

The construction of a hydrologically-correct, annotated 1:500 000 spatial dataset of the rivers of South Africa and contiguous basins

August 2006



water & forestry

Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA

Resource Quality Services
Department of Water Affairs
and Forestry
Private Bag X313

Republic of South Africa

**The construction of a hydrologically-correct,
annotated 1:500 000 spatial dataset of the rivers of
South Africa and contiguous basins.**

First Edition

Department: Water Affairs and Forestry

Directorate: Resource Quality Services

Subdirectorates: Resource Quality Information

August 2006

Published by

Department: Water Affairs and Forestry
Resource Quality Services
Private Bag X313
PRETORIA
0001
Republic of South Africa

Tel: 012 808 9500

Fax: 012 808 2702

This publication may be reproduced only for non-commercial purposes and only after appropriate authorisation by the Department of Water Affairs and Forestry has been provided. Additional copies can be requested from the above address. No part of this publication may be reproduced in any manner without full acknowledgement of the source.

This document should be cited as:

Department: Water Affairs and Forestry. 2006. *The construction of a hydrologically-correct, annotated 1:500 000 spatial dataset of the rivers of South Africa and contiguous basins*, Report Number N/0000/00/REH/0701. DWAF: Resource Quality Services. Pretoria, South Africa.

DOCUMENT INDEX

This document describes the construction of a hydrologically-correct, annotated 1:500 000 spatial dataset of the rivers of South African and contiguous basins.

DOCUMENT STATUS AND APPROVAL

WORKING TITLE: The construction of a hydrologically-correct, annotated 1:500 000 spatial dataset of the rivers of South Africa and contiguous basins

AUTHOR: Michael Silberbauer

REPORT STATUS: Internal report

RQS REPORT NUMBER: N/0000/00/REH/0701

DATE: August 2006

Recommended for the Department of Water Affairs and Forestry:

Director: Resource Quality Services (RQS)

Approved for the Department of Water Affairs and Forestry:

Chief Director: Water Resource Information Management (WRIM)

Contents

Contents	4
Acknowledgements	6
Executive summary	7
Introduction	7
History and requirements	7
Assumptions	8
Original files	8
Editing and verification tools	9
Manual Editing	10
ArcEdit	10
Setting tolerances	12
Consistency checks	12
Other editing procedures	13
Partially automated procedures	13
Allocation of arc “END” attribute	13
Stream order	14
Allocation of reach codes	14
Verification	15
Network	15
Names	15
Consolidation	15
Testing	15
Product	16
Publication	16
Characteristics	16
Bifurcation plots	17
Recommendations	19
References	20
Appendices	22
Appendix: ArcInfo macros to edit river coverages	22
rived.aml	22
rivcaptool.menu	29
tol.aml	32
anodp.aml	33
rivends.aml	35
rivnetsplit.aml	38
rivreach.aml	43
tracerivsort.aml	50
traceriv.aml	55
rivernamesearch.aml	60
appendrivs.aml	63
rivcheck.aml	69
riv2shp.aml	78
RIVER REACH PROCESS	87
Manual check of river coverage	87
Edit	87
Check	87
<input type="checkbox"/> Allocation of arc END attribute:	87
<input type="checkbox"/> Set tolerances with TOL.AML	88

<input type="checkbox"/> Build arcs and nodes.....	88
Semi-automated procedures	88
<input type="checkbox"/> Run RIVNETSPLIT.AML	88
<input type="checkbox"/> Run RIVREACH.AML	88
<input type="checkbox"/> Run TRACERIVSORT.AML*	88
<input type="checkbox"/> Run TRACERIV.AML*	89
<input type="checkbox"/> Run RIVERNAMESEARCH.AML*	89
<input type="checkbox"/> Run APPENDRIVS.AML	89
<input type="checkbox"/> Run RIVCHECK.AML	89
<input type="checkbox"/> Place files on Internet	89
Comments on accuracy	89
Data sources	90
Acknowledgements	90

Acknowledgements

Elise Vorster of GIMS (Midrand) provided the initial RIVEDIT menu.

Danieël Wildemans, Naomi Roberson, Juanita Moolman, Elna Vermaak, Magda Smidt, Kama Chetty and Axel Diefenbach of RQS all edited river arcs at one stage or another. Lungile Gaulana (RQS intern) carefully worked through the river coverage during 2005, mainly checking correctness of names.

Executive summary

In 1995, geographical information system (GIS) users at the Institute for Water Quality Studies (now Resource Quality Services) saw the need for a robust, accurate river network coverage for use in GIS projects. Initially, the coverage was seen as simply a background vector coverage for mapping national monitoring points. It later became important for various modelling tasks and for deriving river profile and valley characteristics.

The river coverage is based on the 1:500 000 scale vector data created by the Chief Directorate of Surveys and Mapping in the early 1990s and has undergone rigorous editing in order to ensure that arcs are interconnected and point downstream, essential criteria for network modelling. The arcs have also been adjusted to match the 1:50 000 data, where available, to within approximately 50 metres. The coverage extends to the limits of international basins, though at a lower accuracy because of the lack of base data.

A key component of the river coverage is the set of attributes attached to each arc. These include a name (where available), a unique reach code and various network descriptors such as Strahler order and link type. These attributes give users fine control of the cartographic quality of their maps and provide useful information for network analysis.

Future developments could include the improvement of the quality of vector data for cross-border basins and the application of the testing procedure developed here to the 1:50 000 river coverages.

Introduction

History and requirements

The original requirement for an accurate regional river coverage was to serve as a reference for visually checking the coordinates of DWAF monitoring points. During the early years of hydrological data capture, monitoring point coordinates were rarely used for locating points on a map, and hydrologists used marked paper map sheets and textual descriptions to find their way around. When GIS became widely used during the 1990s, users began to convert existing coordinate lists into point coverages, only to discover that many monitoring coordinates were inaccurate or contained dummy data. The available vector river coverages were at a coarse scale, and at that stage the concept of using scanned maps as a backdrop in GIS was not feasible because of hardware, software and copyright problems. The river coverage would therefore serve as a reference data set for cleaning up point records of monitoring sites. From this concept developed the idea of mapping water quality interactively with the rivers and other reference data in the background (the WaterMarke system, Cobban & Silberbauer, 1993).

Another potential use for the proposed river coverage was as a network model of South African drainage for use in systems such as BASINS (EPA, 2004). For this reason, all breaks (e.g. dams, bridges, map edges) in the original scanned arcs needed to be joined. To fit in with BASINS, each river arc needed a unique identifier or reach code.

In time, the river coverage has become important for several unexpected applications as well, such as river classification and river profile generation. In these areas, as in modelling, the necessity for a continuous basin network unconstrained by political boundaries was evident. Further information on the background to the development of the river coverage is available in Silberbauer and Wildemans (2001) and Silberbauer and Moolman (2004).

Assumptions

The fundamental assumption behind the simplified 1:500 000 GIS river drainage network is that water flows downhill along single channels. The network model ignores braided channels, tidal networks, impounded flow and exchange with the atmosphere or ground.

Original files

The Chief Directorate of Surveys and Mapping (Department of Land Affairs) created the original 1:500 000 coverage in the early 1990s by scanning and vectorising the blue plates of their published 1:500 000 map sheets. In 1995, the Resource Quality Services Directorate (then IWQS) appointed the consulting group GisLAB to produce a contiguous and consistent arc data set from the raw data. GisLAB filled gaps in the network, aligned arcs downstream and ensured a consistent density of arcs. One requirement was that all DWAF national river monitoring points should be on an arc. In retrospect, this may have caused some recursive errors, in that monitoring points incorrectly positioned would have influenced the retention or deletion of river arcs and incorrectly positioned river arcs would in turn have prompted spurious changes to monitoring point locations. GisLAB also ran the first Strahler stream ordering process on the coverage.

During the decade that this coverage has been in existence, the accuracy of GIS data has continuously improved. In the late 1990s, the almost complete set of vectorised 1:50 000 topographical map blue plates became available for South Africa. This provided a useful reference data set in that the offset for a 1mm scan error is only 50 metres, as against 500m for the 1:500 000 coverage.

The ESRI Digital Chart of the World (PSUL 2006) includes rivers at a scale of 1:1 000 000 from international aeronautical charts. These were used when no other vector sources were available, but only as a last resort because their positional error is greater than one kilometre. Areas in the river coverage using this source are the Z region (Namibia and parts of Botswana connected to the DWAF D region) and the Y region (parts of Botswana, Zimbabwe and Mozambique).

The quaternary drainage region polygons used to allocate reach codes to the river arcs were from the WR90 database (Midgley et al. 1994) as modified for the WSAM project (Schultz & Watson, 2002). Additional modifications were necessary along the northern border of South Africa and in adjacent countries to make the boundaries conform to the drainage network.

Digital elevation models are another source of data for hydrological networks, capable of delineating drainage lines and catchment boundaries. In the 1980s, these were available at a resolution of 1 arc-minute (equivalent to about 1850 metres in the north-south direction and 1600 metres in the east-west direction at 30°S). In the mid-1990s, the United States Geological Survey (USGS) published a free digital elevation data set for most of the Earth at a resolution of 30 arc-seconds. Subsequently, the wireless telecommunications industry generated a requirement for more accurate coverage of South Africa in order to position cellular telephone masts optimally and economically: a 20-metre resolution digital elevation model became available for South Africa and Lesotho, derived from topographical map contours. NASA also released a 30-metre resolution digital elevation model for most of the Earth (the Shuttle Radar Topography Mission or SRTM—USGS 2006): data for southern Africa became available in 2004. This radar-derived data has the advantage over contour-derived data sets that it is sampled from regularly-spaced data points, whereas the contour-derived data is subject to errors of interpolation, particularly in flat areas. These differences affect the accuracy of streams and catchments derived from elevation data.

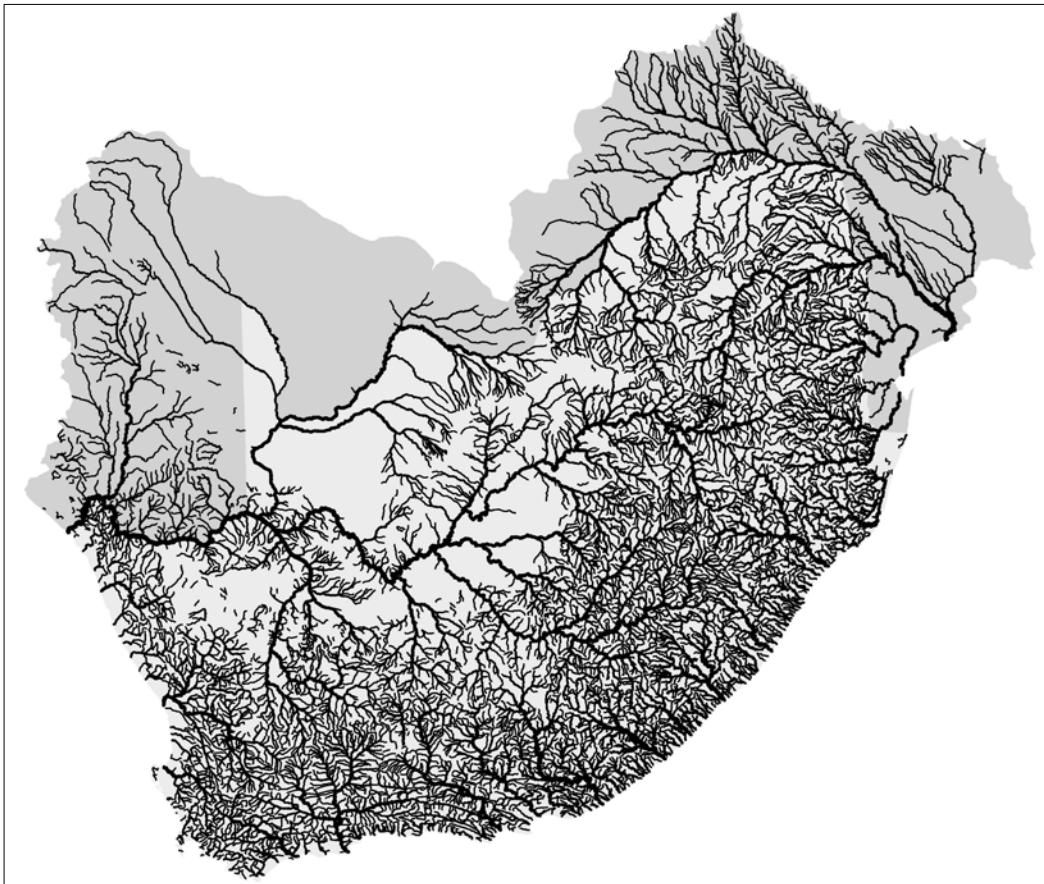


Figure 1 The 1:500 000 river coverage of South Africa. The darker shading shows portions of river basins outside the political boundaries of South Africa.

Editing and verification tools

The ESRI ArcInfo system stores line information in arcs, which consist of between 2 and 500 vertices. The line has a “to” and “from” direction defined at the terminal vertices (nodes). Each vertex is a point with x and y coordinates. In addition to the internal information attached to an arc, it may also have user-defined descriptive or attribute information, such as a name and type. Editing an arc consists of adding, moving or deleting vertices and updating attribute information. Listings of software code are included as Appendices.

Manual Editing

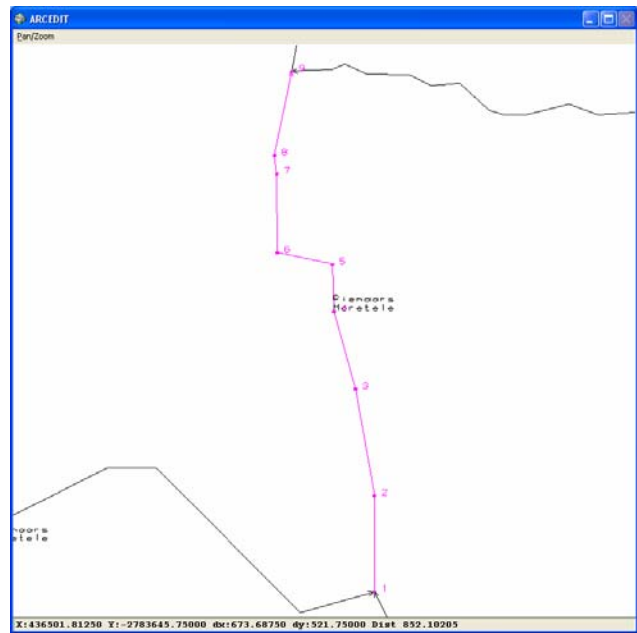
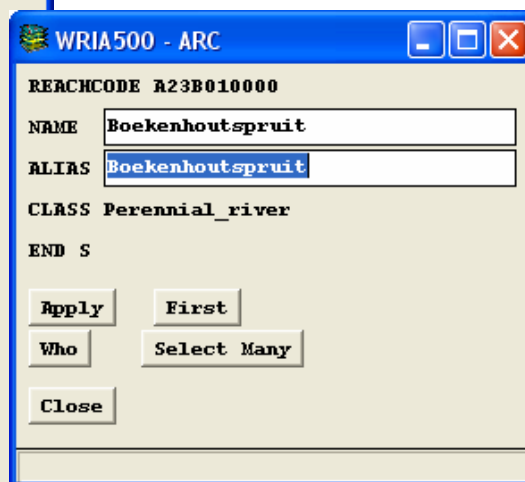


Figure 2 The Arc editing window.

ArcEdit

From the outset editing was accomplished using the standard ArcEdit tools. Elise Vorster of GIMS provided the nucleus of a menu system to reduce the amount of typing required with the ArcEdit text-based command-line interface. Over several years the editing tool (rived.aml) evolved into a convenient and time-saving system. The complete code listings are in Appendix 1.



The aim of the editing process is to adjust the 1:500 000 river arcs to match the background 1:50 000 arcs with an error margin of 50 metres (equivalent to a 1-millimetre error in the scanning process for the original 1:50 000 maps). The accuracy

of adjustment in dryer areas is lower (100m), especially where the drainage is uncertain, e.g. underground. For larger rivers represented by a left and right bank, we estimated the middle line. In order to be able to estimate distances correctly, all editing took place in the Albers Equal Area projection, standard parallels 18°S and 32°S, central meridian 24°E. The arcs are kept in the Cape Datum, because this was the datum in use at the time of

data capture, and some uncertainty existed about the reliability of datum shifting procedures. To reduce the size of the files to be edited, the coverage was split up by primary drainage region.

Table 1 Main menu for river editing.

Layout of main menu commands	
Selection of arc (select the arc or arcs to edit)	
One arc	Many arcs
Box around arcs	Polygon around arcs
Select an arc and zoom to it	Aselect connected arcs
Select one arc downstream of selected arc	Select arc and edit attributes
Select path from start to end arc	Select erroneous loop arc and zoom in
Work with vertices (edit the individual coordinates of an arc: "9" to stop)	
draw the vertices	number each vertex
move vertices	move many vertices by the same amount
add vertices	delete vertices
Work with nodes (move the arc junctions)	
Select and move a node	
Work with arcs (edit complete arcs: can affect topology)	
SPLIT an arc	UNSPLIT (remove nodes between arcs)
RESHAPE an arc (rarely used)	EXTEND an arc to a given point
BREAK! and MOVE a whole arc	DELETE! a whole arc
FLIP the direction of an arc	COASTAL arc selection
LIST attributes of arcs	LIST names only of arcs
= Perennial attribute allocation	= Non perennial attribute allocation
= Dry river attribute allocation	
Get 1:50 000 data*	Editcover 1:500 000 data*
Get 1:250 000 data*	Get Mozambique data*
Drawing of arcs	
Zoom to reach number	
[reach number] entered in this space	
Edit reach number	Set editdistance
Zoom to selected arc	Zoom to full extent
Redraw screen	Set mapextents
No labels	Labels
Backcover toggle	Digital elevation model toggle
Error recovery	
Oops (undo)	
System	
Help	Command line
SAVE	Cancel

* Routines to simplify the incorporation of arcs from other sources into the edit coverage—with limited success because of the technical complexity of the operation.

ArcInfo has an arbitrary limit of 500 on the number of vertices per arc. This is usually sufficient to represent a node-to-node river reach at the 1:500 000 scale. Exceptions occur in highly sinuous rivers, or in areas where few tributaries occur. River network structure relies on node-to-node segments consisting of a single arc, which sometimes involves careful the use of the ArcEdit GENERALIZE command to reduce the number of vertices. Very rarely, a small tributary might be used to break a very long and sinuous arc exceeding 500 vertices. While the original coverage

attempted to show perennial and non-perennial stream types, we have removed nodes that were simply there to divide rivers on the basis of stream type.

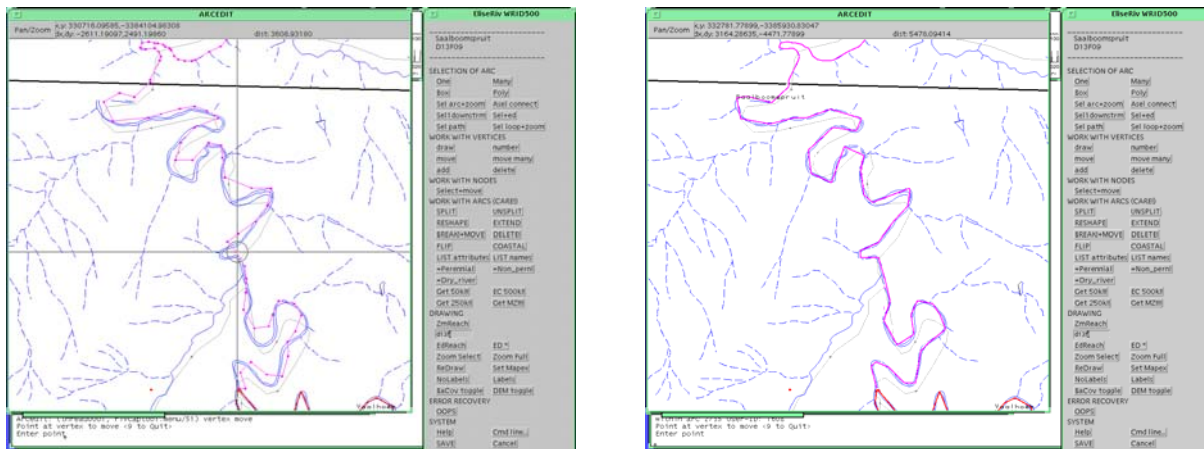


Figure 3 Two steps in the manual editing of river arcs.

The person doing the editing can also add extra arcs at this stage using the standard ArcEdit ADD command. The new arc must point downstream and be attached to the network by a node (unless it is a free-standing, endorheic arc). The new arc also needs a primary drainage region code and a name (if available). Afterwards, other programs calculate the additional attributes required. Situations requiring initiative by the editor are braided drainage, indistinct river courses, changes in river size between maps of different dates and tributary connections in dams.

During the project, scanned 1:50 000 topographical maps in “geographic” or “latitude-longitude” projection became easily available for direct comparison with the river coverage. This development was especially useful where the 1:50 000 vector coverage arcs were indistinct. ArcInfo does not project images on the fly, so in order to compare the edited arcs in Albers Equal Area projection with the geographic topographical maps, a separate session was required, with the river coverage projected to geographical coordinates. This type of “heads-up” digitising could also occur in ArcView 3.x or ArcGIS 8.x or 9.x, although care is required to retain topological consistency and tolerance ranges in these environments (see “Other editing procedures”).

Setting tolerances

In a GIS environment, editing tolerances maintain the balance between having redundant information and losing meaningful detail. For the 1:500 000 coverage, 10 metres is a reasonable distance between points, as it is 5 times more accurate than the estimated 50-metre error in the original data. TOL.AML performs the task of setting tolerances.

Consistency checks

In the network convention for the 1:500 000 rivers, nodes may only exist at a river start, junction or terminus. The Arc command

```
NODEERRORS <coverage> PSEUDO
```

detects and lists all other nodes, or “pseudonodes”. The NODEERRORS x-y coordinates can serve as input to AMLs such as ANODP.AML, which automatically zooms to each pseudo node in turn, facilitating the detection and repair process.

Other editing procedures

Several members of the GIS group tested ArcView 3.x as an editing environment for rivers. The advantages were mainly related to the familiar Windows environment, requiring less training than ArcInfo. The chief disadvantage was that edit tolerances and topology checks could not be set automatically, leading to network breaks that subsequently had to be fixed manually in ArcInfo. An annoyance is the spurious redrawing of the screen after every minor edit, causing frustration on all but the fastest computers. The ArcGIS 8.x and 9.x systems became available late in the editing process, and no skills were available for customising the editing environment. The greatest advantage of the ArcGIS environment for river editing would be that scanned 1:50 000 maps could be displayed in the background in Albers or Transverse Mercator rather than the raw geographic projection. The river arcs could then be edited with known tolerances in metres.

Partially automated procedures

Allocation of arc “END” attribute

The END attribute is a key component of the river structure, indicating where an arc fits into the network. The four types are:

- M river Mouth terminal arc
- E Endorheic river terminal arc
- S stream Starting arc
- N Normal connecting arc

The allocation of all “M”s (connections to the sea) is a manual process, assisted by the “COASTAL arc selection” command (Table 1). When this is complete, the RIVENDS.AML macro selects all remaining dangling arcs and allocates the value of E to endorheic terminal arcs and S to stream source arcs. All remaining linking arcs should have an END value of N.

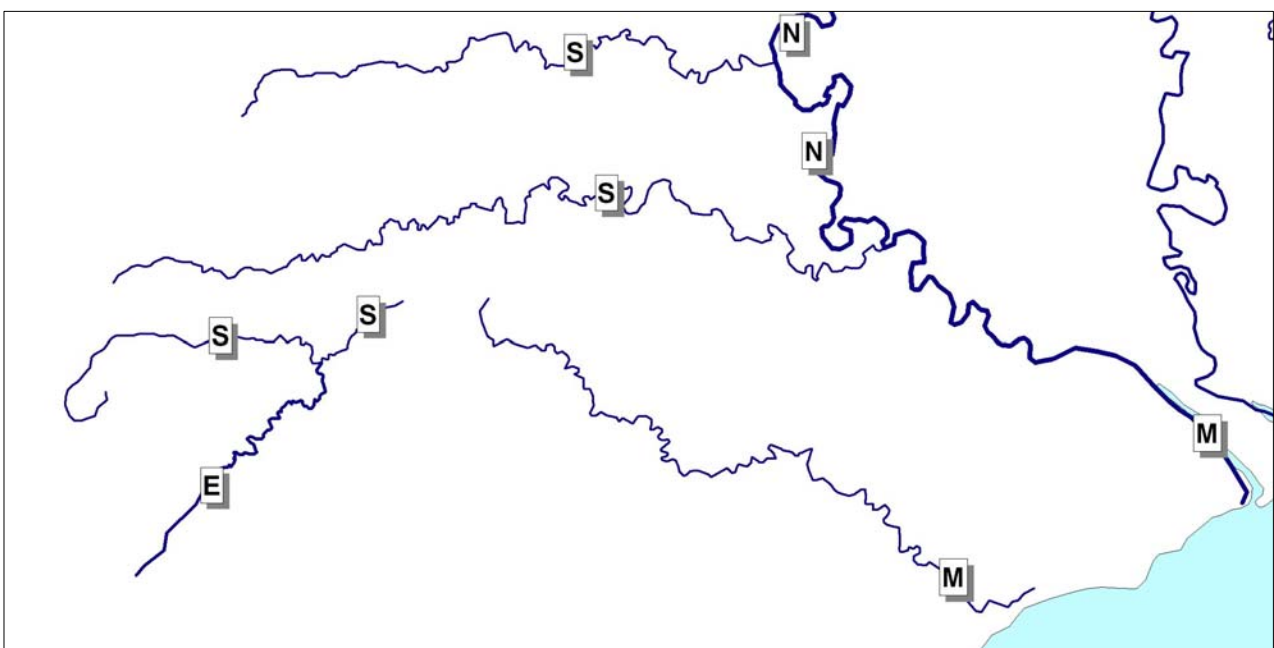


Figure 4 Examples of the allocation of "END" attributes to arcs, to define their position in the network.

