy is that the earliest stations are located at potential dam sites and have a large and mountainous catchment area. Recent developments in the more densely populated 'lowlands' (note that Lesotho holds the claim to be the only country in the World to have all her land above 1000m) has seen the construction of gauging stations particularly in the Mohokare (Caledon) valley funded through capital and technical assistance from UNDTCD.

Water resources in Lesotho far out-strip the demand and projected demand from the growing urban centres. The industrial sector and the extent of irrigation is small and the population is primarily located in the rural areas. The Lesotho Highlands Water Project (LHWP) is designed to transfer up to 2200 million m^3/year of water from Lesotho to the industrial and urban areas in Transvaal in return for loyalty payments over a 50 year period. In addition to the estimated income of between M 50 million to M 100 million per annum (1985 value), Lesotho will benefit from local hydro-electric power generation, improved infra-structure, urban development and higher employment.

The LHWP will be developed in four phases which commenced in 1990;

PHASE IA The major Katse concrete arch dam to create the main reservoir for water storage, first water transfer tunnel system for diverting the water north-wards into

Transvaal and the first hydropower development at Muela.

PHASE IB Matsoku diversion weir and tunnel and the Mohale Dam and the tunnel between Mohale and Katse reservoirs to divert flow from Matsku and Senqunyane rivers into Katse reservoir.

PHASE II Mashai dam, second parallel water transfer tunnel system and second stage hydropower development at Muela. Pumping installation to transfer water upstream from Mashai reservoir to the Katse reservoir.

PHASE IV Required to provide the full diversion flow of 70 m^3/s in accordance with the Treaty. Comprise the Ntoahae dam downstream of the Tsoelike dam on the Senqu River with pumping station to transfer water to the Tsoelike reservoir.

Out of the 72 river flow records available from DWA, 63 are currently operational. In March 1988 widespread flooding caused damage to 35 of the river gauging stations and 5 were severely damaged (G6, G36 and G5 in the mountain territory; G2 and G39 in the mainly lowland Mohokare catchment). Repair work carried out by staff of DWA has almost been completed.

Forty one of the operational stations are equipped with water level recorders, the remaining 17 having staff gauges only. Most of the stations have natural hydraulic controls and artificial controls have been constructed at 11. Three are crump weirs built since 1986 with South African funds as part of the LHWP and the other weirs are mainly sharp/broad crested structures or dam spillways.

The station names are presented with a prefix to denote the river basin: SG - Senqu, MG - Makhaleng and CG - Caledon.

ACTIVITIES

1. HYDATA

a) DWA posses one copy of HYDATA V 3.1 which is fully operational. Prior to the arrival of Mr Andrews no data existed on the system.

b) DWA provided daily mean flow data in standard yearbook format for all stations for the period 1980 - current year of processing. The files containing one year of data were concatenated and the program REFORM was used to generate the HYTRAN format data files which can be efficiently loaded onto HYDATA using the HYTRAN batch mode 2. An example of the DWA and HYTRAN format is presented. The daily mean flow values for all stations for this period (including the 23 FRIEND stations) has been successfully loaded onto HYDATA.

The FORTRAN code for REFORM.FOR has been provided to DWA.

c) Data prior to 1980 has to be calculated from the levels data base at DWA. The levels data was downloaded onto HYDATA for conversion to daily mean flows using the following method.

The level data was supplied in one file per month with 48 readings per day starting at 00:30:00 hrs on the first day of each month. These files were converted into a format for HYTRAN by using the FORTRAN program LEVEL1. The format of the DWA level files and the re-formatted HYTRAN level files are illustrated. The filename of the DWA level files contains a reference number which is used to determine the gauging station number (see sheet):

L0130880.HDB

13 Reference number (SG010 on sheet); 08 month (August) and 80 year (1980). The FORTRAN program LEVEL1 outputs the HYTRAN format data into a file called L0130880.LEV (same filename as above). The FORTRAN program code for LEVEL1.FOR is presented.

The level data for all the gauging stations in Lesotho was then loaded onto HYDATA using the HYTRAN batch mode 2. The level data has not been converted to daily mean flow because Mr Andrews and DWA were inputting the rating equations developed from the DWA system onto HYDATA.

2. FLOOD DATA

Daily maxima values are available for the Lesotho catchments. These were acquired from the annual yearbook style summaries.

3. MASTER REGISTER OF GAUGING STATIONS

Prior to the arrival of Mr Andrews, no work had been done to check the information contained in the gauging station register. A copy of the register has been provided to DWA who are currently completing this task. The register will be sent to IH by end of August 1994.

4. *FRIEND STATION SELECTION PROCEDURE*

Mr Nteso is currently supervising the completion of the questionnaire and will send to IH. The selection of gauging stations currently available to the FRIEND project was based on the degree of artificial influence and data availability. Instructions for the completion of the gauging station questionnaire were given to DWA an it was agreed that this task should be completed by September 1994. Twenty three stations were selected and a further 12 to 15 stations are available from the LHWP. Informal permission has been granted by LHDA via Mrs Nteso for the transfer of the LHDA flow record from Frank Farquharson's group to the FRIEND project. Therefore there was no point in loading the daily mean flow data for the LHDA stations.

5. *CATCHMENT BOUNDARIES*

Catchment boundaries for all the gauging stations selected for the FRIEND project have been drawn on the Lesotho 1:250K maps. DWA does not have GIS technology although they have requested a copy of the ARC/INFO digitized catchment boundaries.

6. *RAINFALL DATA*

Liaison was made via Mrs Nteso and Mr Mokuoane with the Mr Sekoli of the Meteorological Division. Daily rainfall for only 5 stations was provided. These stations were selected because they are the only stations in Lesotho that have had quality checks performed on the data and the data is held on the CLICOM database. This data was provided in CLICOM ASCII data format on floppy disk. The remaining data is either in;

a. Summary book (monthly data) format
b. on monthly recorder sheets
c. on original hardcopy recorder sheets.

Some rainfall data is being used at IH on the LHWP. I have been

granted permission to use this data. I will have to arrange this permission in writing.

A copy of the Meteorological Summary book for the period up to December 1970 is held at IH and arrangements have been made with Mrs Nteso for the Meteorological book for the period up to 1990 to be supplied to the FRIEND project

Without a prior request, the Meteorological Department produced a table showing the station long term monthly rainfall. Unfortunately the periods of measurement are not necessarily coincidental and therefore do not conform to the WMO standard average period.

7. EVAPORATION DATA

No data could be provided on diskette from the Department of Meteorology although monthly values can be obtained from the Meteorological Summary for the period up to 1970. Note that this period is not co-incident with the runoff data. Monthly mean PAN evaporation totals are available for the climatic stations.

8. THEMATIC MAPS

National maps of soil, geology, hydrogeology, vegetation, topography have been purchased although these maps were left behind. Arrangement has been made with Mr Nteso to supervise the transfer of the maps to IH. Money for purchase and postage was left with Mrs Nteso. The catchment boundary map is however at IH.

9. RESEARCH INTERESTS AT DWA

During meetings with Mr Makhoalibe and staff at DWA enthusiastic interest was shown in the FRIEND project. Particular interest was shown in the flood research being carried out at the university of Dar-Es-Salaam. A member a staff will be sent to the UDSM flood training course. It was emphasised to DWA the need to inform UDSM of their research interests. There is no expertise at DWA in GIS.

10. CATCHMENT CHARACTERISTICS

From the DWA database, information regarding the main stream length, altitude, catchment area and river slope (S1085) was

acquired for 26 stations.

ACTION POINTS FOR MR TONY ANDREWS

1. Process pre-1980 levels to flows and return to Maseru. Arrange for DWA to check that the correct rating equations have been used.

2. Arrange for the transfer of the LHDA catchment flow data to be included in the FRIEND project.

3. Arrange for the transfer of the LHDA catchment boundaries to downloaded onto the FRIEND spatial database.

4. Supervise the digitizing of the Lesotho catchment boundaries.

5. Write letter to Mrs Nteso asking for her to arrange a letter from LHDA granting permission for the LHDA flow data to be used in the FRIEND project. In same letter request from Mrs Nteso those stations that would be suitable in her opinion for rainfall runoff modelling work. Criteria to use is the length flow record, < 1000 Km^2, rainfall and evaporation data.

ACTION POINTS FOR DWA

1. DWA to send thematic maps to IH.

2. DWA to send data transfer agreement to UDSM.

3. DWA to acquire evaporation and daily rainfall data that will be available from Department of Meteorology when the 1990 Meteorological Summary has been produced.

4. DWA to complete the gauging station selection scheme supplied in the form of a questionnaire on spreadsheet. It is important that the last columns in the questionnaire under the overall heading 'DATA SUMMARY' should be completed. This will present information regarding the suitability of the station for low flow, flood, rainfall runoff modelling or a combination of these and will provide information on the reason for the rejection of the station. This selection scheme should tie in with the selection

scheme and criteria already used to select the 23 station that exist on the FRIEND project.

5. DWA to complete the checks and any up-dating necessary to the *ENTIRE* gauging station register for Lesotho.

6. DWA to request letter from LHDA to be sent to Tony Andrews granting permission for the transfer of the LHDA flow record and the digitized catchment boundaries at IH (Frank Farquharson's group) to the FRIEND project.

7. DWA to identify those stations in the FRIEND list which are appropriate for rainfall runoff modelling.

3. SOUTHERN AFRICA FRIEND
REPORT ON VISIT TO MALAWI - AUGUST 9th - AUGUST 23rd
Tony Andrews IH, Mr Amon Chirwa, Mr Denis Naketo and Mr Hyde Sibande

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Senior Hydrologist;	Mr Phepani Kaluwa
Senior Hydrologist (Northern);	Mr William Chipeta
Hydrologist (Central);	Mr Hyde Sibande
Senior Hydrologist (Southern);	Mr Francis Mtambo
Hydrologist;	Mr Denis Naketo

METEOROLOGY DEPARTMENT, CHILEKA AIRPORT, BLANTYRE

Chief Meteorologist;	Mr Dandaula
Senior Meteorologist;	Mr Kamdonyo (Drought Monitoring)

Agrometeorologist; Mr Gray Munthali

NATIONAL HYDROLOGY

Malawi is rich in surface water resources, estimated average surface runoff is approximately 196 mm yr^{-1}. Much of this lies in Lake Malawi and the Shire River. Much of the nations power output and irrigation is dependent on the Lake outflow through the Shire River.

In the plateau areas of the central and northern region rainfall is modest and surface runoff is low, streams are seasonal and extensive areas are covered by dambos.

The lake shore areas east of the escarpment zone in the northern and central regions have abundant runoff, perennial streams with significant potential for water supply, irrigation, recreation and hydro-power schemes.

The level of the Shire River is regulated ny the Lake Malawi outlet and at the Kamuzu barrage at Liwonde. Flows in the Shire are strongly correlated to the level of Lake Malawi which means that the flow patterns show large persistence. Tributaries to the Shire in the southern region have generally lower annual yield with the exception of the Ruo, which drains the high rainfall area around Mulanje mountain.

The country has been divided into 17 major catchments or water resource units and the country's water resources is dominated by the Lake and the Shire River. The estimated total surface runoff of the country is 18.5 * 10^9 m^3 $yr_{.1}$ or 585 m_3 $s_{.1}$. The volume of water nominally available from the Lake represents approximately 70% of the total surface water resource. The flow of the other rivers in Malawi are much more variable than the Shire River and many of the smaller streams are ephemeral.

The best aquifers in Malawi are formed by the sandy and gravelly layers of alluvial and lacustarine deposits of the Rift Valley, particularly on the Lake shore and in the Shire Valley. The mesozoic sediments and volcanics are known locally to be permeable and productive and the Basement Complex comprising metamorphic and igneous rocks have low permeability but extensive aquifer within a thick mantle of weathering and in fractured rock.

The annual consumptive water use up to 1990 consists approximately 1,000 million m_3 for irrigation and 86 million m_3 for water supply are small compared with the total water resources in the country. Hydro-power is not a consumptive user of the water in the Shire River.

STATUS SUMMARY

The hydrometric network consists of about 170 discharge gauging stations and 24 water level stations. The station numbering scheme illustrates in which of the 17 water resource units it is located; the sub-catchment within the unit and a sequence number (the attached list shows the water resource units).

The network rapidly developed during the 1950's with approximately 50% of the catchment network operating by 1960. The controls at these stations vary from V-notch or compound weir through to solid rock bar or boulders, to shifting shingle bar or even no visible control.

The network has been rationalised into divisions titles Primary, Secondary and Tertiary. Primary stations are considered to be long term, capable of producing high quality raw data at all times which means that the rating is well defined or sufficient gauging carried out to ensure accuracy of measurement. Secondary stations provide a spatial dimension to supplement the information from the Primary stations. Not necessarily possessing long term data and the quality/reliability requirements are not as high compared to the Primary stations. The Tertiary stations would be operated to serve specific user interests without contributing to the Water Department's network requirements.

Monthly returns, including gauge readers records for each station, in addition at some sites chart records are sent by the district offices to headquarter offices in Lilongwe. The water level is recorded twice daily which is also included on the charts. The twice daily measurements of the gauge plate are used to compute flows using rating equations developed using HYDATA. Charts are currently used only as checks as no digitizing hardware or processing software exists at the Water Department.

In the past, data was stored using programs written using the Ashton-Tate software, dBASE III, as a vehicle. Processing was carried out using spreadsheet program (VISICALC). With the demise of this system and subsequent loss of data, the twice daily gauge

plate readings and any existing processed daily mean flows are loaded onto the Institute of Hydrology's HYDATA software. The rating module is used to derive the rating equations and the daily mean flows are computed using HYDATA convert module.

The loss of the dBASE III database has resulted in large gaps in a station flow record or no flows existing at all. However the gauge readers' returns are stored in gauge books and the Water Department are currently re-inputting this data onto HYDATA. The period 1980/81 - present is considered to carry the highest priority and it is this data that has been provided for the FRIEND project.

With the delivery of the database used for the Southern Africa FRIEND Feasibility Project and the development of the Malawian contribution to the FRIEND project, the flow record form some of the network stations in the Malawi HYDATA national archive has been extended back to the 1950's and in some cases provided the only processed data available.

ACTIVITIES

1. HYDATA

HYDATA v3.1 is currently run over a Novell network and a P.C. is dedicated to HYDATA v3.01. The Water Departments' National archive is stored on the HYDATA v3.1 and the Southern Africa FRIEND database has been loaded onto the HYDATA v3.01.

The FRIEND database comprises an amalgamation of the Malawi National archive and the data from the Feasibility Project. The Feasibility database was used as the recipient and the stations not applicable for the FRIEND project but which were used on the Feasibility Study have been removed from the system.

2. FLOOD DATA

Annual maxima data used in the World Flood Study was acquired from the Institute of Hydrology and provided to the Water Department. The provision of the data for the FRIEND stations which is to be given to Simon Mkhandi has been given the go ahead.

3. *MASTER REGISTER AND SELECTION OF GAUGING STATIONS*

Mr Amon Chirwa supervised the selection of the gauging stations which will comprise the Malawian contribution to the Southern Africa FRIEND project. Although the questionnaire was not used, the overriding criteria used in the selection of the stations was that the flow should not be significantly affected by artificial factors. He next considered the data quality aspect and came up with 46 stations with varying time series of flow data.

It was agreed that the final column in the questionnaire (containing the data suitability flag) would be completed for ALL the gauging stations in Malawi and the entire questionnaire would be completed for the gauging stations selected for the Southern Africa FRIEND project. This will ensure that the reason for the rejection or inclusion of the gauging station and the periods suitable for low flow and flood flow analysis will be represented.

Checks on the gauging station master register had been carried out prior to the arrival of Mr Andrews and has been provided in hard copy format.

4. *CATCHMENT BOUNDARIES*

Catchment boundaries for some of the FRIEND gauging stations had already been drawn onto acetate during the completion of the Drayton et. al. (1980) report. These boundaries have already been digitized at the Institute of Hydrology. Full coverage of the 1:250K maps of Malawi were purchased and the location of the remaining FRIEND gauging stations and the associated catchment boundaries drawn onto the maps and then transferred onto the acetate in pencil. Maps at 1:50K scale were needed for the 2.B.8, 2.B.11, 3.E.1 and 3.E.7 gauging stations because of the small size of the catchment boundary.

5. *RAINFALL DATA*

Monthly rainfall totals were acquired from the Department of Meteorology for 23 rain gauges in Malawi which are located in the vicinity of those catchments identified as being suitable for the rainfall runoff modelling project. The standard average period (1961-1990) monthly rainfall for ALL raingauges in Malawi were also acquired.

The Department of Meteorology holds all rainfall data on a Honeywell Bull mainframe computer and are currently transferring the data onto the CLICOM package on a P.C. The master register of ALL raingauges in Malawi was also provided in ASCII format.

The Department of Meteorology are reluctant to provide daily values of rainfall or evaporation and charge for the monthly totals.

6. EVAPORATION

The long term average monthly actual, PET and PE, in addition to climatological data for all climate station in Malawi are published in the 'Climatological Tables for Malawi (1982) which was purchased from the Department and is therefore the only source of this data.

7. THEMATIC MAPS

There are a limited number of thematic maps in stock for purchase at the Surveyor General's Office. No geological or hydro-geological maps could be purchased for the Surveyor General's Office in Lilongwe. Mr Denis Naketo agreed to enquire from the Geological Survey in Zomba if these maps exist. However maps showing soil, agriculture etc were purchased from the Surveyor General Office in Lilongwe.

8. CATCHMENT CHARACTERISTICS

The river slope (S1085) variable was calculated by Drayton et. al. (1980) for catchments used in that study which will be used in the Southern Africa FRIEND project. Mr Denis Naketo has agreed to undertake the task of computing this variable for the FRIEND stations not used in the Drayton et. al. (1980) study. He will also provided values of stream length and altitude for all the FRIEND catchments. This will be sent to the Institute of Hydrology.

The location of the gauging stations and the catchment boundaries were drawn onto the Water Department's copy of the 1:250K and 1:50K maps. **The boundaries however do not necessarily absolutely conform to those digitized at the institute of hydrology.**

9. MALAWI INPUTS INTO RESEARCH PROGRAMMES

A meeting was held between Mr Liasi and Mr Kafundu in addition to talks with Mr Chirwa regarding the Malawian research interests. Indeed Mr Kafundu explained the research links between the Water Department and Prof. Ian Calder at the Institute of Hydrology which are currently taking place. The collaborative project will be on defining the essential water resources development programmes in Malawi. The research interest on the FRIEND project will be in the Low Flow and Flood Flow. Both Mr Liasi and Mr Kafundu expressed their keen interest in the FRIEND project and would like to further the Department's links with the Institute and the University of Dar-Es-Salaam through the FRIEND project.

A discussion was held between Mr Andrews of IH and Mr Kamdonyo and Mr Munthali of the Department of Meteorology concerning the drought monitoring project and agricultural drought research they are currently coordinating. Both expressed interest in collaborative research in the field on drought definition, monitoring and forecasting. Mr Kamdonyo defines the meteorological drought following the Australian methodology which uses rainfall percentiles to define the varying levels of severity of drought. Maps of Malawi have been produced from grids showing the spatial variability of the annual and monthly percentiles and he has computed from these drought severity maps and drought persistence maps.

ACTION POINTS FOR WATER DEPARTMENT

1. Mr Denis Naketo to contact Geological Survey in Zomba to enquire about the purchase of geological and hydrogeological maps at 1:250K scale.

2. Mr Naketo to complete the catchment characteristic database for the Malawi FRIEND catchments and provide to the Institute of Hydrology by the end of September 1994.

3. Mr Amon Chirwa to provide the completed questionnaire for the gauging stations used in the FRIEND project and ONLY the last column (presenting the data suitability flag) for ALL gauging stations in Malawi.

4. Mr Amon Chirwa to provide the University of Dar-Es-Salaam

any processed daily mean flow values for the stations used on the FRIEND project which will be carried out during the routine up-dating of the Malawi National Water Archive which forms part of the remit of the Water Department.

ACTION POINTS FOR MR TONY ANDREWS

1. Provide the Water Department with:

   a. HYDATA database from the Feasibility project - this has been completed.

   b. A copy of the original dBASE III data files used for the Feasibility project - this has already been completed.

   c. A copy of the Malawi annual maxima data used on the World Flood Study project - this has been completed.

   d. Establish the FRIEND Malawi HYDATA database at Water Department - this has been completed.

   e. Any digitized copies of the thematic maps in GIS format.

4. *SOUTHERN AFRICA FRIEND*
REPORT ON VISIT TO MOZAMBIQUE - June 8th - June 17th
Tony Andrews IH, Mr C. Cuambo and Mr H. Banze, DNA

NATIONAL DIRECTORATE FOR WATER AFFAIRS (DNA), MOZAMBIQUE

ADDRESS National Directorate for Water Affairs, P.O. Box 1143, Av. 25 de Setembro, 942, 13°, MAPUTO, Mozambique

TELEPHONE 420470

FAX 421403

STAFF

FRIEND project coordinator	Mr Cristover Cuambo

Hydrological Section

National Director	Mr Luis Elias
High Level Technician	Mr Tomas Mangue (Head)
High Level Technician	Mr Joao Neto (ARC/INFO)
High Level Technician	Mr Bernardino Novila
Medium Level Technician	Mr Helio Banze
Medium Level Technician	Elcina Mulambo
Basic Level Technician	Mr Carlos Buque
Basic Level Technician	Mr Cristover Macueva
Basic Level Technician	Mr Paulo Langua (ARC/INFO)

There are two Dutch hydrologists working on the Hydrology Sector Assistance Project:

Team coordinator	Mr Leonard S.T. Kranendonk
Assistant coordinator	Mr Harm Albert Zanting

NATIONAL HYDROLOGY

The most important factor to consider in selecting the gauging stations for the FRIEND project was the degree to which the flow is artificially influenced and if so what control there exists in Mozambique. Rivers in the south such as the Maputo, Umbeluzi, Incomati, Limpopo, Save, Buzi, and Zambezi for example are international rivers and therefore the degree to which the rivers are influenced by abstractions and augmentation carried out in the riparian states is either not fully known or the influence is greater than 20% of the average annual runoff, which in both

cases necessitates the exclusion of these stations from the FRIEND database.

The major river basins that are of primary interest which can be considered not to be significantly influenced by artificial factors are the rivers in the northern territories of Mozambique. These include the Pungwe, Licungo, Ligonha, Lurio, Messalo and Rovuma.

