AECOM

Report

Government of Yukon, Faro Mine Project Management Team

2008/09 Water Quality Database Maintenance Report

AECOM

Government of Yukon, Faro Mine Project Management Team

2008/09 Water Quality Database Maintenance Report

Prepared by:

AECOM Canada Ltd.
2251 2nd Avenue, Whitehorse, YT, Canada Y1A 5W1
T 867.633.6474 F 867.633.6321 www.aecom.com

Project Number:

111281-80656-5

Date:

March 2009

Statement of Qualifications and Limitations

The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("Consultant") for the benefit of the client ("Client") in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report:

- are subject to the budgetary, time, scope, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations");
- represent Consultants' professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to Consultant which has not been independently verified;
- have not been updated since the date of issuance of the Report and their accuracy is limited to the time period and circumstances in which they were collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- were prepared for the specific purposes described in the Report and the Agreement;
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time.

Unless expressly stated to the contrary in the Report or the Agreement, Consultant:

- shall not be responsible for any events or circumstances that may have occurred since the date on which the Report was prepared or for any inaccuracies contained in information that was provided to Consultant;
- makes no representations whatsoever with respect to the Report or any part thereof, other than that the Report represents Consultant's professional judgement as described above, and is intended only for the specific purpose described in the Report and the Agreement;
- in the case of subsurface, environmental or geotechnical conditions, is not responsible for variability in such conditions geographically or over time.

Except as required by law or otherwise agreed by Consultant and Client, the Report:

- is to be treated as confidential;
- may not be used or relied upon by third parties.

Any use of this Report is subject to this Statement of Qualifications and Limitations. Any damages arising from improper use of the Report or parts thereof shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report.

AECOM
2251 2nd Avenue, Whitehorse, YT, Canada Y1A 5W1
T 867.633.6474 F 867.633.6321 www.aecom.com

March 31, 2009 Project Number: 111281

Deborah Pitt, Acting Project Manager
Abandoned Mines Branch
Dept. Energy, Mines and Resources
Government of Yukon
Box 2703, K419
Whitehorse, Yukon Y1A 2C6

Acting Project Manager:

Re: AECOM 80656-5 – 2008/2009 Database Maintenance Report

Please find enclosed our *2008/2009 Database Maintenance Report*. This report summarizes the annual database maintenance activities associated with managing water quality data generated through ongoing monitoring programs at the Faro Mine Complex.

Thank you for the opportunity to conduct this work. Please contact the undersigned if you have any questions.

Yours very truly,
AECOM

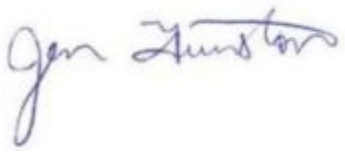
Jay Cherian, M.Sc. (Candidate)
Environmental Scientist/Hydrogeologist
Sincerely,
AECOM Canada Ltd.

Distribution List

# of Copies	Association / Company Name
2 + 1e	Government of Yukon, Assessment and Abandoned Mines
1 + 1e	AECOM
2 + 1e	Faro Mine Project Management Team

Signature Page

Report Prepared By:



Jennifer Funston, B.Sc.
Hydrogeologist

Report Reviewed By:

Jay Cherian, M.Sc. (Candidate)
Environmental Scientist/Hydrogeologist

Table of Contents

Statement of Qualifications and Limitations
Letter of Transmittal
Distribution List

page

Appendices

1. Introduction

Water quality data collected at the Anvil Range Mine in Faro, YT, through surface and groundwater monitoring programs, is recorded and maintained in an electronic, relational water quality database. Prior to 2005, all water quality data was managed through a commercial software program entitled EQWin. As the need for transferability and access to the water quality data increased, and capacity and functionality requirements of the database grew in association with the progression of closure planning and environmental assessment activities, the decision was made to convert the database to a Microsoft Access platform. In late 2005, all historical water quality data was successfully transferred from the EQWin database to a MS-Access interface specifically designed to meet the needs of Anvil Range water monitoring programs. At that time Gartner Lee Ltd. began managing the database on behalf of Anvil Range Mine Interim Receiver, Deloitte and Touche. In 2008 The Yukon Territorial Government (YTG) took over possession of the Anvil Range MS-Access database, and AECOM (formerly Gartner Lee) has continued to manage the database on their behalf. All groundwater and surface water monitoring data for the Anvil Range Site is scheduled to be housed in a central database to be maintained by the Yukon Government.

This report provides a summary of database maintenance activities and upgrades performed by AECOM throughout 2008 and the first quarter of 2009.

2. Water Database Structure

For the purposes of the Anvil Range site water quality data management, Stoneleigh Associates (specialist contractor in database design) has developed a specialized database, titled WATER using Microsoft Access, a common MS-Access software application. The basic relational design of the WATER database has been in use for almost 20 years and allows for broad applications for data storage and display. The database structure ensures referential integrity with unique station and sample result coding, with no redundant parameters within the database framework. Data analysis functions of the database include pre-programmed queries, preliminary data entry QA/QC routines, QA/QC data editing procedures and pre-formatted output report templates. Data for both surface water and groundwater monitoring programs is stored and managed within this single database.