Stream order

The method of Lanfear (1990) was used for calculating the Strahler order of each arc in the network (Figure 3). In order to function correctly, the AML implementation required that the coverage be split into contiguous networks, using RIVNETSPLIT.AML. An Avenue version for ArcView 3.x is also available on the ESRI web site, and recently a comprehensive suite of river network editing software has become available as an extension to ArcGIS 9 (Hornby, 2006). Dunne and Leopold (1978) explain the ordering process very succinctly as follows:

“The smallest streams of the network, which have no tributaries, are called first-order streams. When two of these first-order streams coalesce they form a second-order stream, and further along its course this stream may join another second-order channel to form one of the third order, and so on. A low-order stream, such as one of first order joining one of a higher order, does not alter the rank of the latter.”

Ordering is dependent on the scale of the spatial data and the cartographer’s interpretation of a stream. For example, arcs in the 1:500 000 coverage have completely different orders from those in the 1:50 000 coverage.

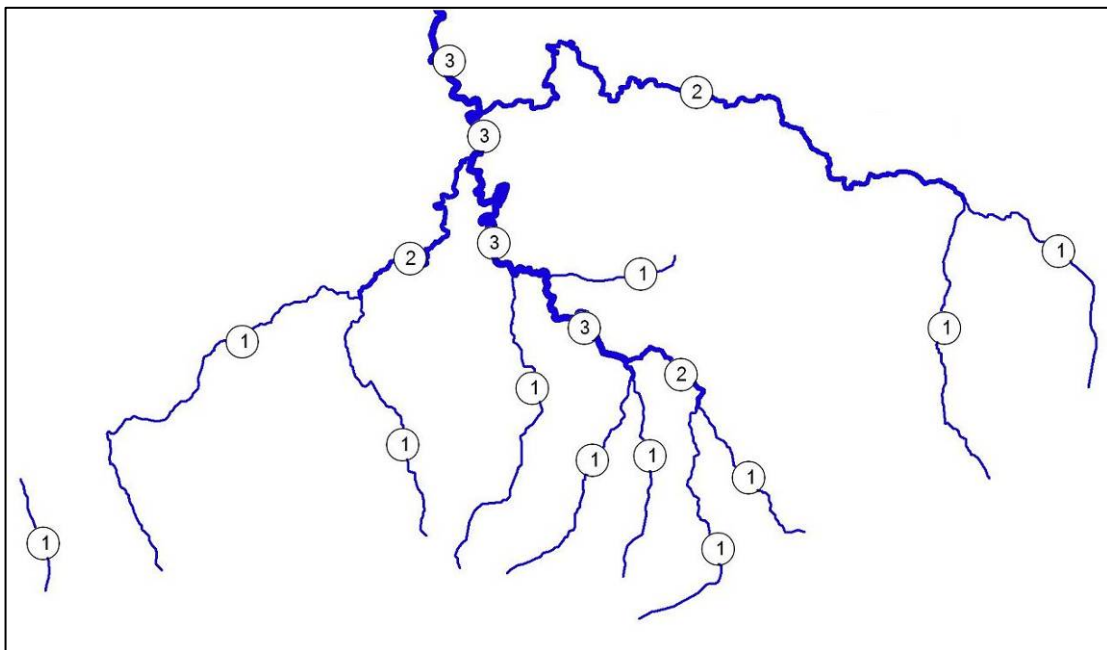


Figure 5 Allocation of Strahler order attribute.

Allocation of reach codes

The BASINS software requires unique identifiers for each reach in the stream network. An important motivation for the development of the river coverage was for use in BASINS, so the reach code format adopted for the river coverage is based on the 1:100 000 national hydrologic database used in the United States (USGS, 2000). The main difference between the code formats is that the South African system uses the alphanumeric quaternary drainage codes for the first four characters of the reach code, whereas the US system has four two-digit numbers. The last six digits are for numbering individual reaches within a quaternary drainage region. In South Africa, at the 1:500 000 scale, the last four digits are zero, to allow for later numbering of the 1:50 000 river arcs. For use in BASINS, the South African alphanumeric codes can be converted to the US-style numeric codes through a lookup table, e.g.:

Table 2 Comparison of South African and USA reach coding.

RSA quaternary basin				sequence number					
A	2	3	A	0	3	0	0	0	0
USA subbasin				sequence number					
0	1	0	2	0	3	0	0	0	0

(Note that the South African quaternary coding system excludes the letters “I” and “O”. The letter “J”, for example, is therefore equivalent to 09, not 10 as might be expected.)

RIVREACH.AML uses a set of tables to store each code once it has been allocated to a reach. The AML currently clears the code tables each time it runs. Eventually, when the coverage is stable, the procedure will need to change so that reach codes remain attached to the same reach except in the case of additions and splits.

Verification

After RIVREACH.AML has done its work comes the process of network and name verification.

Network

With approximately 10 000 network connectors, the chance of errors creeping in during the manual editing process is great. For this reason, the coverage undergoes further processing to ensure that it is consistent. First, TRACERIVSORT.AML refines the code allocation to make reach numbering more or less sequential downstream within a quaternary drainage area. Then TRACERIV.AML adds a SORTER field that is sequential downstream for any drainage path and creates a separate text table of source to mouth reach linkages starting at every END=S arc.

Names

RIVERNAMESEARCH.AML checks for all contiguous arcs with the same name and creates text files listing the reach codes for each one. The files are named `riv_NAME_n_Lkm.txt` where *NAME* is the river name, *n* is the number of the river (e.g. riet_1, riet_2...) and *L* is the length in km. This process is necessary to check for errors in transferring the rather inconsistent and repetitive river names from the map to the coverage. If a river arc needs to be renamed at this stage, the procedures TRACERIV.AML and RIVERNAMESEARCH.AML must be re-run in order to update the trace files.

Consolidation

A macro called APPENDRIVS.AML combines the 22 separate river coverages into a single coverage and automatically updates the source.adf and metadata.xml files describing the coverage. It makes the A to B and C to D primary drainage region links provided that last END=E arc for regions B and C are manually changed to END=N. RIVERSUFFIX.AML creates the fields REACHCODE, RIVN_ROOT (radix of river name), RIVN_SUFIX (suffix, e.g. Spruit, Stream, River) in a new lookup table, to permit cartographers to produce multi-lingual maps by affixing the appropriate prefix or suffix to the radix.

Testing

RIVCHECK.AML generates check maps showing the 1:500 000 river coverage overlain on the 1:50 000 scanned maps and 1:50 000 river coverage for a random sample of 1% of the coverage. These are then manually checked and the number of errors tabulated.

Product



Figure 6 Overlay of the 1:500 000 river coverage using Google Earth. The slight offset shows the discrepancy between the Cape datum of the rivers and the WGS84 datum used in Google Earth.

Publication

An AML called RIV2SHP.AML automates preparation of the coverage for publication on the Internet by setting up the index HTML and creating compressed ZIP shapefiles for each drainage region, with accompanying metadata in text files. The AML also creates a spatial database engine (SDE) compatible version of the rivers, with field names altered so as not to conflict with database reserved names (e.g. NAME, ORDER, PRIMARY).

The 2006 March release of the 1:500 000 river data set is available on the RQS website (http://www.dwaf.gov.za/iwqs/gis_data/river/rivs500k.html).

Characteristics

About three-quarters of all arcs now have names: most of the unnamed arcs do not have names on the original 1:50 000 maps. Of a random sample of 1% of all SA arcs, 97.8% had the correct name. Only 1.1% of arcs do not spatially match the 1:50 000 coverage where it is available, while 4.3% of arcs are in areas with no 1:50 000 reference data. The greatest discrepancy is in the classification of rivers as perennial, non-perennial or dry: only 83.9% are the same as the 1:50 000 classes.

The RivEX software generated the following summary (Analyse Network -> Basic properties of whole network):

Table 3 Properties and attributes of the river coverage.

<i>Network Property</i>	<i>Value</i>	<i>Attribute</i>	<i>Description</i>
Number of Features	10221	Name	Most recent name and orthography
Number of Vertices	1020048	Alias	Previous or alternate names
Min Length (m)	11	Class	Perennial status, if known
Max Length (m)	344931	Primary	Primary drainage region
Sum Length (m)	200324985	Order	Strahler order of arc
Mean Length (m)	19599	End	Network position code
Number of Nodes	10572	Reachcode	Unique reach code for arc
Number of Mouths	351	Sorter	Unique sorting code
Number of Sources	5297	Length_Km	Length of arc in km
Number of Pseudo nodes	0	Shreve	Shreve order of arc
Number of nodes with valency 1	5648	Us_Accum	Distance from source node to end of arc
Number of nodes with valency 3	4902	Catchid	Unique catchment ID
Number of nodes with valency 4	22	Dist2Mth	Distance from start of arc to mouth node
Number of Internal "N" Links	4784		
Number of E Links	5297		
Number of O Links	140		

With its verified network structure, the coverage is useful for creating data structures for other applications, such as generating a "river tree" for database tables in the River Health Programme's RiverDB (Fowler et al., 2000).

Bifurcation plots

Bifurcation is an index of branching in a network (Figure 7). The slope m of the log of the number of streams with a particular order against the order yields the bifurcation ratio as follows:

$$R_b = 10^{-m}$$

The bifurcation ratio for the whole 1:500 000 river data set is 2.14 (Table 4). This is lower than the figure of 3.5 quoted for North America (Leopold, 1971) but within the range 1.5-2.5 calculated by Pegram & Parak (2004) for a selection of South African rivers at 1:250 000 scale.

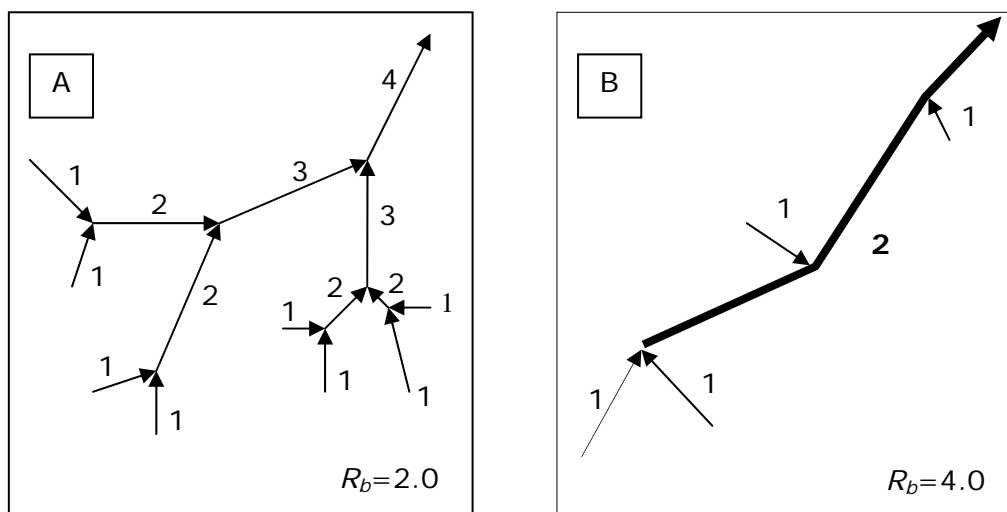


Figure 7 Bifurcation types. (A) Evenly-branching river network; (B) Sparsely-branching river network.

Table 4 Number of arcs with Strahler order 1 to 7 in the 1:500 000 river coverage, for each primary drainage region and for the complete data set, with the bifurcation indices (R_b). Also shown are theoretical figures for a network that branches evenly (each Strahler level consists of half the number of arcs of the one upstream) and a slightly sparser network (each level 1/3 the number upstream).

Order	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	X	All	Even	Thirds
1	394	195	499	1118	181	72	123	81	180	40	159	8	81	27	133	41	110	193	76	122	216	119	4168	4168	4168
2	98	59	150	281	42	16	31	18	37	14	32	1	20	5	27	7	36	74	27	29	55	32	1091	2084	1389
3	31	17	61	72	12	6	9	4	7	2	10	1	6	4	9	1	17	29	8	12	15	11	344	1042	463
4	10	6	33	30	3	1	2	2	4	0	4	0	3	0	2	0	3	10	0	7	6	3	129	521	154
5	12	6	8	19	2	0	0	0	1	0	2	0	0	0	4	0	3	1	0	2	1	1	62	261	51
6	3	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	130	17
7	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	65	6
R_b	2.48	2.52	3.18	2.49	3.21	3.98	3.89	3.53	3.53	4.47	2.95	2.83	3.03	2.60	2.61	6.40	2.63	3.50	3.08	2.62	3.66	3.30	3.04	2.00	3.00

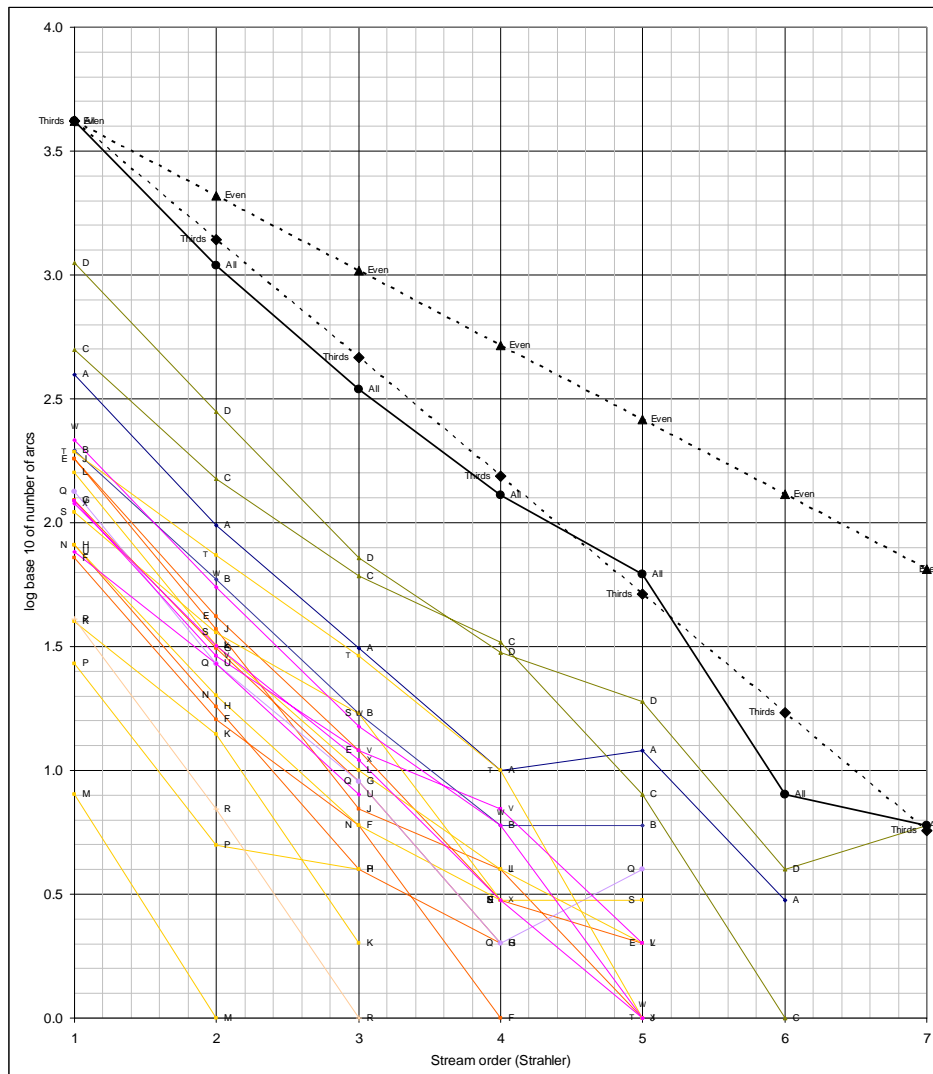


Figure 8 Bifurcation plots for the complete 1:500 000 river coverage (uppermost solid line) and individual primary drainage regions (lower, coloured lines). The dotted lines show theoretical branching rates of one in two and one in three.

Recommendations

The 1:500 000 river coverage is now almost stable, although users occasionally report minor errors. The next step should be to stabilise the reach codes, so that the whole structure is a reference dataset. Other more ambitious developments could include working towards a comprehensive hydrological dataset along the lines of the NHDplus project for the USA hydrologic database (Dewald, 2006). This enhanced data set would include variables such as channel elevation, local drainage area, stream velocity, mean annual precipitation, mean annual temperature, land cover, smoothed river-run elevation and linked gauging stations.

The more accurate and comprehensive 1:50 000 river coverages have undergone extensive editing in a different process managed by DWAF's Directorate of Spatial and Land Information Management. A useful project would now be to apply the 1:500 000 verification and reach allocation procedures to the 1:50 000 coverages. Tests with the editing tools described above have shown that the 1:50 000 coverage, being about 100 times larger than the 1:500 000 coverage, needs about 100 times more processor time to complete the same operations (i.e. weeks instead of days). The RivEX extension to ArcGIS is a more efficient solution and can perform most quality control and annotation tasks in a matter of hours. Whatever the outcome, the 1:500 000 coverage will remain an important resource for quick overview mapping and analysis, especially in drainage regions that extend into neighbouring countries.

Digital elevation model analysis has great potential to improve the 1:500 000 river coverage in adjacent territories where only coarse-scale vector data exist. Eventually, digital elevation models should become accurate enough to also extend the 1:50 000 coverage into poorly-mapped areas. RQI should investigate the suitability of various elevation data sources for drainage network generation.

References

- Cobban, D. A. & Silberbauer, M. J. (1993) Water quality decision-making facilitated through the development of an interface between a geographic information system and a water quality database. In: *Hydrology in Developing Regions... the Road Ahead* (Proc. Sixth South African National Hydrological Symp. ed. by S. A. Lorenz, S. W. Kienzle & M. C. Dent), vol. II, 523-530.
- Dewald, T. (2006) NHDPlus: User Guide. http://www.horizon-systems.com/nhdplus/data/NHDPLUS_UserGuide.pdf on 2006-08-07.
- Dunne, T & L. B. Leopold (1978) *Water in environmental planning*. W.H. Freeman and Company, San Francisco. 818 pp.
- EPA (2004) BASINS: Better Assessment Science Integrating Point & Nonpoint Sources. <http://www.epa.gov/OST/BASINS/>.
- Fowler, J., H. Dallas, & P. Janssens (2000) *Rivers database: A user's manual*. NAEBP Report Series No 11 (revised Edition) Aquatic Biomonitoring – Hydrology. Institute for Water Quality Studies, Department of Water Affairs and Forestry, Pretoria, South Africa.
- Hornby, D. D. (2006) A vector river network processing tool for ArcGIS. <http://www.rivex.co.uk/>.
- Lanfear, K. J. (1990). A fast algorithm for automatically computing Strahler stream order. *Water Resources Bulletin*, 26(6), 977 - 981.
- Midgley D. C., Pitman W. V. & Middleton B. J. (1994) *Surface Water Resources of South Africa 1990*. Vols I-VI. WRC Reports No. 298/1.1/94 to 298/6.1/94. Water Research Commission, Pretoria, South Africa.
- Pegram, G. & Parak, M. (2004) A review of the regional maximum flood and rational formula using geomorphological information and observed floods. *Water SA* **30** 3.
- PSUL (2006) About the Digital Chart of the World Data Server—The Pennsylvania State University Libraries. http://www.maproom.psu.edu/dcw/dcw_about.shtml 2006-08-10.
- Schultz C. B. & Watson M. D. (2002) *Water Situation Assessment Model: A Decision Support System for Reconnaissance Level Planning*. Department of Water Affairs and Forestry, Pretoria.
- Silberbauer M. J. and Wildemans D. E. (2003) A South African surface water drainage network for GIS - poster presented at ZSSA (Zoological Society of South Africa) & SASAQS (Southern African Society of Aquatic Scientists) Joint Congress (SASAQS's 38th annual congress) 29 June - 5 July 2003, University of Cape Town.
- Silberbauer, M. J. & Wildemans D. E. (2001) Adding value to the 1:500 000 rivers coverage of South Africa: Terms of Reference, Resource Quality Services file number N/0000/00/REH/0701.

Silberbauer, M. J. and Moolman J. (2004) The evolution of river and elevation data available for aquatic resource management. Poster presented at the 2004 conference of the Southern African Society of Aquatic Scientists: Water Resources as Ecosystems: Scientists, Government and Society at the Crossroads, 5-8 July 2004, Midrand.

USGS (2000) The National Hydrography Dataset: Concepts and Contents. United States Geological Survey document accessed at <http://nhd.usgs.gov/techref.html> on 2006-08-07.

USGS (2006) Shuttle Radar Topography Mission. <http://srtm.usgs.gov/> on 2006-08-10.