STATUS SUMMARY

There are over 400 gauging stations in Mozambique with approximately 250 currently operational. All but three of the stations are natural sections. The DNA database is called HIDRO which contains the rating equations, rating table, gauging and level data plus a number of daily time series of flow data. DNA have loaded the gauging data onto HYDATA which they are using to re-evaluate the rating equations. This task is currently being undertaken and supervised by Helio Banze and Harm Zanting. DNA believe that HYDATA is a better tool for carrying out this work. Once the rating equations have been re-evaluated the level data held on the HIDRO system can be converted to values of daily mean flow by manually inputting the rating equations developed using HYDATA on to the HIDRO system. Mr Zanting advised that the values of daily mean flow currently held on the HIDRO system are not accurate or reliable. The newly processed data will be supplied to the FRIEND database. Only data up to 1980 will be available due to the closure of many stations during the war in Mozambique. Much data was lost and there are large gaps in the flow record of the stations during the 1980's.

ACTIVITIES

1. HYDATA

HYDATA has been set up at DNA although only the gauging data has been loaded. The Hydrology section is currently re-evaluating the rating equations using HYDATA and will manually input the equations onto the DNA database HIDRO for converting the level data to daily mean flow. Mr Andrews has provided Mr Banze with a FORTRAN program called MOZCONV which will covert the DNA annual summary sheets into HYTRAN format, create the necessary files for running HYTRAN in batch mode 2 which will mean that the transfer from HIDRO to HYDATA will be virtually automatic. A manual was

also provided which explains the program. Mr Joao Neto can program in FORTRAN if there is any problem with the software. As a consequence it was not possible to collect the daily mean flow database.

2. *FLOOD DATA*

Values of monthly instantaneous maxima will be calculated once the rating equations have been re-evaluated using HYDATA and the daily mean flows have been calculated. This data to provided to Mr Mkhandi at the University of Dar-Es-Salaam in ASCII format by the end of August.

3. *MASTER REGISTER AND SELECTION OF GAUGING STATIONS*

A disk containing the register and questionnaire for Mozambique was corrupted and therefore no work could be done on the register. However, there is an on-going project in the Hydrology section, the aim of which is to carry out checks on the full gauging station register. Once this has been completed the Hydrology Department will send a copy either on disk (preferably) or in hard-copy format to Mr Andrews.

4. *CATCHMENT BOUNDARIES*

The catchment boundaries for the Mozambique contribution to the FRIEND project have been drawn on the 1:250K maps. The location of the gauging stations was carried out by members of the Water Resources Branch who have visited the sites and use was made of the station files. Ninety five maps at 1:250K scale cover the whole of Mozambique. The Hydrology Department has access to a digitizer board and PC ARC/INFO. Mr Joao Neto is responsible for the ARC/INFO system. There are no plans or staff resources available for the Hydrology Department to digitize the FRIEND catchment boundaries. This task will be undertaken at the Institute of Hydrology.

5. *RAINFALL DATA*

DNA have the CLICOM meteorological database and hold all the rainfall data for Mozambique. There are over 600 rainfall measuring sites in Mozambique but for the purpose of the FRIEND project only those sites located in the north of the country were

chosen. The total number of rainfall sites is 340 and the data is in CLICOM ASCII format.

6. EVAPORATION DATA

It was not possible to get access to evaporation data due to the many requests for data already. However a report entitled 'Assessment of Land Resources for Rainfed Crop Production in Mozambique written under the auspicies of the 'Land and Water Use Planning Project - UNDP, FAO UK, Ministry of Agriculture, Nov. 1981, contains the mean monthly actual (PAN) evaporation and calculated the calculated mean monthly potential evaporation for over 130 sites in Mozambique in addition to other climatic information.

7. THEMATIC MAPS

Mr Helio Banze has been provided with money to purchase the soil, geology, hydrogeology and vegetation (agriculture?, land use?) maps which will be sent to Mr Andrews at the Institute of Hydrology.

8. CATCHMENT CHARACTERISTICS

A complete download of the DNA gauging station and catchment characteristic database was carried out by Mr Andrews, although maximum altitude and S1085 need to be calculated.

ACTION POINTS FOR DNA

1. Hydrology Department to re-evaluate rating equations for the FRIEND gauging stations using HYDATA and input onto HIDRO system. Values of daily mean flow will be calculated using the HIDRO system and then using the MOZCONV program, Mr Helio Banze will supervise the down-loading of the daily mean flow values onto HYDATA. The aim is to complete this task by September to coincide with the visit of Mr Andrews to the University of Dar-Es-Salaam to establish the FRIEND database.

   Once completed the HYDATA backup disks should be sent to the University of Dar-Es-Salaam and Mr Cuamba inform Mr Andrews of the delivery.

2. Hydrology Department to complete the checks on the ENTIRE gauging station register for Mozambique which is provided in the form of a spreadsheet. This should be sent to Mr Andrews by the end of September.

3. Mr Cuamba will supervise the completion of the FRIEND gauging station selection scheme which is provided in spreadsheet format. If there is not enough time or resources to complete the entire selection, only answer the last columns of the questionnaire which are grouped under the heading 'DATA SUMMARY'. These columns present information regarding the suitability of the gauging station to flood, low flow and/or rainfall runoff modelling research or the reason for the rejection of the gauging station. Since there are many gauging stations in Mozambique and a preliminary selection has already been made based on the degree to which the flow is artificial influenced, it is expected that the Hydrology Section will only complete the 'DATA SUMMARY' section of the questionnaire. This task to be completed by September and sent to Mr Andrews at IH.

4. Mr Banze to supervise the purchase and delivery of the thematic maps (eg soil, geology, vegetation, hydrogeology etc) to Mr Andrews at the Institute of Hydrology.

5. DNA to identify those catchments from the FRIEND list that are suitable for rainfall runoff modelling? Are there any catchments that have been used or considered for rainfall runoff modelling exercises. These catchments should be less than 1000 Km^2 and have concurrent streamflow and rainfall data.

ACTION POINTS FOR MR TONY ANDREWS

1. Since maps do not exist at DNA showing the catchment boundaries IH will undertake the calculation of the stream length using the maps collected during Mr Andrews' visit.

5. *SOUTHERN AFRICA FRIEND*
REPORT ON VISIT TO NAMIBIA - MAY 22nd - JUNE 3rd 1994
Andy Bullock, IH and Antje Eggers, DWA

DEPARTMENT OF WATER AFFAIRS, NAMIBIA

ADDRESS Department of Water Affairs, Ministry of Agriculture, Water and Rural Development, Private Bag 13193, Windhoek, NAMIBIA

TELEPHONE Windhoek 63141

FAX Windhoek 63222

STAFF

The Hydrology Division (Chief: Guido Van Langenhove) has four subdivisions as follows;

a) Hydrological investigations (Chief hydrologist: Rolf Albrecht).

b) Surface water resources (Chief hydrologist: Barbara de Bruine acting).

c) Hydrological Support Services (Chief Technician: Juergen Eysselein) - this subdivision contains hydrometry section and maintenance section).

d) Surface Water Data Management (Chief hydrologist: Antje Eggers).

An organisational chart of the Ministry of Agriculture, Water and Rural Development and a staff matrix of the Hydrology Division is enclosed.

The Deputy Permanent Secretary of the Department of Water Affairs is Mr. Richard Fry, a hydrogeologist formerly with Thames and Anglian Water, with whom a brief introductory meeting was held on Tuesday, 24th May.

The Director of the Directorate of Investigations and Research within the Department of Water Affairs is Mr. Piet Heyns, with whom a discussion regarding the organisation of operational hydrology and hydrological research was held on Tuesday, 31st May.

STATUS SUMMARY

Four perennial rivers are situated on the northern border of the country; the Zambezi, Okavango, Cunene and the Kwando-Linyati-Chobe system. The southern border is formed by another perennial river, the Orange River. The interior comprises only ephemeral rivers, with highly sproadic flow regimes.

DWA archive river flow data on an Informix relational data base with routine and additional query language retrievals for level, flow, rainfall, evaporation, storage etc. series. Flow data are not archived as continuous daily flow data, but as flood event data, although daily flow series can be calculated, and peak flood data extracted.

ACTIVITIES

1. HYDATA

a) DWA possess Version 3.01 of HYDATA which is successfully installed. It is the policy of DWA to continue use of the existing data base facilities and retrievals, and if appropriate to transfer certain data series into HYDATA to utilise certain of the HYDATA facilities that are not available in the existing system.

b) Firesafe information was provided by Software Section, but with the current strategy for HYDATA use, there is not the necessity for DWA to make use of this back-up facility.

c) A short demonstration of the capability of HYDATA was provided to six of the staff of the Hydrology Division.

2. MASTER REGISTER OF GAUGING STATIONS

Antje Eggers provided a revised Master Register of gauging stations, which is incorporated into NAMIBIA.XLS. Stations with "A", "B", "C" etc. identifiers should be replaced by a single entry, with the start and end date representing the overall availability of data at a site.

3. FRIEND STATION SELECTION PROCEDURE

Antje Eggers had undertaken a large component of the recommended station selection procedure prior to the visit, and with advice

from Mr. Guido Van Langenhove, the final selection of FRIEND stations was completed. The spreadsheet is entitled QUESTION.XLS. This resulted in an overall selection of 52 stations, of which 46 stations are suitable for both daily and flood peak analyses, an additional 1 for daily only, and an additional 5 for flood analyses only. A summary of the selected stations, and reasons for rejection is contained in SUMMARY.XLS

The identification of stations suitable for inclusion in rainfall-runoff modelling was discussed between Mr. Guido Van Langehove and Andy Bullock. It was agreed that any ra/ro modelling studies within FRIEND should concentrate on sites with concurrent rainfall, flow and evaporation data on a monthly basis, and that as such a maximum of 13 sites were potential candidates, being 10 in the central area (Sebraskop, Otjompaue, Von Bach, Swakoppoort, Friedenau, Omatako, Otjivero, Daan Viloen, Nauaspoort and Oanob) and three in the Fish river (Hardap, Naute and Dreihuk). Each of these sites represents a dam, and each dam has been the subject of application of the Namibian rainfall-runoff model NAMROM. Hence historic and concurrent data series have been compiled. It should be noted that the flow series are calculated inflows based on storage, evaporation and rainfall rather than gauging station records, but are considered of suitable accuracy on a monthly basis. Any ra/ro model applications of increments less than one month should focus on 2 dams; Friedenau and Oanob. Note that DWA will require involvement in the fitting of multiquadric surfaces for rainfall generation.

Minor modifications were made to the FRIEND station numbering scheme for Namibia (as summarised in "FRIEND" file on diskette) (none of which have knock-on effects in adjacent countries), and FRIEND station numbers were assigned to the selected stations. Note also that DWA or IH should be informed at the earliest opportunity if catchment boundaries are to be digitised for these sites, as the dam sites are not included amongst the daily flow series. Note that the dam locations are marked on the 1:250,000 maps to be drawn at IH and boundaries could be drawn and digitised if required.

4. DOWNLOADING OF RIVER FLOW DATA

Continuous daily river flow series were generated from the Informix data base of event series for 46 stations, and were reformatted into the standard HYTRAN transfer format. Attempts

to transfer selected series into the DWA HYDATA using HYTRAN in single file mode were almost, but not fully, successful. It was left that Andy Bullock would discuss the data format and the *.frm file option selections with Software Section, and pass the necessary information to Antje Eggers by fax. All 46 data series were copied on to diskette to be checked for loading at IH before being passed to Dar Es Salaam.

Annual maximum flood series were extracted for 51 stations, based on Namibian water years (Oct-Sept), with peaks extracted only for years with complete flow data. This selection policy can result in large floods being omitted if they occur in years which are incomplete.

To partially overcome this possible limitation, and to faciltate the construction of partial duration series, monthly maximum flood series were also extracted. Only maxima in complete months were extracted.

DWA could, if a specific and detailed request is submitted and if the request is reasonable in manpower demands, modify the selection of flood peaks from the data base.

5. *CATCHMENT BOUNDARIES*

Locations of the 52 selected stations were depicted on a full set of 1:250,000 map sheets (44) along with their catchment boundaries. These were traced from on 1:250,000 overlay transparencies of locations and boundaries held at DWA. In addition, the boundaries of the principal river basin divisions were traced. DWA wish to be in a position to digitise catchment boundaries themselves as part of an overall spatial data development plan. To this end, Mr. Van Langenhove wrote to Andy Bullock requesting financial support for computer equipment. It is not foreseen, however, that the capability for handling sspatial data within DWA will be established within a timescale appropriate to the FRIEND objectives. However, it was agreed that DWA would pursue the development of this capability, and if the timeframes were compatible, then DWA would themselves digitise boundaries for passing to the FRIEND spatial project. (IH will pass a digitising specification to DWA to assist in this). However, if the FRIEND spatial data timetable was well advanced before the capacity was developed at DWA, then IH would digitise the boundaries in Wallingford. Upon future establishment of appropriate archiving facilities in Namibia, as identified by

DWA, the digitised boundaries will be copied by IH. Note that there is a possibility that Barbara de Bruine could be involved in either the digitising or the transfer of the technology of the process of boundaries into ARCINFO during her visit to Wallingford for conference attendance.

6. RAINFALL DATA

A selection was made of 96 raingauges was made on the basis of containing continuous data for the period 1961 to 1990, in order to comply with WMO standard period. For each raingauge the mean monthly rainfall and the mean annual rainfall for the period 1961-1990 was calculated. Supporting information was provided on name, basin number, lat., long. and altitude. Additionally a report and map of mean annual rainfall produced by DWA was made available to the FRIEND project.

7. EVAPORATION DATA

A map and accompanying report of potential evaporation in Namibia, produced by DWA, and with accompanying monthly time series (in hardcopy format) was made available to the FRIEND project.

8. THEMATIC MAPS

There is no hydrogeological map or vegetation map of Namibia. Mr. Van Langenhove has previously made available national geological coverage and groundwater quality maps to IH.

9. MANUALLY DERIVATION OF CATCHMENT CHARACTERISTICS

DWA made available in computer format a register of catchment area, mean annual rainfall, S1085 and mainstream length for the selected stations.

10. COORDINATION OF NAMIBIAN RESEARCH INPUTS

DWA will continue to coordinate Namibian inputs into the FRIEND research activities, informing the Coordination Centre and additionally the concerned research projects of staff availability, accompanied if necessary by detailed requests for

financial support (travel, subsistence and other possible costs to be incurred but not met by Government). The main focus of interest is likely to be in the field of rainfall-runoff modelling, to a lesser degree design floods, and to a lesser degree low flows, where interest lies only in the perennial international border rivers.

11. PROVISION OF CAPACITY BULIIDING REQUIREMENTS IN DATA PROCESSING

DWA will provide to the Coordination Centre, and copied to IH, a statement supported by financial components of requirements for technical assistance, training, hardware and software to upgrade data processing facilities and/or research capacity within DWA, (if this arises in addition to the existing request to IH for financial support for computing equipment).

12. RESEARCH REVIEW

Discussions were held in association with staff of DWA regarding past and ongoing research activities, and a number of miscellaneous documents and reports were acquired relating to unit runoff, design flood and yield assessment procedures, and rainfall-runoff modelling.

13. GTZ

A brief meeting was held with Dr. Fred Greiner of GTZ, the German Overseas Development Aid Agency, who was fully conversant with the FRIEND project, and appeared willing to continue support of Namibian activities in FRIEND, pointing out that the earlier elements are motivated and budgeted for the better.

6. *SOUTHERN AFRICA FRIEND*
REPORT ON VISIT TO IH BY DENIS HUGHES - SEPTEMBER 1994

ORGANISATIONS IN SOUTH AFRICA

a) Department of Water Affairs and Forestry, Private Bag X313, PRETORIA 001, Rep. of South Africa.

b) Prof. Denis Hughes, Institute of Water Research, Rhodes University, PO Box 6140, Grahamstown, Rep. of South Africa.

Denis Hughes visited the Institute of Hydrology to collate the data he requires for the rainfall modelling project. He has successfully identified with the assistance of the countries concerned, the catchments that will be used for the rainfall runoff modelling study. The relevant time series of river flow and rainfall data was provided to him in ASCII format although further requests to Zimbabwe will be necessary.

Photocopies of thematic maps were taken using the large format photocopier and various reports were also photocopied. These were sent by air mail to South Africa.

Denis Hughes provided Tony Andrews with ARC/INFO digitized catchment boundaries for all gauged stations in South Africa. Furthermore, the digitized river network was provided to IH. This data has been successfully loaded onto ARC/INFO.

7. *SOUTHERN AFRICA FRIEND*
REPORT ON VISIT TO SWAZILAND - MAY 31st - June 7th
Tony, Andrews IH and Mr Robert Thabede, Mr Petros Simelane, DWA

DEPARTMENT OF WATER AFFAIRS, SWAZILAND

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STAFF

Water Resources Branch

Senior Water Engineer	Mr Robert Thabede
Hydrologist	Mr Raphael Sangweni
Hydrological Technician	Mr Petros Simelane
Water Control Officer	Mr Sidney Dlamini

Department of Meteorology

ADDRESS Ministry of Transport and Communications, National Met. Service, P.O. Box 2652, MBABANE

TEL 46274/41530

FAX 46438

Director;	Mr Emmanuel Dumisani Dlamini
Meteorologist in charge of Advisory Services	Mr Samuel S. Shongwe

NATIONAL HYDROLOGY

Swaziland is a land-locked country (17,400 Km^2) and has borders with Mozambique and RSA. The country is topographically divided into four regions; Highveld (5,030 Km^2) average elevation of 1,300 m asl; Middleveld (4,960 Km^2) elevation between 500 m - 1100 m asl; Lowveld (6,415 Km^2) elevation between 200 m asl and gentle relief and Lebombo (1,320 Km^2) average altitude 600 m asl.

Although Swaziland is endowed with surface water resources that exceed demand, groundwater resources are scarce. There are four main river systems in Swaziland, two of which rise in Swaziland;

* Komati and Lomati which lie in the north of the country, both rivers rise in RSA and flowing out of Swaziland back into RSA before entering Mozambique

* Mbuluzi which rises in Swaziland and flows into Mozambique

* Usutu which rises, together with other tributaries in the RSA and flows out of Swaziland into Mozambique

* Ngavuma which rises in Swaziland and flows into RSA before entering Mozambique.

The average annual rainfall varies between 1,500 mm in Highveld to 500 mm in the Lowveld. The rainfall is highly seasonal with 75%-85% of the rainfall falling during the summer months. The country is prone to be struck by tropical cyclones off the Indian Ocean and cyclone Domoina (28th January - 2nd February) deposited 700 mm at several locations.

STATUS SUMMARY

Prior to cyclone Domoina which struck Swaziland at the end of January 1983, the hydrometric network in Swaziland comprises 35 river gauging stations. Severe damage reduced the number of river gauging stations to only 16. The network has been steadily re-habilitated by the construction, repair or upgrading of 14 stations. The network now comprises approximately 36 stations. All stations have autographic recorders (one SEBA and the rest are Leopold and Stevens strip chart recorders). Four stations in the Mbuluzi basin are equipped with telemetric equipment which were installed to regulate agreed flows into Mozambique.

In almost all cases flow is controlled and measured by specially constructed weirs.

The Water Resources Branch is organised into six divisions: Hydrology, Meteorology, Water Quality, Water Control, Engineering and Dam Operation and Maintenance.

The main objectives of the Water Resources Branch are;

a. Monitor cross border inflow and outflow
b. Monitor water availability for existing demand centres (in particular irrigation sector)
c. Monitor inter-basin transfer, consumption and return flows at irrigations schemes in north-east

Existing water resources developments in Swaziland include irrigation, municipal and industrial water supply and hydropower. Historically most demand for water resources development has come from the private sector, particularly commercial farms. However there is little experience and as a consequence no clear mechanism for water resources planning.

Of great importance to water resources planning in Swaziland is the status of the International Water Rights Issue. A Tripartite Permanent Technical Committee (TPTC) between Swaziland, Mozambique and RSA is designed to resolve differences in the use of water common to each country. These rivers rise in RSA, flow through Swaziland and exit through Mozambique. Since Swaziland is not as well advanced as RSA in Water Resource Development, Swaziland has greater difficulty than RSA in justifying its share of water. The Helsinki principle of equitable and reasonable sharing of water could therefore favour RSA especially considering RSA predicted expansion in demand which could outstrip supply early in the next century.

The water resources strategy in RSA could therefore have a significant effect on the economy of Swaziland since the major easterly flowing river basins Usutu, Komati and Lomati all rise in RSA which could leave Swaziland vulnerable. For Swaziland the measurement of flow at her borders with RSA and Mozambique is extremely important together with the estimation of naturalised flows.

ACTIVITIES

1. HYDATA

Prior to the visit of Mr Andrews, Petros Simelane had supervised the transfer of the flow archive used at Water Resources Branch onto HYDATA using the macro module in HYDATA. All stations in Swaziland are therefore held on HYDATA. The simple task of using the restore option in HYDATA was used to install the Swaziland flow data archive on the portable computer. Only data prior to the tropical cyclone Domoina is held on HYDATA.

Mr Andrews gave a practical demonstration of the HYTRAN software and strongly suggested that further transfers should be carried in this way.

2. FLOOD DATA

DWA provided values of monthly instantaneous maxima for all stations contributing to the FRIEND project.

3. MASTER REGISTER OF GAUGING STATIONS

Checks have already been made to the register and the completed version will be sent to IH. This exists currently in a hard copy and ASCII format.

4. FRIEND STATION SELECTION PROCEDURE

The task of completing the gauging station selection questionnaire was undertaken with the assistance of Raphael Sangweni. Those stations significantly influenced by artificial factors were eliminated from the selection immediately. Although not fully completed yet, the final version should be supplied by the end of July as only information regarding data quality needs to be found. A hard copy of the questionnaire in its current state of completion was brought back to IH.

5. CATCHMENT BOUNDARIES

All the catchment boundaries for Swaziland have been drawn on the 1:250K maps. The location of the gauging stations was carried out by members of the Water Resources Branch who have visited the sites and use was made of the station files.

6. RAINFALL DATA

Thirty eight rainfall stations were identified as being useful to the FRIEND project. Daily mean rainfall was collected from the Department of Meteorology in CLICOM format.