Water quality data is typically entered into the database using a batch append procedure from an MS Excel file format. Data retrieval is accomplished through pre-designed queries, allowing the user to retrieve data based on any combination of parameters, including date, station name, and analysis parameter. The retrieved data is transferable to an Excel format for tabulation or statistical analysis including graphing.

The database has the capability to accommodate additional types of data analysis to meet potential future requirements and can be linked to other monitoring and assessment type databases, including the Environment Canada MS-Access interface program.

3. Data Review (QA/QC)

To ensure data integrity and eliminate potential reporting errors, Anvil Range water quality data is continually reviewed at several stages of the data management process:

- Entry into the database – Statistical analysis is performed on all data entered into the WATER database using pre-programmed QA/QC routines (values that are extremely large or small in comparison to previously entered data are flagged);
- Charge balance calculations are performed upon data entry which flags data with charge balances greater than +/- 10%, providing a precursory indication of analytical errors;
- Flagged data is reviewed for data entry errors and where necessary, labs are contacted to re-check suspect values;
- Through graphical identification – visual screening of water quality trend lines (typically done during annual reporting phase); and
- Review of monthly report data by the Project Manager.

If an extreme value or "outlier" is identified during any stage of the data management process, further review of the data is initiated. The first step in this process is to determine the type of outlier the data value represents – a "true outlier" results from transcription errors, changes in detection limits, or measurement problems during sample collection, while a "false outlier" represents actual extreme values of the various parameters (hot spots or peak events) and can be an indication of the "natural" variability of the data set or of introduced effects. As a means of determining the source of an outlier, original laboratory data is reviewed for that sampling event when available (1999 and on). This review of the actual laboratory analytical results provides the best check for possible transcription errors. For instance, in many cases outliers identified may be solely due to using the wrong units: parts per million instead of parts per billion. This error is readily seen in extreme values being out by a factor of 1000. Extreme or incorrect values occurring for all sample parameters during the same sampling event in similarly named sites may be the result of the samples simply being switched or parameters being switched. As well, the occurrence of extreme values in several related sample locations may be indicative of peak events or hot spots such as elevated levels of key parameters during the same sampling event.

After the source of the outlier has been determined, the next step is to determine if the data point should be maintained, corrected or discarded. This step must be done with extreme caution as incorrect removal of data can result in a distortion of the data set and limits its applicability. Water quality data sets can often contain legitimate extreme values. For the Anvil Range Database, a data point is corrected or discarded only if there is adequate justification to do so, such as "hard" confirmation using laboratory sheets or the outlier is obviously due to unit or sample mix up. The modification of the data point is flagged in the database. For cases where it is not possible to determine the source of the extreme values, the data point is maintained and flagged as a possible outlier. The decision of whether to discard this point will then be left to the discretion of the individuals using the data. The Project Manager approves any modifications made to the database. Appendix A. provides QA/QC Issue Memos detailing any modifications made to the 2008/2009 water quality data.

4. Database Maintenance Activities

Throughout 2008 and the first quarter of 2009, regular database maintenance activities were comprised mainly of "housekeeping" tasks, although identification, assessment and correction of outliers continued as part of the established QA/QC protocol. Maintenance tasks included:

- Deletion of duplicates found at various sites;
- Correction of silver and strontium data for October 7/8, 2008 sampling;
- Standardization of station and parameter names;
- Update of groundwater field data;
- Update of well construction details;
- Input of new groundwater and surface water parameters;
- Addition of new groundwater stations for the 2008 SRK additional well monitoring program;
- Input of 2008 groundwater lab and field data from new SRK monitoring wells;
- Addition of a third location, Reference Stations, to the WATER database;
- Addition of new surface water stations, to accommodate monitoring programs, including those done by Minnow, Laberge, SRK and Access Consulting; and
- Import of 2005-2008 surface water lab data from the additional surface water monitoring programs.

The majority of database maintenance modifications were related to the addition of new stations, parameters and lab data, to accommodate additional surface and groundwater monitoring programs being conducted on the Anvil Range Site. The import of this additional data has unified the WATER database, and allowed for a more complete resource for the majority of Anvil Range water quality data users. Tables summarizing these changes to the database are included in Appendix B.

5. Water Quality Data Distribution

Water quality data for the Anvil Range site is distributed to various data users including Deloitte and Touche Inc., the Faro Mine Project Management Team and other consultants through AECOM's (Gartner Lee Ltd.) FTP site. An updated compressed version of the WATER database (known as an MDE file) is placed on the site regularly, allowing pre-approved users to download the file and view the water quality data using any MS-Access software program. This posting is intended to occur monthly after receipt and input of the routine monthly water quality data. The users maintain full functionality of the original database, including pre-programmed queries, but do not have the ability to make changes to the database as these MDE files represent copies of the database and do not provide the user with access to the original database. Obsolete versions are removed from the FTP site, as updates are made available. Access to the original database is limited to the Project Manager and team members within AECOM to ensure original data integrity.