Appendices

Appendix: ArcInfo macros to edit river coverages

rived.aml

```

/* river editing AML, composed of the various primary drainage editing
/* AMLs developed during the river reach project.
/* 2005-05-04 v 1.00 Michael Silberbauer hacked the bits into a single AML.
/* 2005-08-02 v 1.10 Michael Silberbauer added 1:50 000 tools.
/* 2005-11-17 v 1.20 Michael Silberbauer added 1:50 000 field verification.
/* 2005-11-23 v 1.21 Michael Silberbauer incorporated riv50.aml as a routine.

&args rivcov
&sv version = 1.20

&if [null %rivcov%] &then &stop Usage rivedit rivcov
&call OS

&if [length %rivcov%] = 6 &then &sv .rscale = 50
&if [length %rivcov%] = 7 &then &sv .rscale = 500
&if %.rscale% = 500 &then &sv rivdir %enterprise%/db/cover/riv
&if %.rscale% = 50 &then &sv rivdir %enterprise%/db/cover/riv/riv50k/cap/alb

&call ISOdater
&if [exists %rivcov% -cover] &then
&do
    &sv primary [translate [substr [entryname %rivcov% ] 4 1]]
    &sv .primary_drn = %primary%
    &type %ISOdate% Editing drainage region %primary% with %AML$fullfile% %version%
&end
&else
    &stop Please run in same directory as coverage.

&if [SHOW PROGRAM] <> ARCEDIT &then arcedit
ec %rivcov%
ef arc
&if %.rscale% = 50 &then &call verify_fields
&call mapex
de arc arrow
display 9999
display size frame 820 820
&sys arc lc
lineset carto

&call Configure
&if ( ( %.rscale% = 500 ) AND ( [exists %riv50k% -cover] ) ) &then
&do
    bc %riv50k% 103
    backsymbolitem %riv50k% arc rivsym
&end
&else
&do map250 &list %map250_list%
    bc %riv50dir%/S%map250%/rivers50 405
    backsymbolitem %riv50dir%/S%map250%/rivers50 arc rivers50-id
&end

bc %enterprise%/db/cover/s-africa/nms_his 2
bc %enterprise%/db/cover/s-africa/xdn_500 904
bc %enterprise%/db/cover/s-africa/wla_500 24
bc %enterprise%/db/cover/s-africa/hca_4 961
bc %enterprise%/db/cover/s-africa/hca_3 952
bc %enterprise%/db/cover/s-africa/hca_2 943
bc %enterprise%/db/cover/s-africa/hca_1 933

```



```

bc %enterprise%/db/cover/s-africa/xdn_50 984

/*bc %enterprise%/db/cover/riv/sariv 534
bc %enterprise%/db/cover/s-africa/spr_500 742
/*be arc
/*be point
/*bti %enterprise%/db/cover/s-africa/nms_his point description

/*&if %.rscale% = 500 &then textitem arc name\alias
/*&else textitem arc rivname
sds 6
arcplot &r %enterprise%/db/prjws8/users/michael/aml/riv50.aml
draw
image %enterprise%/db/dem/srtm90/srtm90sahsal
image off
&call rivcaptool

&return

/* ---+-----+---
&routine mapex
/* save map extents in text file:

&if [exists map_ex.dat -file] &then
&do
    &sv of = [open map_ex.dat openstat -read]
    &sv fe = [read %of% readstatus]
    mapextent [unquote %fe%]
    &sv ce = [close -all]
&end

&return

/* ---+-----+---
&routine OS

&sv opsys = [extract 1 [show &os] ]

&if %opsys% = SunOS      &then
&do
    &sv enterprise = /hri
    &sv tempdir = %enterprise%/tmp/
    &sv NL = \
    &sv remove = \rm
    &sv listdir = \ls -l
    &sv listfile = \cat
    &sv dirsep = /
    &sv sorti = sort -f -o
    &sv riv50dir = $RIVSYS/dbrivers50/tiles
&end
&if %opsys% = Windows_NT &then
&do
    &sv enterprise = N:
    &sv tempdir = C:\Temp\catalog\
    &sv NL = /&
    &sv remove = del
    &sv listdir = dir
    &sv listfile = type
    &sv dirsep = \
    &sv sorti = [unquote 'sort /o ']
    &sv riv50dir = /hri/db/rpd2/hril/iwqs/db/riv50/dbrivers50/tiles
&end

&return

/* ---+-----+---
&routine ISOdater

/* date in ISO format

```

```

&sv ISOdate [quote [date -year]-[substr[date -usa] 1 2]-[substr[date -vmsdate] 1 2] -
[before[date -vmstime] .] ]
&sv ISOdate = [unquote %ISOdate%]

&return

/* ---+-----+---
&routine Configure

&sv riv50k = %enterprise%/db/cover/riv/riv50k/cap/alb/%primary%/wri%primary%50

&select %primary%

  &when A
  &do
    &sv map250_list = 2228 2230 2326 2328 2330 2426 2428 2524 2526 2528 2626 2628
    bc %enterprise%/db/cover/riv/a/WRI_MZ_LMP 534
  &end

  &when B
  &do
    &sv map250_list = 2230 2330 2430 2530 2328 2428 2528 2628
    bc %enterprise%/db/cover/riv/a/WRI_MZ_LMP 534
  &end

  &when C
  &do
    &sv map250_list = 2624 2626 2628 2630 2724 2726 2728 2822 2824 2826 2828 2922 2924
2926 3024
  &end

  &when D
  &do
    &sv map250_list = 2816 2818 2916 2918 2520 2620 2720 2820 2920 3020 3120 3220 2522
2622 2722 2822 2922 3022 3122 3222 2524 2624 2924 3024 3124 2826 2926 3026 3126 2828
2928 3028 3128
    bc %enterprise%/db/cover/riv/sariv 534
    bc lesrtm90 904
  &end

  &when E
  &do
    &sv map250_list = 2918 3018 3118 3120 3218 3220 3319 3320
  &end

  &when F
  &do
    &sv map250_list = 2816 2916 2918 3017 3018 3118
  &end

  &when G
  &do
    &sv map250_list = 3118 3218 3318 3319 3320 3420
  &end

  &when H
  &do
    &sv map250_list = 3318 3319 3320 3420
  &end

  &when J
  &do
    &sv map250_list = 3220 3222 3319 3320 3322 3420
  &end

  &when K
  &do
    &sv map250_list = 3320 3322 3324 3420
  &end

```

```

&when L
&do
    &sv map250_list = 3122 3124 3222 3224 3322 3324
&end

&when M
&do
    &sv map250_list = 3324
&end

&when N
&do
    &sv map250_list = 3124 3222 3224 3324 3326
&end

&when P
&do
    &sv map250_list = 3324 3326
&end

&when Q
&do
    &sv map250_list = 3124 3126 3224 3226 3324 3326
&end

&when R
&do
    &sv map250_list = 3226 3228 3326
&end

&when S
&do
    &sv map250_list = 3226 3228 3326
&end

&when T
&do
    &sv map250_list = 2928 3028 3030 3126 3128 3226 3228
&end

&when U
&do
    &sv map250_list = 2830 2928 2930 3028 3030
&end

&when V
&do
    &sv map250_list = 2728 2730 2828 2830 2928 2930
&end

&when W
&do
    &sv map250_list = 2530 2630 2632 2730 2830 2930
    bc %enterprise%/db/cover/riv/sariv 534
&end

&when X
&do
    &sv map250_list = 2430 2528 2530 2628 2630
    bc %enterprise%/db/cover/riv/sariv 534
&end

&otherwise
    &stop Invalid drainage %primary%
&return

/* ---+-----+---
&routine rivcaptool

```

```

/* To assist in fixing blapses on 1:500 000 rivers
/* From captool.aml by Michael Silberbauer, 2002-11-20, 2005-04-26
/* calling captool.menu by Elise Vorster, GIMS

&sv .DatDir = %enterprise%
editfeature arc

&call ISOdater

&sv .rivname

&term 9999
&sv .cover [entryname [show editcoverage 1]]
&sv .feature [show editfeature]
&menu %enterprise%/db/michael/aml/rivcaptool.menu &top &pos &ur &screen &ur &stripe
'EliseRiv '%.cover%

&thread &delete rivcaptool
&return

/* ---+-----+---
&routine verify_fields
/* Check that the 1:50 000 coverage has all the fields required.

&sv itemlist 'NAME 30 30 C' 'ALIAS 30 30 C' 'END 1 1 C' 'ORDER 4 5 B' 'REACHCODE 10 10
C' 'PRIMARY 1 1 C' 'CLASS 24 24 C'

&sv field_missing = .FALSE.
&sv OK2add = .FALSE.
&do itemsq &list %itemlist%
  &sv item = [unquote %itemsq%]
  &sv itm = [substr %itemsq% 1 [search %itemsq% ' ']]
  &sv itm = [unquote %itm%]
  &if [iteminfo %rivcov% -line %itm% -exists] &then &type Field %itm% exists
  &else
    &do
      &sv field_missing = .TRUE.
      &type Field %item% does not exist.
    &end
  &end
&end
&if %field_missing% &then &stop Run riv50convert to add required fields.

&return

/* ---+-----+---
&routine riv50sym

/* Routine created from RIV50.AML to plot rivers roughly according to their type
/* using the standard line set (by Michael Silberbauer 1999-05-04).

ARCPLOT

lineset /hri/db/symbol/standard.lin

/* Coastline

linesymbol 14
lineput 5
lineput 7

/* Coastal rock

linesymbol 701
/*lineput 6
lineput 601

/* Harbour

```

```

linesymbol 1
lineput 8
lineput 10

/* Canals, etc

linesymbol 433
linecolor cyan
/*lineput 1
lineput 2
lineput 201
lineput 202
lineput 3
lineput 18
lineput 32
lineput 45

/* Permanent water features

linesymbol 21
linecolor blue
lineput 9
lineput 19
lineput 191
lineput 20
lineput 21
lineput 211
lineput 212
lineput 28
lineput 38
lineput 39
lineput 34
lineput 40
lineput 36
lineput 42

/* River centrelines:

linesymbol 91
linecolor blue
lineput 421

/* ArcEdit SELECT symbol:
linesymbol 91
linecolor magenta
lineput 6

/* ArcEdit DRAW symbol:
linesymbol 91
linecolor red
lineput 1

/* Wetlands:

linesymbol 534
linecolor green
lineput 22
lineput 23

/* Non-perennial features:

linesymbol 111
linecolor blue
lineput 26
lineput 27
lineput 28
lineput 35
lineput 41

```

```
/* Flood zone boundaries:
linesymbol 71
lineput 16
lineput 161
lineput 17

/* Dry features:
linesymbol 174
lineput 14
lineput 15
lineput 25
lineput 33

QUIT

&return
```

rivcaptool.menu

```

7
/* Elise Vorster, GIMS, 25/02/1999
/* Hacked by Mike Silberbauer, 1999, 2000, 2001, 2002, 2004, 2005
/*EDIT COVER = %cov
/*EDIT FEATURE = %curfeature
%srn
%srr

SELECTION OF ARC ++++++++
%son %sma
%sbo %spo
%saz %sac
%sds %sed
%spa %stz
WORK WITH VERTICES ++++++
/* %ved
%vdr %vdn
%vmv %vmm
%vad %vde
WORK WITH NODES
%nsm /*%nmv
WORK WITH ARCS (CARE!) +++
%spl %uns
%res %ext
%mov %del
%flp %scl
%lis %lnm
%ccp %ccn
%cdr
/*%cpa %eca
/*%c25 %cmz
/*%tsc %tfc
DRAWING ++++++
%zmr
%inputreach
%edr %edd
%zms %zme
%dra %zse
%tx0 %tx1
%tmp %tst
%btg %dmt
ERROR RECOVERY ++++++
%ops
SYSTEM ++++++
%hlp %cmd
%sav %qut

/*EDIT FEATURE
/*%cov display .cover 8 value
/*%curfeature display .feature 8 value
/*%forminit &sv .cover [entryname [show editcoverage 1]]; &sv .feature [show
editfeature]
/*%edf CHOICE .capttool$ef SINGLE RETURN 'editfeat %.capttool$ef%' NODE ARC
/*SELECTION
/*%stf BUTTON 'Sel loops' sel tnode# = fnode#;ds;&type LOOPS /&;list $recno
%son BUTTON 'One' select one *;&run %.DatDir%/db/michael/aml/rivcap_sme.aml name
%sma BUTTON 'Many' select many *
%sbo BUTTON 'Box' select box *
%spo BUTTON 'Poly' select polygon *
%saz BUTTON 'Sel arc+zoom' ef arc;select one *;&if [show number selected] = 1
&then;&do;&run %.DatDir%/db/michael/aml/rivcap_sme.aml name;mape sel;draw;ds;&end;&else
&do &type Select ONE arc first;&end
%srn DISPLAY .rivname 20 VALUE
%srr DISPLAY .rivreach 10 VALUE
%sac BUTTON 'A sel connect' aselect connect

```

```

%sds BUTTON 'Selldownstrm' &if [show number selected] = 1 &then;&do;&sv rn [show select
1];&sv tn [show arc %rn% tnode#];sel fnode# = %tn%;&run
%.DatDir%/db/michael/aml/rivcap_sme.aml name;mapex sel;draw;ds;&end;&else &type Select
ONE arc first
%sed BUTTON 'Sel+ed' select one *;&run %.DatDir%/db/michael/aml/rivcap_sme.aml
name;forms form %.DatDir%/db/michael/aml/ednamealias modal
%stz BUTTON 'Sel loop+zoom' &sv a = 0;sel tnode# = fnode#;&if [show number selected] > 0
&then &sv a = [show select 1];sel $recno = %a%;mapex sel;draw;ds
%spa BUTTON 'Sel path' select path
/*WORK WITH VERTICES
/*%ved BUTTON 'edit' vertex edit
%vdr BUTTON 'draw' vertex draw
%vdrn BUTTON 'number' vertex draw ids
%vmv BUTTON 'move' vertex move
%vmm BUTTON 'move many' vertex move many
%vad BUTTON 'add' vertex add
%vde BUTTON 'delete' vertex delete
/*WORK WITH NODES
%nsm BUTTON 'Select+move' ef node;select;move;ef arc
/*%nmv BUTTON 'Node move' move
/*WORK WITH ARCS
%spl BUTTON 'SPLIT' split
%uns BUTTON 'UNSPLIT' unsplit
%ext BUTTON 'EXTEND' extend
%res BUTTON 'RESHAPE' reshape
%mov BUTTON 'BREAK!+MOVE' move;&type *** Warning: broken node! ***
%del BUTTON 'DELETE!' delete
%flp BUTTON 'FLIP' flip
%sc1 BUTTON 'COASTAL' save;&sv edc [show editcover];arcplot;clearselect %edc%
arc;reselect %edc% arc overlap %.DatDir%/db/michael/cover/coastbuf
poly;quit;selectget;bc %.DatDir%/db/michael/cover/coastbuf;mapex sel;draw;ds
%lis BUTTON 'LIST attributes' &fullscreen &popup;list
%lnm BUTTON 'LIST names' &fullscreen &popup;list name, alias
%ccp BUTTON '=Perennial'; calc class = 'Perennial_river'; &fullscreen &popup; list
%ccn BUTTON '=Non_pernl'; calc class = 'Non_pernl_river'; &fullscreen &popup; list
%cdr BUTTON '=Dry_river'; calc class = 'Dry_river';&fullscreen &popup;list
/*%cpa BUTTON 'Get 50k!!!' &run %.DatDir%/db/michael/aml/getriv50.aml
/*%c25 BUTTON 'Get 250k!!!' &run %.DatDir%/db/michael/aml/getriv250.aml
/*%cmz BUTTON 'Get MZ!!!!' &run %.DatDir%/db/michael/aml/getrivmz.aml
/*%eca BUTTON 'EC 500k!!' ec %edco%; show ec
/*%tsc BUTTON 'set TF' transfercover
%.DatDir%/db/michael/aml/a/wri_mz_lmp;transferfeature arc
/*%tfc BUTTON 'transfer' transfer coordinates

/*DRAWING
%inputreach INPUT .inprivreach 10 TYPEIN YES SCROLL NO CHARACTER
%zmr BUTTON 'ZmReach' ~
    sel reachcode cn [quote [translate %.inprivreach%]];&run
%.DatDir%/db/michael/aml/rivcap_sme.aml name;mapextent select;draw;drawselect
%edr BUTTON KEEP 'EdReach' ~
    sel reachcode cn [quote [translate %.inprivreach%]];&run
%.DatDir%/db/michael/aml/rivcap_sme.aml name;mapextent select;draw;drawselect~
;forms form %.DatDir%/db/michael/aml/ednamealias modal
%zms BUTTON 'Zoom Select' mapextent select;draw;drawselect
%zme BUTTON 'Zoom Full' mapextent default;draw
%dra BUTTON 'ReDraw' draw
%zse BUTTON 'Set Mapex' mapextent;draw
%tx1 BUTTON 'LabelArc' textitem arc name; draw
%tx0 BUTTON 'NoLabelArc' textitem arc none; draw
%tst BUTTON 'LabelStn' bti %.DatDir%/db/cover/s-africa/nms_his label station;bti
%.DatDir%/db/cover/s-africa/xdn_50 label sheet50;draw
%tmp BUTTON 'NoLabelStn' bti %.DatDir%/db/cover/s-africa/nms_his label none;bti
%.DatDir%/db/cover/s-africa/xdn_50 label none;draw
%btg BUTTON 'BaCov toggle' &if [quote [show be]] = 'ALL OFF' &then be arc label;&else be
all off;draw
%dmt BUTTON 'DEM toggle' &if [show image] = ON &then;&do;image
off;draw;&end;&else;&do;image on;draw;&end
%edd BUTTON 'ED *' editdistance *
/*ERROR RECOVERY

```



```
%ops BUTTON 'OOPS' oops
/*SYSTEM
%cmd BUTTON 'Cmd line...' &type 'Type &return to return to the menu'; &tty
%hlp BUTTON 'Help' &popup %.DatDir%/db/michael/aml/rivcap_hlp.txt
%sav BUTTON 'SAVE' save; &run %.DatDir%/db/michael/aml/rivcap_sme.aml save;
%qut BUTTON 'Cancel' &return
%forminit &sv .captool$ef [show editfeat]
%FORMOPT SETVARIABLES RETURN
```

tol.aml

```

/* set tolerances for a river coverage
/* Michael Silberbauer 2002-11-21

&args cov

&if [null %cov%] &then &stop Usage TOL <COVERAGE>

&if [SHOW PROGRAM] <> ARC &then &stop Please run at Arc prompt

arccedit

editcoverage %cov%
editfeature arc

&describe %cov%
&type
&type Coverage projection = %PRJ$NAME%
&type Original tolerances:
status tolerance

&if [quote %PRJ$NAME%] = '' &then &stop projection undefined for %cov%

&if ( %PRJ$NAME% = ALBERS ) or ( %PRJ$NAME% = TRANSVERSE ) &then
&do
    snapping first 10
    nodesnap first 10
    weedtolerance 10
    grain 10
    /*editdistance 2000
&end
&else
    &if ( %PRJ$NAME% = GEOGRAPHIC ) &then
    &do
        &format 6
        &sv metre = [calc 0.8 * ( 1 / 60 / 1852 ) ]
        snapping first [calc 10 * %metre%]
        nodesnap first [calc 10 * %metre%]
        weedtolerance [calc 10 * %metre%]
        grain [calc 10 * %metre%]
        /*editdistance [calc 2000 * %metre%]
    &end
    &else
        &type Tolerances unchanged

&type
&type Tolerances are now:
status tolerance
&format 3

save
quit

```

anodp.aml

(Example for “A” region. For “B” region, use bnodp.aml, etc.)

```

/* zoom to each of a list of nodes generated by nodeerrors
/* and massaged into an x-y list
/* Michael Silberbauer March 2003
&args nodenum
&if [null %nodenum%] &then &sv nodenum = 1
&if [SHOW PROGRAM] <> ARCEDIT &then arcedit
ec wria500
ef arc
&call mapex
de arc arrow
disp 9999 3
&sys arc lc
lineset carto

&sv map250_list = 2228 2230 2326 2328 2330 2426 2428 2524 2526 2528 2626 2628
&do map250 &list %map250_list%
    bc $RIVSYS/dbdrivers50/tiles/S%map250%/rivers50 405
    backsymbolitem $RIVSYS/dbdrivers50/tiles/S%map250%/rivers50 arc rivers50-id
&end

bc /hri/db/cover/s-africa/nms_his 2
bc /hri/db/cover/s-africa/xdn_50 984
bc /hri/db/cover/s-africa/xdn_500 804
bc /hri/db/cover/s-africa/wla_500 24
bc /hri/db/cover/s-africa/hca_4 961
bc /hri/db/cover/s-africa/hca_3 951
bc /hri/db/cover/s-africa/hca_2 941
bc /hri/db/cover/s-africa/hca_1 931
/*bc /hri/db/cover/s-africa/spr_500 744
be arc
be point
bti /hri/db/cover/s-africa/nms_his point description
textitem arc order|name
sds 6
ARCPLOT /hri/db/michael/aml/riv50.aml

&sv ca [close -all]
&sv on [open nodep.txt openstatus -read]
&sv nNs = -1
&sv readstatus = 0
&do &until %readstatus% <> 0
    &sv txt = [read %on% readstatus]
    &sv nNs = %nNs% + 1
&end

&if %nNs% <= 0 &then &stop No data

&sv co [close %on%]
&sv on [open nodep.txt openstatus -read]

ec wria500
ef arc
&do nN = 1 &to %nNs%
    &sv txt = [read %on% readstatus]
    &if %nN% >= %nodenum% &then
        &do
            &sv x [extract 1 [unquote %txt%]]
            &sv y [extract 2 [unquote %txt%]]
            &sv xl = [calc %x% - 250]
            &sv yl = [calc %y% - 250]
            &sv xr = [calc %x% + 250]
            &sv yr = [calc %y% + 250]
            mape %xl% %yl% %xr% %yr%
            select screen passthru

```

```

&sv nSel = [show number select]
&sv rivn = [unquote '']
&do nS = 1 &to %nSel%
    &sv rivnam = [show arc [show select %nS%] item name]
    &if rivnam <> '' &then &sv rivn = %rivnam%
&end
draw;ds
list
&type %nN% of %nNs% at %x% %y%
    &select [translate [ response 'Do what?
(Stop/unsplitPerennial/unsplitNonperennial/List/Rename/neXt)' S]]
    &when S
    &do
        &stop Stopped process at node %nN%.
    &end
    &when P
    &do
        sel many;unsplit none;calc class = 'Perennial_river'
        &messages &popup
        &sv name = [quote [response 'Name for river?' %rivn%]]
        &if name = ' ' &then /*calc name = [unquote '']
        &else
            calc name = %name%
        &messages &off;&messages &on;list
    &end
    &when N
    &do
        sel many;unsplit none;calc class = 'Non_pernl_river'
        &messages &popup
        &sv name = [quote [response 'Name for river?' %rivn%]]
        &if name = ' ' &then /*calc name = [unquote '']
        &else
            calc name = %name%
        &messages &off;&messages &on;list
    &end
    &when L
    &do
        sel many;list
    &end
    &when R
    &do
        sel;calc name = [quote [response 'Name for river?' [unquote '']]]
    &end
    &otherwise
        &type Next node...
    &end
&end
&end
&return

/* ---+-----+---
&routine mapex
/* save map extents in text file:

&if [exists map_ex.dat -file] &then
&do
    &sv of = [open map_ex.dat openstat -read]
    &sv fe = [read %of% readstatus]
    mapextent [unquote %fe%]
    &sv ce = [close -all]
&end

&return

```

rivends.aml

```

/* Find the terminal arcs in the rivers of a coverage
/* that has "upstream-downstream" topology.
/* Michael Silberbauer 2003-04-23
/*
/* Select all non-dangling nodes, set end = 'N'
/* Select all dangle nodes
/* unselect those with existing 'M' (mouth) allocation
/* For each dangle arc
/* - select the next arc downstream
/* - if n selected = 0
/* - - dangle arc = 'E' (endorheic end)
/* - if n selected = 1
/* - - dangle arc = 'S' (start)
/* - if n selected is anything else
/* - - sound alarm about braiding or loops

&args rivcov autocontinue

&if [null %autocontinue%] &then &sv .continue = .false.
&else &sv .continue = .true.

build %rivcov% arc
build %rivcov% node

ArcEdit

editcover %rivcov%
editfeature arc
disp 9999
de arc
sds 6

&if ^ [iteminfo %rivcov% -arc end -exists] &then
  additem end 1 1 c
&else
  &if ( ( %.continue% ) OR ( [locase [getchar 'END exists: type y to continue' n]] = y )
  ) &then &type adding end
  &else &stop OK, stopping...

&if ^ [iteminfo %rivcov% -arc seqnum -exists] &then additem seqnum 4 5 b
select all

calc seqnum = $recno
save

/* select all non-dangling nodes, set end = 'N'
select dangle
nselect
calc end = 'N'

/* for each dangling river arc, add seqnum to the list for processing
/* (because ArcEdit changes the internal numbers after each edit):

select dangle
reselect end <> 'M'
/*list $recno seqnum fnode# tnode#
&sv nsel = [show number selected]
/*&sv nsel = 10 /*debug mode
&do n = 1 &to %nsel%
  &sv seqnum%n% = [show arc [show select %n%] item seqnum]
  &sv tonode%n% = [show arc [show select %n%] item tnode#]
  &ty %n% [value seqnum%n%] [value tonode%n%]
&end

unselect all
sel fnode# = [value tonode1]
&do n = 2 &to %nsel%

```

```

    asel fnode# = [value tonode%n%]
&end
nselect
draw:ds; /*list seqnum fnode# tnode#

/* now, for each dangling river arc, check if it is linked to something downstream:
&sv nE = 0
&sv nS = 0
&sv nX = 0
&do n = 1 &to %nsel%
    &sv ArcN = [value seqnum%n%]
    select seqnum = %ArcN%

    &if [show number selected] = 1 &then
    &do
        &sv tn [show arc [show select 1] tnode#]
        select fnode# = %tn%

    &select [show number selected]
        &when 0 /* no further arcs downstream
        &do
            &type %ArcN% is a terminal arc
            /* select ArcN again:
            select seqnum = %ArcN%

            /*list
            /* check that this isn't already a mouth (M) or endorheic (E) arc:
            &sv end = [show arc [show select 1] item end]

            &select end
            &when E
                &type OK %ArcN% is already E
            &when M
                &type OK %ArcN% is already M
            &otherwise
                &do
                    &sv nE = %nE% + 1
                    &sv arcE%nE% = %ArcN%
                    &type calc end = 'E'
                &end
            &end
        &end

        &when 1 /* an arc downstream
        &do
            &type %ArcN% is a starting arc
            &sv nS = %nS% + 1
            &sv arcS%nS% = %ArcN%
            &type calc end = 'S'
        &end

        &otherwise /* several arcs downstream or error condition
        &do
            &type %ArcN% is braided or loopy
            &sv nX = %nX% + 1
            &sv arcX%nX% = %ArcN%
            &type calc end = 'X'
        &end

    &end
&end
    &else &stop Fatal error - multiple arcs with same seqnum = %ArcN%
&end
&type Es
&if ^ [null [value arcE1]] &then
&do
    sel seqnum = [value arcE1]

```

```

&do n = 2 &to %nE%
  asel seqnum = [value arcE%n%]
&end
cal end = 'E'
&end

draw;ds
&if %.continue% &then &type Processing Ss
  &else &sv nu [getchar 'Press a key to continue' y]
&type Ss
sel seqnum = [value arcS1]
&do n = 2 &to %nS%
  asel seqnum = [value arcS%n%]
&end
cal end = 'S'
draw;ds
&if %.continue% &then &type Processing Xs
  &else &sv nu [getchar 'Press a key to continue' y]
&if %nX% = 0 &then &type no weird Xs found
&else
&do
  &type Xs
  &do n = 1 &to %nX%
    &type %n% arc [value arcX%n%] weird
  &end
&end
&end