7. EVAPORATION DATA

Eight stations were identified as useful to the FRIEND project and daily mean actual (Pan) evaporation data was collected. Other climatic information necessary for the calculation of PE was also collected for these stations.

8. THEMATIC MAPS

Soil, geology, hydrogeology and vegetation maps were collected from the relevant departments and are held at IH. There is no expertise in GIS and the Water Resources Branch do not have access to a geographic information system.

9. CATCHMENT CHARACTERISTICS

Information on the upper and lower altitude limits of the catchment were collected although stream length and consequently S1085 will have to be calculated.

ACTION POINTS FOR MR ANDREWS

1. Calculation of the stream length will be carried out at IH and using the altitude values collected from DWA S1085 will be calculated.

ACTION POINTS FOR DWA

1. DWA to complete station selection questionnaire and send to IH by August. The most important columns to be filled in are those grouped under the heading 'DATA SUMMARY'. These columns present information concerning the suitability of the stations for flood, low flow and/or rainfall runoff modelling and the reason for the rejection of the gauging station.

2. DWA to finalise the master register of ALL gauging stations in Swaziland using the register on spreadsheet.

3. DWA to identify catchments that are suitable for rainfall runoff modelling. Have any catchments been used or considered for rainfall runoff modelling exercises?

4. DWA to send the data transfer agreement to the University

of Dar-Es-Salaam.

8. SOUTHERN AFRICA FRIEND
REPORT ON VISIT TO Tanzania - AUGUST 23 - SEPTEMBER 10 1994
Tony Andrews, IH, J. Matondo, UDSM, I. Mwakalinga, MAJI

DEPARTMENT OF WATER AFFAIRS, TANZANIA

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Chief Hydrological Engineer;	Mr Msuya
Senior Hydrologist;	Mr I. Mwakalinga
Hydrologist (seconded to UDSM);	Mr S. Mkhandi
Hydrologist (seconded to UDSM);	Mr Mngodo

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STAFF

Head of Department;	Dr F. Mtalo
Senior Lecturer;	Dr. J. Matondo
Senior Lecturer;	Dr R. Kachroo

ACTIVITIES

1. HYDATA

UDSM possess a number of versions of HYDATA and with the cooperation of UDSM one 486 PC was dedicated to the FRIEND hydrological database. Hydata was installed by Tony Andrews and is fully operational. HYTRAN was also installed on the PC.

2. MASTER REGISTER IF GAUGING STATIONS

The full register was provided to Mr Mwakalinga prior to Mr Andrews' visit and is being checked at the moment. A full completed version of the register will be provided to Mr Andrews in spreadsheet or ASCII data format.

3. *FRIEND STATION SELECTION PROCEDURE*

Mr Mwakalinga and Mr Matondo carried out the selection of gauging stations for FRIEND prior to the visit of Mr Andrews. One hundred and eleven time series have been selected for inclusion onto the FRIEND database. The questionnaire was well underway to completion and will be provided to Mr Andrews' in due time. The time series of flow data was provided by MAJI-UBUNGO in ASCII format and is currently held on a separate computer at the University. Please see APPENDIX A for further information on the data transfer.

4. *CATCHMENT BOUNDARIES*

It was not possible to purchase a full set of the 1:250K maps of Tanzania and so copies will have to be purchased in the UK. A map showing the distribution of the 1:250K series maps was acquired from the Surveyors General Office in Dar-Es-Salaam which will aid in the selection of maps for purchase back in the UK. Since the maps were not available, catchment locations and catchment boundaries could not be drawn. However, catchment boundaries and locations have been drawn for ALL gauging stations in Tanzania and have been copied onto acetate. Although the original maps showing the catchment boundaries and locations are not available, the acetate tracings are held at the Dept. Civil Engineering and can be acquired through Mr Mwakalinga. The drawings are of a high quality but MAJI is reluctant to allow them out of the Department in case of loss or damage.

The maps are currently being digitized using in-house-written digitizing software. It was agreed by Mr Andrews, Mr Mwakalinga and Mr Matondo that the acetates depicting the FRIEND catchment boundaries would be digitized first which then could be provided to Mr Andrews during his next visit so that he can take them back to the UK for digitizing into ARC-INFO. No arrangement was made for the University derived digitized data to be sent to the Institute of Hydrology. This is a mistake and Mr Andrews will be requesting for the digitized data to be sent to IH to determine if the coordinates can be loaded onto ARC-INFO. Otherwise, if a

further visit to Dar-Es-Salaam is not possible this year, photocopies of the gauging station location depicted on a map or from the acetate will be sent to IH. The photocopies will then be used to locate the gauging stations on the 1:250K maps and catchment boundaries drawn from the locations.

5. *RAINFALL DATA*

15 gauging stations were identified as being suitable for rainfall runoff modelling analysis although due to a scarcity of rainfall gauges in some of the catchments this number was reduced 6 stations. Daily rainfall data for the relevant raingauges is currently being manually typed into ASCII files and will be provided to Denis Hughes. Monthly rainfall and mean monthly rainfall data was provided in CLICOM and WORDPERFECT formats, respectively. The master register of raingauges was also provided in WORDPERFECT format. All this data is held at the Dept. Civil Engineering at UDSM.

6. *EVAPORATION DATA*

No evaporation data could be made available to the FRIEND project.

7. *THEMATIC MAPS*

National maps of soil, vegetation and an assortment of other thematic maps were purchased although the availability of maps is poor in Tanzania. Further attempts at purchase should be made in the UK.

8. *ASSISTANCE TO MR MWAKALINGA IN THE DEVELOPMENT OF THE SOUTHERN AFRICA FRIEND HYDATA DATABASE*

Mr Mwakalinga was given a one day demonstration of HYDATA and HYTRAN software. Mr Andrews also provided him with a document entitled 'SOUTHERN AFRICA FRIEND DATA TRANSFER - The Development of a Unified HYDATA Database for All Countries in the SADC Region' which outlines in detail the method and procedure to be adopted in the development of the HYDATA database and the data files which contain the daily time series flow data to be transferred onto HYDATA. This document is reproduced in APPENDIX A. This document will be used by the Database Manager to install the flow data onto HYDATA. This document is central to the whole

procedure and will be used to check the success or failure of transfer of each data file onto HYDATA.

ASCII data files containing time series of flow data have been provided in HYTRAN format together with the relevant HYTRAN.LOG (log), HYTRAN.FMT (format) and HYTRAN.BAT (batch) files. These files have been provided to make the transfer of data as automatic as possible using HYTRAN software. The tables presented between pages 60 to 83 in the document provide information on the start date of the data file and the station number the data should be written to. These tables should be used in conjunction with the HYTRAN.REM file to check the success or failure of the HYTRAN batch transfer.

9. FRIEND GAUGING STATION NUMBERING SCHEME

The FRIEND gauging station numbering scheme was applied to all gauging stations to be used on the FRIEND project and a full list of the stations is presented in APPENDIX B. Each country has been asked to check that the numbering scheme has been applied correctly and any corrections should be sent to Tony Andrews at IH.

10. OTHER MATTERS

a) It was agreed between Tony Andrews and Jonathon Matondo that a Link Agreement or Memorandum of Understanding between UDSM and IH was not necessary.

b) The six monthly progress report for the periods September 1993 - February 1994 and March 1994 - August 1994 were written by Tony Andrews, Denis Hughes, Jonathon Matondo and Simon Mkhandi.

c) Dr Matondo provided Tony Andrews with a detailed proposal for financing unfunded components of the project. This is to be supplied to Osbourne Shela at SADC for possible funding.

d) Dr Matondo has written to IAHS and Henny Colenbrander requesting for 'Task Force for Developing Countries' status for all countries participating in the Southern Africa FRIEND project with the exception of South Africa and Botswana.

e) Dr Matondo has written to the Angolan FRIEND representative regarding the provision of the flow data held at SADC-ELMS in Maseru. He will also write to Osbourne Shela requesting the flow data series once permission has been granted by Angola.

f) Dr Kachroo has written to the Regional Inventory of Agricultural Resource Base (RIARB)/SADC project 4 group in Harare requesting information regarding the availability fo the SADC Soil Map which is based on the FAO classification scheme. Mr Kachroo will write to Tony Andrews informing him of the availability and format of the data. It would be ideal if the SADC Soil Map was in ARC/INFO format.

g) Mr Andrews will provide Mr Mwakalinga with information regarding PC backup and PC networking software.

h) The Database Manager contract was signed by Dr F. Mtalo.

i) One copy of HYFAP software was given to each delegate attending the Short Flood Course at UDSM.

9. SOUTHERN AFRICA FRIEND
REPORT ON VISIT TO ZAMBIA - APRIL 26 - MAY 10 1994
Andy Bullock, IH and Christopher Chileshe, DWA

DEPARTMENT OF WATER AFFAIRS, LUSAKA

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Mrs. Elestina Mwelma, Deputy Officer-in-Charge

Rose Nsamba, Hydrologist
Cecil Nundwe, Water Engineer
Jonathan Kampata, Water Engineer

Grace Makakauliwa, Technician
Florence Sikamundanga, Technician (Diploma)
Wellington Chisala, Technician
Mr. Silwimba, Technician (Diploma)

Olipa Zulu (Supervisor, computer staff)
Roachie Mweene (computing)
Helen Banda (computing)
Agnes Chilemu (computing)
Irene Mubanga (computing)

Robert Mulenga (chemist)

Headquarters at Mulungushi House (Tel. 252570 or 252581)

Mr. Silvester Hibajene, Acting Permanent Secretary
Mr. R.B. Khuti, Acting Director, Department of Water Affairs
Mr. Victor Kasimona, Acting Chief Engineer (Water Resources)
+ other policy staff.
Mr. Matthew Mulipukwa (Drought projects and training)

STATUS SUMMARY

There have been 254 gauging sites in Zambia. DWA have compiled time series of daily water level data as computer data bases under a recent JICA project. A large proportion of stage/discharge data are also on computer. With the recent failure of the computer upon which HYDATA was established, the schedule of calculating rating equations has suffered a setback, and a previous software routine, EUCLID, has been utilised instead of HYDATA. Many of the flow records currently remain unprocessed.

ACTIVITIES

1. HYDATA

a) The PC upon which the DWA Hydata was installed experienced a system failure in November 1993, and was only returned to DWA on 29 April 1994, with Hydata deleted. DWA possess a HYDATA backup from November, but lost the copy protection. AB issued fax to Software Section requesting that a replacement be despatched. This was down on May 5th and delivery was anticipated to DWA by May 9th.

b) Prior to system failure, DWA were unable to run the low flow analysis programmes (for software reasons), but this could not be investigated during this visit. DWA will contact Software Section at IH with appropriate error messages. Any necessary software deliveries should be accomplished during visit by IH staff under Zambian Sugar Corporation contract.

c) The HYDATA training course run under FRIEND was attended by Mr. Victor Kasimona, who is now in a largely administrative role at Mulungushi House, and is divorced from the day-to-day DWA data processing operations at Sheki-Sheki Road, and by a representative from ZESCO (Raphael Mbila). There is no individual now involved with data processing at DWA who has received formal training in HYDATA (except Michael Mutale who attended one of the WMO).

d) Given the large backlog of data processing to be undertaken, there is a good case for DWA to operate an additional copy of HYDATA. Mr. Kasimona will write a letter to IH on this matter, and financial support could be

considered under the FRIEND project, within the context that Zambia did not receive any of the HYDATA installation support provided to other countries.

e) Firesafe information provided by Software Section prior to departure was passed on to DWA and ZESCO.

2. MASTER REGISTER OF GAUGING STATIONS

Mr. Chileshe provided a revised Master Register of gauging stations, which is incorporated into ZAMQUEST.XLS spreadsheet. Station Lat and Longs were checked against yearbook listings. This will replace the previously held ZAMBIA.XLS register which should be deleted.

3. FRIEND STATION SELECTION PROCEDURE

No action on the selection of appropriate stations had been undertaken prior to this visit, and staff availability restricted the completion during the visit. Consequently, the spreadsheet ZAMQUEST was established at DWA, with the responsibility for completion assigned to Ms. Elestina Mwelma. The data availability section was compiled, leading to the rejection of 83 stations, and a more detailed note on assessment of data quality was constructed. A copy of the standard IH station hydrometric form used in UK station files was transferred as a suggested model for adoption, in order to upgrade the summary of hydrometric information on station files.

4. FLOW DATA SOURCES

In addition to the DWA data processing schedule, DWA would seek already processed data series through ZESCO and through a recent JICA project. A copy of ZESCO HYDATA holdings was made available to DWA and passed to IH.

5. CATCHMENT BOUNDARIES

Locations of all 254 gauging stations in Zambia were depicted on a full set of 1:250,000 map sheets (54) along with the boundaries of the seven major catchments. Two sets were produced - one to be returned to Wallingford, the second to reside in DWA. Given

the absence of digitising facilities within DWA, DWA requested IH to digitise catchment boundaries for catchments contributed to the FRIEND project, and this will be undertaken at Wallingford. Upon future establishment of appropriate archiving facilities in Zambia, as identified by DWA, the digitised boundaries will be copied by IH.

5. *RAINFALL DATA*

A visit was made to the Meteorological Dept. and a data request submitted for i) monthly time series for 120 raingauges which represent broad national coverage and possess more than 45 years, ii) daily rainfall series for 36 climatological stations, iii) a copy of the Master Register of raingauges (although a full register is published in SSHAP). Due to the necessity to apply quality control procedures, the data will be made available by Met. Dept (Mr. Winston Salaka) through Mr. Chileshe at DWA, who should retain one copy of all data, by the end of June prior to despatch to IH. IH paid the data charges of 40,000 KWA (approx. 40 pounds) and made 10 pre-formatted diskettes available. Spare diskettes should be retained by DWA. At this time, monthly rainfall series have not been linked to available flow series. A copy of the national mean annual rainfall map was acquired for IH.

6. *EVAPORATION DATA*

Twenty two time series of daily and monthly evaporation data had been assembled by DWA prior to the visit, and copies now reside with both DWA and IH. No national map of PE is known to exist by DWA - one possibility is Irrigation Dept. of Ministry of Agriculture.

7. *THEMATIC MAPS*

National maps of soil and vegetation were acquired by IH, in addition to the already discussed topographic and rainfall maps. No Government agency is known at this time to be using ARCINFO.

The issue of establishing a digitised data base of river networks was discussed, in principle only, with Phanuel Kantumoya (Senior Cartographer at Survey Department (Mulungushi House, P.O. Box 50397, Lusaka). If such an activity were to proceed, the

Depatment would make available blue plates for data capture by an external organisation, or else could undertake digitising internally, with a daily charge rate of 110$US at an estimated input of 1500 man-days (30 days per sheet for 54 sheets). The Dept. has good links (mainly training) with O.S. and Kingston College of Further Education.

8. ZAMBIAN INPUTS INTO RESEARCH PROGRAMMES

The opportunities for Zambian involvement in the research programmes, which should be strongly encouraged, were discussed with respect to two approaches; first, the attendance of formal training courses in flood hydrology (Dar Es Salaam 1994), rainfall-runoff modelling and low flow analysis, whereby Zambia will respond positively to information received from the Coordination Centre; second, through the participation in collaborative activities with the research groups in floods (Dar Es Salaam), rainfall-runoff modelling (Rhodes University) and low flows (IH/University of Zimbabwe/Dar Es Salaam). DWA undertakes to coordinate the possible manpower inputs and to respond to the coordination centre, with expressed interests, staff names, possible time inputs and schedule, and financial requirements (travel, subsistence, and if necessary salary costs, unless met by the Zambian government).

9. MISCELLANEOUS

Discussion was held with Mr. Khuti (Director of DWA) and Mr. Kasimona (Chief Hydrologist) with regard to DWA assuming responsibility for archiving of the now-closed Luano experimental catchment data from National Council of Scientific Research. Mr. Khuti was accomodating to the idea, citing the research opportunities, and encouraged Mr. Kasimona to approach NCSR (Mr. James Kasonde, Head of Water Resources Research Unit) on this matter.

Contact was made with Zambian Sugar Corporation (David Covell, Managing Direcor, Mike Spitteler, General Manager, Paddy Strover, Assistant General Manager (Agriculture), Griifiths Nangomba, Irrigation Manager, and Adrian Himambile, Irrigation Officer) in connection with the ZSC/IH contract on the Kafue.

10. OTHER RELEVANT ORGANISATIONS

a) SADC Hydro-electric Hydrological Assistance Project - headed by Charlie Cadou, with Mr. Chris Mwasile as hydrologist and Mr. Ben Gunther with responsibility for data, based at ZESCO (Zambian Energy Corporation).

b) Water Development Board, Mulungushi House, Lusaka - responsible for water rights.

c) Zambezi River Authority - no further information)

d) IUCN - Mr. Maimbolwa (country representative)

PROGRAMME OF DWA ACTION POINTS

1. STATION SELECTION

a) Data quality assessment; compilation of summary sheet of data quality critera classes, for documentation on station records and input into overall station selection scheme.

b) Artificial influence assessment; either a) assessment of degree of artificial influences using knowledge of experienced staff, or b) assembly of water rights information from WDB, comprises start date (and end if relevant) location and authorised abstraction quantity, annotation of information onto 1:250,000 scale maps, calculation of total abstraction rates *during period of available and good quality data only* (rather than current abstractions), and comparison with flow statistics to assess degree of artificial influences.

c) Compilation of FRIEND data summary; based on the above, and using the ZAMQUEST spreadsheet and accompanying documentation, compile the final summary of stations, data period and suitability for analysis, or rejection criterion for each gauging station. Submit this to both Dar Es Salaam and IH to accompany flow data.

d) FRIEND station numbering; apply, in the FRIEND data summary FRIEND station numbers in accordance with the scheme described in the document entitled "Proposal for the Southern Africa gauging station numbering scheme".

2. DATA PROCESSING

In accordance with the priority established by the station selection procedure, process water levels to flows, and apply appropriate quality control procedures (as detailed in the appropriate note).

3. *DATA EXCHANGE AGREEMENT*

Ensure that the data exchange agreement document, distributed by the University of Dar Es Salaam is returned with the category of data conditions identified.

4. *RIVER FLOW DATA SERIES PROVISION*

By the end of July, despatch in computer format (ideally, but not necessarily HYDATA) time series of river flow data to IH at Wallingford, to enable them to transfer data to UDSM. If this route is to be taken, that data must be received by IH not after July 20th 1994. Alternatively, the data can be despatched directly to Dar Es Salaam to be received not later than August 15th, when IH staff will be in Dar Es Salaam assisting in the construction of the international data base. The deadlines must be adhered to, even if only a portion of the data is available at that time. No more data will be installed onto the Dar data base after the end of August.

5. *RAINFALL DATA SERIES*

Meteorological Office will provide diskettes of rainfall data at the end of June. Monitoring of the preparation of these data should be undertaken by DWA, and at the end of June DWA should receive the data from Met. on diskete, obtain a copy for themselves, and then forward the data to IH, to be received no later than July 20th.

Additionally, but not essentially, DWA should annotate their set of 1:250,000 map sheets with the location of all raingauges in the country (see Mott McDonalds Sub-Saharan Hydrological Assessment report) for future purposes of linking rainfall data to gauged catchments.

6. *MANUAL DERIVATION OF CATCHMENT CHARACTERISTICS*

Using gauging station locations and drawn catchment boundaries, DWA should develop a LOTUS database of the following catchment characteristics for selected gauging stations only, (with supply of the data base directly to Dar Es Salaam);

a) AREA in sq.km. as measured by digital planimeter. These should be compared against pre-published values on the Master Register and any discrepancies (that is differences are greater than 5%) should be resolved. If as a result of this exercise it is dicovered that the location of the gauging station on the 1:250,000 maps is incorrect, then IH should be informed so they can correct the digitised boundary. This correction should be achieved by posting a photocopy of the relevant portion of the map showing both the new and old positions, clearly illustrated.

b) Main stream length, measured in km from the gauging station to the source of the main river. This is best achieved with a pair of dividers.

c) Catchment slope, defined as S1085, being the slope (difference in altitude in metres divided by the distance in metres) over the length of river between a point 10% of mainstream length upstream from the gauging station and a point 85% of mainstream length upstream from the gauging station).

d) Gauging station altitude in metres

e) Maximum catchment altitude in metres

f) If possible, and I suspect that it won't be, mean annual catchment maximum 1-day (or 2-day) rainfall.

7. *LUANO EXPERIMENTAL CATCHMENTS*

Liaise with NCSR regarding

a) The future responsibility for archiving on computer, historic series of river flows, rainfall, evaporation, water levels, and any other original data

b) The opportunity that exists to liaise with the Institute of Hydrology regarding collaborative research to analyse the data, and determine appropriate policy thereupon. Data

analysis could be undertaken under both or either the low flow or rainfall-runoff modelling components of FRIEND.

8. COORDINATION OF ZAMBIAN RESEARCH INPUTS

To coordinate Zambian inputs into the FRIEND research activities, informing the Coordination Centre and through them the research projects of staff availability, accompanied if necessary by detailed requests for financial support (travel, subsistence and other possible costs to be incurred but not met by Government).

9. PROVISION OF CAPACITY BULIIDING REQUIREMENTS IN DATA PROCESSING

To provide to the Coordination Centre, and copied to IH, a statement supported by financial components of requirements for technical assistance, training, hardware and software to upgrade data processing facilities with DWA. Requests for IH to seek direct support should be addressed to the Director of the Institute of Hydrology, Prof. Brian Wilkinson.

10. SOUTHERN AFRICA FRIEND
REPORT ON VISIT TO ZIMBABWE - 25th February - 15th March
Tony Andrews IH, Mr G. Mawere, Mr W Luxemburg, Mr J. Merka and Mr R Chickwana, HYDROLOGICAL BRANCH

HYDROLOGICAL BRANCH, HARARE, ZIMBABWE

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FAX No FAX

STAFF

Chief Hydrological Engineer	Mr G. Maware
Deputy Hydrological Engineer	Mr R. Chickwana
Senior Hydrologist	Mr J. Merka
Senior Hydrologist	Mr W. Luxemburg

STATUS SUMMARY

The hydrometeorlogical monitoring network has comprised over 500 river flow gauges and over 1000 raingauges. At present there are 1065 installations dating back to 1920's and there are currently 720 stations operational. A number of the stations were abandoned during the War for Independence. A subdivision of the stations can be made according to the measurement of stage:

1. Automatic water level recorders (430 stations) - Fischer and Porter, Leopold and Stevens, Kent, 'H' (or Holdstock) recorders
2. Gauge post readings (290 stations)

Most stations are equipped with Kent recorders (over 300) followed by H-type recorders. The weekly hydrography is recorded on charts which are then digitized at the Hydrological Branch. At gauge post stations the stages are read at least daily by an observer.