Pre-authorized users can access an MDE copy of the WATER database using the following procedure (requires the user to have Microsoft Access installed):

1. Access Gartner Lee's FTP site at the following location: ftp://ftps.gartnerlee.com.
   Username: Farodb
   Password: 112105fdb
2. MDE files are located in folder "Faro dBase". Download the zip file "User Water_*Date*.mde" to system hard drive.
3. Open MDE file using the Microsoft Access application.

Several users were given or had individual access codes for the database. Appendix E lists people for whom access to the database was added or extended in 2008. Access to the database will expire as of the end of April 2009, one month after the expiry of AECOM's contract to manage the database. An updated copy of the WATER user manual is provided on the FTP site and appended to the back of this report (Appendix C). The user manual provides instructions on database use and procedures for retrieving water quality data using pre-programmed queries. Additional GROUNDWATER database details are included in the *User Manual for the Anvil Range Project - GROUNDWATER database,* found in Appendix D. Both the WATER and GROUNDWATER user manuals were updated in March 2009.

6. Database Management

The database Project Manager is responsible for the overall management of the database and retains authority within AECOM to authorize changes to the database. The database manager is responsible for data management and posting of the database to ftp.

Stoneleigh Associates is the preferred specialist contractor for implementing design modifications or additions to the database interface.

The “master” database files reside in AECOM’s Whitehorse office. The files are accessed from the office’s network storage systems and are backed up on a daily basis to a separate, external hard drive stored at an off-site location as part of AECOM’s data management procedures. In addition, manual back up of the database to an alternate server location is routinely performed by the Database Manager as part of regular database maintenance activities.

Appendix A

QA/QC Issue Memos

AECOM
2251 2nd Avenue, Whitehorse, YT, Canada Y1A 5W1
T 867.633.6474 F 867.633.6321 www.aecom.com

Memorandum

Date: February 24, 2009
To: Memo to File
From: Leia Fougere
Project Number: 80656
Subject: 2008 Surface Water - QA/QC – Comparison of Field and Lab Parameters

Faro – Surface water – All 2008 data
QA/QC
Potential issues flagged through field and lab data comparisons in database:

Conductivity

Faro: (already checked all raw lab data)

1.) FC2 = NF2 – Access Consulting made mistake in reporting. In Faro WQ master sheet from Access Con. FC results were pasted under NF2 - therefore database results for NF2 are wrong and need to be changed to match annual report.
   a. Changed "37" to "240" in annual report already
   b. 11 dec 08 (422-F vs 240-L) - Also need to check field result – bc may also be an issue
2.) FC –seems to be a field data problem due to trending:
   a. 24 jan 08 (74.2-F vs. 43-L)
   b. 21 Feb. 08 (487-F vs 49-L)
   c. 11 Dec 08 (103 -F vs 37-L)
3.) R1 – seems to be a field data problem due to trending:
   a. 11 mar 08 (244-F vs 300-L) - low
   b. 10 dec 08 (516-F vs 250-L) - high
4.) R4 - seems to be a field data problem due to trending:
   a. 10 dec 08 (456-F vs 360-L) - high
   b. 13 mar 08 (435-F vs 530-L) low
5.) R6 – seems to be a field data problem due to trending:
   a. 10 dec 08 (414-F vs 310-L) high
   b. 13 mar 08 (214-F vs 310-L) low
6.) X10 – seems to be a field data problem due to trending – 10 dec 08 (387-F vs 270-L)

Vangorda: (already checked all raw lab data)

1.) V1 – seems to be a field data problem due to trending
    a. 11 dec 08 (303-F vs 110-L)
2.) V4 – seems to be a field data problem due to trending
    a. 10 dec 08 (908-F vs 600-L)
3.) V6a – seems to be a field data problem due to trending
    a. 10 dec 08 (808-F vs 330-L)
4.) VR – at this site 10 results received – of these 10 samples five were flagged as being >115% - oddly every second sample was a hit. The sites that were off by the most seem to be a field issue due to trending
    a. 24 jan 08 (188-F vs 89-L)
    b. 22 may 08 (188.8-F vs 38-L)

Note: 10/11 dec 08 seems to be a day that's suggests a problem with field data – due to many sites being off by large percentage – all significantly higher than lab results
Note 2: 13 mar 08 data – potential problem with field data – several sites had significantly lower results than lab data.

pH

1.) R3 – 23 jan 08 field pH was 6, compared to 2 separate lab results of 7.9 (Laberge) and 8.1 (Access)

Pulled this out of annual report, need to change in database – decision: problem with field result

2.) V1 – 11 mar 08(6.3-F vs 7.9-L) – seems to be a field issue – due to trending
3.) V4 – 13 mar 08 (6.4-F vs 8.2-L) - seems to be a field data problem due to trending
4.) V6a - seems to be a field data problem due to trending
    a.) 11 mar 08 (6.38–f vs 8.1-L)
    b.) 28 apr 08 (6.72-F vs 8.2-L)

T-Al

X23 – 19 July 08 – value of 39 is very high – but does check out – TSS is also very high. Also many other total metals high for that day.