```

rivnetsplit.aml

```

/* Split each river network (i.e. joined network of rivers terminating in an
/* END=M or END=E arc) into a separate coverage for separate ordering.
/* Generate the AML to rejoin the rivers into a single coverage afterwards.
/* This is necessary because the ordering program can only deal with a single
/* network at a time.
/* First version                                Michael Silberbauer 2003-03-03
/* Fixed special case of only 1 network:        Michael Silberbauer 2005-06-03
/* Enhanced special case of 1 network:         Michael Silberbauer 2005-06-06
/* OS and [joinfile] for Windows use:          Michael Silberbauer 2005-11-24
/* (problem - don't have Windows version of streamorder.c)

&args rivcov

&if [null %rivcov%] &then &stop Usage RIVNETSPLIT rivercoverage
&call OS

&sv errconsist = 0
/* Perform arc attribute consistency checks:
&type Consistency checks

&if [iteminfo %rivcov% -arc END -exists] &then
&do
  ArcEdit
  DISPLAY 0

  ec %rivcov%
  ef arc

  &type Do all arcs have a valid value for END?
  sel end = 'S'
  asel end = 'N'
  asel end = 'E'
  asel end = 'M'
  nsel
  &sv nseltest = [show number selected]
  &if %nseltest% > 0 &then
  &do
    list reachcode end order
    &type Number of arcs with invalid value for END (S,N,E or M) = %nseltest%
    &sv errconsist = %errconsist% + 1
  &end

  &type Are all internal arcs END='N'?
  sel dangle
  nsel
  resel end <> 'N'
  &sv nseltest = [show number selected]
  &if %nseltest% > 0 &then
  &do
    list reachcode end order
    &type Number of internal arcs with END NE N = %nseltest%
    &sv errconsist = %errconsist% + 1
  &end

  &type Are any terminal arcs END = N?
  sel dangle
  resel END = 'N'
  &sv nseltest = [show number selected]
  &if %nseltest% > 0 &then
  &do
    list reachcode end order
    &type Number of terminal arcs with END EQ N = %nseltest%
    &sv errconsist = %errconsist% + 1
  &end

```



```

/*this can't work - think up something else...
&type Are any END=E arcs connected to another END=E arc?
sel END = 'E'
sel connect
resel end = 'E'
&sv nseltest = [show number selected]
&if %nseltest% > 0 &then
&do
    list reachcode end order name
    &type Number of END=E arcs connected to another END=E arc = %nseltest%
    &sv errconsist = %errconsist% + 1
&end

&type Are any END=M arcs connected to another END=M arc?
sel dangle
sel connect
resel end = 'M'
&sv nseltest = [show number selected]
&if %nseltest% > 0 &then
&do
    list reachcode end order name
    &type Number of END=M arcs connected to another END=M arc = %nseltest%
    &sv errconsist = %errconsist% + 1
&end

&if %errconsist% > 0 &then
&do
    &type Failed consistency checks (n=%errconsist%). Program halted.
    QUIT
    &stop Please manually correct these errors or run RIVENDS.AML before re-running
%AML$fullfile%
&end
QUIT
&end
&else /* if no item END:
&do
    &type %rivcov% does not have the END 1 1 C item required for this operation
    &type assign this as follows:
    &type END=M river mouth arc
    &type END=E river endorheic terminal arc
    &type END=S river source arc
    &type END=N river normal arc
&end

&sv rivc = [entryname %rivcov%]
&sv tmp1 = [joinfile %tmp% %rivc%.txt -file]

ArcEdit
disp 9999 3

ec %rivcov%
ef arc
de arc
sds 6

select END = 'M'
aselect END = 'E'

cursor open

&sv nE = %:edit.AML$NSEL%
/*&sv rivlist = [unquote '']

&do nC = 1 &to %nE%
    &type %:edit.$recno% %:edit.end% %:edit.name%
    &if %nC% = 1 &then &sys echo %:edit.$recno% > %tmp1%
    &else &sys echo %:edit.$recno% >> %tmp1%
    /*&sv rivlist = %rivlist% %:edit.$recno%
    cursor next

```

```

&end

cursor close
&call ISOdate

/* write header of AML to run stream_order for each bit:
&sv srtaml = [joinfile %tmpr% %rivc%order.aml -file]
&if [exists %srtaml% -file] &then &sv df [delete %srtaml% -file]
&sys echo [unquote '\/* AML to order'] %rivcov% %ISOdate% > %srtaml%

/* write header of AML to reassemble all the bits later:
&sv getaml = [joinfile %tmpr% %rivc%fix.aml -file]
&if [exists %getaml% -file] &then &sv df [delete %getaml% -file]
&sys echo [unquote '\/* AML to reassemble'] %rivcov% %ISOdate% > %getaml%

/* split the coverage into separate river networks:

&sv rlist [open %tmpl% openstatus -read]

&sv nCov = 0
/*&do rivend &list %rivlist%
&do nC = 1 &to %nE%
  /*&sv rivend = %:edit.$recno%
  &sv rivend = [unquote [read %rlist% readstatus]]
  &sv nCov = %nCov% + 1
  &sv covN = %nCov%
  &if %nCov% < 1000 &then &sv covN = 0%covN%
  &if %nCov% < 100 &then &sv covN = 0%covN%
  &if %nCov% < 10 &then &sv covN = 0%covN%
  &sv outcov = [joinfile %tmpr% [substr %rivc% 1 4]%covn% -file]
  &type River %covN%, end arc number %rivend%
  select $recno = %rivend%
  &sv allsel = .FALSE.
  &do &until %allsel% = .TRUE.
    &sv no = [show number selected]
    aselect connect
    &sv n = [show number selected]
    &if %n% = %no% &then &sv allsel = .TRUE.
    draw
  &end
  &if %no% = 1 &then
  &do
    &sv outcov = %outcov%
    &type *** will not run stream_order on %outcov% (only 1 arc!) ***
  &end
  &type %n% arcs selected for output to %outcov%
  &if [exists %outcov% -cover] &then &sys arc kill %outcov% all
  put %outcov%

  &if %nCov% = 1 &then
  &do /* write start of reassembly AML
    &sv referencecov = %outcov%
    &sys echo tol %outcov% >> %getaml%
    &sys echo ArcEdit >> %getaml%
    &sys echo disp 9999 3 >> %getaml%
    &sys echo editcover %outcov% >> %getaml%
    &sys echo editfeature arc >> %getaml%
    &sys echo de arc arrow >> %getaml%
    &sys echo sds 6 >> %getaml%
    &sys echo mapextent [path %rivcov%] >> %getaml%
  &end
  /* if number > 1 write line to order this coverage
  &if %no% > 1 &then &sys echo stream_order [entryname %outcov%] >> %srtaml%
  &else
  &do
    &sys echo [quote &type skipping stream_order for %outcov% with 1 arc] >> %srtaml%
    &sys echo ArcEdit >> %srtaml%
    &sys echo disp 9999 >> %srtaml%
    &sys echo editcover %outcov% >> %srtaml%

```

```

&sys echo editfeature arc >> %srtaml%
&sys echo de arc arrow >> %srtaml%
&sys echo sds 6 >> %srtaml%
&sys echo select all >> %srtaml%
&sys echo mapextent select >> %srtaml%
&sys echo textitem arc order >> %srtaml%
&sys echo calc order = 1 >> %srtaml%
&sys echo save >> %srtaml%
&sys echo draw >> %srtaml%
&sys echo [unquote '\&pause single arc \&seconds 1'] >> %srtaml%
&sys echo quit >> %srtaml%
&end
/* if not first coverage, write line to add this coverage:
&if %nCov% > 1 &then &sys echo get %outcov% >> %getaml%

&end

/* write lines to end the reassembly AML
&sys echo draw >> %getaml%
&sys echo save >> %getaml%
&sys echo [unquote '\&pause \&seconds 1'] >> %getaml%
&sys echo quit >> %getaml%
&sys echo workspace [show workspace] >> %getaml%
&sys echo [unquote '\&type '] Now rename %rivcov% [substr %rivcov% 1 4][subst [date -
dfmt] '-' ''] >> %getaml%
&sys echo [unquote '\&type '] and copy %referencecov% %rivcov% >> %getaml%

quit no

&type %AML$fullfile% finished
&type Now process %rivcov% AMLs:
&sv wshome [show workspace]
workspace %tmpr%
&run %rivc%order.aml
&run %rivc%fix.aml
/*&type copy coverage back to the original workspace

/*&type workspace %wshome%
&return

&routine ISOdate

/* date in ISO format
&sv ISOdate [date -year]-[substr[date -usa] 1 2]-[substr[date -vmsdate] 1 2] -
[before[date -vmstime] .]

&return

/* ---+-----+---
&routine OS

&sv opsys = [extract 1 [show &os] ]

&if %opsys% = SunOS &then
&do
&sv enterprise = /hri
&sv tempdir = %enterprise%/tmp/
&sv NL = \
&sv remove = \rm
&sv listdir = \ls -l
&sv listfile = \cat
&sv dirsep = /
&sv sorti = sort -f -o
&sv tmpr = %enterprise%/db/iwqs3/tmp/riv
&end
&if %opsys% = Windows_NT &then
&do
&sv enterprise = N:

```

```
&sv tempdir = C:\Temp\catalog\  
&sv NL = /&  
&sv remove = del  
&sv listdir = dir  
&sv listfile = type  
&sv dirsep = \  
&sv sorti = [unquote 'sort /o ']  
&sv tmp = %enterprise%\db\iwqs3\tmp\riv  
&end  
  
&return
```

rivreach.aml

```

/* ArcEdit utility to automate adding river reach numbers to a river coverage.
/* River reach code format: A12B340000
/* A12B is the quaternary code
/* 340000 is the 6-digit river reach number
/* - first two used at quaternary level, rest for finer division later if
needed
/* Note that this is a shortened version of the USGS river reach code format:
/* 11223344110000
/* 11223344 is the decimal equivalent of quaternary code (lookup table available in
qatcov)
/* 110000 is 6-digit river reach number
/* Assumptions about coverage:
/* - the river arc coverage (rivcov) and quaternary drainage region polygon coverage
(qatcov)
/* have the same projection and datum
/* - the river coverage contains the fields ORDER and
/* END 1 1 C = M, E, S or N for mouth, endorheic, source or normal
/* - the quaternary drainage region coverage overlaps all of the river coverage:
/* dummy drainage regions will be used for any rivers that fall outside the numbered
drainage regions -
/* - - "099L" for land areas
/* - - "099S" for sea areas
/* - - "099O" for other areas
/*
/* Process:
/* - initialise a list or file to contain the 10-digit codes allocated
/* (operating system procedures /hri/db/cover/riv/db/qatdirs.hlp, qatkill.bat and
mkdqtat.bat)
/*
/* - add item rch_code 10 10 C to coverage (clear it with warning if it exists)
/* - add item seqnum 4 5 B to coverage (clear it with warning if it exists)
/*
/* - for each river order
/* - - for each river arc
/* - - - call number_allocate procedure
/* - check that all arcs have a code
/* - save changes
/* - exit
/*
/* Number_allocate procedure:
/* - intersect the arc with the quaternary drainage region coverage
/* - find the longest arc and return its 4-character drainage region code
/* - increment a 2-digit counter for the drainage region
/* - assemble the 10-digit code from the 4-character code + 2-digit counter + 0000
/* - check against the list or file of codes allocated that the code is not a duplicate
/* - add the code to the list or file of codes allocated
/* - calculate the coverage rch_code = code
/* - return
/*
/* 2002-12-18 Created from riv_reach.aml prototype Michael Silberbauer
/* 2003-01-10 modified
/* 2003-01-30 modified
/* 2003-03-20 - dummy drainage regions o/9/9/*
/* 2003-03-26 - v1.2: process will halt if more than 99 segments in a quaternary
/* 2003-05-02 - v1.3: builds arcs before starting ArcEdit
/* 2003-05-05 - v1.4: builds nodes before starting ArcEdit
/* 2003-08-11 - v1.5: automates resetting the used reachcodes list
/* (combined with alterations to the drainage region coverage
/* for neighbouring countries: should eliminate "099*" codes)
/* 2005-04-20 - v1.6: option to automatically continue without prompting
/* 2005-05-30 - v1.61: set DISPLAY = 0 and change ALIAS message
/* 2005-06-03 - v1.7: make consistency errors fatal (errconsist)

&args rivcov autocontinue
&sv version = 1.6
&if [null %autocontinue%] &then &sv .continue = .false.

```

```

    &else &sv .continue = .true.
&call ISOdater;&pt

&sv rivdir /hri/db/cover/riv
/*&sv qatcov /hri/db/cover/s-africa/hca_4
&sv qatcov %rivdir%/hca_4
&sv rmer    rmlocks.bat

&if [null %rivcov%] &then &stop Usage rivreach rivcov

&if [exists %rivcov% -cover] &then
&do
    &sv primary [translate [substr [entryname %rivcov% ] 4 1]]
    &type %ISOdate% Reachcodes for %primary% drainage region with %AML$fullfile% %version%
    &sv reachlog = %rivdir%/db/rivreach[locase %primary%].log
    &if ^ [exists %reachlog% -file] &then~
        &sys echo Log file for allocation of reaches to river segments in drainage region
[translate %primary%] > %reachlog%
&end
    &else
        &stop Please run in same directory as coverage.

/*clear used-reachcode records, taking into account
/* illogical WSAM codes for Mozambique:
&if [exists %rmer% -file] &then &sv drm [delete %rmer% -file]

&sv prim = [locase %primary%]
&sv txd = %rivdir%/db/
&sys echo \\rm %txd%prim%/'**/**/'.txt > %rmer%
&if ( %primary% = A ) &then
&do
    &sys echo \\rm %txd%'y/1/**/'.txt' >> %rmer%
    &sys echo \\rm %txd%'y/2/**/'.txt' >> %rmer%
    &sys echo \\rm %txd%'y/3/0/a/**/'.txt' >> %rmer%
    &sys echo \\rm %txd%'y/3/0/d/**/'.txt' >> %rmer%
    &sys echo \\rm %txd%'y/3/0/f/**/'.txt' >> %rmer%
    &sys echo \\rm %txd%'y/3/0/g/**/'.txt' >> %rmer%
    &sys echo \\rm %txd%'y/3/0/h/**/'.txt' >> %rmer%
    &sys echo \\rm %txd%'y/3/0/j/**/'.txt' >> %rmer%
    &sys echo \\rm %txd%'y/3/0/k/**/'.txt' >> %rmer%
&end
&if ( %primary% = B ) &then
&do
    &sys echo \\rm %txd%'y/3/0/b/**/'.txt' >> %rmer%
    &sys echo \\rm %txd%'y/3/0/c/**/'.txt' >> %rmer%
    &sys echo \\rm %txd%'y/3/0/e/**/'.txt' >> %rmer%
&end
&if ( %primary% = D ) &then
&do
    &sys echo \\rm %txd%'z/**/**/'.txt' >> %rmer%
&end
&if ( %primary% = W ) &then
&do
    &sys echo \\rm %txd%'y/5/0/**/'.txt' >> %rmer%
    &sys echo \\rm %txd%'y/6/0/**/'.txt' >> %rmer%
    &sys echo \\rm %txd%'y/7/0/**/'.txt' >> %rmer%
&end
&if ( %primary% = X ) &then
&do
    &sys echo \\rm %txd%'y/4/0/**/'.txt' >> %rmer%
&end

&sys chmod 755 %rmer%

&type script %rmer%:
&sys cat %rmer%
&if %.continue% &then
    &sys %rmer%
&else

```

```

&do
  &if [response [quote Execute above script to purge reachcode files (Y/n)?] Y/n] = Y
  &then
    &sys %rmer%
  &else
    &stop Please delete manually and try again.
  &end

tol %rivcov%
build %rivcov% arcs
build %rivcov% nodes
index %rivcov% line

ArcEdit

DISPLAY 0

&call ISOdater
&sv starttime = %ISOdate%
&sys echo Ver%version% %ISOdate% %rivcov% and %qatcov% >> %reachlog%
ec %rivcov%
ef arc

&sv errconsist = 0
/* Perform basic consistency checks:
&type Consistency checks

&type How many ALIASes have a value when NAMES have a value?
sel name = '' ; nsel
resel alias = ''
&sv nseltest = [show number selected]
&if %nseltest% > 0 &then
&do
  &type number of ALIASes with no value when NAMES have a value = %nseltest%
  &sys echo number of ALIASes with no value when NAMES have a value = %nseltest% >> %reachlog%
&reachlog%
&end

&type Do all arcs have an order?
sel order = 0
&sv nseltest = [show number selected]
&if %nseltest% > 0 &then
&do
  list reachcode end order
  &type Number of arcs without order = %nseltest%
  &sys echo Number of arcs without order = %nseltest% >> %reachlog%
  &sv errconsist = %errconsist% + 1
&end

&type Are all starting arcs order 1?
sel end = 'S'
resel order <> 1
&sv nseltest = [show number selected]
&if %nseltest% > 0 &then
&do
  list reachcode end order
  &type Number of arcs with Starting arcs order NE 1 = %nseltest%
  &sys echo Number of arcs with Starting arcs order NE 1 = %nseltest% >> %reachlog%
  &sv errconsist = %errconsist% + 1
&end

&type Are all internal arcs order > 1?
sel end = 'N'
resel order = 1
&sv nseltest = [show number selected]
&if %nseltest% > 0 &then
&do
  list reachcode end order
  &type Number of arcs with Normal arcs order EQ 1 = %nseltest%

```

```

&sys echo Number of arcs with Normal arcs order EQ 1 = %nselect% >> %reachlog%
&sv errconsist = %errconsist% + 1
&end

&type Do all arcs have a primary drainage region?
sel primary = ''
asel primary = ' '
&sv nselect = [show number selected]
&if %nselect% > 0 &then
&do
    list reachcode primary
    &type Number of arcs with no Primary drainage region = %nselect%
    &sys echo Number of arcs with no Primary drainage region = %nselect% >> %reachlog%
    &sv errconsist = %errconsist% + 1
&end

&if %errconsist% > 0 &then
&do
    &sys echo Failed consistency checks, n=%errconsist%. Program halted. >> %reachlog%
    &type Failed consistency checks (n=%errconsist%). Program halted.
    QUIT
    &stop Please manually correct these errors before re-running %AML$fullfile%
&end

sel all
&sv nselall = [show number selected]
&if [iteminfo %rivcov% -arc reachcode -exists] &then
&do
    cal reachcode = ''
&end
&else
    additem reachcode 10 10 C

&if ^ [iteminfo %rivcov% -arc seqnum -exists] &then additem seqnum 4 5 B
sel all
cal seqnum = $recno

sel all
statistics
    maximum order
end

&sv nArc = 0 /* counter

&sv nOrder = [show statistic 1 1]

/* - for each river order
/*&do order = 4 &to 4 /* debug
&do order = 1 &to %nOrder%

    &sv nR = 0
    &sv nsel = 99999
    select order = %order%
    &sv nsel = [show number selected]

    /* - for each river arc add seqnum to list for processing:
    &do n = 1 &to %nselect%
        &sv ArcNum = [show select %n%]
        &sv seqnum%n% = [show arc %ArcNum% item seqnum]
    &end

    /* - for each river arc
    &do n = 1 &to %nselect%
        &sv nArc = %nArc% + 1
        &sv ArcN = [value seqnum%n%]
        /* - - call code_allocate procedure
        &call CodeAllocate
    &end

```



```

&end

/* - check that all arcs have a code
select reachcode = ''
&sv nsel = [show number selected]
&call ISOdater
&type Started at %starttime%, finished at %ISOdate%
&type number of arcs without a reach code = %nsel%
&if %nsel% = 0 &then
&do
  &type Now SAVING...
  save
  &type
  &type Run /prjws8/users/michael/aml/tracerivsort %rivcov%
  &type followed by TRACERIV to tidy things up.
  &type Finally, run RIVERNAMESEARCH to check on duplicate river names.
  &if %.continue% &then
  &do
    quit
    &r /prjws8/users/michael/aml/tracerivsort %rivcov%
  &end
  &else
  &do
    &type Would you like to run /prjws8/users/michael/aml/tracerivsort %rivcov% now?
    &if [translate [getchar 'Y or N?' N] ] = Y &then
    &do
      quit
      &r /prjws8/users/michael/aml/tracerivsort %rivcov%
    &end
  &end
&end

&end
&else
&do
  &type Something went wrong! Maybe no node or arc topology?
  &sys echo Ver%version% %ISOdate% %rivcov% Something went wrong! Maybe no node or arc
topology? >> %reachlog%
  &stop ERROR
&end

&sv cfa [close -all]
&return

/*-+-----+-----+-----+-----+
&routine CodeAllocate
/* env: ArcEdit
/* why: allocate 10-digit code to arc based on quaternary where
/* majority of arc lies

/* Code_allocate procedure:
sel seqnum = %ArcN%
list
/*&sv fnd [show arc %ArcN% item fnode#]
&if [exists TEMP$ARC -cover] &then &sys arc kill TEMP$ARC all
put TEMP$ARC
&if [exists TEMP$INT -cover] &then &sys arc kill TEMP$INT all

/* - intersect the arc with the quaternary drainage region coverage
&sys arc intersect TEMP$ARC %qatcov% TEMP$INT line 2 join
&sys arc build TEMP$INT arc
&if [exists TEMP$AAT.TMP -info] &then &sv di [delete TEMP$AAT.TMP -info]
&sys arc copyinfo TEMP$INT.AAT TEMP$AAT.TMP

/* - find the longest arc and return its 4-character drainage region code
ARCPLLOT
clearselect TEMP$AAT.TMP info
reselect TEMP$AAT.TMP info length > 0
&sv nAat = [extract 1 [show select TEMP$AAT.TMP info]]
&if %nAat% = 0 &then

```

```

&do
    &sv qat = o99o
&end
&if %nAat% = 1 &then
&do
    /*&sv qat [show select TEMP$AAT.TMP info 1 item QUATERNARY] /*fails sometimes, so:
    listoutput temp.tmp init
    list TEMP$AAT.TMP info quaternary
    listoutput screen
    &sv t [open temp.tmp os -read]
    &sv r [read %t% rs]
    &sv r [read %t% rs]
    &sv c [close %t%]
    &sv qat [extract 2 [unquote %r%]]
&end
&if %nAat% > 1 &then
&do
    /*sort TEMP$AAT.TMP info length descending /* "feature count mismatch encountered"
    &data ARC INFO
        ARC
        SELECT TEMP$AAT.TMP
        SORT ON LENGTH (D)
        export TEMP.TMP ASCII INIT QUATERNARY,LENGTH
        Q STOP
    &end
    /*&sv qat [show select TEMP$AAT.TMP info 1 item QUATERNARY] /*fails sometimes, so:
    /*listoutput temp.tmp init
    /*list TEMP$AAT.TMP info quaternary
    /*listoutput screen
    &sv t [open info/temp.tmp os -read]
    &sv r [read %t% rs]
    &sv c [close %t%]
    &sv r [subst %r% ' ' ' ']
    &sv r [subst %r% ' ' ' ']
    &sv qat [unquote %r%]
&end

QUIT

&if %qat% = o99o &then
&do
    &type      reach %ArcN% does not overlap drainage region coverage %qatcov%
    &sys echo reach %ArcN% does not overlap drainage region coverage %qatcov% >>
%reachlog%
&end

/* - calculate new code, allocate to river arc.
&call NumberAllocate
&call ISOdater
&sv code10 = %qat%%code2%%code3%
&type %rivcov% %nArc% of %nselall%: %ISOdate% Adding %code10% to reach %ArcN% order
%order%;&pt
&sys echo %n%. %ISOdate% Adding %code10% to reach %ArcN% order %order% >> %reachlog%
cal reachcode = [quote %code10%]

&return

/*-+-----+-----+-----+-----+
&routine NumberAllocate

/* - increment a 2-digit counter for the drainage region
/* - (couldn't get INFO-based system to work so use text-based system)
/* - Hierarchy of files, Primary-secondary-tertiary-quaternary
/*   (See %rivdir%/db for qatdirs.hlp to see how to set up the directory hierarchy)
/* - open the appropriate file, find the highest number, add 1, add to file

&sv code3 = 0000

&sv qc [locase %qat%]

```

```

&sv p [substr %qc% 1 1] /* primary letter
&sv s [substr %qc% 2 1] /* secondary digit
&sv t [substr %qc% 3 1] /* tertiary digit
&sv q [substr %qc% 4 1] /* quaternary letter
&sv qf %rivdir%/db/%p%/s%/t%/q%/qat.txt

&sv readstatus = 0
&if [exists %qf% -file] &then
&do
  &sv qFile [open %qf% openstatus -read]
  &sv codeq = 9999
  &do &while %readstatus% ne 102
    &sv rFile [read %qFile% readstatus]
    &sv qcode = %codeq%
    &sv codeq = [unquote %rFile%]
  &end
  &sv cFile [close %qFile%]
  &sv code2 = [calc [unquote %qcode%] + 1]
  &if %code2% < 10 &then &sv code2 0%code2%
  &if %code2% > 99 &then
    &do
      &sys echo ERROR code2 %p%%s%%t%%q% exceeded 99! This should not happen in a 1:500
000 coverage... >> %reachlog%
      &type code2 %p%%s%%t%%q% exceeded 99! This shouldn't happen in a 1:500 000
coverage...
      &stop ...check that code storage file %qf% was correctly reset!
    &end
    &sv qFile [open %qf% openstatus -append]
  &end
&else
&do
  &if [exists %rivdir%/db/%p%/s%/t%/q% -directory] &then
    &do
      &sv code2 = 01
      &sv qFile [open %qf% openstatus -write]
    &end
  &else
    &do
      &sys echo ERROR %rivdir%/db/%p%/s%/t%/q% not found >> %reachlog%
      &type ERROR %rivdir%/db/%p%/s%/t%/q% not found
    &end
  &end
&end

&sv wFile [write %qFile% [quote %code2%]]
&sv cFile [close %qFile%]

&return

/*-+-----+-----+-----+-----+-----+
&routine ISOdater

/* date in ISO format
&sv ISOdate [quote [date -year]-[substr[date -usa] 1 2]-[substr[date -vmsdate] 1 2] -
[before[date -vmstime] .] ]
&sv ISOdate = [unquote %ISOdate%]

&return