Of the 720 potential operational stations:

1. 505 contain a notch, being either a V-notch, or a rectangular or sloped notch. At 205 locations a V-notch is

installed
2. 146 contain flume. There exists 111 Parcel flumes and 44 Cut Throat Flumes.

Both of the above types are often combined with a broad crested weir. Seldom a combination of flumes and notches is applied.

3. 14 structures consist of a broad crested weir only
4. 55 stations contain structures not further specified, and are rated through a series of calibrated stage and flow values
5. there are 6 natural control sections

ACTIVITIES

1. HYDATA

Mr Andrews installed HYDATA on one of the WANG PC's and wrote a FORTRAN program to convert the annual summary daily flow data files derived from the Hydrological Branch system into HYTRAN format. Mr Luxemburg was provided with a copy of the FORTRAN code and the executable file together with a short manual describing the procedure to down load data from the Hydrological Branch data base system onto HYDATA using HYTRAN. Mr Andrews undertook the task of converting the Hydrological Branch data files into HYTRAN format and downloaded the daily mean flow data series onto HYDATA.

2. FLOOD DATA

Values of monthly daily maxima are available on HYDATA for the FRIEND gauging stations.

3. MASTER REGISTER AND SELECTION OF GAUGING STATIONS

Mr Luxemburg is currently supervising the completion of the gauging station register and will send a copy to Mr Andrews on completion. This task was due for completion by the end of April.

No attempt had been made to complete the gauging station selection questionnaire and so Mr Andrews initiated this task. Mr Chickwana is supervising the completion of this task and will arrange for the delivery to IH. The initial selection of 87

gauging stations from the 720 operational stations was conducted by Mr Chickwana with the aid of the regional hydrologists. The selection was based on the degree of artificial influence and data quality which Mr Chickwana has personal experience.

Mr Chickwana is advised only to answer the last columns of the questionnaire which are grouped under the heading 'DATA SUMMARY'. These columns provide information regarding the suitability of the gauging station for flood, low flow and/or rainfall runoff modelling and the reason for the rejection of the gauging station. Please consult the document that accompanies the questionnaire when answering these questions.

4. *CATCHMENT BOUNDARIES*

The catchment boundaries for the 87 stations were drawn on the 1:250K maps. The location of the gauging stations was assisted by the use of the water rights maps which are to the 1:50K scale.

5. *RAINFALL DATA*

Rainfall data from thirty nine climatological sites which record daily rainfall were acquired from Mr C.T. Temba at the Department of Meteorology. Only data recorded at the climate stations is available on computer because a lightening strike destroyed the Department of Meteorology data base which contained daily rainfall data from the rainfall sites. Hard copies of the daily rainfall can however be acquired from the Department of Meteorology. The rainfall data has been supplied in CLICOM ASCII format. A full register of the raingauges in Zimbabwe was obtained in ASCII format.

6. *EVAPORATION DATA*

Twenty four daily time series of actual evaporation (PAN) was collected from the Department of Meteorology. These measurements have been made at the climatological sites in Zimbabwe. This data is available in ASCII CLICOM format.

7. *THEMATIC MAPS*

Soil, geology, hydrogeology maps were purchased by Godfrey

Nedzwine and are to be sent to Mr Andrews at IH.

8. CATCHMENT CHARACTERISTICS

The catchment characteristic data base has to be developed at IH. Minimum altitude is given in the register and the catchment characteristics for a number of the selected FRIEND catchments are presented in Dr. Bullock's Ph.D.

ACTION POINTS FOR HYDROLOGICAL BRANCH

1. Mr Chickwana is advised ONLY to answer the last columns of the FRIEND gauging station selection questionnaire which are grouped under the heading 'DATA SUMMARY'. These columns provide information regarding the suitability of the gauging station for flood, low flow and/or rainfall runoff modelling and the reason for the rejection of the gauging station. Please consult the document that accompanies the questionnaire when answering these questions.

2. Mr Luzemburg to supervise the completion of the gauging station register for all the gauging stations in Zimbabwe. A copy will be sent to Mr Andrews in ASCII format on diskette.

3. Hydrological Branch to send the purchased soil, geology, hydrogeology, vegetation and a selection of 1:250K maps to Mr Andrews at IH.

4. Mr Mawere to write a letter to Mr Andrews confirming the permission from the Hydrological Branch for the use on the FRIEND project of the Erin and Chisengu experimental catchment databases developed for the ODA Land Use Change project.

5. Mr Chickwana to confirm that no further gauging stations will be contributed to the FRIEND project.

ACTION POINTS FOR MR TONY ANDREWS

1. IH to digitize the catchment boundaries into ARC/INFO.

2. Since the catchment boundaries do not exist at the

Hydrological Branch, IH will attempt to undertake the task of calculating the stream length of the catchments in the FRIEND project.

APPENDIX A

SOUTHERN AFRICA FRIEND

DATA TRANSFER

THE DEVELOPMENT OF

A UNIFIED HYDATA

DATABASE FOR ALL

COUNTRIES IN THE

SADC REGION

Anthony Andrews

Institute of Hydrology

7th September 1994

METHODOLOGY AND INFORMATION FOR DATA TRANSFER

1.0 INTRODUCTION

This document is meant to be used as a manual which contains information about how to load the daily flow data from the country databases onto the unified southern Africa FRIEND HYDATA database. The document also contains information about the data files to be transferred onto HYDATA, specifically the name of the files, station numbers and the start date of the data. The document is also intended to provide information which will be of use in the future to determine the success/failure of the data transfer. It is absolutely essential that the information contained in this document is used to validate the transfer of the data.

The Institute of Hydrology's HYTRAN software which was provided to each country along with the copy of HYDATA will be used to transfer the ASCII data files containing the flow data onto HYDATA.

The GETOFF.EXE executable program was used to abstract the daily flow series data from HYDATA. This method and HYTRAN will be explained in the text.

2.0 METHOD TO ABSTRACT DATA FROM HYDATA - GETOFF

A HYDATA databse was established for each country on the FRIEND project and therefore the data has to be downloaded into ASCII files and re-loaded onto the FRIEND "unified" database. The following procedure was used for this purpose.

The HYDATA software package is provided with an executable program designed to provide a user orientated method to abstract a daily time series of flow data from HYDATA and to create an

ASCII file containing the time series data. This program is called GETOFF.

Method

i. In the HYDATA data directory that contains the data to be abstratced type on the DOS command line:

GETOFF

ii. The user is then prompted for the HYDATA password which is optional and dependent on whether a password control has been introduced using HDBINS. If no password is required hit the ENTER key which will then take you to the next menu prompting for the abstraction mode. Type 4 for daily time series.

iii. The next menu is to determine the number of stations to be abstracted. For the purpose of this methodology enter 1 although up to 5 stations can be downloaded at any one time.

iv. The station type is indictaed from the next menu, from which you should choose 1, which is for flow station.

v. The HYDATA station number(s) is then requested in the next menu which requires a valid station number present on the HYDATA data directory that you are running GETOFF. The number MUST NOT exceed 8 integers in length.

vi. The start year and end year of the data is requested in the next two questions which are then followed by the start month and end month for the period specified in the previous two questions. Finally the data period is completed by the next two questions which require the start day of the start month of the start year and the end day of the end month of the end year. For example if the period to be abstracted is 1st Oct 1950 to 30th September 1994 the following sequence will be typed: 1950, 1994, 10, 9, 1, 30.

vii. The format of the daily flow data is determined in the next menu with a choice of f10.0, f10.1, f10.2, or f10.3. I strongly suggest using f10.3 and this is the format that I have adopted for all data transfers

carried out.

viii The value for the missing data is given in the next prompt and I have used either -999999999 or -9.999 although any negative value or character is valid **AS LONG AS THIS IS REMEMBERED FOR THE HYTRAN FORMAT FILE** which will be explained later.

ix. The name of the data file to be created is given on the next line which has to be a valid DOS filename. I always suggest that the filename shuld contain the station code/number is one form or another and have the extension .DAT, .DLY or .FLW.

x. The last menu presents the user with the chance to re-enter details, exit to DOS or to execute the command. Option 3 should be chosen if you are satisfied that you have answered all the questions correctly. The data file specified in this section will be created in the working directory with the format of one value per line and the data format specfied in vii. above.

EXAMPLE:

Download the daily flow time series data for station 11223344 for the period 1st October 1980 - 30th September 1994.

COMMAND SEQUENCE		DESCRIPTION
GETOFF	>>>>>>	INVOKE THE PROGRAM
4	>>>>>>	ABSTRACTION MODE
1	>>>>>>	NUMBER OF STATIONS
1	>>>>>>	STATION TYPE
11223344	>>>>>>	STATION NUMBER
1980	>>>>>>	START YEAR
1994	>>>>>>	END YEAR YEAR
10	>>>>>>	MONTH OF START YEAR
9	>>>>>>	MONTH OF END YEAR
1	>>>>>>	DAY OF START MONTH
30	>>>>>>	DAY OF END MONTH
4	>>>>>>	ASCII DATA FILE FORMAT (F10.3)
-999999999	>>>>>>	CODE FOR MISSING VALUE

3.0 HYDATA/HYLIBM SUBROUTINE LIBRARY FOR SOUTH AFRICAN DATA

HYLIBM is a library of FORTRAN subroutines which may be used to access data stored on HYDATA. The library is available in Moicrosoft FORTRAN 77 Version 5 and has been compiled for use with the large model. See page 10.1 to 10.30 for the available subroutines. However the three most useful routines for handling data are HYGY, HYWS and DATEY. The first two routines could be used in place of the GETOFF program. The possibility of using these subroutines to download the South African database is currently being investigated. However, the choice is either GETOFF or the HYDATA/HYLIBM subroutines.

The only data that needs to be abstracted from a HYDATA databse is the South African data. You may consider using the subroutines listed in the HYTRAN manual to fully automate the downloading of an entire station record into file with the format of 8F10.3 which has a filename of:

<FRIEND STATION NUMBER>.QFL eg. 27521003.QFL

Alternatively you can run the GETOFF.EXE program for each station (295 for South Africa), and then write a FORTRAN program to reformat the F10.3 line format acquired from GETOFF.EXE into the recommended HYTRAN line format of 8F10.3

4.0 DATA TRANSFERS

The data files created using GETOFF have the format of one record per line and each record f10.3 (which is dependent on what was input in part vii. above). Since the limitation of the size of the data files that can be loaded onto HYDATA using HYTRAN is 2500 lines, this equates to 6 years of daily data. Almost all the data files that are to be loaded onto HYDATA contain more than 6 years of daily data. These files are reformatted using a FORTRAN program called ARRANGE.EXE into the format 8f10.3. This effectively raises the number of years that can be loaded on to HYDATA using HYTRAN from 6 years to 50 years. The data files that are to be loaded contain a header showing the start date of the data series and the files are read across so that line one of the data starts with day 1 and the eighth value on the first line represents day 8 of the data series and so on. **IT IS ESSENTIAL TO HAVE THE START DATE HEADER INFORMATION IN ALL THE DATA FILES. LOOK AT THE PRE-EXISTING DATA FILES THAT HAVE THE FILENAME EXTENSION OF ".QFL".**

4.1 HYTRAN

HYTRAN is the data input program that forms part of the Institute of Hydrology's HYDATA database system. HYTRAN has been designed to read data files containing continuous time series data and to transfer the data automatically to a HYDATA database. HYTRAN is operated using screen menus of the type used in HYDATA. Datafile formats are defined interactively and, once defined, can be stored for use with other files from the same data source. Data can be transferred either automatically, using a stored format, or can first be checked on the screen, using HYTRAN's screen display facilities. Full error checking is performed before the start of each transfer. However, the batch facility will be used to transfer data and the method is described below.

4.1.1 HYTRAN Batch Transfer

The batch transfer mode allows more than one datafile to be transferred onto HYDATA in a single operation. During the transfer, the specified datafiles are checked and transferred in turn. Any resulting errors are reported before proceeding automatically to the next datafile. The checks consist of 'ordering' the data according to the specified format and then 'scanning' to check the data against the limits for the specified

HYDATA station. It should be noted that during a batch transfer HYTRAN transfers ALL values regardless of the station limits and **WILL ASSUME THAT THE DATA SERIES IS CONTINUOUS**. Therefore missing values must be presented in the data file and the format for the missing value recognised by the HYTRAN format file. Before starting a batch transfer there are several points which should be checked:

1. The HYDATA database must have space allocated for each of the station numbers specified in the .LOG file (see later).

2. The datafiles must all be in the same directory, although, unlike with a manual transfer, this directory need not be the one containing the HYDATA database.

3. The HYDATA database must be in the current directory together with the format file (or files), the batch job file and a valid .LOG file. These files are described later.

The different batch transfer methods are presented in SECTION 5.1 of the HYRTAN manual but for the purpose of the transfer of data onto the FRIEND database, batch mode 2 will be used.

4.1.2 Batch Mode 2

When using this mode, the names of the datafiles must be specified using a single 'code' made up from some combination of letters, numbers, numbers from station number, and characters from the identifier. This facility allows several datafiles to be defined by a single statement (the 'code'), and encourages the use of datafile names which reflect the source of the data. The station numbers and/or identifiers used by the code are taken from the .LOG file which means that the .LOG file provides the list of the datafiles and the corresponding station numbers for use in the batch transfer. A single format file must be specified for use with all of the datafiles. An example of a BATCH FILE is given below together with the associated .LOG file.

1. CONTENTS OF THE HYTRAN BATCH JOB

Line #	Description	Contents of Datafile
Line 1	Comments	Example of batch mode 2
Line 2	Batch mode	2
Line 3	DOS directory for datafiles	C:\HYDATA\TANZANIA
Line 4	Name of .LOG file	TANZANIA.LOG
Line 5	Name of format file	TAMZANIA.FMT
Line 6	Datafile identifier	i1i2i3i4i5.DAT

2. CONTENTS OF TANZANIA.LOG FILE

Description	Contents
Datafile name read from identifier ...	50411.DAT
Station number for the datafile	98119033
	50412.DAT
	98119033
	60113.DAT

In the example on the following page the batch job would transfer the datafiles according to the identifier, i1i2i3i4i5.DAT from the C:\HYDATA\TANZANIA directory into the HYDATA data directory using the TANZANIA.FMT file. Note that there are limitations on the input datafile which are listed in APPENDIX B of the HYTRAN manual. The most important constraints are on the maximum number of lines in the datafile (2500), and the maximum number of datafiles in one batch job (50). If these are exceeded the batch transfer will not work.

4.1.3 HYTRAN Format File

I have provided you with all the relevant HYTRAN format files

EXAMPLE CONSTRUCTION OF DATA FORMAT FILE (.FMT)

DATAFILE: 50411.DAT WITH A FORMAT 8F10.3 - BELOW IS AN EXAMPLE OF THE FIRST LINE OF THE DATAFILE

START DATE: 01/10/1980
DD MM YYYY
11111.111 22222.222 33333.333 44444.444 55555.555 CONT...
vvvvvvvvv vvvvvvvvv vvvvvvvvv vvvvvvvvv vvvvvvvvv

The first line of the datafile is the header which contains the start date of the datafile (first record on the second line). This line is read by the HYTRAN format file through the use of the DD (Day), MM (Month) and YYYY (Year) format specifiers. Note that the date specifiers MUST BE GIVEN IN UPPER CASE.

needed for the transfer of data. These are given together with the data, .BAT and .LOG files although I strongly advise you to familiarise yourself with the procedure to define data formats. Refer to section 4.2 of the HYTRAN manual for instructions. Note that the format file is defined during a manual batch transfer which can then be saved for use during batch transfers. For a more detailed description of the format specifiers please refer to the HYTRAN instruction manual starting on page 4.9 Section 4.2. The manual HYTRAN method for loading data onto HYDATA has been demonstrated and is given ample description in the HYTRAN manual. If other HYTRAN format files have to be created please read the HYTRAN manual data loading section of the

HYTRAN manual.

4.2 PROVISION OF DATAFILES AND HYTRAN FILES

The data to be loaded onto the unified Southern Africa FRIEND HYDATA database has been provided on a country by country basis contained in PKZIP files on floppy diskette. The following section presents information on the datafiles and the associated HYTRAN files. The datafiles have been compressed using PKZIP software by the following method:

PKZIP <FILENAME>.ZIP *.<EXT> (where EXT = filename extension)

This compresses all the <FILENAME>.EXT datafiles in the working directory and creates the ZIP datafile: <FILENAME>. ZIP.

To deflate the ZIP file use the following command:

PKUNZIP <FILENAME>.ZIP

This will 'unzip' the ZIP file back into its constituent parts (i.e. the original datafiles).

TABLES FOR EACH COUNTRY PRESENTING:

A. THE DATAFILE NAMES

B. THE FRIEND GAUGING STATION NUMBERS INTO WHICH THE DATA WILL BE LOADED

C. THE DATA PERIOD OF RECORD IN THE DATAFILES.

Note that these files MUST be used to check the transfer of the data using the HYTRAN batch facility. The station number, datafile name and the data period can be cross-checked directly against the information presented in the HYTRAN.REM file which is created after each batch jub. (SEE SECTION 4.3 FOR FURTHER INFORMATION).

For a second cross-check look at the <HYTRAN>.LOG files for each country to see if the correct gauging station number has been assigned to the correct datafile.

BOTSWANA

FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
67538011	2411.QFL	1969/70-1993/94
67538021	2421.QFL	1969/70-1993/94
67538012 TO BE ADDED		
67530011	3111.QFL	1969/70-1993/94
67530021	3121.QFL	1969/70-1993/94
67530022	3221.QFL	1969/70-1993/94
67537021	3321.QFL	1969/70-1993/94
67537031	3331.QFL	1969/70-1993/94
67536021	4121.QFL	1969/70-1993/94
67536031	4131.QFL	1969/70-1993/94
67536041	4141.QFL	1969/70-1993/94
67535161	4361.QFL	1969/70-1993/94
67535511	4411.QFL	1969/70-1993/94
67535411	4511.QFL	1969/70-1993/94
67536011	4611.QFL	1969/70-1993/94
67921011	5111.QFL	1969/70-1993/94
67921012	5211.QFL	1969/70-1993/94
67921013	5311.QFL	1969/70-1993/94
67933112	7112.QFL	1969/70-1993/94
67933113	7412.QFL	1969/70-1993/94
67933122	7722.QFL	1969/70-1993/94
67933114	7812.QFL	1969/70-1993/94
67933115	7912.QFL	1969/70-1993/94
67922012	8112.QFL	1969/70-1993/94
67922022	8122.QFL	1969/70-1994/95

CONTINUED

LESOTHO

LOCAL STATION NUBER	DATAFILE NAME	DATA PERIOD
66819303	31.DAT	1975/76-1980/81
66819303	32.DAT	1981/82-1986/87
66819303	33.DAT	1987/88-1990/91
66819304	41.DAT	1980/81-1985/86
66819304	42.DAT	1986/87-1990/91
66819305	51.DAT	1980/81-1985/86
66819305	52.DAT	1986/87-1990/91
66819306	61.DAT	1980/81-1985/86
66819306	62.DAT	1986/87-1991/92
66819307	71.DAT	1980/81-1985/86
66819307	72.DAT	1986/87-1991/92
66819308	81.DAT	1980/81-1985/86
66819308	82.DAT	1986/87-1991/92
66819310	101.DAT	1977/78-1982/83
66819310	102.DAT	1983/84-1988/89
66819310	103.DAT	1989/90-1991/92
66819311	111.DAT	1980/81-1985/86
66819311	112.DAT	1986/87-1991/92
66819312	121.DAT	1980/81-1985/86
66819312	122.DAT	1986/87-1991/92
66819314	141.DAT	1980/81-1985/86
66819314	142.DAT	1986/87-1991/92
66819317	171.DAT	1980/81-1985/86
66819317	172.DAT	1986/87-1991/92
66819318	181.DAT	1980/81-1985/86
66819318	182.DAT	1986/87-1991/92
66819318	183.DAT	1992/93-1993/94
66819219	191.DAT	1980/81-1985/86
66819219	192.DAT	1986/87-1991/92
66819223	231.DAT	1987/88-1992/93
66818024	241.DAT	1980/81-1985/86
66818024	242.DAT	1986/87-1991/92
66818034	341.DAT	1980/81-1985/86
66818034	342.DAT	1986/87-1991/92
66819336	361.DAT	1980/81-1985/86
66819336	362.DAT	1986/87-1991/92
66818039	391.DAT	1984/85-1989/90
66818039	392.DAT	1990/91-1991/92
66819340	401.DAT	1975/76-1980/81

MALAWI

FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
65312101		
65312103	98011803.QFL	1952/53-1990/91
65312118	98011818.QFL	1963/64-1990/91
65312107		
65282008	98020208.QFL	1986/87-1990/91
65282011		
65282022	98020222.QFL	1959/60-1990/91
65283003	98020303.QFL	1980/81-1990/91
65312901	98030501.QFL	1953/54-1990/91
65312902	98030502.QFL	1980/81-1990/91
65312903	98030503.QFL	1957/58-1990/91
65312907	98030507.QFL	1959/60-1990/91
65312803	98040203.QFL	1975/76-1990/91
65312804	98040204.QFL	1977/78-1990/91
65312805	98040404.QFL	1952/53-1990/91
65312806	98040406.QFL	1957/58-1990/91
65312801	98040501.QFL	1980/81-1990/91
65312806	98040606.QFL	1974/75-1990/91
65312601	98050301.QFL	1974/75-1990/91
65312604	98050401.QFL	1959/60-1979/80
65312602	98050402.QFL	1953/54-1990/91
65312603	98050403.QFL	1987/88
65312501		
65312403	98070103.QFL	1955/56-1990/91
65312404	98070104.QFL	1980/81-1990/91
65312405		
65312402	98070602.QFL	1956/57-1990/91
65312406	98070603.QFL	1970/71-1990/91
65312414	98070714.QFL	1957/58-1990/91
65312303	98070803.QFL	1980/81-1990/91
65312301	98080105.QFL	1968/69-1990/91
65312302	98090103.QFL	1980/81-1990/91
65312304		
65312305	98090105.QFL	1969/70-1990/91
65312306	98090205.QFL	1980/81-1990/91
65312307	98090207.QFL	1980/81-1990/91
65312110	98140102.QFL	1954/55-1990/91
65312102	98140202.QFL	1951/52-1990/91