Follow-up:

Jay Cherian (AECOM) followed up with Access Consulting, to verify field parameters that were measured through Access' and Minnow Environmental's program (Interim Aquatic Monitoring Program), in conjunction with Selkirk First Nation. The questions were passed through Stuart VanBibber (Access Consulting) to Dan Cornett (Access Consulting), and as of March 2009, no response has been received by AECOM. The data has not been removed from the database, and possible issues remain unresolved.

AECOM
2251 2nd Avenue, Whitehorse, YT, Canada Y1A 5W1
T 867.633.6474 F 867.633.6321 www.aecom.com

Memorandum

Date:	February 24, 2009
To:	Memo to File
From:	Leia Fougere
Project Number:	80656
Subject:	2008 Surface Water - QA/QC – Comparison of Field and Lab Parameters

Faro – Groundwater – All 2008 data

QA/QC – January 2009

Corrections to database:

Conductivity
Based on a comparison of field and lab conductivity, the following errors have been identified:

PO3-09-02, Aug 12, 2008: field conductivity: change from 12.89 to 1289
Verification: field notes say 1289 µS

BH 14A, Sep 18, 2008: field conductivity: removed field conductivity
Verification: field notes show temperature values were entered as conductivity; and that conductivity probe was thought to be malfunctioning and therefore no entry for temperature should be made

BH14B, Sep 18, 2008: field conductivity: change from 4.1 to 4100
Verification: field notes show temperature values were entered as conductivity; and that conductivity probe was thought to be malfunctioning and therefore no entry for temperature should be made

pH
A comparison of field and lab pH was made: no errors to correct

AECOM
2251 2nd Avenue, Whitehorse, YT, Canada Y1A 5W1
T 867.633.6474 F 867.633.6321 www.aecom.com

Memorandum

Date: March 31, 2009
To: Memo to File
From: Jennifer Funston
Project Number: 80656
Subject: 2005 – 2007 Outliers – Minnow Environmental Inc.

Minnow Environmental Inc. flagged a select number of surface water parameters as outlier values through 2005 – 2007. Of these, all dissolved oxygen values have been removed from the database with the value and comments flagged.

Dissolved Oxygen:

- R6 sampled 26-Sept-07; DO = 294 mg/L is a statistical outlier. Maximum saturation in water is about 15 mg/L (0°C and atmospheric pressure of 790 mmHg). Value was removed from database tables and recorded in comments field along with statistical outlier rational.
- V1 DO = 75.5 mg/L and UWFV/VR DO = 70.4 mg/L; sampled 26-Sept-07. Values are not statistical outliers but are outside the range of normal oxygen concentrations in surface waters. Values were removed from database tables and recorded in comments field along with rational noted above.

All other parameters were retained within the database, with comments as recorded by Minnow added to the comments field:

- V1 **selenium** = 0.011 mg/L, sampled 7-Jun-05 is a statistical outlier. Value is considerably higher than the rest of the data (data range = <0.00004 – 0.002 mg/L);
- R7 **thorium** = 0.002 mg/L, sampled 6-Sept-05 is a statistical outlier. It is the only quantifiable value (ie. all other values are below the method detection limit of 0.0005 mg/L) and may represent an analytical, reporting, or entry error;
- V1 **colour** = 20 CU, sampled 5-Jun-06 is a statistical outlier. Other values ranged between <5 and 8 CU. This datum will substantially increase the background benchmark if included in the data set;

- **Silver:**
  - R6 = 0.0017 mg/L, sampled 29-Mar-05 is a statistical outlier
  - R7 = 0.0004 mg/L, sampled 20-Jun-05 is not a statistical outlier.
  - Above values are conspicuous because all but one other value (at 0.00002 mg/L) were below detection (<0.00025 mg/L or lower) as would be expected for silver in natural surface waters. Low TSS values for those dates indicate the silver values cannot be attributed to a high-flow (high particulate) event.

AECOM
2251 2nd Avenue, Whitehorse, YT, Canada Y1A 5W1
T 867.633.6474 F 867.633.6321 www.aecom.com

Memorandum

Date: March 30, 2009
To: Memo to File
From: Jennifer Funston
Project Number: 80656
Subject: 2008 Surface Water and Groundwater QA/QC Database Updates

The database has been reposted to the ftp site including the following corrections:

- V1 (Background/Upstream Vangorda Creek):
  - Turbidity = 314 NTU sampled September 2, 2004 is 3 orders of magnitude greater than historic values; the value was flagged within the database.
  - Dissolved Aluminum = 0.97 mg/L sampled March 20, 2006 is close to 2 orders of magnitude greater than historic values; the value was flagged within the database.
- VR (VR):
  - Total Zirconium = 0.23 mg/L sampled September 26, 2007 by Access Consulting is 3 orders of magnitude greater than historic values, however value matches original lab file; the value was flagged within the database.
  - Dissolved Silicon = 0.00451 mg/L sampled October 25, 2007 by Access Consulting was entered under incorrect units. The value should read 0.00451 µg/L which is equal to 4.51 mg/L. This value will be corrected and flagged within the database.
- V27 (Vangorda Creek upstream of confluence with Shrimp Creek): Total Antimony = 0 mg/L sampled September 26, 2007 by Access Consulting was recorded with an insufficient number of significant digits. The value matching the original lab file is 0.06 µg/L which is equal to 0.00006 mg/L. This value will be corrected and flagged within the database.
- V8 (Vangorda Creek at Town of Faro): Total Cyanide = 190 mg/L sampled December 15, 2002 is 4 orders of magnitude greater than historic values; the value was flagged within the database.
- X5 (Cross Valley Dam decant): Dissolved Zirconium = 7 mg/L sampled August 15, 2006 is close to 3 orders of magnitude greater than historic values. This value was previously removed from the database.

In addition, the groundwater samples at well P01-04 A/B became switched during the summer 2005 sampling event (sampled July 21, 2005) and remained switched through the fall 2008 sampling event (sampled September 17, 2008). Sampling was completed by AECOM (Gartner Lee) where the switch was clearly shown through the respective sulphate concentrations. The database has been updated accordingly and care should be taken to ensure the wells are labelled correctly during the 2009 field season.

Appendix B

Database Update Summary Tables

Table 1: Summary of 2008/2009 Parameter Changes

Parameter Identification	Measurement Units	Number of Records
Acenaphthene	mg/L	1
Acenaphthylene	mg/L	1
ACID-T	mg/L	165
Acridine	mg/L	1
AG-D	mg/L	927
AG-D	mg/L	7
AG-T	mg/L	689
AG-T	mg/L	7
AL-D	mg/L	934
ALK-C	mg/L	498
ALK-H	mg/L	498
ALK-PP	mg/L	190
ALK-T	mg/L	809
AL-T	mg/L	696
Anion Sum	meq/L	134
Anthracene	mg/L	1
AS-D	mg/L	934
AS-T	mg/L	696
BA-D	mg/L	934
BA-T	mg/L	696
B-D	mg/L	934
BE-D	mg/L	934
Benz(a)anthracene	mg/L	1
Benzo(a)pyrene	mg/L	1
Benzo(b)fluoranthene	mg/L	1
Benzo(g,h,i)perylene	mg/L	1
Benzo(k)fluoranthene	mg/L	1
BE-T	mg/L	696
BI-D	mg/L	854
BI-T	mg/L	691
BR-T	mg/L	25
B-T	mg/L	696
CA-D	mg/L	1001
CA-T	mg/L	702
Cation Sum	meq/L	134
Cation-anion Balance	%	134
CD-D	mg/L	934
CD-T	mg/L	696
Chrysene	mg/L	1
CL-D	mg/L	485
CN-T	mg/L	188
CN-WAD	mg/L	173
CO-D	mg/L	934
COLOR	CU	357
COND-F	µS/cm	436
COND-F	µS/cm	2
COND-L	µS/cm	988

Parameter Identification	Measurement Units	Number of Records
CO-T	mg/L	696
CR-D	mg/L	934
CR-T	mg/L	696
CU-D	mg/L	934
CU-T	mg/L	696
d10-Acenaphthene (SS)	%	1
d10-Phenanthrene (SS)	%	1
d12-Chrysene (SS)	%	1
d8-Naphthalene (SS)	%	1
d9-Acridine (SS)	%	1
Dibenz(a,h)anthracene	mg/L	1
DO	mg/L	82
DO-%	%	105
DOC	mg/L	173
EPH10-19	mg/L	1
EPH19-32	mg/L	1
F-D	mg/L	178
FE-D	mg/L	993
FE-T	mg/L	696
Fluoranthene	mg/L	1
Fluorene	mg/L	1
F-T	mg/L	20
HARD	mg/L	723
HARD-C	mg/L	461
HCO3	mg/L	498
HEPH	mg/L	1
HG-D	mg/L	235
HG-T	mg/L	513
Indeno(1,2,3-c,d)pyrene	mg/L	1
ION_BAL	no Unit	133
K-D	mg/L	999
K-T	mg/L	703
LEPH	mg/L	1
LI-D	mg/L	934
LI-T	mg/L	687
MG-D	mg/L	1001
MG-T	mg/L	702
MN-D	mg/L	993
MN-T	mg/L	696
MO-D	mg/L	934
MO-T	mg/L	696
NA-D	mg/L	1000
Naphthalene	mg/L	1
NA-T	mg/L	703
NH3	mg/L	663
NI-D	mg/L	934
NI-T	mg/L	696
NO2	mg/L	178
NO2NO3	mg/L	178
NO3	mg/L	177
N-T	mg/L	15