```

tracerivsort.aml

```

/* Start at each "S" (start) arc in a river coverage and work downstream until
/* encountering a terminal "E" (endorheic) or "M" (mouth) arc
/* If necessary, swap reach numbers around so that they increase downstream.
/* Michael Silberbauer 2003-01-15 traceriv.aml
/* Michael Silberbauer 2003-01-30 add reach number sorting
/* Michael Silberbauer 2003-04-04 separate reach number sorting into this dedicated
program
/* Michael Silberbauer 2003-05-19 add arc and node build functions
/* Michael Silberbauer 2003-06-03 add ability to restart at a selected reachcode
/* Michael Silberbauer 2004-04-16 add start next program dialogue
/* Michael Silberbauer 2004-04-16 add map title
/* Michael Silberbauer 2005-04-20 allow automatic execution of next process

/* ARCPLOT
/* Choose river coverage
/* For each M arc
/* - check no from-arc
/* end
/* For each E arc
/* - check no from-arc
/* end
/* Select all "S" arcs
/* Put "S" arcs in a list
/* For each "S" arc
/* - do until end arc ("E" or "M")
/* - - do until whole sequence sorted
/* - - - check for sort order of river numbers (seq) within a quaternary region
/* - - - if seq numbers decrease downstream, swap them around
/* - - - select next arc downstream
/* - - end
/* - end
/* End

&args riv startcode
&if [null %riv%] &then &stop no river coverage

&sv rivdir /hri/db/cover/riv
&sv primary [translate [substr [entryname %riv% ] 4 1]]

&type Using %primary% for primary drainage region.
&sv reachlog = %rivdir%/db/rivreach[locase %primary%].log
&if ^ [exists %reachlog% -file] &then~
  &sys echo Log file for allocation of reaches to river segments in drainage region
  [translate %primary%] > %reachlog%

&call ISOdate
&type %ISOdate%: River coverage %riv%
&sv starttime = %ISOdate%
&sv coverstatus = OK
&sv .errcount = 0

tol %riv%
build %riv% arc
build %riv% node

ARCPLOT
disp 9999 3

move 0.2 0.2
text [quote %ISOdate% %AML$FILE% %riv%] LL

clearselect %riv% arc
reselect %riv% arc REACHCODE = ''
&sv nRCH0 = [extract 1 [show select %riv% arc]]

&if %nRCH0% > 0 &then
&do

```

```

&type -----
&if %nRCH0% = 1 &then &type %nRCH0% arc has no value for REACHCODE
&if %nRCH0% > 1 &then &type %nRCH0% arcs have no value for REACHCODE
list %riv% arc name length end
&sv .errcount = %.errcount% + 1
&type -----
&stop please fix this error in %riv% and try again
&end

clearselect %riv% arc
reselect %riv% arc END = ''
&sv nEND0 = [extract 1 [show select %riv% arc]]

&if %nEND0% > 0 &then
&do
&type -----
&if %nEND0% = 1 &then &type %nEND0% arc has no value for END
&if %nEND0% > 1 &then &type %nEND0% arcs have no value for END
list %riv% arc name length end
&sv .errcount = %.errcount% + 1
&type -----
&stop please fix this error in %riv% and try again
&end

nselect %riv% arc
mapextent arc %riv%
textset font
textsymbol 1
textscale 0.5
textcolor black
linecolor 4
clear/arcs %riv%
linecolor black

&do EM &list 'E' 'M'
clearselect %riv% arc
reselect %riv% arc end = %EM%
&sv nEMs = [extract 1 [show select %riv% arc]]
infofile %riv% arc temp$sorts reachcode order end name fnode# length init

&if %nEMs% > 0 &then
&do nEM = 1 &to %nEMs%
&sv fnd = [show select temp$sorts info %nEM% item fnode#]
clearselect %riv% arc
reselect %riv% arc tnode# = %fnd%
&call ReachSortSingle
&end
&end

clearselect %riv% arc
reselect %riv% arc end = 'S'
&sv nSs = [extract 1 [show select %riv% arc]]
infofile %riv% arc temp$sorts reachcode order end name length init

&data arc info
ARC
select [translate temp$sorts]
sort on REACHCODE
Q STOP
&end

&if [null %startcode%] &then
&sv n1 = 1
&else
&do
&do nS = 1 &to %nSs%
&sv reachcode = [show select temp$sorts info %nS% item reachcode]
&if %reachcode% = %startcode% &then &sv n1 = %nS%
&end

```

```

&type Incomplete trace process starting at %n1% %reachcode%
&end

&do nS = %n1% &to %nSs%
  &label resort /* do until Reachsort reports "sorted = .TRUE."
    &sv reachcode = [show select temp$sorts info %nS% item reachcode]
    &sv sorted = .TRUE.
    clearselect %riv% arc
    reselect %riv% arc reachcode = [quote %reachcode%]
    &sv length_sum = 0
    &sv nmbr = 0
    &sv upreachcode = %reachcode%
    &call ReachSort
    &do &until ( %end% = 'M' or %end% = 'E' )
      clearselect %riv% arc
      reselect %riv% arc fnode# = %tnd%
      &call ReachSort
    &end
    &if ^ %sorted% &then &goto resort /* start at label resort again
&end

reselect %riv% arc sorter = ''
&sv nEr = [extract 1 [show select %riv% arc]]
&if %nEr% <> 0 &then &sv coverstatus = %coverstatus% %nEr% arcs without SORTER!
&call ISodate
&type -----
&type %starttime% to %ISodate%: %AML$FULLFILE% %riv% %coverstatus%
&type Status of coverage = %coverstatus%.
&type All arcs should be red or green.
&type If any blue arcs remain, check that:
&type S (source), N (none), E (endorheic end) and M (mouth end) END
&type allocations are correct.
&type If all is well,
&type run /prjws8/users/michael/aml/traceriv %riv%
&type to tidy things up.
&type Finally, run RIVERNAMESEARCH to check on duplicate river names.
&type -----

&sys echo %starttime% - %ISodate%: %AML$FULLFILE% %riv% %coverstatus% >> %reachlog%
&if %coverstatus% <> OK &then &stop %coverstatus%

&if ( %.continue% AND %coverstatus% = OK ) &then
&do
  quit
  &r /prjws8/users/michael/aml/traceriv %riv%
&end
&else
&do
  &type Would you like to run /prjws8/users/michael/aml/traceriv %riv% now?
  &if [translate [getchar 'Y or N?' N] ] = Y &then
  &do
    quit
    &r /prjws8/users/michael/aml/traceriv %riv%
  &end
&end
&end

&return

&routine ReachSort

&sv nRchs = [extract 1 [show select %riv% arc]]
&if %nRchs% > 1 &then
&do
  &call ISodate
  &type ERROR: %nRchs% multiple reaches for %reachcode%
  &sv .errcount = %.errcount% + 1
  &sv coverstatus = ERROR, see %reachlog%
  &sys echo %aml$fullfile% %ISodate% ERROR: %nRchs% multiple reaches for %reachcode% >>
  %reachlog%

```

```

    &if %.errcount% > 42 &then &stop *** TOO MANY ERRORS ***
&end
&if %nRchs% < 1 &then
&do
    &sv coverstatus = ERROR, see %reachlog%
    &sv .errcount = %.errcount% + 1
    &type -----
    &type ERROR no reach for %reachcode%
    &type check for arc pointing wrong way, terminal arc without end = M or E
    &type and try BUILD [translate %riv%] NODE
    &type -----
    &sys echo %aml$fullfile% %ISOdate% ERROR: no reach for %reachcode% >> %reachlog%
    &if %.errcount% > 42 &then &stop *** TOO MANY ERRORS ***
&end

&sv order      = [show select %riv% arc 1 item order      ]
&sv name       = [show select %riv% arc 1 item name       ]
&sv end        = [show select %riv% arc 1 item end        ]
&sv tnd        = [show select %riv% arc 1 item tnode#     ]
&sv length     = [show select %riv% arc 1 item length     ]
&sv reachcode  = [show select %riv% arc 1 item reachcode ]

textcolor red
linecolor red
arcs %riv%
arctext %riv% reachcode
textcolor black
linecolor black

/* split reach codes:
&sv oldqat = [substr %upreachcode% 1 4]
&sv qat    = [substr %reachcode% 1 4]
&sv oldzro = [substr %upreachcode% 7 4]
&sv zro    = [substr %reachcode% 7 4]

/* check for sort order of river numbers (seq) within a quaternary region:
&if ( %oldqat% = %qat% ) AND ( %oldzro% = %zro% ) &then
&do
    &sv oldseq = [calc 1 * [substr %upreachcode% 5 2]]
    &sv seq    = [calc 1 * [substr %reachcode% 5 2]]
    &if %seq% < %oldseq% &then
    &do
        textcolor blue
        &sv sorted = .FALSE.
        /* if seq numbers decrease downstream, swap them around:
        &type swap %reachcode% (%seq%) and %upreachcode% (%oldseq%)
        &sv bookmark = [substr %reachcode% 1 6]mark
        clearselect %riv% arc
        reselect %riv% arc reachcode = [quote %reachcode%]
        moveitem %riv% arc [quote %bookmark%] to reachcode
        clearselect %riv% arc
        reselect %riv% arc reachcode = [quote %upreachcode%]
        moveitem %riv% arc [quote %reachcode%] to reachcode
        arctext %riv% reachcode
        clearselect %riv% arc
        reselect %riv% arc reachcode = [quote %bookmark%]
        moveitem %riv% arc [quote %upreachcode%] to reachcode
        arctext %riv% reachcode
        textcolor black
    &end
&end

&sv upreachcode = %reachcode%

&return

&routine ReachSortSingle

&sv nRchs = [extract 1 [show select %riv% arc]]

```

```

&if %nRchs% < 1 &then
&do
  &sv order      = [show select temp$sorts info %nEM% item order      ]
  &sv name       = [show select temp$sorts info %nEM% item name       ]
  &sv end        = [show select temp$sorts info %nEM% item end        ]
  &sv fnd        = [show select temp$sorts info %nEM% item fnode#      ]
  &sv length     = [show select temp$sorts info %nEM% item length     ]
  &sv reachcode  = [show select temp$sorts info %nEM% item reachcode]
  &type Single %end% reach is whole river!
  clearselect %riv% arc
  reselect      %riv% arc reachcode = [quote %reachcode%]
  textcolor green
  linecolor green
  arcs %riv%
  arctext %riv% reachcode
  textcolor black
  linecolor black
&end

&return

&routine ISOdate

/* date in ISO format
&sv ISOdate [date -year]-[substr[date -usa] 1 2]-[substr[date -vmsdate] 1 2] -
[before[date -vmstime] .]

&return

```


traceriv.aml

```

/* Start at each "S" (start) arc in a river coverage and work downstream until
/* encountering a terminal "E" (endorheic) or "M" (mouth) arc
/* For each trace, create a text file with the starting reach code as its name,
/* in comma-separated format, showing the reach code, river name and cumulative
kilometres.
/* Michael Silberbauer 2003-01-15
/* Michael Silberbauer 2003-01-30 added sort of reachcodes within quaternary
/* Michael Silberbauer 2003-04-04 sort reachcodes removed to tracerivsort.aml
/* Michael Silberbauer 2003-04-04 add nSorter field for river direction
/* Michael Silberbauer 2005-04-20 allow automatic execution of next process

/* ARCPLOT
/* Choose river coverage
/* Check for SORTER field: assign or clear it
/* For each M arc
/* - if no from-arc write reachcode, name and order
/* end
/* For each E arc
/* - if no from-arc write reachcode, name and order
/* end
/* Select all "S" arcs
/* Put "S" arcs in a list
/* For each "S" arc
/* - do until end arc ("E" or "M")
/* - - calculate sort code
/* - - assign sort code to arc (may occur several times during run)
/* - - select next arc downstream
/* - end
/* end
/* For each "S" arc
/* - do until end arc ("E" or "M")
/* - - write reachcode, sortcode, name and order
/* - - select next arc downstream
/* - end
/* End

&args riv
&if [null %riv%] &then &stop no river coverage e.g.: /hri/db/cover/riv/h/wrih500

&sv rivdir /hri/db/cover/riv
&sv primary [translate [substr [entryname %riv% ] 4 1]]

&type Using %primary% for primary drainage region.
&sv reachlog = %rivdir%/db/rivreach[lowercase %primary%].log
&if ^ [exists %reachlog% -file] &then~
    &sys echo Log file for allocation of reaches to river segments in drainage region
    [translate %primary%] > %reachlog%

&sv rmer [scratchname -prefix xxtmp -suffix .bat -file]
&sys echo \\rm [lowercase %primary%]'*0000.txt' > %rmer%
&if %primary% = A &then &sys echo \\rm 'y*0000.txt' >> %rmer%
&if %primary% = A &then &sys echo \\rm 'o*0000.txt' >> %rmer%
&if %primary% = B &then &sys echo \\rm 'y*0000.txt' >> %rmer%
&if %primary% = D &then &sys echo \\rm 'z*0000.txt' >> %rmer%
&if %primary% = D &then &sys echo \\rm 'o*0000.txt' >> %rmer%
&if %primary% = W &then &sys echo \\rm 'y*0000.txt' >> %rmer%
&if %primary% = X &then &sys echo \\rm 'y*0000.txt' >> %rmer%
&sys chmod 755 %rmer%
&sys cat %rmer%
&type executing %rmer%
&sys %rmer%

&call ISOdate
&type %ISOdate%: River coverage %riv% in %primary% drainage region
&sv starttime = %ISOdate%

&if ^ [iteminfo %riv% -arc sorter -exists] &then ~

```

```

additem %riv%.aat %riv%.aat sorter 9 9 c

&sv closeall [close -all]
&sv coverstatus = OK

ARC PLOT
disp 9999 3

clearselect %riv% arc
reselect %riv% arc END = ''
&sv nEND0 = [extract 1 [show select %riv% arc]]

&if %nEND0% > 0 &then
&do
    &type -----
    &if %nEND0% = 1 &then &type %nEND0% arc has no value for END
    &if %nEND0% > 1 &then &type %nEND0% arcs have no value for END
    list %riv% arc name length end
    &sv %.errcount% = %.errcount% + 1
    &type -----
    &stop please fix this error in %riv% and try again
&end

nselect %riv% arc
mapextent arc %riv%
moveitem %riv% arc [quote _00000000] to sorter
&sv nSorter = 0

textset font
textsymbol 1
move 0.2 0.2
text [quote %ISODate% %AML$FILE% %riv%] LL
textscale 0.5
textcolor black
linecolor 4
clear/arcs %riv%
linecolor black

&do EM &list 'E' 'M'
    clearselect %riv% arc
    reselect %riv% arc end = %EM%
    &sv nEMs = [extract 1 [show select %riv% arc]]
    infofile %riv% arc temp$starts reachcode order end name fnode# length init

    &if %nEMs% > 0 &then
    &do nEM = 1 &to %nEMs%
        &sv fnd = [show select temp$starts info %nEM% item fnode#]
        clearselect %riv% arc
        reselect %riv% arc tnode# = %fnd%
        &call ReachReportSingle
    &end
&end

clearselect %riv% arc
reselect %riv% arc end = 'S'
&sv nSs = [extract 1 [show select %riv% arc]]
infolfile %riv% arc temp$starts reachcode order end name length init

&data arc info
    ARC
    select [translate temp$starts]
    sort on REACHCODE
    Q STOP
&end

&do nS = 1 &to %nSs%
    &sv reachcode = [show select temp$starts info %nS% item reachcode]
    &type %primary% (S %nS% of %nSs%) %reachcode% sort
    &message &off

```

```

clearselect %riv% arc
reselect      %riv% arc reachcode = [quote %reachcode%]
&message &on
&call ReachSorterCode
&do &until ( %end% = 'M' or %end% = 'E' )
    &message &off
    clearselect %riv% arc
    reselect      %riv% arc fnode# = %tnd%
    &message &on
    &call ReachSorterCode
&end
&end

&do nS = 1 &to %nSs%
    &sv reachcode = [show select temp$starts info %nS% item reachcode]
    &type (S %nS% of %nSs%) %reachcode% textfile
    &message &off
    clearselect %riv% arc
    reselect      %riv% arc reachcode = [quote %reachcode%]
    &message &on
    &sv length_sum = 0
    &sv nmbrr      = 0
    &sv rList [open %reachcode%.txt openstatus -write]
    &sv wList [write %rList% [quote Sequence,Sorter,Order,Reachcode,Name,kmCumulate]]
    &call ReachReport
    &do &until ( %end% = 'M' or %end% = 'E' )
        &message &off
        clearselect %riv% arc
        reselect      %riv% arc fnode# = %tnd%
        &message &on
        &call ReachReport
    &end
    &sv cList [close %rList%]
&end

&call ISOdate
&type -----
&type %starttime% - %ISOdate%: %AML$FULLFILE% %riv%
&type Coverage status is %coverstatus%
&type All arcs should be red or green.
&type If any blue arcs remain, check that:
&type S (source), N (none), E (endorheic end) and M (mouth end) END
&type allocations are correct.
&type If everything is OK,
&type run /prjws8/users/michael/aml/rivernamesearch %riv%
&type to check on duplicate river names
&type -----

&sys echo %starttime% - %ISOdate%: %AML$FULLFILE% %riv% %coverstatus% >> %reachlog%
&if %coverstatus% <> OK &then &stop %coverstatus%

&if ( %.continue% AND %coverstatus% = OK ) &then
&do
    quit
    &r /prjws8/users/michael/aml/rivernamesearch %riv%
&end
&else
&do
    &type Would you like to run /prjws8/users/michael/aml/rivernamesearch %riv% now?
    &if [translate [getchar 'Y or N?' N] ] = Y &then
    &do
        quit
        &r /prjws8/users/michael/aml/rivernamesearch %riv%
    &end
&end

&return

/*~~~~~

```

```

&routine ReachSorterCode

&call IncnSorter

&sv nRchs = [extract 1 [show select %riv% arc]]
&if %nRchs% > 1 &then
&do
    &call ISOdate
    &type ERROR: %nRchs% multiple reaches for %reachcode%
    &sv coverstatus = ERROR, see %reachlog%
    &sys echo %aml$fullfile% %ISOdate% ERROR: %nRchs% multiple reaches for %reachcode% >>
    %reachlog%
    /*&stop Debug
&end
&if %nRchs% < 1 &then
&do
    &call ISOdate
    &sv coverstatus = ERROR, see %reachlog%
    &type -----
    &type ERROR no reach for %reachcode%
    &type check for arc pointing wrong way, terminal arc without end = M or E
    &type and try BUILD [translate %riv%] NODE
    &type -----
    &sys echo %aml$fullfile% %ISOdate% ERROR: no reach for %reachcode% >> %reachlog%
&end

&sv end      = [show select %riv% arc 1 item end      ]
&sv tnd      = [show select %riv% arc 1 item tnode#    ]

moveitem %riv% arc [quote %Sn%] to sorter

linecolor cyan
arcs %riv%
linecolor black

&return

/*~~~~~
&routine ReachReport

&sv nRchs = [extract 1 [show select %riv% arc]]
&if %nRchs% > 1 &then &type ERROR: %nRchs% reaches for %reachcode%
&if %nRchs% < 1 &then
&do
    &type -----
    &type ERROR no reach for %reachcode%
    &type check for arc pointing wrong way, terminal arc without end = M or E
    &type and try BUILD [translate %riv%] NODE
    &type -----
&end

&sv order      = [show select %riv% arc 1 item order      ]
&sv sorter      = [show select %riv% arc 1 item sorter      ]
&sv name        = [show select %riv% arc 1 item name        ]
&sv end         = [show select %riv% arc 1 item end         ]
&sv tnd         = [show select %riv% arc 1 item tnode#      ]
&sv length      = [show select %riv% arc 1 item length      ]
&sv reachcode   = [show select %riv% arc 1 item reachcode   ]
&sv length_sum  = %length_sum% + [calc %length% / 1000 ]
&sv length_sum  = [calc [round [calc %length_sum% * 100]] / 100]
&sv nmbr        = %nmbr% + 1
&sv wList [write %rList% [quote %nmbr%,%sorter%,%order%,%reachcode%,%name%,%length_sum%
]]
&type %nmbr% %sorter% %reachcode% %order% %length_sum% km %name%

textcolor red
linecolor red
arcs %riv%
arctext %riv% reachcode

```

```

textcolor black
linecolor black

&return

/*~~~~~
&routine ReachReportSingle

&call IncnSorter

/* Confirm that this is a single, unlinked arc:
&sv nRchs = [extract 1 [show select %riv% arc]]
&if %nRchs% < 1 &then
&do
  &sv order      = [show select temp$starts info %nEM% item order    ]
  &sv name       = [show select temp$starts info %nEM% item name     ]
  &sv end        = [show select temp$starts info %nEM% item end       ]
  &sv fnd        = [show select temp$starts info %nEM% item fnode#    ]
  &sv length     = [show select temp$starts info %nEM% item length    ]
  &sv reachcode  = [show select temp$starts info %nEM% item reachcode]
  &sv length_sum = [calc %length% / 1000 ]
  &sv length_sum = [calc [round [calc %length_sum% * 100]] / 100]
  moveitem %riv% arc [quote %Sn%] to sorter
  &sv rList [open %reachcode%.txt openstatus -write]
  &sv wList [write %rList% [quote Sequence,Sorter,Order,Reachcode,Name,kmCumulate]]
  &sv wList [write %rList% [quote 1,[unquote
%Sn%],%order%,%reachcode%,%name%,%length_sum% ]]
  &sv cList [close %rList%]
  &type Single %end% reach is whole river!
  &type 1 [unquote %Sn%] %reachcode% %order% %length_sum% km %name%
  clearselect %riv% arc
  reselect %riv% arc reachcode = [quote %reachcode%]
  textcolor green
  linecolor green
  arcs %riv%
  arctext %riv% reachcode
  textcolor black
  linecolor black
&end

&return

/*~~~~~
&routine ISOdate

/* date in ISO format
&sv ISOdate [date -year]-[substr[date -usa] 1 2]-[substr[date -vmsdate] 1 2] -
[before[date -vmstime] .]

&return

/*~~~~~
&routine IncNsorter
/* convert numbers to 8-char strings padded with leading zeroes

&sv nSorter = %nSorter% + 1

&if %nSorter% > 99999999 &then &stop Fatal error nSorter > 99999999
&if %nSorter% < 10000000 &then &sv Sn = 0%nSorter%
&if %nSorter% < 1000000 &then &sv Sn = 0%Sn%
&if %nSorter% < 100000 &then &sv Sn = 0%Sn%
&if %nSorter% < 10000 &then &sv Sn = 0%Sn%
&if %nSorter% < 1000 &then &sv Sn = 0%Sn%
&if %nSorter% < 100 &then &sv Sn = 0%Sn%
&if %nSorter% < 10 &then &sv Sn = 0%Sn%

&sv Sn %primary%%Sn%

&return

```

rivernamesearch.aml

```

/* Generate a list of all the named rivers in the coverage.
/* For each river in the list of names, search the river coverage for that name
/* and extract the linked arcs. Take into account duplicate names.
/* Michael Silberbauer 2003-04-04
/* Michael Silberbauer 2003-08-14 add automatic deletion of riv_*.txt files
/* Michael Silberbauer 2003-11-18 add generation of AML to display duplicates

&args rivcov

&call ISOdate
&sv starttime = %ISOdate%

&sv primary [translate [substr [entryname %rivcov% ] 4 1]]
&sv rivdir /hri/db/cover/riv

&type Using %primary% for primary drainage region.
&sv reachlog = %rivdir%/db/rivreach[locase %primary%].log
&if ^ [exists %reachlog% -file] &then~
  &sys echo Log file for allocation of reaches to river segments in drainage region
  [translate %primary%] > %reachlog%

ArcEdit
display 0
editcover %rivcov%
editfeature arc

&type Removing all riv_*.km.txt files in [show workspace]:
&sys \rm riv_*.km.txt

/*&if ^ [iteminfo %rivcov% -arc seqnum -exists] &then additem seqnum 4 5 B
/*sel all
/*cal seqnum = $recno

&sv nNams = [listunique %rivcov% -arc name rivnames.txt]
/*&sv nNams = 1 /*debug
&sv co [close -all]
&sv of [open rivnames.txt openstatus -read]

/*For each river name in the list:
&do nNam = 1 &to %nNams%
  &sv rf [read %of% readstatus]
  &sv rivnam = [quote [unquote %rf%]]
  &type (%nNam% of %nNams%) %rivnam%
  &sv numofriv = 0

  /* Select all river arcs with the name:
  &sv recnolist = [unquote '']
  &if %rivnam% <> '' &then
    &do
      select name = %rivnam%
      &sv nRivs = [show number selected]
    &end
  &else
    &sv nRivs = 0
    &if %nRivs% = 0 &then &type %rivnam% not found
  &else
    &do

      /* Create a list of all the river arc record numbers:
      &do nRiv = 1 &to %nRivs%
        &sv recnolist = %recnolist% [show select %nRiv%]
      &end

      &sv checked = 0

      /* Look at each record number in recnolist:
      &do nRec &list %recnolist%