NAMIBIA

FRIEND STATION NUMBER	DATAFILE NAME	FIRST BLOCK	LAST BLOCK
64811001	0482M01.DAT	1/2/70	1/2/93
64812001	0491M01.DAT	1/6/70	1/9/92
64812002	0491M02.DAT	1/12/76	1/9/92
64812003	0491M03.DAT	1/12/76	1/9/92
64812004	0491M06.DAT	1/1/76	1/9/92
64812005	0492M02.DAT	1/12/76	1/9/92
64812006	0493M01.DAT	1/11/73	1/9/92
64812007	0493M03.DAT	1/2/78	1/9/90
64812008	0496M01.DAT	27/1/61	1/8/92
64812009	0496M02.DAT	2/5/75	1/7/90
64812010	0497M02.DAT	12/5/70	1/2/81
64812011	0497M03.DAT	12/12/75	1/4/93
64812012	0497M05.DAT	27/1/76	1/11/92
64812013	0498M02.DAT	30/1/73	1/12/89
64812014	0499M02.DAT	29/1/76	1/7/90
64812015	0499M03.DAT	26/2/79	1/2/93
64370001	2300M01A.DAT	29/12/42	12/12/67
64370001	2300M01B.DAT	1/1/89	1/12/93
64370001	2300M01C.DAT	1/1/68	1/12/88
64932101	2511M01A.DAT	1/10/45	1/12/68
64932101	2511M01B.DAT	1/1/69	1/9/92
64932102	2512M04A.DAT	1/10/49	1/12/72
64932102	2512M04B.DAT	1/1/73	1/9/92
64932301	2531M01.DAT	11/3/61	1/9/81
64740001	2811M01.DAT	1/11/61	1/9/74
64740002	2814M05.DAT	2/2/80	1/11/90
64735002	2954M01.DAT	6/11/74	1/11/91
64734001	2961M02.DAT	10/3/61	1/3/93
64734002	2962M03.DAT	3/10/67	1/9/92
64734003	2962M06.DAT	2/7/77	1/9/91
64733002	2971M02.DAT	26/10/67	1/11/92
64733003	2971M03.DAT	24/9/74	1/4/93
64732002	2982M06.DAT	6/12/83	1/1/92
64732003	2984M01.DAT	8/2/62	1/9/91
64732004	2986M01.DAT	23/9/67	1/8/93
64732005	2986M03.DAT	7/12/78	1/8/93
64731001	2991M01.DAT	1/2/61	1/5/93
64731002	2991M03.DAT	27/10/76	1/5/91
64731003	2991M06.DAT	18/12/80	1/8/90

CONTINUED ..... NAMIBIA

FRIEND STATION NUMBER	DATAFILE NAME	FIRST BLOCK	LAST BLOCK
64813202	3111M02.DAT	5/11/73	1/1/93
64813203	3112M02.DAT	15/11/73	1/1/93

Note that the datafiles have a different format to the other data files and is infact similar to the recommended HYTRAN daily data format (see HYTRAN manual). HYTRAN will intuitively know that each block contains one month of data (because the HYTRAN format file contains an end of block marker which is the text 'END OF MONTH') and starts on the date specified in the header for that block. Therefore in the table above only the start date of the first and last blocks are given and it is up to you to check that the correct blocks have been loaded by HYTRAN.

ZIMBABWE

FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
63351108	1008.QFL	1953/54-1989/90
63351113	1013.QFL	1952/53-1988/89
63351120	1020.QFL	1955/56-1989/90
63351122	1022.QFL	1955/56-1989/90
63351137	1037.QFL	1964/65-1989/90
63351138	1038.QFL	1966/67-1989/90
63351139	1039.QFL	1964/65-1989/90
63351141	1041.QFL	1965/66-1989/90
63351147	1047.QFL	1966/67-1989/90
63351152	1052.QFL	1969/70-1989/90
63351160	1060.QFL	1971/72-1991/92
63351161	1061.QFL	1971/72-1991/92
63351165	1065.QFL	1973/74-1989/90
63351166	1066.QFL	1974/75-1989/90
63534113	2013.QFL	1951/52-1989/90
63534115	2015.QFL	1952/53-1989/90
63534123	2023.QFL	1956/57-1989/90
63534128	2028.QFL	1957/58-1989/90
63534129	2029.QFL	1960/61-1989/90
63534131	2031.QFL	1958/59-1989/90
63510035	2035.QFL	1959/60-1989/90
63514139	2039.QFL	1963/64-1989/90
63534156	2056.QFL	1965/66-1992/93
63534162	2062.QFL	1966/67-1989/90
63534265	2065.QFL	1966/67-1989/90
63534274	2074.QFL	1968/69-1989/90
63534275	2075.QFL	1968/69-1989/90
63534177	2077.QFL	1969/70-1989/90
63534178	2078.QFL	1969/70-1988/89
63341006	3006.QFL	1948/49-1989/90
63341012	3012.QFL	1950/51-1989/90
63341018	3018.QFL	1962/63-1989/90
63323023	3023.QFL	1956/57-1989/90
63323028	3028.QFL	1954/55-1989/90
63341029	3029.QFL	1977/78-1989/90
63341033	3033.QFL	1983/84-1989/90
63341039	3039.QFL	1959/60-1988/89
63341041	3041.QFL	1962/63-1989/90
63341042	3042.QFL	1957/58-1988/89

CONTINUED .... ZIMBABWE

FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
63315542	4042.QFL	1968/69-1989/90
63315546	4046.QFL	1969/70-1989/90
63315547	4047.QFL	1976/77-1987/88
63315548	4048.QFL	1971/72-1989/90
63315549	4049.QFL	1975/76-1989/90
63315550	4050.QFL	1970/71-1989/90
63315555	4055.QFL	1970/71-1989/90
63315556	4056.QFL	1970/71-1989/90
63422219	5019.QFL	1954/55-1989/90
63433121	5021.QFL	1956/57-1989/90
63423528	5028.QFL	1957/58-1983/84
63423342	5042.QFL	1980/81-1989/90
63422143	5043.QFL	1959/60-1989/90
63423344	5044.QFL	1959/60-1989/90
63423345	5045.QFL	1960/61-1989/90
63423348	5048.QFL	1959/60-1989/90
63423349	5049.QFL	1960/61-1989/90
63423354	5054.QFL	1960/61-1989/90
63422361	5061.QFL	1962/63-1989/90
63423369	5069.QFL	1972/73-1989/90
63423293	5093.QFL	1966/67-1989/90
63423208	5108.QFL	1966/67-1989/90
63423414	5114.QFL	1973/74-1989/90
63422120	5120.QFL	1968/69-1989/90
63422126	5126.QFL	1970/71-1987/88
63422330	5130.QFL	1981/82-1989/90
63423133	5133.QFL	1971/72-1989/90
63423551	5151.QFL	1975/76-1988/89
63423353	5153.QFL	1974/75-1989/90
63422362	5162.QFL	1978/79-1989/90
63422301	6001.QFL	1957/58-1989/90
63422306	6006.QFL	1964/65-1989/90
63414007	6007.QFL	1958/59-1989/90
63414010	6010.QFL	1966/67-1989/90
63414014	6014.QFL	1970/71-1989/90
63415015	6015.QFL	1971/72-1984/85
63414016	6016.QFL	1972/73-1984/85
63415018	6018.QFL	1975/76-1989/90

SWAZILAND

FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
68632202	2.QFL	1958/59-1990/91
68620003	3.QFL	1959/60-1990/91
68620004	4.QFL	1960/61-1990/91
68632205	5.QFL	1961/62-1990/91
68632206	6.QFL	1957/58-1992/93
68632207	7.QFL	1960/61-1990/91
68632208	8.QFL	1960/61-1991/92
68632209	9.QFL	1952/53-1990/91
68620010	10.QFL	1963/64-1991/92
68613111	11.QFL	1955/56-1990/91
68632212	12.QFL	1964/65-1991/92
68632213	13.QFL	1966/67-1991/92
68632215	15.QFL	1967/68-1990/91
68632219	19.QFL	1971/72-1990/91
68620020	20.QFL	1973/74-1990/91
68632221	21.QFL	1973/74-1990/91
68632222	22.QFL	1974/75-1990/91
68632223	23.QFL	1974/75-1990/91
68632224	24.QFL	1975/76-1991/92
68632225	25.QFL	1976/77-1990/91
68632228	28.QFL	1976/77-1990/91
68613129	29.QFL	1977/78-1989/90
68613130	30.QFL	1978/79-1992/93
68632231	31.QFL	1979/80-1990/91
68620032	32.QFL	1979/80-1989/90
68632233	33.QFL	1980/81-1990/91
68613134	34.QFL	1980/81-1990/91
68620035	35.QFL	1974/75-1990/91
68620036	36.QFL	1976/77-1990/91
68620037	37.QFL	1974/75-1990/91
68620038	38.QFL	1975/76-1990/91
68632239	39.QFL	1981/82-1990/91
68620040	40.QFL	1974/75-1990/91
68620041	41.QFL	1975/76-1990/91
68613142	42.QFL	1979/80-1989/90
68632243	43.QFL	1983/84-1990/91

ZAMBIA

FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
60370030	203050.FLW	1950/51
60370030	203051.FLW	1951/52
60370030	203052.FLW	1952/53
60370030	203053.FLW	1953/54
60370030	203054.FLW	1954/55
60370030	203055.FLW	1955/56
60370030	203056.FLW	1956/57
60370030	203057.FLW	1957/58
60370030	203058.FLW	1958/59
60370030	203059.FLW	1959/60
60370030	203060.FLW	1960/61
60370030	203061.FLW	1961/62
60370030	203062.FLW	1962/63
60370030	203063.FLW	1963/64
60370030	203064.FLW	1964/65
60370030	203065.FLW	1965/66
60370030	203066.FLW	1966/67
60370030	203067.FLW	1967/68
60370030	203068.FLW	1968/69
60370030	203069.FLW	1969/70
60370030	203070.FLW	1970/71
60370030	203071.FLW	1971/72
60370030	203072.FLW	1972/73
60370030	203073.FLW	1973/74
60370030	203074.FLW	1974/75
60370030	203075.FLW	1975/76
60370030	203076.FLW	1976/77
60370030	203077.FLW	1977/78
60370030	203078.FLW	1978/79
60370030	203079.FLW	1979/80
60370030	203080.FLW	1980/81
60370030	203081.FLW	1981/82
60370030	203082.FLW	1982/83
60370030	203083.FLW	1983/84
60370030	203084.FLW	1984/85
60370030	203085.FLW	1985/86
60370030	203086.FLW	1986/87
60370030	203087.FLW	1987/88
60370030	203088.FLW	1988/89

ZAMBIA .... CONTINUED

FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
60370000	240051.FLW	1951/52
60370000	240052.FLW	1952/53
60370000	240053.FLW	1953/54
60370000	240054.FLW	1954/55
60370000	240055.FLW	1955/56
60370000	240056.FLW	1956/57
60370000	240057.FLW	1957/58
60370000	240058.FLW	1958/59
60370000	240059.FLW	1959/60
60370000	240060.FLW	1960/61
60370000	240061.FLW	1961/62
60370000	240062.FLW	1962/63
60370000	240063.FLW	1963/64
60370000	240064.FLW	1964/65
60370000	240065.FLW	1965/66
60370000	240066.FLW	1966/67
60370000	240067.FLW	1967/68
60370000	240068.FLW	1968/69
60370000	240069.FLW	1969/70
60370000	240070.FLW	1970/71
60370000	240071.FLW	1971/72
60370000	240072.FLW	1972/73
60370000	240073.FLW	1973/74
60370000	240074.FLW	1974/75
60370000	240075.FLW	1975/76
60370000	240076.FLW	1976/77
60370000	240077.FLW	1977/78
60370000	240078.FLW	1978/79
60370000	240079.FLW	1979/80
60370000	240080.FLW	1980/81
60370000	240081.FLW	1981/82
60370000	240082.FLW	1982/83
60370000	240083.FLW	1983/84
60370000	240084.FLW	1984/85
60370000	240085.FLW	1985/86
60370000	240086.FLW	1986/87
60370000	240087.FLW	1987/88
60370000	240088.FLW	1988/89
60370000	240089.FLW	1989/90

ZAMBIA .... CONTINUED

FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
60335030	313074.FLW	1974/75
60335030	313075.FLW	1975/76
60335030	313076.FLW	1976/77
60335030	313077.FLW	1977/78
60335030	313078.FLW	1978/79
60335030	313079.FLW	1979/80
60335030	313080.FLW	1980/81
60335030	313081.FLW	1981/82
60335030	313082.FLW	1982/83
60335030	313083.FLW	1983/84
60335030	313084.FLW	1984/85
60334005	400562.FLW	1962/63
60334005	400563.FLW	1963/64
60334005	400564.FLW	1964/65
60334005	400565.FLW	1965/66
60334005	400566.FLW	1966/67
60334005	400567.FLW	1967/68
60334005	400568.FLW	1968/69
60334005	400569.FLW	1969/70
60334005	400570.FLW	1970/71
60334005	400571.FLW	1971/72
60334005	400572.FLW	1972/73
60334005	400573.FLW	1973/74
60334005	400574.FLW	1974/75
60334005	400575.FLW	1975/76
60334005	400576.FLW	1976/77
60334005	400577.FLW	1977/78
60334005	400578.FLW	1978/79
60334005	400579.FLW	1979/80
60334005	400580.FLW	1980/81
60334005	400581.FLW	1981/82
60334005	400582.FLW	1982/83
60334005	400583.FLW	1983/84
60334005	400584.FLW	1984/85
60334005	400585.FLW	1985/86
60334005	400586.FLW	1986/87
60334005	400587.FLW	1987/88
60334005	400588.FLW	1988/89
60334005	400589.FLW	1989/90

ZAMBIA .... CONTINUED

FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
60334015	401570.FLW	1970/71
60334015	401571.FLW	1971/72
60334015	401572.FLW	1972/73
60334015	401573.FLW	1973/74
60334015	401574.FLW	1974/75
60334015	401575.FLW	1975/76
60334015	401576.FLW	1976/77
60334015	401577.FLW	1977/78
60334015	401578.FLW	1978/79
60334015	401579.FLW	1979/80
60334015	401580.FLW	1980/81
60334015	401581.FLW	1981/82
60334015	401582.FLW	1982/83
60334015	401583.FLW	1983/84
60334015	401584.FLW	1984/85
60334015	401585.FLW	1985/86
60334015	401586.FLW	1986/87
60334015	401587.FLW	1987/88
60334015	401588.FLW	1988/89
60334015	401589.FLW	1989/90
60334015	401590.FLW	1990/91
60334015	401591.FLW	1991/92
60334050	405059.FLW	1959/60
60334050	405060.FLW	1960/61
60334050	405061.FLW	1961/62
60334050	405062.FLW	1962/63
60334050	405063.FLW	1963/64
60334050	405064.FLW	1964/65
60334050	405065.FLW	1965/66
60334050	405066.FLW	1966/67
60334050	405067.FLW	1967/68
60334050	405068.FLW	1968/69
60334050	405069.FLW	1969/70
60334050	405070.FLW	1970/71
60334050	405071.FLW	1971/72
60334050	405072.FLW	1972/73
60334050	405073.FLW	1973/74
60334050	405074.FLW	1974/75
60334050	405075.FLW	1975/76

ZAMBIA .... CONTINUED

FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
60334015	401570.FLW	1970/71
60334015	401571.FLW	1971/72
60334015	401572.FLW	1972/73
60334015	401573.FLW	1973/74
60334015	401574.FLW	1974/75
60334015	401575.FLW	1975/76
60334015	401576.FLW	1976/77
60334015	401577.FLW	1977/78
60334015	401578.FLW	1978/79
60334015	401579.FLW	1979/80
60334015	401580.FLW	1980/81
60334015	401581.FLW	1981/82
60334015	401582.FLW	1982/83
60334015	401583.FLW	1983/84
60334015	401584.FLW	1984/85
60334015	401585.FLW	1985/86
60334015	401586.FLW	1986/87
60334015	401587.FLW	1987/88
60334015	401588.FLW	1988/89
60334015	401589.FLW	1989/90
60334015	401590.FLW	1990/91
60334015	401591.FLW	1991/92
60334050	405059.FLW	1959/60
60334050	405060.FLW	1960/61
60334050	405061.FLW	1961/62
60334050	405062.FLW	1962/63
60334050	405063.FLW	1963/64
60334050	405064.FLW	1964/65
60334050	405065.FLW	1965/66
60334050	405066.FLW	1966/67
60334050	405067.FLW	1967/68
60334050	405068.FLW	1968/69
60334050	405069.FLW	1969/70
60334050	405070.FLW	1970/71
60334050	405071.FLW	1971/72
60334050	405072.FLW	1972/73
60334050	405073.FLW	1973/74
60334050	405074.FLW	1974/75
60334050	405075.FLW	1975/76

ZAMBIA .... CONTINUED

FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
60334050	405085.FLW	1985/86
60334050	405086.FLW	1986/87
60334050	405087.FLW	1987/88
60334050	405088.FLW	1988/89
60334050	405089.FLW	1989/90
60334050	405090.FLW	1990/91
60334050	405091.FLW	1991/92
60334050	405092.FLW	1992/93
60334050	405093.FLW	1993/94
60334240	424071.FLW	1971/72
60334240	424072.FLW	1972/73
60334240	424073.FLW	1973/74
60334240	424074.FLW	1974/75
60334240	424075.FLW	1975/76
60334240	424076.FLW	1976/77
60334240	424077.FLW	1977/78
60334240	424078.FLW	1978/79
60334240	424079.FLW	1979/80
60334240	424080.FLW	1980/81
60334240	424081.FLW	1981/82
60334240	424082.FLW	1982/83
60334240	424083.FLW	1983/84
60334240	424084.FLW	1984/85
60334240	424085.FLW	1985/86
60334240	424086.FLW	1986/87
60334240	424087.FLW	1987/88
60334240	424088.FLW	1988/89
60334245	424571.FLW	1971/72
60334245	424572.FLW	1972/73
60334245	424573.FLW	1973/74
60334245	424574.FLW	1974/75
60334245	424575.FLW	1975/76
60334245	424576.FLW	1976/77
60334245	424577.FLW	1977/78
60334245	424578.FLW	1978/79
60334245	424579.FLW	1979/80
60334245	424580.FLW	1980/81
60334245	424581.FLW	1981/82
60334245	424582.FLW	1982/83

ZAMBIA .... CONTINUED

FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
60334245	424592.FLW	1992/93
60334245	424593.FLW	1993/94
60334250	425066.FLW	1966/67
60334250	425067.FLW	1967/68
60334250	425068.FLW	1968/69
60334250	425069.FLW	1969/70
60334250	425070.FLW	1970/71
60334250	425071.FLW	1971/72
60334250	425072.FLW	1972/73
60334250	425073.FLW	1973/74
60334250	425074.FLW	1974/75
60334250	425075.FLW	1975/76
60334250	425076.FLW	1976/77
60334250	425077.FLW	1977/78
60334250	425078.FLW	1978/79
60334250	425079.FLW	1979/80
60334250	425080.FLW	1980/81
60334250	425081.FLW	1981/82
60334250	425082.FLW	1982/83
60334250	425083.FLW	1983/84
60334250	425084.FLW	1984/85
60334250	425085.FLW	1985/86
60334250	425086.FLW	1986/87
60334250	425087.FLW	1987/88
60334250	425088.FLW	1988/89
60334250	425089.FLW	1989/90
60334250	425090.FLW	1990/91
60334280	428063.FLW	1963/64
60334280	428064.FLW	1964/65
60334280	428065.FLW	1965/66
60334280	428066.FLW	1966/67
60334280	428067.FLW	1967/68
60334280	428068.FLW	1968/69
60334280	428069.FLW	1969/70
60334280	428070.FLW	1970/71
60334280	428071.FLW	1971/72
60334280	428072.FLW	1972/73
60334280	428073.FLW	1973/74
60334280	428074.FLW	1974/75

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FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
60334280	428084.FLW	1984/85
60334280	428085.FLW	1985/86
60334280	428086.FLW	1986/87
60334280	428087.FLW	1987/88
60334280	428088.FLW	1988/89
60334280	428089.FLW	1989/90
60334280	428090.FLW	1990/91
60334280	428091.FLW	1991/92
60334280	428092.FLW	1992/93
60334340	434071.FLW	1971/72
60334340	434072.FLW	1972/73
60334340	434073.FLW	1973/74
60334340	434074.FLW	1974/75
60334340	434075.FLW	1975/76
60334340	434076.FLW	1976/77
60334340	434077.FLW	1977/78
60334340	434078.FLW	1978/79
60334340	434079.FLW	1979/80
60334340	434080.FLW	1980/81
60334340	434081.FLW	1981/82
60334340	434082.FLW	1982/83
60334340	434083.FLW	1983/84
60334340	434084.FLW	1984/85
60334340	434085.FLW	1985/86
60334340	434086.FLW	1986/87
60334450	445050.FLW	1950/51
60334450	445051.FLW	1951/52
60334450	445052.FLW	1952/53
60334450	445053.FLW	1953/54
60334450	445054.FLW	1954/55
60334450	445055.FLW	1955/56
60334450	445056.FLW	1956/57
60334450	445057.FLW	1957/58
60334450	445058.FLW	1958/59
60334450	445059.FLW	1959/60
60334450	445060.FLW	1960/61
60334450	445061.FLW	1961/62
60334450	445062.FLW	1962/63
60334450	445063.FLW	1963/64