Parameter Identification	Measurement Units	Number of Records
PB-D	mg/L	934
PB-T	mg/L	696
P-D	mg/L	699
Phenanthrene	mg/L	1
PH-F	pH unit	966
PH-L	pH unit	515
P-ORTH	mg/L	5
P-T	mg/L	650
PURGE VOL	L	299
Pyrene	mg/L	1
Quinoline	mg/L	1
SB-D	mg/L	934
SB-T	mg/L	696
S-D	mg/L	342
SE-D	mg/L	934
SE-T	mg/L	696
SI-D	mg/L	854
SI-T	mg/L	682
SN-D	mg/L	934
SN-T	mg/L	696
SO4	mg/L	1022
SR-D	mg/L	854
SR-T	mg/L	691
S-T	mg/L	197
TDS	mg/L	193
TE-D	mg/L	515
TEMP-F	°C	985
TE-T	mg/L	508
TH-D	mg/L	515
TH-T	mg/L	508
TI-D	mg/L	934
TI-T	mg/L	696
TKN	mg/L	15
TL-D	mg/L	934
TL-T	mg/L	696
TOC	mg/L	168
TSS	mg/L	688
TURB	NTU	357
U-D	mg/L	934
U-T	mg/L	696
V-D	mg/L	934
V-T	mg/L	696
WL-M	m	304
ZN-D	mg/L	997
ZN-T	mg/L	696
ZR-D	mg/L	841
ZR-T	mg/L	691

Table 2: New Parameters - 2008

Measurement Technique ID	New Parameter ID	Parameter Description	Count Of Measurement ID	Date Created
270	ALK-PP	Alkalinity (PP of CaCO3)	258	17-Dec-08
269	DOC	Dissolved Organic Carbon	239	17-Dec-08
268	TOC	Total Organic Carbon in sample	233	27-Nov-08
267	S-D	SULPHUR: DISSOLVED S	400	22-Sep-08
266	ION_BAL	Balance of Ions in sample	133	22-Sep-08
265	HEPH	HEPH	1	08-Jul-08
264	LEPH	LEPH	1	08-Jul-08
263	EPH19-32	EPH19-32 extractable hydrocarbon	1	08-Jul-08
262	EPH10-19	EPH10-19 extractable hydrocarbon	1	08-Jul-08
261	d10-Phenanthrene (SS)	d10-Phenanthrene (SS)	1	08-Jul-08
260	d8-Naphthalene (SS)	d8-Naphthalene (SS)	1	08-Jul-08
259	d10-Acenaphthene (SS)	d10-Acenaphthene (SS)	1	08-Jul-08
258	d9-Acridine (SS)	d9-Acridine (SS)	1	08-Jul-08
257	d12-Chrysene (SS)	d12-Chrysene (SS)	1	08-Jul-08
256	Quinoline	Quinoline	1	08-Jul-08
255	Pyrene	Pyrene	1	08-Jul-08
254	Phenanthrene	Phenanthrene	1	08-Jul-08
253	Naphthalene	Naphthalene	1	08-Jul-08
252	Indeno(1,2,3-c,d)pyrene	Indeno(1,2,3-c,d)pyrene	1	08-Jul-08
251	Fluorene	Fluorene	1	08-Jul-08
250	Fluoranthene	Fluoranthene	1	08-Jul-08
249	Dibenz(a,h)anthracene	Dibenz(a,h)anthracene	1	08-Jul-08
248	Chrysene	Chrysene	1	08-Jul-08
247	Benzo(g,h,i)perylene	Benzo(g,h,i)perylene	1	08-Jul-08
246	Benzo(k)fluoranthene	Benzo(k)fluoranthene	1	08-Jul-08
245	Benzo(b)fluoranthene	Benzo(b)fluoranthene	1	08-Jul-08
244	Benzo(a)pyrene	Benzo(a)pyrene	1	08-Jul-08
243	Benz(a)anthracene	Benz(a)anthracene	1	08-Jul-08
242	Anthracene	Anthracene	1	08-Jul-08
241	Acridine	Acridine	1	08-Jul-08
240	Acenaphthylene	Acenaphthylene	1	08-Jul-08
239	Acenaphthene	Acenaphthene	1	08-Jul-08
238	Cation-anion Balance	percent balance of cations and anions	134	08-Jul-08
237	Cation Sum	Measures the sum of cations in a sample	134	08-Jul-08
236	Anion Sum	Measures the sum of the anions in a sample	134	08-Jul-08