```

```

/* If we've already seen this arc, we don't need to look at it again:
&sv checkedthis = .FALSE.
&do cZk &list %checked% &until %checkedthis%
  &if %nRec% = %cZk% &then &sv checkedthis = .TRUE.
&end

&if %checkedthis% &then &type Allocated %nRec% already...
&else
  &do
    /* Select contiguous arcs with the same name until
    /* there are no more to select:
    select $recno = %nRec%
    &sv nChecked = 0
    &sv AllLinked = .FALSE.
    &do &until %AllLinked%
      &message &off
      aselect connect
      reselect name = %rivnam%
      &sv nSel = [show number selected]
      &message &on
      &if %nChecked% = %nSel% &then &sv AllLinked = .TRUE.
      &sv nChecked = %nSel%
    &end

    /* If we've already seen any of these arcs, we can skip this bit:
    &sv nLinked = [show number selected]
    &sv checkedlink = .FALSE.
    &do nLink = 1 &to %nLinked% &until %checkedlink%
      &sv link = [show select %nLink%]
      &do cZk &list %checked% &until %checkedlink%
        &if %link% = %cZk% &then &sv checkedlink = .TRUE.
      &end
    &end

    &if %checkedlink% &then &type OK %link% already done
    &else
      &do
        &sv numofriv = %numofriv% + 1
        statistics # # init
        sum length
        end

        &sv sumkm = [round [calc [show statistic 1 1] / 1000]]

        &sv rivfile [unquote [subst [quote %rivnam%] ' ' '']]
        &sv rivfile [locase riv_[unquote %rivfile%_%numofriv%_%sumkm%km].txt]
        &type Complete river for (%nNam%) %rivnam% %numofriv% in %rivfile%
        listoutput temprivfile.txt init
        list sorter reachcode name
        listoutput screen
        &sys grep -v Record temprivfile.txt > %rivfile%
        &sys sort -o %rivfile% -k 2 %rivfile%
        /* Now all that remains is to add all these arcs to the "seen" list:
        &do nLink = 1 &to %nLinked%
          &sv link = [show select %nLink%]
          &sv checked = %checked% %link%
        &end
      &end
    /* end of else
  &end
&end
&end
&end
&sv cf [close -all]

quit

&type River names used at least twice:

```

```

&sys ls riv_ *_2_*.txt
&sys echo River names used at least twice >> %reachlog%
&sys ls riv_ *_2_*.txt >> %reachlog%
&if [exists rivdups.aml -file] &then &sv drdf [delete rivdups.aml -file]
&sys echo ArcEdit > rivdups.aml
&sys echo lineset plotter >> rivdups.aml
&sys echo linesymbol 10 >> rivdups.aml
&sys echo lineput 6 >> rivdups.aml
&sys echo disp 9999 3 >> rivdups.aml
&sys echo sds 6 >> rivdups.aml
&sys echo ec %rivcov% >> rivdups.aml
&sys echo ef arc >> rivdups.aml
&sys echo de arc >> rivdups.aml
&sys ls -l riv*.txt | grep _2_ | nawk -f /prjws8/users/michael/data/rivdups.awk >>
rivdups.aml
&sys echo quit >> rivdups.aml
&type To see the duplicate rivers, run rivdups.aml
&call ISOdate
&sys echo %starttime% - %ISOdate%: %AML$FULLFILE% %rivcov% >> %reachlog%
&return

```

```

&routine ISOdate

```

```

/* date in ISO format
&sv ISOdate [date -year]-[substr[date -usa] 1 2]-[substr[date -vmsdate] 1 2] -
[before[date -vmstime] .]

```

```

&return

```


appendrivs.aml

```

/* combine primary-catchment river files into a single coverage
/* and fine-tune attributes. - Michael Silberbauer 2003-05-14
/* Fix reserved words in coverage - Michael Silberbauer 2003-08-11
/* Make backup copy of wri_500
/* before proceeding - Michael Silberbauer 2004-04-20
/* Streamline creation of XML
/* metadata - Michael Silberbauer 2005-07-11

&sv rivdir /hri/db/cover/riv

w %rivdir%
&sv rivcov = wri_500

&if [exists %rivcov%[date -tag] -cover] &then kill %rivcov%[date -tag] all
&if [exists %rivcov% -cover] &then rename %rivcov% %rivcov%[date -tag]
&sv pri b c d e f g h j k l m n p q r s t u v w x
copy a/wria500 %rivcov%

ArcEdit
duplicatearcs no
ec %rivcov%
ef arc
&do p &list %pri%
    &type %p%
    get %p%/wri%p%500
&end

&type Add a length field that will survive projection:
additem LENGTH_KM 4 12 F 3
sel all
calculate LENGTH_KM = LENGTH / 1000

save
quit

/* Remove unnecessary temporary fields:
dropitem %rivcov%.aat %rivcov%.aat Z KEY-ID FLIP SEQNUM

ArcEdit
ec %rivcov%
ef arc

/* make the connections between adjacent drainage regions:
sel name = 'Orange'
sel connect
resel name = 'Vaal'
cal end = 'N'
sel name = 'Limpopo'
sel connect
resel name = 'Elefantes'
cal end = 'N'

/* standardise the river flow type descriptions:

sel CLASS = 'Dry_river'
cal CLASS = 'Dry'

sel CLASS cn 'Non'
cal CLASS = 'NonPerennial'

sel CLASS = 'PERENNIAL_RIVER'
asel CLASS = 'Perennial'
asel CLASS = 'Perennial-river'
asel CLASS = 'Perennial_rive'
asel CLASS = 'Perennial_river'
cal CLASS = 'Perennial'

```

```

sel CLASS      = ''
cal CLASS      = 'Unknown'

/* remove aliases that are the same as river names:
sel NAME       = ''
nselect
resel ALIAS    = NAME
cal ALIAS      = ''

save
quit

/* confirm tolerances and build topology:
tol %rivcov%
build %rivcov% arc
build %rivcov% node
index %rivcov% line

/* make entry in log file:
&call ISOdate
&sys echo %AML$FullFile% %ISOdate% by user [username] >>
/hri/db/cover/riv/db/rivreach.log

/* update metadata file and place in coverage:
&sys echo [substr [quote %ISOdate%] 1 10] >> source.adf
&sys cp source.adf %rivcov%
&r /prjws8/users/michael/aml/source2xml cover replace %rivcov%

/* create and build geographic version of coverage:
&if [exists %rivcov%-geo -cover] &then kill %rivcov%-geo all
project cover %rivcov% %rivcov%-geo /hri/db/michael/aml/alb2geo.prj

tol %rivcov%-geo
build %rivcov%-geo arc
build %rivcov%-geo node
index %rivcov%-geo line
cp source.adf %rivcov%-geo
&r /prjws8/users/michael/aml/source2xml cover replace %rivcov%-geo

/* Rename river fields that conflict with SDE reserved words.

&sv sderiv /hri/db/cover/riv/wri_sde-geo
&sv ri [entryname %sderiv%]
&if [exists %ri% -cover] &then kill %ri% all
copy %rivcov%-geo %ri%

&call ISOdate

&DATA arc info
ARC
SELECT [TRANSLATE %ri%.aat]
    ALTER NAME,RIV_NAME,,,,,,,,
    ALTER ALIAS,RIV_ALIAS,,,,,,,,
    ALTER ORDER,RIV_ORDER,,,,,,,,
    ALTER CLASS,RIV_CLASS,,,,,,,,
    ALTER PRIMARY,RIV_PRIMARY,,,,,,,,
    ALTER END,RIV_END,,,,,,,,
    ALTER SORTER,RIV_SORTER,,,,,,,,

Q STOP

&end
&call MetaUpdater

&r /prjws8/users/michael/aml/source2xml cover replace %ri%
/*&if [exists %ri%.e00 -file] &then &sv df [delete %ri%.e00 -file]
/*export cover %ri% %ri%
```

```

&call ISOdate
&type %ISOdate% finished - now please check the river order values at the Vaal-Orange
and Elefantjes-Limpopo intersections!

&return

/*=====

&routine ISOdate

/* date in ISO format
&sv ISOdate [date -year]-[substr[date -usa] 1 2]-[substr[date -vmsdate] 1 2] -
[before[date -vmstime] .]

&return

/*=====

&routine MetaUpdater

&sv sf = source.adf
&sv md %ri%/source.adf

&if [exists %sf% -file] &then &sv fs = [open %sf% openstatus -read]
&else &stop No file %sf%
&if [exists %md% -file] &then &sv dmd [delete %md% -file]
&sv dm = [open %md% openstatus -write]
&sv openfile =
&sv readstatus = 0
&sv writestatus = 0
&do &while %readstatus% = 0
    &sv rs [read %fs% readstatus]
    &sv wmd [write %dm% %rs%]
    &if [quote %rs%] = '.History' &then
        &do
            &sv wmd [write %dm% '-----']
            &sv wmd [write %dm% ~
                [quote Version with field names that do not conflict with SDE usage.]]
            &sv wmd [write %dm% [quote Inserted [unquote %ISOdate%]]]
            &sv wmd [write %dm% [quote use RIV_NAME      for NAME]]
            &sv wmd [write %dm% [quote use RIV_ALIAS     for ALIAS]]
            &sv wmd [write %dm% [quote use RIV_ORDER    for ORDER]]
            &sv wmd [write %dm% [quote use RIV_CLASS     for CLASS]]
            &sv wmd [write %dm% [quote use RIV_PRIMARY  for PRIMARY]]
            &sv wmd [write %dm% [quote use RIV_END      for END]]
            &sv wmd [write %dm% [quote use RIV_SORTER   for SORTER]]
            &sv wmd [write %dm% '-----']
        &end
    &end
&sv cmd [close %dm%]
&sv cfs [close %fs%]

&return

```

```

riversuffix.aml
/* Separate the suffix "spruit" or "se loop" etc from the river name:
/* We've already done this for the rivers called "... River" or "...rivier"
/* using locase_wri.aml (December 1994).
/* Michael Silberbauer 2003-08-13 : test on text file of river names
/* Michael Silberbauer 2004-05-11 : version for arc attribute file
/* Michael Silberbauer 2004-05-12 : dropped ALIAS as too complex

/* Create the fields REACHCODE, RIVN_ROOT, RIVN_SUFX in a new LUT
/* (Reach code, root of river name, suffix for river).
/* -assume the default value of RIVN_SUFX is 'River'
/* - -check each river NAME and split off the suffix where necessary
/* - -populate the REACHCODE, RIVN_ROOT, RIVN_SUFX fields

&args rivcov Debug

&if [null %rivcov%] &then &stop Usage: riversuffix rivercoverage {Debug}
&if [null %Debug%] &then &sv Debug = .false.
  &else &sv Debug = .true.

&if [exists %rivcov% -cover] &then &type Splitting river names in %rivcov%
  &else &stop Could not find %rivcov%

&sv ca [close -all]
w [dir %rivcov%]
&sv AsciiFile = [entryname %rivcov%]nam.txt

&sv rf [open tmp%AsciiFile% openstatus -write]

&sv Suffixlist = ' River' 'rivier' 'river' 'sloot' ' Stream' 'stream' 'stroom' 'se Grip' '
Vlei' 'put' 'spruit' 'se Spruit' ' Spruit' 'seloop' 'loop' 'se Loop' 'leegte' 'se
Leegte' 'laagte' 'se Laagte' 'holte' 'se Holte' ' se' 'pan' ' Pan' ' Harbour'

ARCPLOT
clearselect %rivcov% arc
reselect %rivcov% arc $recno > 0
&sv nArcs = [extract 1 [show select %rivcov% arc]]
&type %nArcs% in %rivcov%

&do nArc = 1 &to %nArcs%
  &message &off
  clearselect %rivcov% arc
  reselect %rivcov% arc $recno = %nArc%
  &message &on
  &sv RivName = [show select %rivcov% arc 1 item name ]
  &if ( [quote [unquote %RivName%]] NE [quote [unquote '']] ) &then
    &do
      &sv ReachCode = [show select %rivcov% arc 1 item reachcode]
      &sv name = [unquote %RivName%]
      &sv rSufx = River
      &call suffix
      &sv name = [unquote [trim [quote %name%]]]
      &sv line = %reachcode%, [unquote %name%], [unquote %rSufx%], [unquote %name%]
[unquote %rSufx%]
      &ty %nArc%: %RivName% %line%
      &sv wf [write %rf% [quote [unquote %line%]]]
    &end
  &end
&end
QUIT /* ARCPLOT

&sv ca [close -all]
&sv InfoName = [translate [entryname %rivcov%].NAM]
&if [exists %InfoName% -info] &then &sv di [delete %InfoName% -info]
&ty Creating lookup table %InfoName%

&DATA ARC INFO
ARC
DEFINE %InfoName%
REACHCODE,10,10,C

```

```

RIVN_ROOT,40,40,C
RIVN_SUFX,15,15,C
RIVN      ,42,42,C

ADD FROM ../tmp%AsciiFile% rivnamerr.tmp
LIST 1,10 REACHCODE,RIVN_ROOT,RIVN_SUFX
Q STOP
Q
&end

/* Put in a header line for ArcView, Excel, etc.
&sv rf [open tmp%AsciiFile% openstatus -read]
&sv wf [open      %AsciiFile% openstatus -write]
&sv line [read %rf% readstatus]
&if %readstatus% = 0 &then
&do
    &sv of [write %wf% [quote ReachCode,Rivn_Root,Rivn_Sufx,Rivn]]
    &sv of [write %wf% %line%]
    &do &while %readstatus% = 0
        &sv line [read %rf% readstatus]
        &sv of [write %wf% %line%]
    &end
&end
&sv ca [close -all]
&sv df [delete tmp%AsciiFile% -file]
&type ASCII text file: %AsciiFile%
&type INFO  data file: %InfoName%

&return

/*.....
&routine suffix
&do Sufx &list %Sufxlist%

/* Check that we are working with the last suffix in the name
/* (trap compound names like Kleinveispruitloop, which
/*  should become Kleinveispruit Loop)
/* 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 2
/* 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0
/* K l e i n v l e i s p r u i t l o o p
/* s_len   = 4 (loop).....- - - -
/* s_start = 16.....-
/* s_end   = 19.....-
/* chk_len = 4

&sv s_len   = [length %Sufx%]
&sv s_start = [index [quote %RivName%] %Sufx%]
&sv s_end   = [length [quote %RivName%]]
&sv chk_len = [calc 1 + ( %s_end% - %s_start% ) ]

&if ( %s_len% EQ %chk_len% ) AND ( %s_start% > 0 ) &then
&do
    &sv n_end = %s_start% - 1
    &sv name = [substr [quote %RivName%] 1 %n_end%]
    &if %Sufx% = ' se' &then
    &do
        &sv rSufx 'se River'
        &return
    &end
    &sv rSufx = [substr [quote %RivName%] %s_start% %s_end%]
    &if %rSufx% = %Sufx% &then
    &do
        &if [substr %Sufx% 1 1] = ' ' &then
        &do
            &sv rSufx = [substr %Sufx% 2 [length %Sufx%]]
        &end
        &else
        &do
            &if [substr %Sufx% 1 3] = 'se ' &then &sv rSufx = %Sufx%

```

```
&else
  &if %Sufx% = 'seloop' &then &sv rSufx = 'se Loop'
  &else
    &sv rSufx = [translate [substr %Sufx% 1 1]][substr %Sufx% 2 [length %Sufx%]]
  &end
&end
&return
&end
&end

&return
```

rivcheck.aml

```

/* Produce check maps for randomly-selected river arcs from
/* the old 1:500k river coverage and compare them with the
/* new edited coverage, for statistical purposes.
/* Select a river segment from its wri_500-geo# number;
/* zoom to the area of the river;
/* choose the 1:50 000 maps that cover this area;
/* set the DISPLAY to the appropriate pixel size;
/* plot the map, the river segment, the new river and any other information;
/*
/* Michael Silberbauer 2002-03-07 (stmapimg.aml)
/*                2002-11-06 zoom and map river segments
/*                2005-07-12 update image directories

&args p_s De_bug

&if [null %p_s%] &then &sv ps = .false.
  &else &sv ps = .true.
&if [null %De_bug%] &then &sv Debug = .false.
  &else &sv Debug = .true.

&sv sd 42
&sv pc 1
&sv pt /hri/db/cover/s-africa/nms_his-geo
/*&sv pt /iwqs/usr/juanita/ecotype/croc/monpnts-11
&sv mb /hri/db/cover/s-africa/xdn_50-geo
&sv rb /hri/db/cover/s-africa/xdn_500-geo
&sv m1 /hri/db/img/map50000/geo
/*&sv m2 /iwqsl/db/img/map50000/geo
&sv m2 = %m1%
&sv rd /hri/db/cover/riv
&sv rl %rd%/wri_500-geo
&sv rn %rd%/d/wrinamgeo
/*&sv r2 %rd%/c/danieel/wric500-geo
&sv pr /hri/db/cover/s-africa/hca_1-geo
&sv pv /hri/db/cover/s-africa/spr_500-geo
&sv r500 /hri/db/cover/s-africa/wri_500-geo
&sv n500 /hri/db/cover/s-africa/wri_nsa-geo
&sv l500 /hri/db/cover/s-africa/wla_500-geo
&sv td /iwqs3/tmp/riv/rivstatcheck
&sv od /iwqs3/tmp/riv/rivstatcheck
&sv th %od%/[username][after [date -ftag] .].html
&sv tx %od%/[username][after [date -ftag] .].txt
&sv tl [username][after [date -ftag] .].tmp
&if [exists %tl% -info] &then &sys \rm %tl%

/* here the image size is selected

&sv x_wide    = 0.0337
&sv y_high    = 0.0411

/* Randomly selected arc numbers:
/* First list:
/*&sv rList = 164 268 384 504 709 995 1004 1056 1136 1164 1203 1484 1625 1642 1726 1786
2098 2100 2251 2259 2275 2303 2326 2390 2482 2600 2680 2737 2783 2793 2871 3040 3350
3357 3476 3707 3712 3994 4000 4049 4101 4109 4204 4209 4291 4469 4518 4537 4618 4837
4884 4993 5005 5015 5034 5085 5296 5601 5649 5708 5807 5969 6065 6288 6685 6707 6779
6844 6956 7149 7207 7268 7270 7298 7301 7407 7446 7556 7835 7983 8168 8247 8601 8706
8722 8845 8927 9013 9045 9091 9168 9181 9249 9330 9408

/* Second list:
/*&sv rList 195 267 420 565 611 664 669 718 844 893 923 1166 1188 1286 1499 1754 1853
2048 2117 2221 2231 2447 2580 2643 2895 2942 3058 3066 3076 3323 3366 3454 3458 3627
3744 3796 3858 3950 3973 3994 4000 4215 4235 4381 4578 4740 5060 5276 5389 5521 5561
5580 5664 5738 5968 6023 6028 6046 6287 6344 6577 6774 6865 6909 6932 6954 6960 7115
7198 7291 7368 7403 7409 7430 7543 7557 7574 7667 7699 7829 7849 8022 8033 8171 8185
8288 8376 8426 8472 8528 8561 8845 9099 9270 9285

```

```

/* Third selection (getting fancier):
ARCPLOT
clearselect %r1% arc
reselect    %r1% arc primary = 'O'
aselect     %r1% arc primary = 'a'
aselect     %r1% arc primary = 'b'
aselect     %r1% arc primary = 'd'
aselect     %r1% arc primary = 'y'
aselect     %r1% arc primary = 'z'
nselect     %r1% arc
reselect    %r1% arc RANDOM %pc% PERCENT %sd%
&sv nRivs = [extract 1 [show select %r1% arc]]
&sv nRivT = [extract 2 [show select %r1% arc]]
infofile %r1% arc %t1% [entryname %r1%]# init
&sv rList = [unquote '']
&do nRiv = 1 &to %nRivs%
    &sv nArc = [show select %t1% info %nRiv% item [entryname %r1%]#]
    &sv rList = %rList% %nArc%
&end
QUIT

/* Fixed list
/*&sv rList 7543

/* <<This bit is for backward compatibility with fixed lists:
&sv nRivs = 0
&do nRiv &list %rList%
    &sv nRivs = %nRivs% + 1
&end
/*----->>

/* date in ISO format and header for reference files:
&sv ISOdate [quote [date -year]-[substr[date -usa] 1 2]-[substr[date -vmsdate] 1 2] -
[before[date -vmstime] .] ]
&type Job run on %ISOdate%
&sys echo    '<html>' > %th%
&sys echo    '<title>' >> %th%
&sv textline River arc sample %ISOdate%
&sys echo    [quote %textline%] >> %th%
&sys echo    '</title>' >> %th%
&sys echo    [quote %textline%] > %tx%
&sys echo    '<body>' >> %th%
&sv textline <H2>River data in %r1% </H2><br><H2>%r1%</H2><br>AML %AML$fullfile%<br>
&sys echo    [quote %textline%] >> %th%
&sv textline Drawn on [unquote %ISOdate%] <B>seed</B>=%sd% <B>percent</B>=%pc%<br>
&sys echo    [quote %textline%] >> %th%
&sys echo    [quote %textline%] >> %tx%
&sv textline using %nRivs% of the %nRivT% arcs available.<br>
&sys echo    [quote %textline%] >> %th%
&sys echo    [quote %textline%] >> %tx%
&sys echo    '<table border alt="River arc sample">' >> %th%

ARCPLOT
disp 1040 1
tmp

&sv nR = 0
&do nRiv &list %rList%
    &sv nR = %nR% + 1
    clearselect %r1% arc
    reselect %r1% arc [entryname %r1%]# = %nRiv%
    &sv name    [show select %r1% arc 1 item name      ]
    &sv alias   [show select %r1% arc 1 item alias     ]
    &sv length  [show select %r1% arc 1 item length_km]
    &sv class   [show select %r1% arc 1 item class     ]
    &sv order   [show select %r1% arc 1 item order     ]
    &sv primary [show select %r1% arc 1 item primary   ]
    &sv reach   [show select %r1% arc 1 item reachcode]
    &sv end     [show select %r1% arc 1 item end       ]

```



```

&sv length = [round [calc %length% * 1000]]
&sv PrintFile [locase [quote %reach%]]
/*
    &sv PrintFile [locase seg[quote %nRiv%]]
/*&if %nRiv% < 10000 &then &sv PrintFile [locase seg[quote 0%nRiv%]]
/*&if %nRiv% < 1000 &then &sv PrintFile [locase seg[quote 00%nRiv%]]
/*&if %nRiv% < 100 &then &sv PrintFile [locase seg[quote 000%nRiv%]]
/*&if %nRiv% < 10 &then &sv PrintFile [locase seg[quote 0000%nRiv%]]
&sv pf %od%/[unquote %PrintFile%]
&sv pf_s %od%/small/[unquote %PrintFile%]_s
&if %ps% &then &type (%nR% of %nRivs%) Processing %reach% (%name%) as %pf%.ps and
%pf%.pdf
    &else &type (%nR% of %nRivs%) Processing %reach% (%name%) as %pf%.jpg and %pf%_s.jpg
    &call map_gen
&end
QUIT
&sys echo '</table></body></html>' >> %th%
&type Reference file is %th%
&sv dtl [delete %tl% -info]

&return

/*-----

&routine map_gen

&sv xpage 21.0
&sv ypage 29.7

&sv ym02 [calc %ypage% / 02]
&sv ym04 [calc %ypage% / 04]
&sv ym08 [calc %ypage% / 08]
&sv ym10 [calc %ypage% / 10]
&sv ym20 [calc %ypage% / 20]
&sv ym40 [calc %ypage% / 40]
&sv ym80 [calc %ypage% / 80]

&sv xm02 [calc %xpage% / 02]
&sv xm04 [calc %xpage% / 04]
&sv xm08 [calc %xpage% / 08]
&sv xm10 [calc %xpage% / 10]
&sv xm20 [calc %xpage% / 20]
&sv xm40 [calc %xpage% / 40]
&sv xm80 [calc %xpage% / 80]

/*&if [exists %pf%.ps -file] &then &sv dps [delete %pf%.ps -file]
/*&type postscript %pf% %pf%.ps
/*postscript %pf% %pf%.ps
&sv map_ps = %od%/[unquote %PrintFile%].ps
&sv map_pdf = %od%/[unquote %PrintFile%].pdf

&sv map_jpg = %pf%_s%.jpg
&sv map_jgw = %pf%_s%.jgw
&sv map_jpg_s = %pf%_s%.jpg
&sv map_jgw_s = %pf%_s%.jgw

&if %ps% &then
&do
    display 1040 2
    %map_ps%
&end
&else
    display 9999 2

pageunits cm
shadeset color
pagesize %xpage% %ypage%
box 0 0 [show pagesize]
/*maplimits %xm10% %ym04% [calc %xpage% - %xm10%] [calc %ypage% - %xm10%]
maplimits %xm20% %ym08% [calc %xpage% - %xm20%] [calc %ypage% - %xm20%]