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FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
60334450	445073.FLW	1973/74
60334450	445074.FLW	1974/75
60334450	445075.FLW	1975/76
60334450	445076.FLW	1976/77
60334450	445077.FLW	1977/78
60334450	445078.FLW	1978/79
60334450	445079.FLW	1979/80
60334450	445080.FLW	1980/81
60334450	445081.FLW	1981/82
60334450	445082.FLW	1982/83
60334450	445083.FLW	1983/84
60334450	445084.FLW	1984/85
60334450	445085.FLW	1985/86
60334450	445086.FLW	1986/87
60334450	445087.FLW	1987/88
60334450	445088.FLW	1988/89
60334450	445089.FLW	1989/90
60334450	445090.FLW	1990/91
60334450	445091.FLW	1991/92
60334460	446067.FLW	1967/68
60334460	446068.FLW	1968/69
60334460	446069.FLW	1969/70
60334460	446070.FLW	1970/71
60334460	446071.FLW	1971/72
60334460	446072.FLW	1972/73
60334460	446073.FLW	1973/74
60334460	446074.FLW	1974/75
60334460	446075.FLW	1975/76
60334460	446076.FLW	1976/77
60334460	446077.FLW	1977/78
60334460	446078.FLW	1978/79
60334460	446079.FLW	1979/80
60334460	446080.FLW	1980/81
60334460	446081.FLW	1981/82
60334460	446082.FLW	1982/83
60334460	446083.FLW	1983/84
60334460	446084.FLW	1984/85
60334460	446085.FLW	1985/86
60334460	446086.FLW	1986/87

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FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
60334500	450074.FLW	1974/75
60334500	450075.FLW	1975/76
60334500	450076.FLW	1976/77
60334500	450077.FLW	1977/78
60334500	450078.FLW	1978/79
60334500	450079.FLW	1979/80
60334500	450080.FLW	1980/81
60334500	450081.FLW	1981/82
60334500	450082.FLW	1982/83
60334500	450083.FLW	1983/84
60334500	450084.FLW	1984/85
60334500	450085.FLW	1985/86
60334500	450086.FLW	1986/87
60334550	455068.FLW	1968/69
60334550	455069.FLW	1969/70
60334550	455070.FLW	1970/71
60334550	455071.FLW	1971/72
60334550	455072.FLW	1972/73
60334550	455073.FLW	1973/74
60334550	455074.FLW	1974/75
60334550	455075.FLW	1975/76
60334550	455076.FLW	1976/77
60334550	455077.FLW	1977/78
60334550	455078.FLW	1978/79
60334550	455079.FLW	1979/80
60334550	455080.FLW	1980/81
60334550	455081.FLW	1981/82
60334550	455082.FLW	1982/83
60334550	455083.FLW	1983/84
60334550	455084.FLW	1984/85
60334550	455085.FLW	1985/86
60334550	455086.FLW	1986/87
60334550	455087.FLW	1987/88
60334550	455088.FLW	1988/89
60334550	455089.FLW	1989/90
60334550	455090.FLW	1990/91
60334550	455091.FLW	1991/92
60334550	455092.FLW	1992/93
60334620	462064.FLW	1964/65

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FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
60334620	462074.FLW	1974/75
60334620	462075.FLW	1975/76
60334620	462076.FLW	1976/77
60334620	462077.FLW	1977/78
60334620	462078.FLW	1978/79
60334620	462079.FLW	1979/80
60334620	462080.FLW	1980/81
60334620	462081.FLW	1981/82
60334620	462082.FLW	1982/83
60334620	462083.FLW	1983/84
60334620	462084.FLW	1984/85
60334620	462085.FLW	1985/86
60334620	462086.FLW	1986/87
60334620	462087.FLW	1987/88
60334620	462088.FLW	1988/89
60334620	462089.FLW	1989/90
60334620	462090.FLW	1990/91
60334620	462091.FLW	1991/92
60334620	462092.FLW	1992/93
60334669	466972.FLW	1972/73
60334669	466973.FLW	1973/74
60334669	466974.FLW	1974/75
60334669	466975.FLW	1975/76
60334669	466976.FLW	1976/77
60334669	466977.FLW	1977/78
60334669	466978.FLW	1978/79
60334669	466979.FLW	1979/80
60334669	466980.FLW	1980/81
60334669	466981.FLW	1981/82
60334669	466982.FLW	1982/83
60334669	466983.FLW	1983/84
60334669	466984.FLW	1984/85
60334669	466985.FLW	1985/86
60334669	466986.FLW	1986/87
60334669	466987.FLW	1987/88
60334669	466988.FLW	1988/89
60334669	466989.FLW	1989/90
60334669	466990.FLW	1990/91
60334669	466991.FLW	1991/92

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FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
60334977	497769.FLW	1969/70
60334977	497770.FLW	1970/71
60334977	497771.FLW	1971/72
60334977	497772.FLW	1972/73
60313040	594036.FLW	1936/37
60313040	594037.FLW	1937/38
60313040	594038.FLW	1938/39
60313040	594039.FLW	1939/40
60313040	594040.FLW	1940/41
60313040	594041.FLW	1941/42
60313040	594042.FLW	1942/43
60313040	594043.FLW	1943/44
60313040	594044.FLW	1944/45
60313040	594045.FLW	1945/46
60313040	594046.FLW	1946/47
60313040	594047.FLW	1947/48
60313040	594048.FLW	1948/49
60313040	594049.FLW	1949/50
60313040	594050.FLW	1950/51
60313040	594051.FLW	1951/52
60313040	594052.FLW	1952/53
60313040	594053.FLW	1953/54
60313040	594054.FLW	1954/55
60313040	594055.FLW	1955/56
60313040	594056.FLW	1956/57
60313040	594057.FLW	1957/58
60313040	594058.FLW	1958/59
60313040	594059.FLW	1959/60
60313040	594060.FLW	1960/61
60313040	594061.FLW	1961/62
60313040	594062.FLW	1962/63
60313040	594063.FLW	1963/64
60313040	594064.FLW	1964/65
60313040	594065.FLW	1965/66
60313040	594066.FLW	1966/67
60313040	594067.FLW	1967/68
60313040	594068.FLW	1968/69
60313040	594069.FLW	1969/70
60313040	594070.FLW	1970/71

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FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
60313040	594080.FLW	1980/81
60313040	594081.FLW	1981/82
60313040	594082.FLW	1982/83
60313040	594083.FLW	1983/84
60313040	594084.FLW	1984/85
60313040	594085.FLW	1985/86
60313040	594086.FLW	1986/87
60313040	594087.FLW	1987/88
60313040	594088.FLW	1988/89
60313040	594089.FLW	1989/90
60313040	594090.FLW	1990/91
60313040	594091.FLW	1991/92
60313040	594092.FLW	1992/93
60773230	613074.FLW	1974/75
60773230	613075.FLW	1975/76
60773230	613076.FLW	1976/77
60773230	613077.FLW	1977/78
60773230	613078.FLW	1978/79
60773230	613079.FLW	1979/80
60773230	613080.FLW	1980/81
60773230	613081.FLW	1981/82
60773245	614574.FLW	1974/75
60773245	614575.FLW	1975/76
60773245	614576.FLW	1976/77
60773245	614577.FLW	1977/78
60773245	614578.FLW	1978/79
60773245	614579.FLW	1979/80
60773245	614580.FLW	1980/81
60773245	614581.FLW	1981/82
60773245	614582.FLW	1982/83
60773245	614583.FLW	1983/84
60773245	614584.FLW	1984/85
60773245	614585.FLW	1985/86
60773245	614586.FLW	1986/87
60773245	614587.FLW	1987/88
60773245	614588.FLW	1988/89
60773245	614589.FLW	1989/90
60773245	614590.FLW	1990/91
60773245	614591.FLW	1991/92

ZAMBIA .... CONTINUED

FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
60773235	623573.FLW	1973/74
60773235	623574.FLW	1974/75
60773235	623575.FLW	1975/76
60773235	623576.FLW	1976/77
60773235	623577.FLW	1977/78
60773235	623578.FLW	1978/79
60773235	623579.FLW	1979/80
60773235	623580.FLW	1980/81
60773235	623581.FLW	1981/82
60773235	623582.FLW	1982/83
60773235	623583.FLW	1983/84
60773235	623584.FLW	1984/85
60773235	623585.FLW	1985/86
60773235	623586.FLW	1986/87
60773235	623587.FLW	1987/88
60773235	623588.FLW	1988/89
60773235	623589.FLW	1989/90
60773235	623590.FLW	1990/91
60773235	623591.FLW	1991/92
60773275	627564.FLW	1964/65
60773275	627565.FLW	1965/66
60773275	627566.FLW	1966/67
60773275	627567.FLW	1967/68
60773275	627568.FLW	1968/69
60773275	627569.FLW	1969/70
60773275	627570.FLW	1970/71
60773275	627571.FLW	1971/72
60773275	627572.FLW	1972/73
60773275	627573.FLW	1973/74
60773275	627574.FLW	1974/75
60773275	627575.FLW	1975/76
60773275	627576.FLW	1976/77
60773275	627577.FLW	1977/78
60773275	627578.FLW	1978/79
60773275	627579.FLW	1979/80
60773275	627580.FLW	1980/81
60773275	627581.FLW	1981/82
60773275	627582.FLW	1982/83
60773275	627583.FLW	1983/84

ZAMBIA .... CONTINUED

FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
60773230	633057.FLW	1957/58
60773230	633058.FLW	1958/59
60773230	633059.FLW	1959/60
60773230	633060.FLW	1960/61
60773250	635070.FLW	1970/71
60773250	635071.FLW	1971/72
60773250	635072.FLW	1972/73
60773250	635073.FLW	1973/74
60773250	635074.FLW	1974/75
60773250	635075.FLW	1975/76
60773250	635076.FLW	1976/77
60773250	635077.FLW	1977/78
60773250	635078.FLW	1978/79
60773250	635079.FLW	1979/80
60773250	635080.FLW	1980/81
60773250	635081.FLW	1981/82
60773250	635082.FLW	1982/83
60773250	635083.FLW	1983/84
60773250	635084.FLW	1984/85
60773250	635085.FLW	1985/86
60773250	635086.FLW	1986/87
60773250	635087.FLW	1987/88
60773250	635088.FLW	1988/89
60773250	635089.FLW	1989/90
60773250	635090.FLW	1990/91
60773250	635091.FLW	1991/92
60773105	700569.FLW	1969/70
60773105	700570.FLW	1970/71
60773105	700571.FLW	1971/72
60773105	700572.FLW	1972/73
60773105	700573.FLW	1973/74
60773105	700574.FLW	1974/75
60773105	700575.FLW	1975/76
60773105	700576.FLW	1976/77
60773105	700577.FLW	1977/78
60773105	700578.FLW	1978/79
60773105	700579.FLW	1979/80
60773105	700580.FLW	1980/81
60773105	700581.FLW	1981/82

ZAMBIA .... CONTINUED

FRIEND STATION NUMBER	DATAFILE NAME	DATA PERIOD
60773105	700591.FLW	1991/92

4.3 RUNNING HYTRAN BATCH JOBS

The HYTRAN files required for batch transfers using HYTRAN are:

<FILENAME>.BAT	BATCH FILE
<FILENAME>.LOG	LOG FILE CONTAINING DATA FILENAMES AND STATION NUMBERS
<FILENAME>.FMT	HYTRAN FORMAT FILE

These files have been created for each country and provided on the floppy diskette which also contain the compressed data files. Note that these files can be edited to suit your own requirements.

To begin the HYTRAN batch transfer type on the DOS command line (making sure that you are in the correct working directory that contains the data files and the HYDATA database):

HYTRAN

The menu style of HYTRAN is similar to HYDATA and the first menu prompts for manual or batch transfers. Select the batch transfer. This takes you to the second level menu and you should select option 2 and type the name of the <FILENAME>.BAT (i.e. HYTRAN batch filename).

This will begin the batch job, the datafile names which are to be loaded are contained in the <FILENAME>.LOG file. On completion, a file called HYTRAN.REM is created in the working directory. This file contains information regarding the transfer of each datafile listed in the <FILENAME>.LOG file. The file shows the results of the 'ordering' and 'scanning' of the data that HYTRAN carries out prior to loading onto HYDATA. It is imperative that this file is scrutinized to check for any errors in the transfer to HYDATA. An example of the HYTRAN.REM file is presented below in which only one file was loaded onto HYDATA.

```
**********************************************************************
 HYTRAN BATCH JOB                              Date : 1994 Aug 25
**********************************************************************

Batch file  : test.bat
Format file : test.fmt
Directory   : c:\hydata\test


----------------------------------------------------------------------
1. DATAFILE : 50.dat

Identifier          : 50.DAT
HYDATA Station No. :       50
Data type           : Flow

HYDATA Station limits                 Maximum      =      100.000
                                      Minimum      =        0.000
                                      Max. change  =      100.000

Scan results          Start date                    = 1953 Jan  1
                      No. values in datafile        =        13726
                      Maximum value in file         =       27.240
                      Times max. limit exceeded     =            0
                      Minimum value in file         =        0.080
                      Times below min. limit        =            0
```

In the above example the data contained in 50.DAT has no values above or below the HYDATA limits, contains 13726 values and the start date of the data is 1st January 1953. The data was loaded into station number 50 on the HYDATA database located on C:\HYDATA\TEST using TEST.BAT batch file with the format specified in TEST.FMT. The transfer results indicate that 13726 values were transferred with the start and end date being 1st January 1953 and 31st July 1990, respectively. The transfer results are the most important piece of information as this can be checked directly against the information contained in the tables presented earlier.

Infact, it is essential to scrutinize the HYTRAN.REM file after each batch transfer to check that the correct datafile has been used; that the data was loaded into the correct HYDATA station number and that the correct data period was transferred.

NOTE THAT A NEW VERSION OF THE HYTRAN.REM FILE IS CREATED AFTER EACH BATCH TRANSFER AND IS AUTOMATICALLY OVERWRITTEN. A COPY OF THE FILE SHOULD BE MADE BEFORE THE NEXT BATCH TRANSFER BY EITHER COPYING TO A DIFFERENT NAME OR RENAMING THE FILE USING THE DOS COMMANDS COPY OR RENAME, RESPECTIVELY.

SUMMARY OF ACTION POINTS AND DETAILS OF THE DATAFILES, HYTRAN FILES AND THE HYDATA BATCH FILES FOR EACH COUNTRY.

The files discussed in this section have been provided on floppy diskettes and have been loaded into the appropriate country directory on the HYDATA PC. This is done to provide a backup.

This section provides you with information regarding the name of the HYTRAN files (.LOG, .FMT, .BAT), the datafiles (which are contained in a ZIP file) and the HYDATA batch file which should be used to install the station numbers/ details onto HYDATA before you attempt to load any data using HYTRAN.

Each page contains a table showing the names and the status of the files to be used for that country. I have developed these files during my two weeks in Dar-Es-Salaam.

However there are a number of specific action points that need top be addressed by you. Specifically the HYTRAN files required to develop the South Africa and Tanzanian databases need to be developed by you. READ THIS DOCUMENT CAREFULLY.

BOTSWANA

FILE	FILENAME	COMMENTS
DATA	BOTUSE.ZIP	Zip file conatining data
BATCH	BOTSWANA.BAT	HYTRAN batch file
FORMAT	BOTSWANA.FMT	HYTRAN format file
LOG	BOTSWANA.LOG	HYTRAN LOG file - note that the FRIEND gauging station numbers have been applied.
STATION	BOTSTN.BAT	HYDATA batch file to install the gauging stations and details into HYDATA. Note that the FRIEND gauging station numbers have been applied.

BATCH JOB 2 FOR THE BOTSWANA DATA

DATA WAS DELIVERED ON 7/9/94 BY KALOATE KALAOTE TO THE UNIVERSITY OF DAR ES SALAAM AND THIS DATA UPDATES THE DATA CONTAINED ON THE ORIGINAL FILES.

LESOTHO

FILE	FILENAME	COMMENTS
DATA	LESUSE.ZIP	Zip file conatining data
BATCH	LESOTHO1.BAT	HYTRAN batch with LESOTHO1.LOG
	LESOTHO2.BAT	HYTRAN batch with LESOTHO2.LOG
FORMAT	LESOTHO.FMT	HYTRAN format file
LOG	LESOTHO1.LOG	HYTRAN LOG with LESOTHO1.BAT
	LESOTHO2.LOG	HYTRAN LOG with LESOTHO2.BAT
		Note that the FRIEND station numbers have been applied.
STATION	LESSTN.BAT	HYDATA batch file to install the gauging stations and details into HYDATA. Note that the FRIEND gauging station numbers are used.

MALAWI

FILE	FILENAME	COMMENTS
DATA	MALUSE.ZIP	Zip file conatining data
BATCH	MALAWI1.BAT	HYTRAN batch with MALAWI1.LOG
	MALAWI2.BAT	HYTRAN batch with MALAWI2.LOG
FORMAT	MALAWI.FMT	HYTRAN format file
LOG	MALAWI1.LOG	HYTRAN LOG with MALAWI1.BAT
	MALAWI2.LOG	HYTRAN LOG with MALAWI2.BAT
		Note that in the .LOG files the FRIEND gauging station numbers have been applied.
STATION	MALSTN.BAT	HYDATA batch file to install the gauging stations and details into HYDATA. Note that the FRIEND gauging station numbers have been applied.

NAMIBIA

FILE	FILENAME	COMMENTS
DATA	NAMIBIA.ZIP	Zip file conatining data
BATCH	NAMIBIA1.BAT	HYTRAN batch with NAMIBIA1.LOG
	NAMIBIA2.BAT	HYTRAN batch with NAMIBIA2.LOG
FORMAT	NAMIBIA.FMT	HYTRAN format file
LOG	NAMIBIA1.LOG	HYTRAN LOG with NAMIBIA1.BAT
	NAMIBIA2.LOG	HYTRAN LOG with NAMIBIA2.BAT
		Note that the FRIEND gauging station numbers have been applied.
STATION	NAMSTN.BAT	HYDATA batch file to install the gauging stations and details

SOUTH AFRICA

FILE	FILENAME	COMMENTS
DATA	N/A	Data needs to be downloaded from the four constituent databases named as ABDATA, CGDATA, HSDSATA and TXDATA. Either use the GETOFF.EXE program or the HYDATA/HYLIBM subroutine library facility.
		Note that the FRIEND gauging station numbers have been applied and that the name of the datafiles to be loaded should be as follows:
		<FRIEND NUMBER>.QFL
	e.g....	**27817101.QFL**
BATCH	SAFRICA1.BAT	HYTRAN batch with ABDATA.LOG
	SAFRICA2.BAT	HYTRAN batch with CGDATA.LOG
	SAFRICA3.BAT	HYTRAN batch with HSDATA1.LOG
	SAFRICA4.BAT	HYTRAN batch with HSDATA2.LOG
	SFARICA5.BAT	HYTRAN batch with TXDATA1.LOG
	SAFRICA6.BAT	HYTRAN batch with TXDATA2.LOG
	SAFRICA7.BAT	HYTRAN batch with TXDATA3.LOG
FORMAT	N/A	To be defined once the data series has been prepared. If the format 8f10.3 is adopted in the data file and missing data is given as -9.999 then the BOTSWANA.FMT can be used.
LOG	ABDATA.LOG	HYTRAN LOG with SAFRICA1.BAT
	CGDATA.LOG	HYTRAN LOG with SAFRICA2.BAT
	HSDATA1.LOG	HYTRAN LOG with SAFRICA3.BAT
	HSDATA2.LOG	HYTRAN LOG with SAFRICA4.BAT
	TXDATA1.LOG	HYTRAN LOG with SAFRICA5.BAT
	TXDATA2.LOG	HYTRAN LOG with SAFRICA6.BAT
	TXDATA3.LOG	HYTRAN LOG with SAFRICA7.BAT
STATION	ABDATA.BAT	HYDATA batch files to install
	CGDATA.BAT	the gauging stations and
	HSDATA.BAT	details into HYDATA. Note that

SWAZILAND

FILE	FILENAME	COMMENTS
DATA	SWAZUSE.ZIP	Zip file conatining data
BATCH	SWAZILA1.BAT	HYTRAN batch with SWAZILA1.LOG
	SWAZILA2.BAT	HYTRAN batch with SWAZILA2.LOG
FORMAT	SWAZILAN.FMT	HYTRAN format file
LOG	SWAZILA1.LOG	HYTRAN LOG with SWAZILA1.BAT
	SWAZILA2.LOG	HYTRAN LOG with SWAZILA2.BAT
		Note that the FRIEND gauging station numbers have been applied.
STATION	SWAZSTN.BAT	HYDATA batch file to install the gauging stations and details into

TANZANIA

FILE	FILENAME	COMMENTS
DATA	N/A	The data files are to be prepared according to the agreed format. Note that the .FMT file has been developed under the assumption of the 'HH' file formats. The name of the file should incorporate the 8 digit FRIEND station number and have an extension of <FILENAME>.QFL - see the LOG files for the names. **Note that the FRIEND gauging station numbers have been applied and that the name of the datafiles to be loaded should be as follows:** **<FRIEND NUMBER>.QFL** **e.g.... 55213101.QFL**
BATCH	TANZANI1.BAT TANZANI2.BAT TANZANI3.BAT	HYTRAN batch with TANZANI1.LOG HYTRAN batch with TANZANI2.LOG HYTRAN batch with TANZANI3.LOG
FORMAT	TANZANIA.FMT	HYTRAN format file developed under the assumption that the data files have the data format as appears in the 'HH' files
LOG	TANZANI1.LOG TANZANI2.LOG TANZANI3.LOG	HYTRAN LOG with TANZANI1.BAT HYTRAN LOG with TANZANI2.BAT HYTRAN LOG with TANZANI3.BAT Note that the FRIEND gauging station numbers have been applied.
STATION	TANZSTN.BAT	HYDATA batch file to install the gauging stations and details into HYDATA. Note that the FRIEND gauging station numbers been applied.

ZAMBIA

FILE	FILENAME	COMMENTS
DATA	ZAM2USE.ZIP ZAM3USE.ZIP ZAM4USE.ZIP ZAM5USE.ZIP ZAM6USE.ZIP ZAM7USE.ZIP	Zip files conatining data for the 2*.flw etc data files .. note that the data filenames show the local code and the year. e.g 405169.flw contains data for 1969/70 for gauging station 4051.
BATCH	ZAMBIA1.BAT ZAMBIA2.BAT . . ZAMBIA19.BAT	HYTRAN batch with ZAMBIA1.LOG HYTRAN batch with ZAMBIA2.LOG HYTRAN batch with ZAMBIA19.LOG
FORMAT	ZAMBIA.FMT	HYTRAN format file
LOG	ZAMBIA1.LOG ZAMBIA2.LOG . . ZAMBIA19.LOG	HYTRAN LOG with ZAMBIA1.BAT HYTRAN LOG with ZAMBIA2.BAT HYTRAN LOG with ZAMBIA19.BAT Note that the FRIEND gauging station numbers have been applied.
STATION	ZAMSTN.BAT	HYDATA batch file to install the gauging stations and details into HYDATA. Note that the FRIEND gauging station numbers have been applied. Although no station details yet.

