Mapping Water Quality on a Desktop Computer

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http://www.dwaf.gov.za/iwqs/

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http://www.dwaf.gov.za/iwqs/water_quality/NCMP

Introduction:
Why do we need Water Quality Maps?

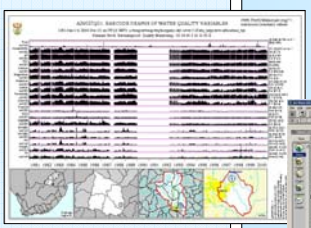
In terms of the National Water Act (Chapter 14) the Department of Water Affairs must maintain a national information system on the status of water resources.

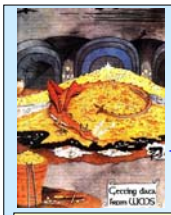
The Department is already the custodian of a database of anion and cation analyses dating as far back as the early 1970s, containing the results of more than half a million samples from about 1600 stations around the country: The Department's Institute for Water Quality Studies therefore initiated the National Chemical Monitoring Programme report as a way to provide an overview of the surface water chemistry of South Africa to water resource managers, scientists and the public, using existing water quality data.

In order to show where in the country water quality deviates from accepted guidelines, the report includes a set of ten maps with symbols for water quality status at representative sites.

This poster outlines the process for generating these maps: the actual mechanisms are explained in more detail on our web site:

http://www.dwaf.gov.za/iwqs/water_quality/NCMP





Method
How did we make the maps?

Extracting data from a well-protected modern database is a little like trying to steal treasure from a dragon: only the bravest Dwaf attempts the task, though the rewards are great...

- Export the raw data from the Water Management System: a database specialist does this using the **SQL** language
- Reformat the list data into a spreadsheet-like table with a **Perl** script
- Further tidy up the data with an **awk** script so that the Geographical Information System **Arc/Info** can import it

The next steps are for data visualisation...

- **BARCODE** generates summary sheets for each of the monitoring points of interest
- **MEANER** generates spreadsheet-compatible lists of monitoring points and percentile statistics
- **CHEM_A3**, an ArcView project, generates the final maps

Perl data reformatting

```
if ($sampleid == $oldid) {
#       still same record, so read in only
changed values.
            ($name, $value) =
(split/$delimiter/)[13, 14];
            $name = "gaga" if (!defined
($name));
            $value = -9999 if (!defined
($value));
    } else { #new sample id
            print ERRF "Sample ID change from
$oldid to $sampleid ... NEW  RECORD\n";
            dump_record;          # remember that
this reset sampleid
#       read new record
            ($featureid, $description,
$region, $sampleid, $date, $time, $enddepth,
$preserve, $name, $value)
                = (split /$delimiter/)[0, 1,
4, 5, 6, 7, 11, 12, 13, 14];
            $name = "gaga" if (!defined
($name));
            $value = -9999 if (!defined
($value));
```

SQL Extraction from WMS

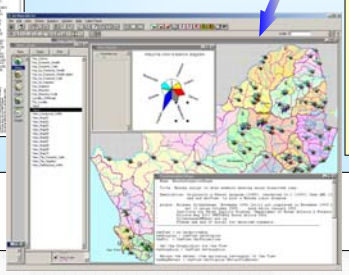
```
unload to 'magda_94_00.unl' delimiter ';'
select rr.mon_feature_id, sf.feature_name,
       pl.point_latitude, pl.point_longitude,
       rr.primary_drain_code,
       rr.sample_no, rr.sample_begin_date,
       rr.sample_begin_time,
       rr.sample_end_date, rr.sample_end_time,
       rr.sample_begin_depth, rr.sample_end_depth,
       pr.preservative_abbr,mv.mon_variable_abbr,
       rr.result_num_value, rr.result_alpha_value
from released_result rr,
     spatial_feature sf,
     point_location pl,
     preservative pr,
     monitorng_variable mv
where rr.mon_feature_id = sf.feature_id
  and sf.point_location_id = pl.point_location_id
  and rr.preservative_id = pr.preservative_id
  and rr.mon_variable_id = mv.mon_variable_id
  and rr.sample_begin_date >= "1994-01-01"
  and rr.sample_begin_date <= "2000-12-31"
  and rr.mon_variable_id in (395,245,241,252)
order by rr.mon_feature_id, rr.sample_no
```

awk data reformatting

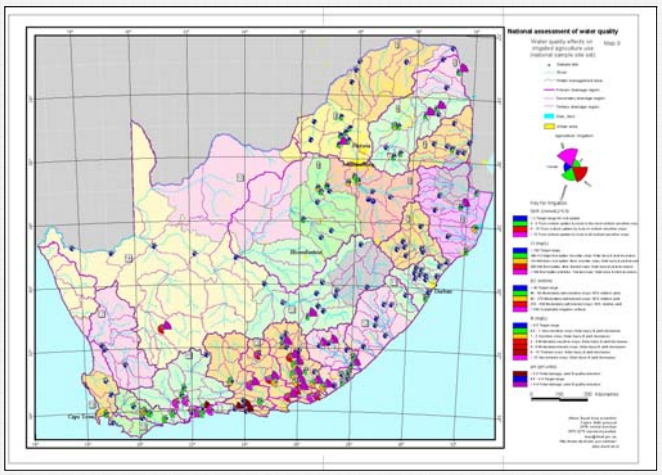
```
 cat = substr($3,2,1)
  if( cat == " " ) cat = "?"
  rec =
station","cat","substr($4,2,10)","substr($5,2,2)substr($
5,5,2)
  output_it = 0
  for( j=6;j<=25;j++ )
  {
    if( $j == " -9999" || $j == " -99999" ) x = -9
     else
     {
       x = 1 * $j
       output_it = 1
     }
   rec = rec"," x
  }
```