```

```

mapextent    arc %r1%
markerset    mineral
textset      font
lineset      plotter

/*&sv xmin = %x% - ( 0.5 * %x_wide% )
/*&sv xmax = %x% + ( 0.5 * %x_wide% )
/*&sv ymin = %y% - ( 0.5 * %y_high% )
/*&sv ymax = %y% + ( 0.5 * %y_high% )

&sv xmin [extract 1 [show mapextent]]
&sv ymin [extract 2 [show mapextent]]
&sv xmax [extract 3 [show mapextent]]
&sv ymax [extract 4 [show mapextent]]

&type [show mapextent]
&sv x [calc ( %xmax% + %xmin% ) / 2.0 ]
&sv y [calc ( %ymax% + %ymin% ) / 2.0 ]
&type x %x% y %y%
&sv xw [calc ( %xmax% - %xmin% ) ]
&sv yw [calc ( %ymax% - %ymin% ) ]
/* approximate height of selection box in metres: degLat*60*1852:
&sv yhm [calc %yw% * 60 * 1852]
/* approximate width in metres: degLon*(cos degLat)*60*1852:
&sv xhm [calc %xw% * [cos [angrad %yw%]] * 60 * 1852]
&type xw %xw% ([round %xhm%]m) yw %yw% ([round %yhm%]m)
/* map distances equivalent to 50 metres:
&sv xw50m = [calc ( %xw% / %xhm% ) * 50 ]
&sv yw50m = [calc ( %yw% / %yhm% ) * 50 ]

mapposition    cen cen
clipmapextent  off

/* select the area to plot, both for vector 1:50k data and raster
/* 1:50k data:

clearselect %r1% arc
reselect    %r1% arc  box %xmin% %ymin% %xmax% %ymax%

/*clearselect %r2% arc
/*reselect    %r2% arc  box %xmin% %ymin% %xmax% %ymax%

clearselect %rb% poly
reselect    %rb% poly box %xmin% %ymin% %xmax% %ymax%

clearselect %mb% poly
reselect    %mb% poly box %xmin% %ymin% %xmax% %ymax%
reselect    %mb% poly tile-name <> ''

clearselect %n500% arc
reselect    %n500% arc box %xmin% %ymin% %xmax% %ymax% passthru

/* Now that we have an image catalog this is simple...
image /hri/db/img/map250000/geo/map250k composite 1 2 3
image /hri/db/img/map50000/geo/map50k composite 1 2 3

/*... but we'll keep this bit because it was hard to do!

&sv sheets = [unquote 'Sheets ']
&sv nmbs = [extract 1 [show select %mb% poly]]
&if %nmbs% = 0 &then
&do
    &type No overlapping coverage available for %xmin% %ymin% %xmax% %ymax%!
    &sv Sheets No overlapping coverage available!
&end
&else
&do nmb = 1 &to %nmbs%

    &sv maplist = ''

```

```

&sv tile%nmb% = [locase [show select %mb% poly %nmb% item tile-name]]

/* The maps are on different disks:
&if [substr [quote [value tile%nmb%]] 1 1] = 3 &then &sv md = %m2%
&else &sv md = %m1%

&sv tiledir = %md%/[substr [quote g[value tile%nmb%]] 1 3]
&sv tilefile = %tiledir%/g[value tile%nmb%].jpg
&if [exists %tilefile%] &then
&do
  &type tile%nmb% = %tilefile%
  /*image %tilefile% composite 1 2 3
  &sv Sheets = %Sheets% [translate [value tile%nmb%]]
&end
&else
&do
  &sv tilex = [quote [value tile%nmb%]]
  &if [quote [unquote %tilex%]] = [quote [unquote '']] &then
    &type Blank tile name!
  &else
  &do
    &sv regex = g[substr %tilex% 1 2]*[substr %tilex% 3 4]*.jpg
    &type searching for tiles like %tiledir%/regex%
    &sv maplist = [listfile %tiledir%/regex% -file -FULL]
    &if %maplist% = '' &then
    &do
      &type no image like %tilefile%
      &call ISodate
      &sys echo %ISodate%: (%reach%) no image like %tilefile% >>
/iwqs3/tmp/riv/log.txt
    &end
    &else
    &do
      &sv nmaps = [token %maplist% -count]
      &do nmap = 1 &to %nmaps%
        &sv imgfile [extract %nmap% %maplist%]
        /*image %imgfile% composite 1 2 3
        &sv Sheets = %Sheets% [translate [before [entryname %imgfile%] .]]
      &end
    &end
  &end
&end
&end
&end

&sv nrbs = [extract 1 [show select %rb% poly]]
&do nrb = 1 &to %nrbs%
  &sv tile500%nrb% = [show select %rb% poly %nrb% item tile-name]
  /*&r /prjws8/users/michael/aml/riv50.aml
  &r riv50.aml
  &if [substr [value tile500%nrb%] 1 2] = 33 &then
  &do
    arclines %rd%/riv3317-geo riv3317-geo-id
    arclines %rd%/riv3321-geo riv3321-geo-id
    arclines %rd%/riv3324-geo riv3324-geo-id
  &end
  &else
  &do
    &sv rivertile riv[value tile500%nrb%]-geo
    &if [exists %rd%/rivertile% -cover] &then arclines %rd%/rivertile% rivertile%-id
  &end
&end

lineset plotter
linesymbol 6 /*red thick
arcs %n500% /*Namibia
arcs %rn%
textsymbol 2
textscale 2
textcolor 'red'

```

```

arctext %rn% name|'_Nam' # point2

linesymbol 18 /*red thin - - -
arcs %r500%
/*arcs %r2%

linesymbol 11 /*green thick
arcs %r1%
linesymbol 1

textsymbol 2
textscales 2.5
textcolor 'blue'
arctext %r1% name\alias # point2
/*arctext %r2% name\order # point2
textscales 1
textsymbol 1

/* date in ISO format
&sv ISOdate [quote [date -year]-[substr[date -usa] 1 2]-[substr[date -vmsdate] 1 2] -
[before[date -vmstime] .] ]
&type Job run on %ISOdate%

units          map
markersymbol 405
markerscale 2
/*marker      %x% %y%
/* Put in lines to show centre and size:
linesymbol 2 /* red thin
line          %xmin% %y% %xmax% %y%
line          %x% %ymin% %x% %ymax%
box           %xmin% %ymin% %xmax% %ymax%
box           [calc %x% - %xw50m%] [calc %y% - %yw50m%] [calc %x% + %xw50m%] [calc %y% +
%yw50m%]
units         page

textsymbol 1
textscales 1.5
&call        DD2DMS
move         %xm20% %ym40%
&sv textline [quote %nR% of %nRivs%: reach %reach% type %class% end %end% order %order%
primary%primary%\Length %length% ( red box is [round %xhm%]m x [round %yhm%]m)\Map
%Sheets%\%GeoLabel% (%ylat% %xlon%)\Drawn on [unquote %ISOdate%] seed=%sd%
percent=%pc%\using data in %r1% (green) and %r500% (red)\using AML %AML$fullfile%] 11
text         %textline%

&sv textline %nR%,%reach%,%class%,%order%,%primary%,%name%,%alias%
&sys echo    [quote %textline%] >> %tx%
&sv textline <tr><td><B>%nR%</B> of %nRivs%: arc <a href="out/[entryname
%map_pdf%]">%reach% (%name%)</a> %class% order %order% Primary %primary%<br>
&sys echo    [quote %textline%] >> %th%
&sv textline [round %length%]m long (box is [round %xhm%]m x [round %yhm%]m)<br>
&sys echo    [quote %textline%] >> %th%
/*&sv textline Map %Sheets%<br>GeoLabel% (%ylat% %xlon%)<br>
&sv textline Map %Sheets%<br> (%ylat% %xlon%)<br>
&sys echo    [quote %textline%] >> %th%
&sv textline Drawn on [unquote %ISOdate%]
&sys echo    [quote %textline%] >> %th%

move [calc %xpage% - %xm20%] [calc %ypage% - %xm20%]
textscales 2
textoffset 0 0.1
text %reach% lr
move          %xm20% [calc %ypage% - %xm20%]
textscales 1
text 'River check sheet'
textoffset 0 0

box [show maplimits]

```

```

&call locality

&if %ps% &then
&do
  QUIT
  &sys mv %map_ps% %od%/in
&end
&else
&do
  &if [exists temp.ras -file] &then &sv dt [delete temp.ras -file]
  &if [exists temp.rasw -file] &then &sv dt [delete temp.rasw -file]
  screensave temp.ras

  QUIT
  ARCPLOT

/* A way to create a small version of the image for a button:
  disp 9999 size canvas 95 135
  mape image temp.ras
/*mapposition cen cen
  image temp.ras
  screensave temp_s.ras

/*&stop
QUIT

&type Converting graphics file temp.ras into %map_jpg% with world file %map_jgw%...
&if [exists %map_jpg% -file] &then &sv deljpg [delete %map_jpg% -file]
&if [exists %map_jgw% -file] &then &sv deljgw [delete %map_jgw% -file]
convertimage temp.ras %map_jpg% jfif
&if [exists %map_jpg_s% -file] &then &sv deljpg [delete %map_jpg_s% -file]
&if [exists %map_jgw_s% -file] &then &sv deljgw [delete %map_jgw_s% -file]
convertimage temp_s.ras %map_jpg_s% jfif

&if ^ %Debug% &then
&do
  &if [exists temp.ras -file] &then &sv dt [delete temp.ras -file]
  &if [exists temp.rasw -file] &then &sv dt [delete temp.rasw -file]
  &if [exists temp_s.ras -file] &then &sv dt [delete temp_s.ras -file]
  &if [exists temp_s.rasw -file] &then &sv dt [delete temp_s.rasw -file]
  &if [exists %map_jgw% -file] &then &sv deljgw [delete %map_jgw% -file]
  &if [exists %map_jgw_s% -file] &then &sv deljgw [delete %map_jgw_s% -file]
&end

&end
ARCPLOT

&return

/*-----

&routine DD2DMS

&sv xlon = [round [ calc %x% * 1000000 ] ] / 1000000
&sv ylat = [round [ calc %y% * 1000000 ] ] / 1000000
&sv longitude %x%
&sv latitude %y%
&sv LonD = [truncate %longitude%]
&sv LonM = [truncate [calc ( %longitude% - %LonD% ) * 60 ] ]
&sv LonS = [calc ( ( [calc %longitude% - %LonD%] * 60 ) - %LonM% ) * 60]
&sv LatD = [truncate %latitude%]
&sv LatM = [truncate [calc ( %latitude% - %LatD% ) * 60 ] ]
&sv LatS = [calc ( ( [calc %latitude% - %LatD%] * 60 ) - %LatM% ) * 60]
&sv LonM = [abs %LonM%]
&sv LonS = [abs %LonS%]
&sv LatM = [abs %LatM%]
&sv LatS = [abs %LatS%]
&sv LatS = [round [calc ( %LatS% * 10 ) ] ] / 10
&sv LonS = [round [calc ( %LonS% * 10 ) ] ] / 10

```

```

&if %LonS% = 60 &then
&do
    &sv LonM = %LonM% + 1
    &sv LonS = 0
&end
&if %LonM% = 60 &then
&do
    &sv LonD = %LonD% + 1
    &sv LonM = 0
&end
&if %LonD% > 180 &then &sv LonD = %LonD% - 360
&if %LatS% = 60 &then
&do
    &sv LatM = %LatM% + 1
    &sv LatS = 0
&end
&if %LatM% = 60 &then
&do
    &sv LatD = %LatD% + 1
    &sv LatM = 0
&end
&if %LatD% > 90 &then &sv LatD = %LatD% - 90
&sv LonA = [unquote '']
&sv LatA = [unquote '']
&if %LonD% > 0 &then &sv LonA = E
&if %LonD% < 0 &then &sv LonA = W
&if %LatD% > 0 &then &sv LatA = N
&if %LatD% < 0 &then &sv LatA = S
&if %LonM% = 0 &then &sv LonM = 00
&if %LonS% = 0 &then &sv LonS = 00
&if %LatM% = 0 &then &sv LatM = 00
&if %LatS% = 0 &then &sv LatS = 00
&if %LonM% > 0 and %LonM% < 10 &then &sv LonM = 0%LonM%
&if %LonS% > 0 and %LonS% < 10 &then &sv LonS = 0%LonS%
&if %LatM% > 0 and %LatM% < 10 &then &sv LatM = 0%LatM%
&if %LatS% > 0 and %LatS% < 10 &then &sv LatS = 0%LatS%

&sv GeoString = [abs %LatD%]°%LatM%/%LatS%"%LatA% [abs %LonD%]°%LonM%/%LonS%"%LonA%
&sv GeoLabel = [abs %LatD%]°%LatM%/%LatS%"%LatA% [abs %LonD%]°%LonM%/%LonS%"%LonA%

&return

/*-----

&routine locality

linesymbol 1
/*box [calc %xm02% + %xm20%] %ym20% [calc %xpage% - %xm10%] [calc %ym04% - %xm20%]
/*mapl [calc %xm02% + %xm20%] %ym20% [calc %xpage% - %xm10%] [calc %ym04% - %xm20%]
box [calc %xm02% + %xm04%] %ym40% [calc %xpage% - %xm20%] [calc %ym08% - %ym80%]
maplimits [calc %xm02% + %xm04%] %ym40% [calc %xpage% - %xm20%] [calc %ym08% - %ym80%]
mapextent 16.5 -35 33 -21
clipmap off
mapposition cen cen
arcs %pr%
shadesymbol 2
patch %xmin% %ymin% %xmax% %ymax%

units map
linesymbol 2
line 16 %y% 34 %y%
line %x% -35 %x% -22
units page

textsymbol 1
textscale 2
&call DD2DMS
move %xm10% [calc %ym08% ]

```

```
&return
```

```
/*-----
```

```
&routine ISOdate
```

```
/* date in ISO format
```

```
&sv ISOdate [quote [date -year]-[substr[date -usa] 1 2]-[substr[date -vmsdate] 1 2] -  
[before[date -vmstime] .] ]
```

```
&return
```

riv2shp.aml

```

/* copy river coverages and files from Enterprise to shapefiles zipped on PC:
/* run on PC.
/* Michael Silberbauer 2003-06-19 : RQS, DWAF
/* Michael Silberbauer 2004-04-21 : removed GOTCHA! of DOS PKZIP only seeing files
/*                                     : that comply with 8.3 notation
/* Michael Silberbauer 2004-11-18 : changed %version% to %ISOdate%
/* Michael Silberbauer 2004-11-18 : added METADATA.XML
/* Michael Silberbauer 2005-07-27 : Make the ZIP program name a variable
/* Michael Silberbauer 2006-03-15 : Add references for RivEX fields, SHREVE, US_ACCUM,
CATCHID, DIST2MTH
/* Michael Silberbauer 2006-03-16 : Add shapefile of complete coverage
/* Michael Silberbauer 2006-08-22 : Fix problem of partial copy of *0000.txt files

&sv cf [close -all]
&sv ws0 = [show workspace]
&sv opsys = [extract 1 [show &os] ]

&if %opsys% = SunOS      &then
&do
    &stop Please run on PC.
    &sv enterprise = /hri
    &sv NL = \
    &sv remove = \rm
    &sv rename = mv
    &sv copy = \cp
&end

&if %opsys% = Windows_NT &then
&do
    &sv enterprise = N:
    &sv NL = /&
    &sv remove = del
    &sv rename = rename
    &sv copy = copy /y
    /*&sv zip_add C:\UTILS\PKZip\pkzip -a
    &sv zip_add pkzipc -add
&end

&call ISOdate
/*&s version = [response 'Please enter a version, e.g. third' draft]
&sv rivcov %enterprise%\db\cover\riv\wri_500-geo
&sv sderiv %enterprise%\db\cover\riv\wri_sde-geo
&sv rivdir %enterprise%\db\cover\riv
&sv projectdefine_Cape C:\data\AV\utilities\projection\wrim500.prj
&sv legend_order C:\Data_large\av\s-africa\wri_500-geo.avl
&sv metadata_SDE_txt %sderiv%\source.adf
&sv metadata_HTML C:\Temp\catalog\wri_500-geo.htm
&sv metadata_thumbnail C:\Temp\catalog\wri_500-geo.jpg
&sv lut_reachcode_rsa2usa C:\DATA\AV\Rivers\qat4qat8.txt
&sv logo_sa N:\db\clip\dwaf_logo_button.jpg

&sv pri a b c d e f g h j k l m n p q r s t u v w x

&sv error = .false.
&sv essentialfiles
&if ^ [exists %rivcov% -cover] &then
&do
    &sv error = .true.
    &type %rivcov% missing
&end
&if ^ [exists %sderiv% -cover] &then
&do
    &sv error = .true.
    &type %sderiv% missing
&end
&sv essentialfiles ~
    %projectdefine_Cape% ~

```



```

%legend_order% ~
%metadata_HTML% ~
%metadata_thumbnail% ~
%lut_reachcode_rsa2usa% ~
%metadata_SDE_txt% ~
%logo_sa%

&do ef &list %essentialfiles%
&if ^ [exists %ef% -file] &then
&do
&sv error = .true.
&type %ef% missing
&end
&end
&do p &list %pri%
&if ^ [exists %rivdir%\%p% -workspace] &then
&do
&sv error = .true.
&type %rivdir%\%p% missing
&end
&end

&if %error% &then &stop *** Essential files missing ***

build %rivcov% arc
build %rivcov% node

/* Go to the CD work area and create the necessary directories and files:
w C:\tmp\RiverCD
&if ^ [exists riv[date -tag] -directory] &then &sys mkdir riv[date -tag]
w riv[date -tag]
&if ^ [exists website -directory] &then &sys mkdir website
&if [exists wri_500-geo.avl -file] &then &sv delfil [delete wri_500-geo.avl -file]
&sys %copy% %legend_order% .
&if [exists metadsde.txt -file] &then &sv delfil [delete metadsde.txt -file]
&sys %copy% %metadata_SDE_txt% metadsde.txt
&sys %copy% %metadata_HTML% WRI_500-GEO.HTM
&sys %copy% %rivdir%\wri_500-geo\metadata.xml .

/* HTML files for locating data:
&sys %copy% %enterprise%\db\cover\html\hca_riv\*.html website
&sys %copy% %enterprise%\db\cover\html\hca_riv\*.jpg website
&sys %copy% %enterprise%\db\cover\html\hca_riv\*.map website

/* Sundry background information:
/* River name file
&if [exists website\rivnam.zip -file] &then &sv drnf [delete website\rivnam.zip -file]
&sys %zip_add% website\rivnam.zip %rivdir%\wri_500nam.txt
/* Quaternary drainage file
/* to be added *****
/* Dams file
/* to be added *****
/* Metadata file
&if [exists website\metadata.zip -file] &then &sv dxml [delete website\metadata.zip -
file]
&sys %zip_add% website\metadata.zip %rivdir%\wri_500-geo\metadata.xml

/* FULL E00 FILE section -----
/* create a README.TXT file
&call ISOdate
&sv rdme [open 0readme.txt openstatus -write]
&sv wr [write %rdme% [quote ZIP file for South African rivers created on %ISOdate%]]
&call writel
&sv wr [write %rdme% [quote -----]]
&sv wr [write %rdme% [quote The files are:]]
&call writemetfiles
&sv wr [write %rdme% [quote WRI_500-GEO.AVL: legend file for ArcView 3.x - line width
proportional to Strahler order.]]
&sv wr [write %rdme% [quote -----]]

```

```

&sv wr [write %rdme% [quote WRI500.E00: ESRI export file.]]
&sv wr [write %rdme% [quote The export file contains the South African 1:500 000 river
coverage]]
&sv wr [write %rdme% [quote for South Africa, in the Cape Datum, geographical
coordinates.]]
&sv wr [write %rdme% [quote The fields are:]]
&sv wr [write %rdme% [quote FNODE#, TNODE#, LPOLY#, RPOLY#, LENGTH, TMPRIV#, TMPRIV-ID:
internal fields - ignore them.]]
&call writearcfields
&sv cf [close %rdme%]

&if [exists wri500.e00 -file] &then &sv de [delete wri500.e00 -file]
export cover %rivcov% wri500.e00
&sv zip_file WebSite\wri500e0.zip
&if [exists %zip_file% -file] &then &sv dz [delete %zip_file% -file]
&sys %zip_add% %zip_file% wri500.e*
&sys %zip_add% %zip_file% 0readme.txt
&sys %zip_add% %zip_file% wri_500-geo.avl
&sys %zip_add% %zip_file% WRI_500-GEO.HTM
&sys %zip_add% %zip_file% wri_500-geo\metadata.xml
&sys %zip_add% %zip_file% %metadata_thumbnail%
&sys %zip_add% %zip_file% %logo_sa%
&sys %zip_add% %zip_file% %lut_reachcode_rsa2usa%

/* SDE-compatible E00 file:
&call ISOdate
&sv rdme [open 0readme.txt openstatus -write]
&sv wr [write %rdme% [quote ZIP file for South African rivers created on %ISOdate%]]
&call writel
&sv wr [write %rdme% [quote -----]]
&sv wr [write %rdme% [quote The files are:]]
&call writemetfiles
&sv wr [write %rdme% [quote WRI_500-GEO.AVL: legend file for ArcView 3.x - line width
proportional to Strahler order.]]
&sv wr [write %rdme% [quote -----]]
&sv wr [write %rdme% [quote WRISDE.E00: ESRI export file.]]
&sv wr [write %rdme% [quote The export file contains the South African 1:500 000 river
coverage]]
&sv wr [write %rdme% [quote for South Africa, in the Cape Datum, geographical
coordinates.]]
&sv wr [write %rdme% [quote The fields are:]]
&sv wr [write %rdme% [quote FNODE#, TNODE#, LPOLY#, RPOLY#, LENGTH, TMPRIV#, TMPRIV-ID:
internal fields - ignore them.]]
&call writesdefields
&sv cf [close %rdme%]

&if [exists wrisde.e00 -file] &then &sv de [delete wrisde.e00 -file]
export cover %sderiv% wrisde.e00
&sv zip_file WebSite\wrisde00.zip
&if [exists %zip_file% -file] &then &sv dz [delete %zip_file% -file]
&sys %zip_add% %zip_file% wrisde.e00
&sys %zip_add% %zip_file% 0readme.txt
&sys %zip_add% %zip_file% wri_500-geo.avl
&sys %zip_add% %zip_file% WRI_500-GEO.HTM
&sys %zip_add% %zip_file% wri_sde-geo\metadata.xml
&sys %zip_add% %zip_file% %metadata_thumbnail%
&sys %zip_add% %zip_file% %logo_sa%
&sys %zip_add% %zip_file% %lut_reachcode_rsa2usa%
&sys %zip_add% %zip_file% metadsde.txt

/* if alltxt directory does not exist, create it:
&if [exists alltxt -directory] &then &type using alltxt
&else &sys mkdir alltxt

/* delete all files in alltxt directory
&sys del /q alltxt\*. *

/* Primary drainage region shapefiles:
&sv listplus %pri% All

```

```

&do p &list %listplus%
  &call ISOdate
  &type [translate %p%] on %ISOdate%: arcshape %rivcov% %p%/wri%p%500

&do shptyp &list shp shx dbf sbn sbx xml avl e00 shp.xml prj
  &if [exists wri%p%500.%shptyp% -file] &then &sv ds [delete wri%p%500.%shptyp% -file]
&end

&if %p% = All &then
&do
  &if [exists tmpriv -cover] &then kill tmpriv
  copy %rivcov% tmpriv
  arcshape tmpriv arcs wri%p%500
&end
&else
&do
  &if [exists tmpriv -cover] &then kill tmpriv
  ArcEdit
    ec %rivcov%
    ef arc
    select primary = [quote [translate %p%]]
    aselect primary = [quote %p%] /* for catchments along the border of SA
    put tmpriv
    quit
  index tmpriv line
  arcshape tmpriv arcs wri%p%500
&end

&sys %copy% %rivdir%\wri_500-geo\metadata.xml wri%p%500.shp.xml
&sys %copy% %legend_order% wri%p%500.avl
&sys %copy% %projectdefine_Cape% wri%p%500.prj

export cover tmpriv wri%p%500
&if %opsys% = Windows_NT &then
&do
  /* SHAPEFILE section -----
  /* create a README_%p%.TXT file
  &call ISOdate
  &sv rdme [open 0read_%p%.txt openstatus -write]
  &sv wr [write %rdme% [quote ZIP file for South African rivers in drainage region
[translate %p%] created on %ISOdate%]]
  &call writel
  &sv wr [write %rdme% [quote -----]]
  &sv wr [write %rdme% [quote The files are:]]
  &call writemetasfiles
  &sv wr [write %rdme% [quote [translate wri%p%500.avl]: legend file for ArcView 3.x -
line width proportional to Strahler order.]]
  &sv wr [write %rdme% [quote -----]]
  &sv wr [write %rdme% [quote [translate wri%p%500.prj]: ESRI projection definition
file.]]
  &sv wr [write %rdme% [quote [translate wri%p%500.shp.xml]: ESRI metadata file.]]
  &sv wr [write %rdme% [quote [translate wri%p%500.shp], [translate wri%p%500.shx],
[translate wri%p%500.dbf]: ESRI shape file components.]]
  &sv wr [write %rdme% [quote The shape file contains the South African 1:500 000
river coverage]]
  &sv wr [write %rdme% [quote for drainage region(s) [translate %p%], in the Cape
Datum, geographical coordinates.]]
  &sv wr [write %rdme% [quote (All editing occurred in Albers Equal Area projection
for exact tolerance setting.))]
  &sv wr [write %rdme% [quote (The data is being kept in its original datum until a
standard datum-shift to]]
  &sv wr [write %rdme% [quote Hartebeesthoek94 or WGS84 is agreed upon, to avoid
inadvertent data corruption.))]
  &sv wr [write %rdme% [quote The fields are:]]
  &sv wr [write %rdme% [quote ]]
  &sv wr [write %rdme% [quote . -----]]
  &sv wr [write %rdme% [quote (1) INTERNAL FIELDS (ignore)]]