ZIMBABWE

FILE	FILENAME	COMMENTS
DATA	ZIMUSE.ZIP	Zip file conatining data
BATCH	ZIMBABW1.BAT	HYTRAN batch with ZIMBABW1.LOG
	ZIMBABW2.BAT	HYTRAN batch with ZIMBABW2.LOG
FORMAT	ZIMBABWE.FMT	HYTRAN format file
LOG	ZIMBABW1.LOG	HYTRAN LOG with ZIMBABW1.BAT
	ZIMBABW2.LOG	HYTRAN LOG with ZIMBABW2.BAT
		Note that the FRIEND gauging station numbers have been applied.
STATION	ZIMSTN.BAT	HYDATA batch file to install the gauging stations and details into HYDATA. Note that the FRIEND gauging station numbers have been applied.

APPENDIX B

PRELIMINARY LIST OF GAUGING STATIONS TO BE USED ON THE SOUTHERN AFRICA FRIEND PROJECT (TO DATE: OCTOBER 1994)

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
BOTSWANA		
67530011	3111	BONWAPITSE AT NTSWANEWG (BOT)
67530021	3121	TAUPSWE AT BONDUNGWE HILL (BOT)
67530022	3221	MAHAPSWE AT MADIBA (BOT)
67535161	4361	SHASHE AT MOOKE WEIR (BOT)
67535411	4511	TATI AT TATI WEIR (BOT)
67535511	4411	NTSHE AT NTSHE WEIR (BOT)
67536011	4611	LETLHAKANE AT MMADINARE (BOT)
67536021	4121	MOTLOUTSE AT TOBANE (BOT)
67536031	4131	MOTLOUTSE AT TOBANE (BOT)
67536041	4141	MOTLOUTSE AT MMADINARE (BOT)
67537021	3321	LOTSANE AT MAUNATLALA (BOT)
67537031	3331	LOTSANE AT PALAPSE (BOT)
67538011	2411	METSEMOTLHABE AT MOREMA (BOT)
67538012	2511	KOLOBENG AT KUMAKWANE (BOT)
67538021	2421	METSEMOTLHABE AT THAMAGA (BOT)
67921011	5111	MOSOPE AT MATSITAMA (BOT)
67921012	5211	MOTSETSE AT MOTSETSE (BOT)
67921013	5311	NATA AT OLD BRIDGE (BOT)
67922012	8112	BOTETI AT SAMEDUPE (BOT)
67922022	8122	BOTETI AT RAKOPS (BOT)
67933112	7112	OKAVANGO AT MTAEMBO (BOT)
67933113	7412	BORO JUNCTION (BOT)
67933114	7812	THAMALAKANE AT MAUN BRIDGE (BOT
67933115	7912	LAKE RIVER AT BUND (BOT)
67933122	7722	SHASHE AT SHASHE BRIDGE (BOT)
LESOTHO		
66818024	CG24	S. PHUTHIATSANA AT MASIANOKENG
66818034	CG34	N. PHUTHIATSANA AT MAPOTENG
66818039	CG39	MOHOKARE AT MOHLOKAQALA
66818044	CG44	TLAMETLU AT LOWER QEME
66818046	CG46	MOROEROE AT BUTHA-BUTHE
66819219	MG19	MAKHALENG AT MOLIMO-NTHUSE
66819223	MG23	MAKHALENG AT QABA
66819303	SG03	SENQU AT SEAKA BRIDGE
66819304	SG04	SENQU AT WHITEHILL
66819305	SG05	SENQU AT KOMA-KOMA
66819306	SG06	SENQU AT MOKHOTLONG
66819307	SG07	TSOELIKE AT TSOELIKE BRIDGE

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
66819308	SG08	MALIBAMATSO AT PARAY
66819310	SG10	MALIBAMATO AT OX BOW
66819311	SG11	TSEHLANYANE AT OX BOW
66819312	SG12	TLOLOHATSE AT OX BOW
66819314	SG14	MOTETE AT MAHLASELA
66819317	SG17	SENQUNYANE AT MARAKABEI
66819318	SG18	MALETSUNYANE AT SEMONKONG
66819336	SG36	KHUBELU AT TLOKOENG
66819340	SG40	QOMOQOMNG AT QUTHING
66819342	SG42	MATSOKU AT SESHOTES
66819364	SG64	MANTSONYANE AT MANTSONYANE
MALAWI		
65282008	02.B.08	MULUNGUZI AT ZOMBA PLATEAU (MAL)
65282011	02.B.11	MULUNGUZI @ WILLIAMS FALLS (MAL)
65282022	02.B.22	THONDWE AT JALI (MAL)
65283003	02.C.03	DOMASI @ DOMASI TT COLLEGE (MAL)
65312101	01.M.01	MKURUMADZI AT MLONGOLA (MAL)
65312110	14.A.02	LUCHENZA AT LUCHENZA (MAL)
65312103	01.R.03	RIVI RIVI AT BALAKA (MAL)
65312102	14.B.02	THUCHILA @ CHENDO (MAL)
65312109	14.C.02	RUO AT MI ROADBRIDGE (MAL)
65312107	01.S.07	NKASI AT KALEMBO (MAL)
65312108	14.C.08	LICHANYA @ MILONDE (MAL)
65312118	01.R.18	MPAMADZI AT GUMBU (MAL)
65312301	08.A.05	NORTH RUKURU AT MWAKIMEME (MAL)
65312302	09.A.03	CHAMBO @ CHIWANA (MAL)
65312303	07.H.03	NORTH RUMPHI @ CHIWETA (MAL)
65312304	09.A.04	LUFIRA @ CHILANGA (MAL)
65312305	09.A.05	KALENJE AT CHIPWERA (MAL)
65312306	09.B.05	HANGA @ DAVID KAMEME (MAL)
65312307	09.B.07	SONGWE @ MWANDINGA (MAL)
65312402	07.F.02	SOUTH RUMPHI AT RUMPHI (MAL)
65312403	07.A.03	SOUTH RUKURU AT CHIMSEWEZO (MAL
65312404	07.A.04	MZIMBA @ MUWERU BUKULUTI (MAL)
65312405	07.D.03	LUNYANGWA @ ZOMBWE (MAL)
65312406	07.F.03	RUNYINA AT MJUMA (MAL)
65312414	07.G.14	SOUTH RUKURU @ PHEWZI (MAL)
65312501	06.C.01	DWANGA AT KWENGWELE (MAL)
65312502	16.F.02	LWEYA AT ZAYUKA (MAL)
65312503	16.F.01	LIMPHASA @ TIMBIRI (MAL)

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
65312505	16.F.05	LUCHELEMU AT MAZAMBE (MAL)
65312506	16.E.06	DWAMBADZI @ NTHANDA (MAL)
65312510	16.F.10	LUCHELEMU AT MAZAMBA (MAL)
65312601	05.C.01	BUA AT S53 ROADBRIDGE (MAL)
65312602	05.D.02	BUA AT KASESE (MAL)
65312603	05.D.03	MTITI @ MTITI (MAL)
65312604	05.D.01	BUA AT BUA DRIFT (MAL)
65312708	15.A.08	LINGADZI @ KANICHE (MAL)
65312801	04.E.01	LINGADZI AT MI ROADBRIDGE (MAL)
65312803	04.B.03	LINTHIPE AT LINTHIPE (MAL)
65312804	04.B.04	DIAMPWE AT CHILOWA NEW BR. (MAL
65312805	04.D.04	LILONGWE AT LILONGWE O.T. (MAL)
65312806	04.D.06	LILONGWE AT MALINGUNDE (MAL)
65312807	04.F.06	LUMBADZI @ SIMAKUMI (MAL)
65312901	03.E.01	NADZIPOKWE AT MUA MISSION (MAL)
65312902	03.E.02	NAMIKOKWE @ MUA-LIVULEZI F R MA
65312903	03.E.03	LIVULEZI AT KHWEKHWELELE (MAL)
65312907	03.E.07	NKHANDE AT THOBOLA (MAL)

MOZAMBIQUE

No data supplied from Mozambique although gauging station list exists for this country. No list presented here until data has been received.

NAMIBIA

64370001	2300M01	ZAMBEZI AT KATIMA MULILO (NAM)
64722401	3022M01	TSAUCHAB AT SESRIEM (NAM)
64731001	2991M01	KUISEB AT SCHLESIEN WEIR (NAM)
64731002	2991M03	KUISEB AT US (NAM)
64731003	2991M06	BISMARK AT STANCO (NAM)
64731004	2991M07	SIMMENAU AT WASSERVALLEI (NAM)
64731005	2991M08	HEUSIS AT HEUSIS (NAM)
64731006	2991M09	WESTENDE AT WESTENDE (NAM)
64731007	2991M10	KATROS AT TWEESPRUIT (NAM)
64731008	2991M11	HUIS AT KOS WEIR (NAM)
64731010	2993M02	KUISEB AT GOBABEB (NAM)
64731011	2994M01	KUISEB AT ROOIBANK (NAM)
64732002	2982M06	AREBBUSCH AT MONRAVIA (NAM)
64732003	2984M01	SWAKOP AT WESTFALENHOF (NAM)

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
64732004	2986M01	KHAN AT AMEIB (NAM)
64732005	2986M03	DAWIB AT DAWIB (NAM)
64733002	2971M02	OMARURU AT ETEMBA A (NAM)
64733003	2971M03	OMARURU AT OMBURO (NAM)
64734001	2961M02	UGAB AT PETERSBURG A (NAM)
64734002	2962M03	UGAB AT VINGERKLIP A (NAM)
64734003	2962M06	UGAB AT UGAB SLAB (NAM)
64735002	2954M01	ABA-HUAB AT ROOIBERG (NAM)
64740001	2811M01	KUNENE AT RUACANA (NAM)
64740002	2814M05	OMUHONGA AT OMBUKU (NAM)
64811001	0482M01	HAM AT TSAMAB (NAM)
64812001	0491M01	FISH AT GRAS (NAM)
64812002	0491M02	KAM AT DRAAIHOEK (NAM)
64812003	0491M03	FISH AT DIRICHAS (NAM)
64812004	0491M06	KAM AT KLEIN AUB (NAM)
64812005	0492M02	PACKRIEM AT KARRIS (NAM)
64812006	0493M01	HUTUP AT RIETKUIL (NAM)
64812007	0493M03	HUTUP AT BRECKHORN (NAM)
64812008	0496M01	FISH AT SEEHEIM A (NAM)
64812009	0496M02	FISH AT TSES A (NAM)
64812010	0497M02	LOEWEN AT AIKANES (NAM)
64812011	0497M03	LOEWEN AT ALTDORN (NAM)
64812012	0497M05	LOEWEN AT GEDULD (NAM)
64812013	0498M02	KONKIEP AT BETHANIEN (NAM)
64812014	0499M02	FISH AT AI-AIS A (NAM)
64812015	0499M03	GAB AT HOLOOG (NAM)
64813201	3111M01	BLACK NOSSOB AT HENOPSRUS (NAM)
64813202	3111M02	BLACK NOSSOB AT MENTZ (NAM)
64813203	3112M02	WHITE NOSSOB AT AMASIB (NAM)
64932101	2511M01	OKAVANGO AT RUNDU (NAM)
64932102	2512M04	OKAVANGO AT MUKWE (NAM)
64932301	2531M01	OMATAKO AT OUSEMA (NAM)
SOUTH AFRICA		
27521003	B7H003	SELATIRIVIER
27521004	B7H004	KLASERIERIVIER
27521008	B7H008	SELATIRIVIER
27521009	B7H009	OLIFANTSRIVIER
27521010	B7H010	NGWABITSIRIVIER
27521014	B7H014	SELATIRIVIER
27522001	B9H001	SHISHARIVIER

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
27523011	B8H011	TSENDERIVIER
27524001	B6H001	BLYDERIVIER
27524002	B6H002	TREURRIVIER
27524003	B6H003	TREURRIVIER
27525005	B4H005	WATERVALRIVIER
27525009	B4H009	DWARSRIVIER
27526002	B5H002	OLIFANTSRIVIER
27527001	B3H001	OLIFANTSRIVIER
27528001	B2H001	BRONKHORSTSPRUIT
27529001	B1H001	OLIFANTSRIVIER
27529002	B1H002	SPOOKSPRUIT
27541001	A9H001	LUVUVHURIVIER
27541002	A9H002	MUTSHINDUDIRIVIER
27541004	A9H004	MUTALERIVIER
27543003	A7H003	SANDRIVIER
27545010	A6H010	BADSELOOPRIVIER
27545012	A6H012	OLIFANTSPRUIT
27545018	A6H018	RASLOOPRIVIER
27545019	A6H019	HESSIE SE WATER
27545020	A6H020	MIDDELFONTEINSPRUIT
27545021	A6H021	DE WETSPRUIT
27545022	A6H022	HARTEBEESTLAAGTE-SPRUIT
27546004	A5H004	PALALARIVIER
27547001	A3H001	KLEIN-MARICORIVIER
27547018	A3H018	MALMANIELOOP
27547029	A2H029	EDENVALESPRUIT
27547032	A2H032	SELONSRIVIER
27547039	A2H039	WATERKLOOF-BO
27547050	A2H050	KROKODILRIVIER
27547053	A2H053	STERKSTROOM
27548002	A4H002	MOKOLORIVIER
27548004	A4H004	MATLABASRIVIER
27548007	A4H007	TAMBOTIERIVIER
27548008	A4H008	STERKSTROOM
27711108	G5H008	SOUTRIVIER
27711206	G4H006	KLEINRIVIER
27711208	G4H008	KLEIN-JAKKALSRIVIER
27711209	G4H009	JAKKALSRIVIER
27711308	G2H008	JONKERSHOEKRIVIER
27711312	G2H012	DIEPRIVIER
27711313	G2H013	MOSSELBANKRIVIER
27711318	G2H018	SILWERSTROOMRIVIER

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
27711403	G1H003	FRANSCHHOEKRIVIER
27711407	G1H007	BERGRIVIER
27711408	G1H008	KLEIN-BERGRIVIER
27711409	G1H009	BRAKKLOOFSPRUIT
27711410	G1H010	KNOLVLEISPRUIT
27711411	G1H011	WATERVALSRIVIER
27711412	G1H012	WATERVALSRIVIER
27711414	G1H014	ZACHARIASHOEKRIVIER
27711415	G1H015	KASTEELKLOOFSPRUIT-BO
27711416	G1H016	KASTEELKLOOFSPRUIT ONDER
27711417	G1H017	ZACHARIASHOEKSPRUIT-BO
27711418	G1H018	BAKKERSKLOOFSPRUIT
27711419	G1H019	BANGHOEKRIVIER
27711421	G1H021	KLEIN-BERGRIVIER
27711428	G1H028	VIER EN TWINTIG-RIVIER
27711501	G3H001	KRUISRIVIER
27712202	E2H002	DORINGRIVIER
27712207	E2H007	LEEURIVIER
27712306	E1H006	JAN DISSELSRIVIER
27713201	F5H001	SWART-DORINGRIVIER
27811003	D8H003	ORANJERIVIER
27814003	D5H003	VISRIVIER
27814011	D5H011	RENOSTERRIVIER
27814013	D5H013	SAKRIVIER
27814016	D5H016	SAKRIVIER
27814019	D5H019	SAKRIVIER
27815102	D7H002	ORANJERIVIER
27815205	D3H005	ORANJERIVIER
27815208	D3H008	ORANJERIVIER
27817207	C5H007	RENOSTERSPRUIT
27817208	C5H008	RIETRIVIER
27817209	C5H009	OSPOORTSPRUIT
27817212	C5H012	RIETRIVIER
27817303	C3H003	HARTSRIVIER
27817426	C2H026	MIDDELVLEISPRUIT
27817427	C2H027	KOCKSOORTDSPRUIT
27817428	C2H028	RIETFONTEINSPRUIT
27817465	C2H065	LEEUDORINGSPRUIT
27817467	C2H067	SANDSPRUIT
27817502	C4H002	VETRIVIER
27817602	C6H002	VALSRIVIER
27817603	C6H003	VALSRIVIER

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
27817604	C6H004	VALSRIVIER
27817703	C7H003	HEUNINGSPRUIT
27817803	C8H003	CORNELIUSRIVIER
27817805	C8H005	ELANDSRIVIER
27817812	C8H012	VAALBANKSPRUIT
27817822	C8H022	WILGERIVIER
27817908	C1H008	WATERVALRIVIER
27818012	D2H012	KLEIN-CALEDONRIVIER
27819101	D1H001	WONDERBOOMSPRUIT
27819103	D1H003	ORANJERIVIER
27819109	D1H009	ORANJERIVIER
27819111	D1H011	KRAAIRIVIER
27672101	R3H001	GQUNUBERIVIER
27672201	R2H001	BUFFELSRIVIER
27672205	R2H005	BUFFELSRIVIER
27672206	R2H006	MGQAKWEBERIVIER
27672208	R2H008	QUENCWERIVIER
27672209	R2H009	MGQOKWENIRIVIER
27672212	R2H012	MGQAKWEBERIVIER
27672401	R1H001	TYUMERIVIER
27672405	R1H005	KEISKAMMARIVIER
27672406	R1H006	RABULARIVIER
27672407	R1H007	MTWAKURIVIER
27672413	R1H013	KEISKAMMARIVIER
27672414	R1H014	TYUMERIVIER
27672415	R1H015	KEISKAMMARIVIER
27673102	Q9H002	KOONAPRIVIER
27673113	Q9H013	KAPRIVIER
27673116	Q9H016	KOONAPRIVIER
27673117	Q9H017	BLINKWATERRIVIER
27673119	Q9H019	BALFOURRIVIER
27673403	Q6H003	BAVIAANSRIVIER
27673603	Q4H003	VLEKPOORTRIVIER
27673704	Q3H004	PAULSRIVIER
27673802	Q2H002	GROOT-VISRIVIER
27673901	Q1H001	GROOT-VISRIVIER
27673912	Q1H012	TEEBUSRIVIER
27681101	P4H001	KOWIERIVIER
27682209	N2H009	VOLKERS(SKOENMAKERS)RIVIE
27682302	N3H002	VOELRIVIER
27683204	M1H004	ELANDSRIVIER
27691206	L7H006	GROOTRIVIER

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
27691301	L8H001	WABOOMSRIVIER
27691302	L8H002	HAARLEMSPRUIT
27691501	L6H001	HEUNINGKLIPRIVIER
27691901	L1H001	SOUTRIVIER
27691902	L1H002	SOUTRIVIER
27692301	K7H001	BLOUKRANSRIVIER
27692401	K6H001	KEURBOOMSRIVIER
27692402	K6H002	KEURBOOMSRIVIER
27692501	K5H001	GOUNARIVIER
27692502	K5H002	KNYSNARIVIER
27692602	K4H002	KARATARARIVIER
27692603	K4H003	DIEPRIVIER
27692701	K3H001	KAAIMANSRIVIER
27692703	K3H003	MAALGATERIVIER
27692704	K3H004	MALGASRIVIER
27692705	K3H005	TOUWSRIVIER
27692901	K1H001	HARTENBOSRIVIER
27692902	K1H002	BENEKERIVIER
27693103	J4H003	WEYERSRIVIER
27693104	J4H004	LANGTOURIVIER
27693215	J1H015	BOKRIVIER
27693216	J1H016	SMALBLAARRIVIER
27693304	J3H004	OLIFANTSRIVIER
27693312	J3H012	GROOTRIVIER
27693313	J3H013	PERDEPOORTRIVIER
27693316	J3H016	WILGERIVIER
27693317	J3H017	KANDELAARSRIVIER
27693318	J3H018	WYNANDSRIVIER
27693320	J3H020	MEULRIVIER
27693405	J2H005	HUISRIVIER
27693406	J2H006	BOPLAAS(WILGEHOUT)RIVIER
27693407	J2H007	JOUBERTRIVIER
27694104	H9H004	KRUISRIVIER
27694105	H9H005	KAFFERKUILSRIVIER
27694301	H7H001	BREERIVIER
27694303	H7H003	BUFFELJAGSRIVIER
27694304	H7H004	HUISRIVIER
27694307	H7H007	GROOTKLOOFRIVIER
27694403	H6H003	RIVIERSONDEREND
27694406	H6H006	ELANDSRIVIER
27694407	H6H007	DU TOITSRIVIER
27694408	H6H008	RIVIERSONDEREND

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
27694410	H6H010	WATERKLOOFRIVIER
27694601	H3H001	KINGNARIVIER
27694604	H3H004	KEISIERIVIER
27694605	H3H005	KEISIERIVIER
27694705	H4H005	WILLEM NELSRIVIER
27694707	H4H007	KOORIVIER
27694708	H4H008	KOORIVIER
27694709	H4H009	HOEKSRIVIER (SK KEISER R.
27694712	H4H012	WATERKLOOFSPRUIT
27694801	H2H001	HEXRIVIER
27694805	H2H005	ROOI-ELSKLOOFRIVIER
27694907	H1H007	WITRIVIER
27694912	H1H012	HOLSLOOTRIVIER
27694913	H1H013	KOEKEDOURIVIER
27711201	S6H001	KUBUSIRIVIER
27711202	S6H002	KUBUSIRIVIER
27711203	S6H003	TOISERIVIER
27711502	S3H002	KLAAS SMITSRIVIER
27711504	S3H004	SWART-KEIRIVIER
27711506	S3H006	KLAAS SMITSRIVIER
27611004	X4H004	NWANEDZIRIVIER
27613001	X3H001	SABIERIVIER
27613002	X3H002	KLEIN-SABIERIVIER
27613003	X3H003	MAC-MACRIVIER
27613004	X3H004	NOORDSANDRIVIER
27613006	X3H006	SABIERIVIER
27613007	X3H007	WHITE WATERSRIVIER
27613008	X3H008	SANDRIVIER
27613101	X1H001	KOMATIRIVIER
27613103	X1H003	KOMATIRIVIER
27613114	X1H014	MLUMATIRIVIER
27613120	X1H020	POPONYANERIVIER
27613202	X2H002	WITRIVIER
27613205	X2H005	NELSRIVIER
27613206	X2H006	KROKODILRIVIER
27613208	X2H008	QUEENSRIVIER
27613210	X2H010	NOORDKAAPRIVIER
27613211	X2H011	ELANDSRIVIER
27613212	X2H012	DAWSONI'SSPRUIT
27613213	X2H013	KROKODILRIVIER
27613214	X2H014	HOUTBOSLOOP
27613215	X2H015	ELANDSRIVIER