Table 3: Station ID's and Descriptions

Station ID	StationName	Station Description	Project ID	Well Type	Creation Date
BH10A	BH10A	added during database and review	Faro - GW	nested well	18-Jun-08
BH10B	BH10B	added during database and review	Faro - GW	nested well	18-Jun-08
BH5	W of Zone II (8.33m)		Faro - GW	conventional	11-Jul-08
X24A-96	X24A-96		Faro - GW	nested well	11-Jul-08
TH86-5	TH86-5	Gartner Lee Added Station	Faro - GW	conventional	11-Jul-08
TH86-13	TH86-13	Gartner Lee Added Station	Faro - GW	conventional	11-Jul-08
TRIP BLANK GW	Trip blank groundwater	trip blank -QAQC groundwater	Faro - GW		22-Sep-08
TH86-2	TH86-2		Faro - GW	conventional	20-Oct-08
TH86-15	TH86-15		Faro - GW	conventional	20-Oct-08
TH86-14	TH86-14		Faro - GW	conventional	20-Oct-08
SRK08-SPW1	SRK08-SPW1		Faro - GW	conventional	20-Oct-08
RGC-PW3	RGC-PW3		Faro - GW	conventional	20-Oct-08
BH8	BH8		Faro - GW	conventional	20-Oct-08
SRK08-SP7A	SRK08-SP7A		Faro - GW	conventional	28-Oct-08
SRK08-SP7B	SRK08-SP7B		Faro - GW	conventional	28-Oct-08
SRK08-SP8A	SRK08-SP8A		Faro - GW	conventional	28-Oct-08
SRK08-SP8B	SRK08-SP8B		Faro - GW	conventional	28-Oct-08
SRK08-SBR1	SRK08-SBR1		Faro - GW	conventional	28-Oct-08
SRK08-SBR2	SRK08-SBR2		Faro - GW	conventional	28-Oct-08
SRK08-SBR3	SRK08-SBR3		Faro - GW	conventional	28-Oct-08
SRK08-SBR4	SRK08-SBR4		Faro - GW	conventional	28-Oct-08
SRK08-SPW2	SRK08-SPW2		Faro - GW	conventional	28-Oct-08
SRK08-P9	SRK08-P9	piezometer - uphill along powerline near toe of waste rock dump from S-cluster area	Faro - GW	conventional	13-Nov-08
SRK08-P10A	SRK08-P10A	deep piezometer -S of main road on hill above gully where tailings seepage discharges	Faro - GW	conventional	13-Nov-08
SRK08-P11A	SRK08-P11A	deep piezometer-beside creek, N of parking lot	Faro - GW	conventional	13-Nov-08
SRK08-P11B	SRK08-P11B	shallow piezometer-beside creek, N of parking lot	Faro - GW	conventional	13-Nov-08
SRK08-P10B	SRK08-P10B	shallow piezometer -S of main road on hill above gully where tailings seepage discharges	Faro - GW	conventional	13-Nov-08
SRK08-P12A	SRKO8-P12A	deep piezometer - in BH-well area (near north fork rose ck); on creek gravel bar on floodplain	Faro - GW	conventional	13-Nov-08
SRK08-P12B	SRK08-P12B	shallow piezometer- in BH-well area (near north fork rose ck); on creek gravel bar on floodplain	Faro - GW	conventional	13-Nov-08
SRK08-P13A	SRK08-P13A	deep piezometer- in BH-well area (near north fork rose ck); 278 m downstream of P12	Faro - GW	conventional	13-Nov-08
SRK08-P13B	SRK08-P13B	shallow piezometer- in BH-well area (near north fork rose ck); 278 m downstream of P12	Faro - GW	conventional	13-Nov-08
SRK08-P14	SRK08-P14	piezometer - above blasted rock bench and piles of rock, in natural small stream channel (not active now)	Vangorda - GW	conventional	13-Nov-08
SRK08-P15	SRK08-P15	piezometer - at toe of waste rock dump, 2 benches down fdrom P14, along cat trail in forest	Vangorda - GW	conventional	13-Nov-08
SRK08-P16	SRK08-P16	piezometer - along old forest road at bottom of waste rock dumps	Vangorda - GW	conventional	13-Nov-08
SRK08-DPI	SRK08-DPI (DP5)	New 2008 SRK Well - Drivepoint in S-Cluster Area	Faro - GW	drive point	27-Nov-08
SRK08-SPW4	SRK08-SPW4	New 2008 Pumping Well in S-Cluster: 3 m W from SRK05-SP4b	Faro - GW	conventional	27-Nov-08
SC-1	NFRC SC-1	North Fork Rose Creek near S-Cluster vicinity	Faro Mine-SW	Surface Water	04-Dec-08
SC-2	NFRC SC-2	North Fork Rose Creek in S-cluster vicinity	Faro Mine-SW	Surface Water	04-Dec-08
SC-3	NFRC SC-3	North Fork of Rose Creek in vicinity of S-cluster Area	Faro Mine-SW	Surface Water	04-Dec-08
SC-4	NFRC SC-4	North Fork Rose Creek in S-Cluster Vicinity	Faro Mine-SW	Surface Water	04-Dec-08
P1	P1	(~1km u/s of bridge)	Faro Mine-SW	Surface Water	17-Dec-08
P2	P2	Station sampled by access consulting - description to be filled in d/s of the bridge into town over the Pelly River	Faro Mine-SW	Surface Water	17-Dec-08
P3	P3	Pelly River u/s of Anvil Creek	Faro Mine-SW	Surface Water	17-Dec-08
P4	P4	Station sampled by access consulting - description to be filled in Pelly River d/s of Anvil Creek (1km)	Faro Mine-SW	Surface Water	17-Dec-08
A1	A1	Sampled by Access Consulting - description to be filled in	Faro Mine-SW	Surface Water	17-Dec-08
VR	VR	Sampled by Access Consulting - description to be filled in later	Vangorda-SW	Surface Water	17-Dec-08
UWFV	WF Vangorda (West Fork)	West fork of Vangorda Creek - Minnow station	Vangorda-SW	Surface Water	09-Jan-09
USFR	SF Rose Ck U/S Haul Rd	South fork of Rose Creek - Minnow Station	Faro Mine-SW	Surface Water	09-Jan-09
RC1	Rose Creek (1st Tributary)	Rose Creek (1st Tributary)-Minnow Station	Faro Mine-SW	Surface Water	09-Jan-09
BEC	Beautiful Creek	Beautiful Creek - Minnow reference site east of Faro	Reference Stations - SW	Surface Water	14-Jan-09
BLC	Blind Creek	Blind Creek - Minnow regional Reference Station east of Faro on Pelly Watershed	Reference Stations - SW	Surface Water	14-Jan-09
BTT	BTT Near Pelly River	Minnow reference station east of Faro - near Pelly River	Reference Stations - SW	Surface Water	14-Jan-09
BUC	Buttle Creek	Minnow Reference site east of Faro on Buttle Creek	Reference Stations - SW	Surface Water	14-Jan-09
GRC	Grew Creek	Minnow Reference site on Grew Creek East of Faro, along Pelly River	Reference Stations - SW	Surface Water	14-Jan-09
HOC	Horton Creek	Minnow Reference Station on Horton Creek, East of Faro off Pelly River	Reference Stations - SW	Surface Water	14-Jan-09
NEXC	Next Creek	Minnow reference site on Next Creek - off of Rose Creek	Faro Mine-SW	Surface Water	14-Jan-09
STC	Starr Creek	Minnow reference site on Starr Creek - east of Faro - off of Pelly River	Reference Stations - SW	Surface Water	14-Jan-09
REF-1	Reference Site	Minnow Reference Site	Reference Stations - SW	Surface Water	14-Jan-09
REF-2	Reference Site - 2	Minnow Reference Site	Reference Stations - SW	Surface Water	14-Jan-09