```

```

&sv wr [write %rdme% [quote . =====]]
&sv wr [write %rdme% [quote SHAPE, FNODE_, TNODE_, LPOLY_, RPOLY_, LENGTH,
TMPRIV_, TMPRIV_ID.]]
&call writearcfields
&sv cf [close %rdme%]

&if [exists WebSite\%p%.zip -file] &then &sv dz [delete WebSite\%p%.zip -file]
&sys %zip_add% WebSite\%p%.zip wri%p%500.s*
&sys %zip_add% WebSite\%p%.zip wri%p%500.d*
&sys %zip_add% WebSite\%p%.zip wri%p%500.prj
&sys %zip_add% WebSite\%p%.zip 0read_%p%.txt
&sys %zip_add% WebSite\%p%.zip wri%p%500.avl
&sys %zip_add% WebSite\%p%.zip wri%p%500.shp.xml
&sys %zip_add% WebSite\%p%.zip WRI_500-GEO.HTM
&sys %zip_add% WebSite\%p%.zip %metadata_thumbnail%
&sys %zip_add% WebSite\%p%.zip %logo_sa%
&sys %zip_add% WebSite\%p%.zip %lut_reachcode_rsa2usa%

/*do shptyp &list shp shx dbf sbn sbx
/* &if [exists wri%p%500.%shptyp% -file] &then &sv ds [delete wri%p%500.%shptyp% -
file]
/*&end

/* EXPORT (.E00) FILE section -----
/* create a README_%p%.TXT file
&call ISOdate
&sv rdme [open 0read_%p%.txt openstatus -write]
&sv wr [write %rdme% [quote ZIP file for South African rivers in drainage region(s):
[translate %p%] created on %ISOdate%]]
&call writel
&sv wr [write %rdme% [quote -----]]
&sv wr [write %rdme% [quote The files are:]]
&call writemetfiles
&sv wr [write %rdme% [quote -----]]
&sv wr [write %rdme% [quote WRI[translate %p%]500.E00: ESRI export file.]]
&sv wr [write %rdme% [quote The export file contains the South African 1:500 000
river coverage]]
&sv wr [write %rdme% [quote for drainage region(s) [translate %p%], in the Cape
Datum, geographical coordinates.]]
&sv wr [write %rdme% [quote The fields are:]]
&sv wr [write %rdme% [quote FNODE#, TNODE#, LPOLY#, RPOLY#, LENGTH, TMPRIV#, TMPRIV-
ID: internal fields - ignore them.]]
&call writearcfields
&sv cf [close %rdme%]

&if [exists WebSite\%p%e00.zip -file] &then &sv dz [delete WebSite\%p%e00.zip -file]
&sys %zip_add% WebSite\%p%e00.zip wri%p%500.e*
&sys %zip_add% WebSite\%p%e00.zip 0read_%p%.txt
&sys %zip_add% WebSite\%p%e00.zip wri%p%500.avl
&sys %zip_add% WebSite\%p%e00.zip WRI_500-GEO.HTM
&sys %zip_add% WebSite\%p%e00.zip %metadata_thumbnail%
&sys %zip_add% WebSite\%p%e00.zip %logo_sa%
&sys %zip_add% WebSite\%p%e00.zip %lut_reachcode_rsa2usa%

/* TEXTFILE section -----
/* if tmptxt directory does not exist, create it:
&if [exists tmptxt -directory] &then &type using tmptxt
    &else &sys mkdir tmptxt

/* delete all files in tmptxt directory
&sys del /q tmptxt\*. *

/* create a 0README.TXT file in tmptxt
&call ISOdate
&sv rdme [open tmptxt\0readme.txt openstatus -write]
&sv wr [write %rdme% [quote ZIP file with supplementary information for South
African rivers in drainage region [translate %p%] created on %ISOdate%]]
&call writel

```

```

&sv wr [write %rdme% [quote -----]]
&sv wr [write %rdme% [quote Each file lists the reaches in the South African 1:500
000 river coverage]]
&sv wr [write %rdme% [quote for a particular source reach code (truncated to 8
characters in the file name).]]
&sv wr [write %rdme% [quote ALWAYS USE THE SAME VERSION OF THE SUPPLEMENTARY FILE AS
THE RIVER COVERAGE.]]
&sv wr [write %rdme% [quote The files are related by the REACHCODE, which can change
between versions.]]
&sv wr [write %rdme% [quote ]]
&sv wr [write %rdme% [quote Fields are comma-delimited:]]
&sv wr [write %rdme% [quote SEQUENCE: numerical sequence of reach in each file]]
&sv wr [write %rdme% [quote SORTER: sorting field - always increases downstream in a
river network]]
&sv wr [write %rdme% [quote ORDER: Strahler order, starting from source=1]]
&sv wr [write %rdme% [quote REACHCODE: 10-character reach code made up as follows:]]
&sv wr [write %rdme% [quote - char 1 to 4: quaternary drainage region in which MOST
of the river falls]]
&sv wr [write %rdme% [quote (note that some USA programs like BASINS expect an 8-
digit numerical code. The qat4qat8.txt lookup table contains the correct DWAF
conversions.]]
&sv wr [write %rdme% [quote - char 5 to 6: arbitrary sequence number of the reaches
within a quaternary drainage region]]
&sv wr [write %rdme% [quote - char 7 to 10: 0000 in the 1:500 000 coverage, intended
for use at more detailed scale]]
&sv wr [write %rdme% [quote NAME: generally, the name assigned to the reach on a
topographical map]]
&sv wr [write %rdme% [quote - sometimes the correctness, spelling and acceptability
are uncertain]]
/* &sv wr [write %rdme% [quote ALIAS: alternate name or names for the reach,
separated by \]]
&sv wr [write %rdme% [quote KMCUMULATE: cumulative kilometres from source]]
&sv cf [close %rdme%]

&if %p% = All &then
&do
    &type Using all .txt files for pseudo-region %p%.
    &if [exists WebSite\%p%txt.zip -file] &then &sv dz [delete WebSite\%p%txt.zip -
file]
    &sys %zip_add% WebSite\%p%txt.zip %lut_reachcode_rsa2usa%
    &sys %zip_add% WebSite\%p%txt.zip %legend_order%
    &do p_ &list %pri%
    &sys %copy% %rivdir%\%p%\*0000.txt tmptxt
    &end
    &sys %zip_add% WebSite\%p%txt.zip tmptxt\*.txt
    &sys %remove% tmptxt\*.txt
    /* The following failed:
    /* run pkzip then delete temporary files:
    /* &if [exists WebSite\%p%txt.zip -file] &then &sv dz [delete
WebSite\%p%txt.zip -file]
    /* &sys %zip_add% WebSite\%p%txt.zip alltxt\*.txt
    /* &sys %remove% alltxt\*.txt
    /* &sys %zip_add% WebSite\%p%txt.zip %lut_reachcode_rsa2usa%
    &end
    &else
    &do
        &if [exists WebSite\%p%txt.zip -file] &then &sv dz [delete WebSite\%p%txt.zip
-file]
        /*Failed because Windows doesn't see complete file set:
        /*&sys %zip_add% WebSite\%p%txt.zip %rivdir%\%p%\*0000.txt
        &sys %zip_add% WebSite\%p%txt.zip %lut_reachcode_rsa2usa%
        &sys %copy% %rivdir%\%p%\*0000.txt tmptxt
        &sys %zip_add% WebSite\%p%txt.zip tmptxt\*.txt
        &sys %remove% tmptxt\*.txt
        /*The following failed to copy all files:
        /*get list of text files for this drainage region, e.g. %p%0.txt, riv_*km.txt
        /*&type [filelist %rivdir%\%p%\riv_*km.txt tmp1list.txt -file]
        /*&type [filelist %rivdir%\%p%\*0.txt tmp1list.txt -file]

```

```

/* open a copytxt.bat file
/*&sv batf [open copytxt.bat openstatus -write]

/* for each file in the list add a line to the .bat file
/*&sv flst [open tmplist.txt openstatus -read]
/*&sv readstatus = 0
/*&do &while %readstatus% = 0
    /*&sv fname = [read %flst% readstatus]
    /*&sv wf [write %batf% [quote copy %rivdir%\%p%\%fname% tmptxt\[substr
%fname% 1 8].txt]]
    /*&sv wf [write %batf% [quote copy %rivdir%\%p%\%fname% alltxt\[substr
%fname% 1 8].txt]]
    /*&end
    /*&sv cf [close %batf%]
    /*&sv cf [close %flst%]

/*&sys copytxt.bat

/* run pkzip then delete temporary files:
/*&if [exists WebSite\%p%txt.zip -file] &then &sv dz [delete
WebSite\%p%txt.zip -file]
/*&sys %zip_add% WebSite\%p%txt.zip tmptxt\*.txt
/*&sys %remove% tmptxt\*.txt
&end

&end
&end

workspace %ws0%
&return

/* -----
&routine ISOdate

/* date in ISO format
&sv ISOdate [date -year]-[substr[date -usa] 1 2]-[substr[date -vmsdate] 1 2] -
[before[date -vmstime] .]

&return

/* -----
&routine writel
&sv wr [write %rdme% [quote by the Resource Quality Services directorate of the
Department of Water Affairs and Forestry.]]
&sv wr [write %rdme% [quote This is the release of %ISOdate% and may still contain
errors and inconsistencies.]]
&sv wr [write %rdme% [quote The developers would welcome any feedback and corrections.]]
&sv wr [write %rdme% [quote (Please refer to rivers by their reachcode when reporting
errors.))]
&sv wr [write %rdme% [quote Contact address: SilberbauerM@dwaf.gov.za]]
&sv wr [write %rdme% [quote ]]

&return

/* -----
&routine writearcfields
&sv wr [write %rdme% [quote ]]
&sv wr [write %rdme% [quote (2) ATTRIBUTES]]
&sv wr [write %rdme% [quote . =====]]
&sv wr [write %rdme% [quote NAME: generally, the name assigned to the reach on a
topographical map]]
&sv wr [write %rdme% [quote - sometimes the correctness, spelling and acceptability are
uncertain.]]
&sv wr [write %rdme% [quote ALIAS: alternate name or names for the reach, separated by
\]]
&sv wr [write %rdme% [quote CLASS: unreliable indicator of seasonality of river flow.
The classes and allocation require review:]]
&sv wr [write %rdme% [quote - Dry=dry river, Perennial=perennial river, Non=non-
perennial river,]]

```

```

&sv wr [write %rdme% [quote Unknown=not present in original coverage or not
transferred from source map.]]
&sv wr [write %rdme% [quote PRIMARY: primary drainage region where the reach occurs.]]
&sv wr [write %rdme% [quote - a lower-case letter indicates a pseudo drainage region
outside South Africa.]]
&sv wr [write %rdme% [quote ORDER: Strahler order, starting from source=1.]]
&sv wr [write %rdme% [quote END: S=Source, N=iNtermediate, M=Mouth, E=Endorheic.]]
&sv wr [write %rdme% [quote REACHCODE: 10-character reach code made up as follows:]]
&sv wr [write %rdme% [quote - 1 to 4: quaternary drainage region in which MOST of the
river falls.]]
&sv wr [write %rdme% [quote (Note that some USA programs like BASINS expect
eight numerical digits.]]
&sv wr [write %rdme% [quote The gat4gat8.txt lookup table contains the
correct DWAF to USA conversions.))]
&sv wr [write %rdme% [quote - 5 to 6: arbitrary sequence number of the reaches within a
quaternary drainage region.]]
&sv wr [write %rdme% [quote - 7 to 10: four zeroes (0000) in the 1:500 000 coverage,
intended for later use at more detailed scale.]]
&sv wr [write %rdme% [quote SORTER: sorting field - always increases downstream in a
river network]]
&sv wr [write %rdme% [quote LENGTH_KM: length of reach in kilometres (not to be
confused with the meaningless LENGTH field).]]
&sv wr [write %rdme% [quote RivEX fields: (see http://www.rivex.co.uk/))]
&sv wr [write %rdme% [quote - SHREVE: Shreve order.]]
&sv wr [write %rdme% [quote - US_ACCUM: Accumulated upstream metres at the lower node of
each arc.]]
&sv wr [write %rdme% [quote - CATCHID: Automatically generated ID for each end node
(i.e. when END='E' or 'M').]]
&sv wr [write %rdme% [quote - DIST2MTH : Distance to the mouth in metres from the upper
node of each arc.]]

&return

/* -----
&routine writesdefields
&sv wr [write %rdme% [quote RIV_NAME: generally, the name assigned to the reach on a
topographical map]]
&sv wr [write %rdme% [quote - sometimes the correctness, spelling and acceptability are
uncertain.]]
&sv wr [write %rdme% [quote RIV_ALIAS: alternate name or names for the reach, separated
by \.]]
&sv wr [write %rdme% [quote RIV_PRIMARY: primary drainage region where the reach
occurs.]]
&sv wr [write %rdme% [quote - a lower-case letter indicates a pseudo drainage region
outside South Africa.]]
&sv wr [write %rdme% [quote RIV_ORDER: Strahler order, starting from source=1.]]
&sv wr [write %rdme% [quote RIV_END: S=Source, N=iNtermediate, M=Mouth, E=Endorheic.]]
&sv wr [write %rdme% [quote REACHCODE: 10-character reach code made up as follows:]]
&sv wr [write %rdme% [quote - 1 to 4: quaternary drainage region in which MOST of the
river falls.]]
&sv wr [write %rdme% [quote (Note that some USA programs like BASINS expect
eight numerical digits.]]
&sv wr [write %rdme% [quote The gat4gat8.txt lookup table contains the
correct DWAF to USA conversions.))]
&sv wr [write %rdme% [quote - 5 to 6: arbitrary sequence number of the reaches within a
quaternary drainage region.]]
&sv wr [write %rdme% [quote - 7 to 10: four zeroes (0000) in the 1:500 000 coverage,
intended for later use at more detailed scale.]]
&sv wr [write %rdme% [quote SORTER: sorting field - always increases downstream in a
river network]]
&sv wr [write %rdme% [quote LENGTH_KM: length of reach in kilometres (not to be
confused with the meaningless LENGTH field).]]
&sv wr [write %rdme% [quote RIV_CLASS: unreliable indicator of seasonality of river
flow. The classes and allocation require review:]]
&sv wr [write %rdme% [quote - Dry=dry river, Perennial=perennial river, Non=non-
perennial river,]]
&sv wr [write %rdme% [quote - Unknown=not present in original coverage or not
transferred from source map.]]
&sv wr [write %rdme% [quote RivEX fields: (see http://www.rivex.co.uk/))]

```

```

&sv wr [write %rdme% [quote - SHREVE: Shreve order.]]
&sv wr [write %rdme% [quote - US_ACCUM: Accumulated upstream metres at the lower node of
each arc.]]
&sv wr [write %rdme% [quote - CATCHID: Automatically generated ID for each end node
(END='E' or 'M').]]
&sv wr [write %rdme% [quote - DIST2MTH : Distance to the mouth in metres from the upper
node of each arc.]]

&return

/* -----
&routine writemetfiles
&sv wr [write %rdme% [quote [translate [entryname %metadata_HTML%]]: metadata summary.]]
&sv wr [write %rdme% [quote [translate [entryname %metadata_thumbnail%]]: subsidiary
file required for correct display of metadata summary.]]
&sv wr [write %rdme% [quote [translate [entryname %logo_sa%]]: subsidiary file required
for correct display of metadata summary.]]
&sv wr [write %rdme% [quote METADATA.XML: metadata generated in ESRI xml format.]]
&sv wr [write %rdme% [quote [translate [entryname %lut_reachcode_rsa2usa%]]: lookup
table for conversion from South African to USGS-style quaternary codes.]]
&sv wr [write %rdme% [quote (mainly of interest to ESA BASINS users).]]

&return

```


RIVER REACH PROCESS

Michael Silberbauer

2003-05-21, 2004-03-04, 2004-07-23, 2005-04-20, 2005-07-11, 2006-03-15

Manual check of river coverage

Edit

□ Run the editing AML, e.g. A.AML (calls CAPTOOL.AML and CAPTOOL.MENU) to perform a visual check of the rivers. Don't go overboard with accuracy, 50 metres is acceptable particularly for the large drainage regions. The accuracy in dryer areas can be reduced to ± 100 metres in dryer areas of large drainage regions especially where the surface drainage disappears underground. Try to follow the main drainage line of rivers represented by double lines.

□ ArcInfo has an arbitrary limit of 500 on the number of vertices per arc. This is usually sufficient to represent a node-to-node river reach at the 1:500 000 scale. Exceptions occur in highly sinuous rivers, or in areas where the river coverage is a bit thin. Our simplistic approach relies on node-to-node segments consisting of a single arc. To achieve this, simplify bends on rivers or insert strategic tributaries from the 1:50 000 coverage. You may need to GENERALIZE (**not** with automatic BENDSIMPLIFY!) to remove vertices if an arc has more than 500 vertices (start with GENERALIZE 5 and gradually increase the number until the combined arc will be less than 500 vertices). The principle is to rather place a few meaningful vertices than a huge number of incorrect ones. Remember that 1:500 000 is a fairly coarse scale.

The original coverage attempted to show perennial and non-perennial flow. We have removed nodes that are simply there to divide rivers on this basis.

When the main drainage line is indistinct, passes through a water body or is braided, use an arbitrary streamline roughly following the actual river course to represent the drainage link.

When a river join is indistinct (for example when the river zig-zags across a map boundary), create the best possible node position based on the information available.

□ Use the RIV_EDIT.APR ArcView project to view areas with 1:50 000 scanned maps in the background where information is sketchy or to see river names.

Check

□ Use the Arc command NODEERRORS <coverage> PSEUDO to find pseudonodes, i.e. nodes that do not form a river start, junction or terminus (AMLs such as DNODP.AML can read a file of x-y coordinates generated by NODEERRORS—copy and paste the screen display from NODEERRORS into a file and edit it so that only the x-y coordinates remain).

□ Allocation of arc END attribute:

M (mouth terminal arc)

E (endorheic terminal arc)

S (starting arc)

N (normal connecting arc)

First allocate all the Ms (CAPTOOL.AML has an automated method using the coastline) then use RIVENDS.AML, which selects dangle arcs, reselects END = ‘ and allocates the S arcs. All remaining arcs should be N arcs)

□Set tolerances with TOL.AML

Very important, as nodes may snap together if the tolerance is not 10 metres.

□Build arcs and nodes.

Semi-automated procedures

(Using AMLs in /prjws8/users/Michael/aml/)

□Run RIVNETSPLIT.AML

This splits the coverage into single networks for river order calculation using the Strahler method. It then uses the automatically generated WRIn500ORDER.AML to run STREAM_ORDER.AML on each of the resultant coverages and the recombination AML WRIn500FIX.AML to put the whole lot together again afterwards (STREAM_ORDER.AML requires the compiled C program strahler.c). The process may show up shortcomings in the coverage, necessitating more editing before re-running it.

After this process is complete, follow the instructions on-screen to rename the previous version of the river coverage to a backup name, and copy the new ordered coverage in the old one's place.

Four drainage regions are artificially split for convenience, so you will need to manually edit the arcs for about nine arcs downstream of the Vaal-Orange junction to ORDER=6, and the four arcs downstream of the Elefantes-Limpopo junction to ORDER=6, so that they are correct when the coverages are joined.

□Run RIVREACH.AML

This uses a set of tables to store each code once it has been allocated to a reach. The AML will clear the code tables each time you re-run it. Eventually, when the coverage is relatively stable, the procedure will need to change so that reach codes remain attached to the same reach except in the case of additions and splits.

*If you use the “auto” option and the process runs to completion without errors, it will trigger the next processes (TRACERIVSORT, TRACERIV, RIVERNAMESEARCH) automatically, e.g.:

```
&run /prjws8/users/michael/aml/rivreach wrix500 auto
```

□Run TRACERIVSORT.AML*

TRACERIVSORT.AML refines the code allocation of RIVREACH.AML to make reach numbering more or less sequential downstream within a quaternary drainage.

□Run TRACERIV.AML*

This adds a SORTER field that is sequential downstream for any drainage path. It also creates a table of source to mouth reach linkages for every end=S arc.

□Run RIVERNAMESEARCH.AML*

This checks for all contiguous arcs with the same name and creates text files listing the reach codes for each one. The files are named riv_NAME_n_Lkm.txt where NAME is the river name, n is the number of the river (e.g. riet_1, riet_2,...) and L is the length in km. If you rename a river at this stage, you will need to re-run TRACERIV.AML and RIVERNAMESEARCH.AML in order to update the trace files.

RIVERNAMESEARCH generates a test AML, RIVDUPS.AML, that displays all rivers with the same name. This helps in the detection of inconsistent naming, though this is often a true reflection of the actual names!

□Run APPENDRIVS.AML

Before running APPENDRIVS.AML note that it makes the A to B and C to D primary drainage region links automatically. The last END=E arc for region B needs to become an END=N arc. Similarly for the last arc in the Vaal River in region C. APPENDRIVS.AML combines all the individual primary drainage coverages into a single coverage and automatically updates the source.adf and metadata.xml files describing the coverage.

□Run RIVCHECK.AML

Check the reliability of the river coverage by running RIVCHECK.AML, which takes a random sample of 1% of the coverage and generates proof maps showing the 1:500 000 river coverage overlain on the 1:50 000 scanned maps and 1:50 000 river coverage so that you can check the accuracy.

□Run RIVERSUFFIX.AML

RIVERSUFFIX.AML creates the fields REACHCODE, RIVN_ROOT (radix of river name), RIVN_SUFIX (suffix, e.g. Spruit, Stream, River) in a new LUT (lookup table).

□Place files on Internet

Run the AML RIV2SHP.AML on the PC.

Comments on accuracy

Operator skills and GIS techniques improved over the period of creation of the river coverage, so the quality is uneven. While the target is within 50 metres of the 1:50 000 river coverage arcs, in many areas this is not true, especially parts of the D drainage region with vast numbers of dry riverbeds and the areas outside South Africa where no 1:50 000 maps are available.

To prepare a large-scale map, users can plot the unnamed 1:50 000 coverage arcs and use the 1:500 000 names for annotation.

The editors have tried to correct river names where possible, using the 1:50 000 map sheets as a reference, as well as information from STASKAT (where a river is unnamed and the name provided by STASKAT appears to have geographical merit). We suggest adding a field called ALIAS to store all the old or alternative names for each river. Eventually we will have to sort out diacritical marks (e.g. Voël not Voel), apostrophes (Queen's not Queens), case conventions (kwaZunga or KwaZunga for Kwazunga), prefix language (Groot or Great?), vernacular (Crocodile, Krokodil, Ngwenya?) and cross-border name changes (Komati, Incomati).

Data sources

- 1:500 000 river coverage from Surveys and Mapping, edited by GisLAB 1995 (thinned, linked, directed...)
- on-screen copying from 1:50 000 map sheets and coverages
- rarely: copying and GENERALIZING of 1:50 000 coverages
- outside South Africa:
 - DCW river arcs, compared with 1:500 000 scanned maps... thinned, linked, directed. Most thinning on Namibia's Fish River, very dense DCW network reduced by cutting out most first-order streams.
 - Mozambique data from the Atlas for Data Preparedness and Response in the Limpopo Basin, INGC, University of Eduardo Mondlane, Department of Geography and USAID/ FEWS NET MIND 2003.
 - Shuttle Radar Topography Mission (SRTM) 90-metre digital elevation model.

Acknowledgements

This coverage has been a mammoth task, entailing many hours of work by Resource Quality Information subdirector Danieël Wildemans, Juanita Moolman, Elna Vermaak, Naomi Roberson, Axel Diefenbach, Magda Smidt, Lungile Gaulana and Kama Chetty. The contribution of users such as Kobus Myburgh in pointing out errors and discrepancies has also been invaluable.