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
27613216	X2H016	KROKODILRIVIER
27613218	X2H018	MBYAMITIRIVIER
27613223	X2H023	WITRIVIER
27613224	X2H024	SUIDKAAPRIVIER
27613225	X2H025	HOUTBOSLOOP
27613226	X2H026	BEESTEKRAALSPRUIT NV
27613227	X2H027	BLYSTAANSPRUIT
27613228	X2H028	KANTOORBOSSPRUIT
27613230	X2H030	SUIDKAAPRIVIER
27613231	X2H031	SUIDKAAPRIVIER
27632104	W4H004	BIVANERIVIER
27632108	W4H008	BRAKSLOOT
27632201	W5H001	JESSIEVALESPRUIT
27632204	W5H004	NGWEMPISIRIVIER
27632206	W5H006	SWARTWATERRIVIER
27632207	W5H007	USUTURIVIER
27632208	W5H008	BONNIE BROOK
27632211	W5H011	MPULUZIRIVIER
27650111	W3H011	MKUZERIVIER
27650114	W3H014	MPATERIVIER
27650202	W2H002	SWART-MFOLOZIRIVIER
27650206	W2H006	SWART-MFOLOZIRIVIER
27650209	W2H009	WIT-MFOLOZIRIVIER
27650304	W1H004	MLALAZIRIVIER
27650309	W1H009	MHLATUZERIVIER
27650310	W1H010	MATIGULURIVIER
27650325	W1H025	MLALAZISYSTROOM
27661102	V5H002	TUGELARIVIER
27661303	V6H003	WASBANKRIVIER
27661304	V6H004	SONDAGSRIVIER
27661402	V3H002	BUFFELSRIVIER
27661403	V3H003	NGAGANERIVIER
27661405	V3H005	SLANGRIVIER
27661407	V3H007	NCANDURIVIER
27661409	V3H009	HORNRIVIER
27661501	V2H001	MOOIRIVIER
27661505	V2H005	MOOIRIVIER
27661506	V2H006	KLEIN-MOOIRIVIER
27661507	V2H007	HLATIKULURIVIER
27661618	V7H018	KLEINBOESMANSRIVIER
27661701	V1H001	TUGELARIVIER
27661702	V1H002	TUGELARIVIER

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
27661704	V1H004	MLAMBONJARIVIER
27661709	V1H009	BLOUKRANSRIVIER
27661710	V1H010	KLEIN-TUGELARIVIER
27661726	V1H026	TUGELARIVIER
27661729	V1H029	GELUKSBURGSPRUIT
27661731	V1H031	SANDSPRUIT
27661734	V1H034	KHOMBERIVIER
27661741	V1H041	MLAMBONJARIVIER
27661901	U7H001	ZWATENIRIVIER
27661905	U7H005	LOVU SYTAK 3
27661906	U7H006	LOVU SYTAK 4
27661907	U7H007	LOVURIVIER
27662002	U6H002	MLAZIRIVIER
27662202	U4H002	MVOTIRIVIER
27662203	U4H003	HLIMBITWARIVIER
27662301	U3H001	TONGATIRIVIER
27662302	U3H002	MDLOTIRIVIER
27662401	U2H001	MGENIRIVIER
27662406	U2H006	KARKLOOFRIVIER
27662407	U2H007	LIONS(MPOFANA)RIVIER
27662412	U2H012	STERKRIVIER
27662413	U2H013	MGENIRIVIER
27662505	U1H005	MKOMAZIRIVIER
27662506	U1H006	MKOMAZIRIVIER
27663102	T5H002	BISIRIVIER
27663103	T5H003	POLELARIVIER
27663104	T5H004	MZIMKULURIVIER
27663105	T5H005	NKONZORIVIER
27663201	T4H001	MTAMVUNARIVIER
27663301	T6H001	MNTAFUFURIVIER
27663504	T3H004	MZINTLAVARIVIER
27663505	T3H005	TINARIVIER
27663508	T3H008	MZIMVUBURIVIER
27663509	T3H009	MOOIRIVIER
27663602	T2H002	MTATARIVIER
27663804	T1H004	BASHEERIVIER
SWAZILAND		
68613111	11	LOMATI (NGONINI ESTATE)
68613129	29	KOMATI (ENTRANCE TO SWAZILAND)
68613130	30	KOMATI(MANANGA BORDER)

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
68613134	34	MLUMATI (MATSAMO)
68613142	42	MZIMNENE (BHALEKANE)
68620003	03	MBULUZI (LEPER SETTLEMENT)
68620004	04	BLACK MBULUZI (LEPER SETTLEMENT
68620010	10	WHITE MBULUZI (MPISI FARM)
68620020	20	MBULUZI
68620032	32	MBULUZI (MLAWULA)
68620035	35	LUTALA (RETURN FLOWS)
68620036	36	VOLINDE (RETURN FLOWS)
68620037	37	MNKENKE (RETURN FLOWS)
68620038	38	LUFUTWANA (RETURN FLOWS)
68620040	40	THABANKULU WEIR (MBULUZI) RETURN
68620041	41	TABANKULU WEIR (MBULUZI) RETURN
68632202	02	USUSHWANA (MATSAPHA BRIDGE)
68632205	05	NGWEMPISI (MANKAYANE)
68632206	06	GREAT USUTHU (SIPHOFANENI)
68632207	07	MKHONDVO (MAWELAWELA)
68632208	08	NGWAVUMA (NSOKO)
68632209	09	GREAT USUTHU (BHUNYA)
68632212	12	MHLATHUZANE (SITHOBELA)
68632213	13	MHLATUZE (MALOMA)
68632215	15	USUSHWANA (SIPHOCOSINI)
68632219	19	MHLATHUZANE (MADLENYA)
68632221	21	NGWEMPISI (BOSCK HOEK)
68632222	22	HLELO (RSA BORDER)
68632223	23	MPULUZI
68632224	24	MTILANE (LOZITHA)
68632225	25	MKHONDVO (GEGE)
68632228	28	MPONONO (USUTU CATCHMENT)
68632231	31	GREAT USUTHU (SANDLANE BORDER)
68632233	33	ULUNDI, R.S.A. BORDER.
68632239	39	NDLOTANE
68632243	43	LUPHALWANE
TANZANIA		
55111001	5A1A	NGONO @ KYAKA RD.BRIDGE
55111003	5A3A	NGONO @ KALEBE BRIDGE
55113003	5C3	MOAME @ PAMBANI BRG.
55113004	5C4	MAGOGO @ MZA/SHY RD.BR
55113005	5C5	UP.MAGOGO @ SUB INDEX NGUDU
55114002	5D2	DUMA @ SAYAKA

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
55114005	5D5	BARIADI @ BARIADI
55115001	5E2	MBALAGETI @ DS MZ/MUSOMA RD
55116003	5F3	GRUMET D/S @ MZ/MUSOMA RD.
55119001	5J1	MORI @ UTEGI VILLAGE
55124020	2K20	MANGO @ BADI-SHIA
55125025	2R25	MSEMEMBO @ U/S MSEMEMBO
55125029	2R29	BUBU @ THAWI
55131008	3A8	MYOVISI @ GT.NORTH RD.
55131017	3A17	SONGWE @ IGALULA
55132002	3B2	MOMBA @ DS CON MTEMBWA
55132006	3B6	SAISI @ MOMBA
55132008	3B8	MPEMBA @ GT.NORTH RD.
55132013	3B13	MPEMBA @ KOMBE
55132016	3B16A	SAMVIA @ YUNGA
55132050	3B15A	MTEMBWA @ LUASHO/KAPOMA
55133002	3CB2	MSAIDIA @ USEVIA U/S BR.
55133008	3C8	KATUMA @ SITALIKE
55133102	3CC2	MFWIZI @ MTATUMBILA
55133201	3CD1	MUSE @ US MUSE VILL.
55133202	3CD2	LUICHE @ USIA
55212001	1C1	SIGI @ LANCONI ESTATE
55212002	1C2	SIGI @ MIEMBENI
55213201	1DA1A	LUENGERA @ KOROGWE
55213203	1DA3A	LUENGERA @ MAJI REST HSE.
55213302	1DB2A	SESENI @ GULUTU
55213318	1DB18	HINGILILI @ KIRUKA
55213322	1DB22	MKUSU @ KIBOHERO
55213411	1DC11A	HIMO @ MOSHI/TANGA BR.
55215001	1E1	MSANGAZI @ KWADILOMBA
55221101	1G1	WAMI @ DAKAWA
55221106	1G6	KISANGATA @ MVUMI
55221201	1GA1A	LUKIGURA @ KIMAMBA RD. BR.
55221202	1GA2	MZIHA @ MZIHA
55221529	1GD29	MKONDOA @ MBARAHWE
55221530	1GD30	LUMUMA @ KILIMALULU
55221531	1GD31	MDUKWE @ MDUKWE
55223105	1H5	RUVU @ KIBUNGO
55223108	1H8	RUVU @ MOROGORO RD.BR
55223110	1H10	RUVU @ MIKULA
55223208	1HA8A	MOROGORO @ MOROGORO
55223209	1HA9A	NGERENGERE @ KONGA
55223302	1HB2	MGETA @ MGETA

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
55223403	1HC2A	MVUHA @ TULO SCHOOL
55224006	1J6	MZINGA @ MAJIMATITU
55232102	1KA2A	LT. RUAHA @ IRINGA NDIUKA
55232107	1KA7A	CHIMALA @ CHITEKELO
55232108	1KA8A	GT. RUAHA @ SALIMWANI
55232109	1KA9	KIMANI @ GT.N.ROAD
55232111	1KA11A	MBARALI @ IGAWA
55232112	1KA12	HALALI @ D/S IYAYI
55232115	1KA15A	NDEMBERA @ ILONGA
55232150	1KA50A	MSWISWI @ WILIMA
55232151	1KA51A	UMROBO @ GT. N.ROAD
55232156	1KA56	RUAHA @ MALANGALI
55232241	1KA41	KISIGO @ ILANGALI
55232321	1KA21A	LT.RUAHA @ IHIMBU
55232322	1KA22	MTITU @ MTITU
55232323	1KA23A	HUKUNI @ IYAYI
55232332	1KA32A	LT. RUAHA @ MAKALALA
55232339	1KA39A	LT. RUAHA @ U/S IWAWA
55232437	1KA37A	LUKOSI @ MTANDIKA
55232438	1KA38A	YOVI @ GT.RUAHA CONF.
55233008	1KB8	MPANGA @ MPANGA MISSION
55233012	1KB12A	MCHILIPA @ U/S UTETE
55233014	1KB14A	LUMEMO @ KIBURUBUTU
55233015	1KB15	MGETA @ D/S MCHOMBE MIS
55233019	1KB19	HAGAFIRO @ HAGAFIRO
55233023	1KB23	SONJO @ SONJO
55233024	1KB24	SANJE @ SANJE
55233027	1KB27	RUIPA @ MBINGU
55233050	1KB15A	MGETA @ U/S BRIDGE
55241005	1L5	ZINGA @ MIGURUWE
55243006	1M6	MBWEMKURU @ SINGIRA
55244002	1N2A	NYANGAO @ NYANGAO
55244004	1N4A	LULULEDI @ MTUA
55250004	1Q4	MUHUWESI @ MUHUWESI
55250007	1Q7	RUVUMA @ MAHINGA
55250009	1Q9	MIESI @ MIKELE
55250011	1Q11	MSINJEWE @ MTWARO
55250012	1Q12	MBAGALA @ MAHINYO HILLS
55312211	1RB2	RUHUHU @ MASIGIRA CONF.
55312212	1RB3	RUHUHU @ KIKONGE
55312214	1RB5A	RUTAKIRA @ NEW RD.BRG/S
55312215	1RB6	MNGAKA @ NAMBUNJU RD.BR.

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
55312217	1RB9	KITEWAKA @ MABOGA
55312218	1RB10	MWINAMAJI @ ROAD BRIDGE
55312231	1RC2A	KIWIRA @ KYELA/IPYANA
55312232	1RC3A	MBAKA @ MWAYA
55312233	1RC5A	KIWIRA @ U/S KIWIRA VIL.
55312234	1RC8A	KIWIRA @ NATURAL BRIDGE
55312236	1RC11	RUMAKALI @ HUMAGE
55312251	1RD2	ITUMBA @ KUSHISAKWA
55773101	4B9A	LUICHE DS @ KIGOMA SIMBORD
55773102	4B10	LUICHE @ JIMBI
55773103	4B11	MKUTI @ MKUTI
55773116	4AB1A	MAKERE DS @ MAKERE PUMP HOU
55773121	4AE1	KAHOGO @ NYAKANAZI
55773126	4AG4A	IGOMBE @ IGOMBE BRIDGE
55773133	4AH7	WALA @ PANGALE
55773137	4AH18	MWALEZI @ UVINZA RD.BR
55773138	4AH20	NKULULU @ MAGAWE
55773150	4D1	LUEGELE @ LUBALISI
55773170	4G2	LUAMFI @ MASOLO
55773181	4G3	SAMBA @ MASOLO
55773185	4H1	KALAMBO @ KALAMBO FALLS
ZAMBIA		
60313040	5940	LUANGWA AT LUANGWA ROAD BRIDGE
60334005	4005	KAFUE AT KIPUSHI
60334015	4015	MUCHINDAMU AT MUCHINDAMU
60334050	4050	KAFUE AT RAGLAN FARM
60334240	4240	KAFUBU AT FISENGE
60334245	4245	KAFUBU AT MASAITI BOMA
60334250	4250	KAFULAFUTU AT MIPUTU HILLS
60334280	4280	KAFUE AT MACHIYA FERRY
60334340	4340	LUSWISHI AT KANGONDI
60334350	4350	KAFUE AT CHILENGA
60334450	4450	KAFUE AT LUBUNGU
60334460	4460	KAFUE AT KANIKOMBE HILLS
60334500	4500	MUTANDA AT MUTANDA MISSION
60334550	4550	LUNGA AT KELONGWA SCHOOL
60334620	4620	LUFUPA BELOW KASEMPA
60334669	4669	KAFUE AT KAFUE HOOK BR
60334670	4670	KAFUE AT HOOK PONTOON

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
60334977	4977	KAFUE AT KASAKA
60335030	3130	KALOMO AT KALOMO DAM SITE
60370000	2400	ZAMBEZI AT SENANGA
60370030	2030	ZAMBEZI AT LUKULU
60380050	1950	KABOMPO AT WATOPA PONTOON
60380051	1650	KABOMPO AT KABOMPO PONTOON
60390050	1150	ZAMBEZI AT ZAMBEZI P. HOUSE
60773105	7005	LUNZUA KAMBOLE
60773230	6130	NAKONDE AT NAKONDE DAM SITE
60773235	6235	KALUNGU AT KALUNGU
60773245	6145	CHAMBESHI AT MBESUMA PONTOON
60773250	6350	LUKULU AT KASAMA LUWINGU ROAD BRIDGE
60773275	6275	MANSHYA AT SHIWA NGANDU
ZIMBABWE		
63315506	D006(4006)	SHAWANOYA AT MUTOKO ROAD BRIDGE
63315524	D024(4024)	POTI AT ARCADIA UPPER G/W
63315542	D042(4042)	MUFURUDZI AT EBEN DAM U/S G/W
63315546	D046(4046)	MWARAZI AT MWARAZI DAM U/S G/W
63315547	D047(4047)	NYAGADZI NEYA T.T.L. G/W
63315548	D048(4048)	WENGI @ MWENJE DAM U/S FLUME&L/F
63315549	D049(4049)	SAWI AT MWENJI DAM U/S G/W
63315550	D050(4050)	NYAMASANGA AT MWENJI DAM U/S FLU
63315555	D055(4055)	DORA AT MWARAZI DAM U/S G/W
63315556	D056(4056)	NYAZIKATSI AT PIRIMANGWE FLUME
63323023	C023(3023)	NYATSIME AT EDINBURG G/W
63323028	C028(3028)	MUKUVISI @ CLEVELAND DAM D/S G/W
63323081	C081(3081)	HUNYANI @ HENRY HALLAM DAM U/S
63323082	C082(3082)	RUWA AT HENRY HALLAM DAM U/S G/W
63323083	C083(3083)	GWEBI AT DARWENDALE DAM U/S G/W
63341006	C006(3006)	NGESI AT NGESI DAM U/S G/W
63341012	C012(3012)	MUPFURE AT TWYFORD WEIR
63341018	C018(3018)	MUNYATI AT DYKE G/W
63341029	C029(3029)	SEBAKWE AT DUTCHMANS POOL DAM
63341033	C033(3033)	SEBAKWE AT ENKELDOORN G/W
63341039	C039(3039)	WERIWEDZI AT SEBAKWE DAM U/S G/W
63341041	C041(3041)	UNVUMI AT SEBAKWE DAM U/S G/W
63341042	C042(3042)	CHIMACHI AT SEBAKWE DAM U/S G/W
63341047	C047(3047)	SEBAKWE AT SEBAKWE DAM U/S G/W
63341059	C059(3059)	SANYATI AT COPPER QUEEN C/S#
63341070	C070(3070)	MUPFURE AT BEATRICE G/W

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
63341087	C087(3087)	UMSWESWE AT CLAW DAM U/S FLUME
63351108	A008(1008)	KANE AT KANE SLIGHTS WEIR
63351113	A013(1013)	GWERU AT GWERU RIVER C\W
63351120	A020(1020)	SHANGANI @ LOW RAIL WEIR&L/F NOT
63351122	A022(1022)	GWAYI @ KAMATIVI G/W
63351137	A037(1037)	KANA AT JAPIWA DIP G/W
63351138	A038(1038)	GWAYI AT DAHLIA CONTROL SECTION
63351139	A039(1039)	BUBI AT LUPANE G/W
63351141	A041(1041)	TSHONGOKWE AT KANA ROAD G/W
63351147	A047(1047)	MANANDA AT MANANDA U/S G/S
63351152	A052(1052)	LUKOSI @ VICTORIA FALLS RD FLUME
63351160	A060(1060)	TIYABENZI @ TIYABENZI DAM U/S FL
63351161	A061(1061)	SHANGANI @ TIYABENZI DAM U/S FLU
63351165	A065(1065)	DEKA AT DEKA GOURLAY BLOCK FLUME
63351166	A066(1066)	INYANTUE AT INYANTUE FLUME
63414007	F007(6007)	NYAHODI AT NYARUWA FLUME & G/W
63414010	F010(6010)	ZONWI AT HOBOKEN G/W
63414014	F014(6014)	PUNGWE AT PUNGWE CAUSEWAY G/W
63414016	F016(6016)	CHIPUDZANA @ SOUTHDOWN L/F NOTCH
63415015	F015(6015)	BUSI AT BANGAZAAN G/W
63415018	F018(6018)	BUSI AT YPRES
63422120	E120(5120)	BIRIVIRI AT NYANY. D U/S G/W
63422121	E021(5021)	SAVI AT CONDO D/S G/W
63422126	E126(5126)	SHINJA AT SHINJA NYANYADZI G/W
63422143	E043(5043)	SAVE AT SAVE GORGE C/S
63422219	E019(5019)	MACHEKE AT CONDO U/S G/W
63422301	F001(6001)	MAPOPO AT STAPLEFORD G/W
63422306	F006(6006)	TSANGA AT TROUTBECK DAM U/S G/W
63422330	E130(5130)	ODZI AT ODZI GORGE G/W
63422361	E061(5061)	ODZI AT ODZI BRIDGE CONTROL SECT
63422362	E162(5162)	ODZI AT ODZI FALLS FLUME
63423133	E133(5133)	RUNDE AT RUNDE U/S IGESI FLUMES
63423208	E108(5108)	CHIREDZI @ MANJIRENJI DAM U/S FL
63423293	E093(5093)	IMPALI AT IMPALULI G/W
63423342	E042(5042)	UMTEBEKWE AT RIETFONTEIN G/W
63423344	E044(5044)	BEVUMI AT KYLE DAM U/S G/W
63423345	E045(5045)	MUTIRIKWI AT KYLE DAM U/S G/W
63423348	E048(5048)	MSALI AT KYLE DAM U/S G/W
63423349	E049(5049)	POPOTEKWE AT KYLE DAM U/S G/W
63423353	E153(5153)	UMSHAGASHE @ MAKAHOLI DAM U/S FL
63423354	E054(5054)	UMPOPINYANI AT KYLE DAM U/S G/W
63423369	E069(5069)	UNSHAGASHI AT KYLE DAM U/S G/W

FRIEND STATION NUMBER	LOCAL STATION NUMBER	RIVER NAME AND LOCATION OF THE STATION
63423414	E114(5114)	ROSWA AT ROSWA TURGWE FLUME
63423528	E028(5028)	NGEZI @ MBERENGWA RD. BRIDGE G/
63423551	E151(5151)	NGESI AT SIVUMBA FLUME
63510035	B035(2035)	LIMPOPO @ BEITBRIDGE PUMP STATN
63514139	B039(2039)	MPOPONA AT MPOPONA DAM U/S G/W
63534113	B013(2013)	KANGESI AT ESKDALE CAUSEWAY
63534115	B014(2015)	LUMANE AT INSINDI WEIR
63534120	B020(2020)	UMZINGWANI AT GLASS BLOCK G/W
63534123	B023(2023)	MPOPONA AT MPOPONA DAM D/S FLUME
63534128	B028(2028)	MWENEZI AT JEKA BRIDGE G/W
63534129	B029(2029)	MCHABESI AT SHEET DAM U/S G/W
63534131	B031(2031)	THULI AT THULI GORGE G/W
63534156	B056(2056)	THULI AT MAKWE DAM U/S G/W
63534162	B062(2062)	UMZINGWANI AT DODDIEBURN RANCH
63534177	B077(2077)	SHASHANI AT ANTELOPE DAM U/S G/W
63534178	B078(2077)	ZGALANGAMATE @ ANTELOPE DAM U/S
63534265	B065(2065)	INSIZA @ SILALABUHWA DAM D/S G/W
63534274	B074(2074)	JAMA AT RIXON DAM U/U G/W
63534275	B075(2075)	INSIZA AT RIXON DAM U/S G/W