Meaner output

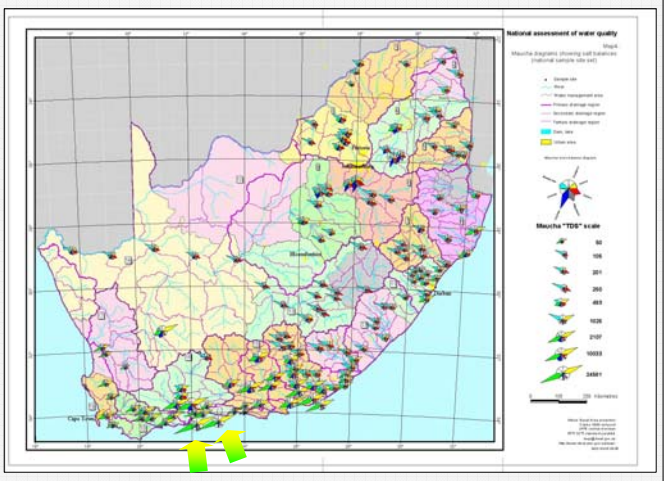
```
Station,Longitude,Latitude,nDate,minDate,medDate,p95Date,maxDate,nTP,minTP,medTP,p95TP,maxTP,nPO4(P),minPO4(
P),medPO4(P),p95PO4(P),maxPO4(P),nKN,minKN,medKN,p95KN,maxKN,nNO3(N),minNO3(N),medNO3(N),p95NO3(N),maxNO3(N)
,nNH4(N),minNH4(N),medNH4(N),p95NH4(N),maxNH4(N),nSO4,minSO4,medSO4,p95SO4,maxSO4,nSi,minSi,medSi,p95Si,maxS
i,nF,minF,medF,p95F,maxF,nCl,minCl,medCl,p95Cl,maxCl,nTAL,minTAL,medTAL,p95TAL,maxTAL,nNa,minNa,medNa,p95Na,
maxNa,nK,minK,medK,p95K,maxK,nMg,minMg,medMg,p95Mg,maxMg,nCa,minCa,medCa,p95Ca,maxCa,nTDS,minTDS,medTDS,p95T
DS,maxTDS,npH,minpH,medpH,p95pH,maxpH,nEC,minEC,medEC,p95EC,maxEC,nFlow,minFlow,medFlow,p95Flow,maxFlow,nB,m
inB,medB,p95B,maxB,Description
X1H003Q01,31.78333262,-25.68111078,199,19960102,19980414,20000815,20001030,0,-9,-9,-9,-
9.198,0.001,0.016,0.043,0.386,0,-9,-9,-9,-
9.198,0.007,0.168,0.447,0.705,197,0.001,0.027,0.071,0.121,198,2,8.3,14.92,20.395,198,2.99,8.345,10.229,11.31
,198,0.12,0.18,0.285,0.37,198,4.1,14.153,89.594,213.7,198,24,68.294,146.409,200.7,198,2.1,15.65,67.783,134.6
,198,0.378,1.261,2.994,4.6,198,2.4,7.7,20.39,29.7,198,4,9.5,22.32,33.4,198,67,139,380 538,674,198,7.12,8.09,
8.466,8.58,198,10.8,20.2,58.67,105.6,0,-9,-9,-9,-9,198,0.151,0.931,2.646,4.135,Komati River  Tonga  Quality
Monitoring
1996-01-01 to 2000-12-31 from IWQS GIS file $WMSYS/wmdata/wq/inorganic.dat to
/hri/db/barcode/mmsimichael200112041610 19.txt
meaner # # X1H003Q01 m f 8 1996 2000 95 Debug=_false.
/prjwsB/users/michael/aml/meaner.aml v2.1 data summary by user michael on 2001-12-04 - 16:11:07
Institute for Water Quality Studies\Department of Water Affairs & Forestry\Private Bag X313 PRETORIA\tel
(012) 808 0375\fax (012) 808 2702\E-mail: eck@dwaf-hri.pwv.gov.za
```



Results
Batches of pies and flocks of Maucha symbols illustrate where water quality and potential water use may be on a collision course.



A pinch of salt
Careful interpretation is required: some of the monitoring points showing high salinity in the map below are naturally so because of the influence of sea water...



Conclusions

While the maps provide an instantaneous overview of water quality conditions, they are complex and require detailed explanation in order to be meaningful.

Development of the computer tools focused on utility rather than user-friendliness, leading to a more rapid application. The downside of this is that the methods are less portable.

Acknowledgements

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Reference

Hohls, B.C., Silberbauer, M.J., Kühn, A.L., and Kempster, P.L. (2002). **National Water Resource Quality Status Report: Inorganic Chemical Water Quality of Surface Water Resources in SA – The Big Picture.**
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