Table 4: Measurement Technique Updates

ParameterCode	Measurement Units	ClassID	CreateDate
Anion Sum	meq/L	PHYSICAL	08-Jul-08
Cation Sum	meq/L	PHYSICAL	08-Jul-08
Cation-anion Balance	%	PHYSICAL	08-Jul-08
Acenaphthene	mg/L	PAH	08-Jul-08
Acenaphthylene	mg/L	PAH	08-Jul-08
Acridine	mg/L	PAH	08-Jul-08
Anthracene	mg/L	PAH	08-Jul-08
Benz(a)anthracene	mg/L	PAH	08-Jul-08
Benzo(a)pyrene	mg/L	PAH	08-Jul-08
Benzo(b)fluoranthene	mg/L	PAH	08-Jul-08
Benzo(k)fluoranthene	mg/L	PAH	08-Jul-08
Benzo(g,h,i)perylene	mg/L	PAH	08-Jul-08
Chrysene	mg/L	PAH	08-Jul-08
Dibenz(a,h)anthracene	mg/L	PAH	08-Jul-08
Fluoranthene	mg/L	PAH	08-Jul-08
Fluorene	mg/L	PAH	08-Jul-08
Indeno(1,2,3-c,d)pyrene	mg/L	PAH	08-Jul-08
Naphthalene	mg/L	PAH	08-Jul-08
Phenanthrene	mg/L	PAH	08-Jul-08
Pyrene	mg/L	PAH	08-Jul-08
Quinoline	mg/L	PAH	08-Jul-08
d12-Chrysene (SS)	%	PAH	08-Jul-08
d9-Acridine (SS)	%	PAH	08-Jul-08
d10-Acenaphthene (SS)	%	PAH	08-Jul-08
d8-Naphthalene (SS)	%	PAH	08-Jul-08
d10-Phenanthrene (SS)	%	PAH	08-Jul-08
EPH10-19	mg/L	EXTRACT HYDROC	08-Jul-08
EPH19-32	mg/L	EXTRACT HYDROC	08-Jul-08
LEPH	mg/L	EXTRACT HYDROC	08-Jul-08
HEPH	mg/L	EXTRACT HYDROC	08-Jul-08
ION_BAL	no Unit	PHYSICAL	22-Sep-08
S-D	mg/L	Metals - Dissolved	22-Sep-08
TOC	mg/L	OTHER PARAMETERS	27-Nov-08
DOC	mg/L	OTHER PARAMETERS	17-Dec-08
ALK-PP	mg/L	ANIONS	17-Dec-08

Appendix C

WATER Database Manual

User Manual
For the
Anvil Range Project

WATER QUALITY database

Updated: May 2005
November 2005
March 2008
April 2008
June 2008
March 2009

Barbara A. Hutchinson
Stoneleigh Associates Inc

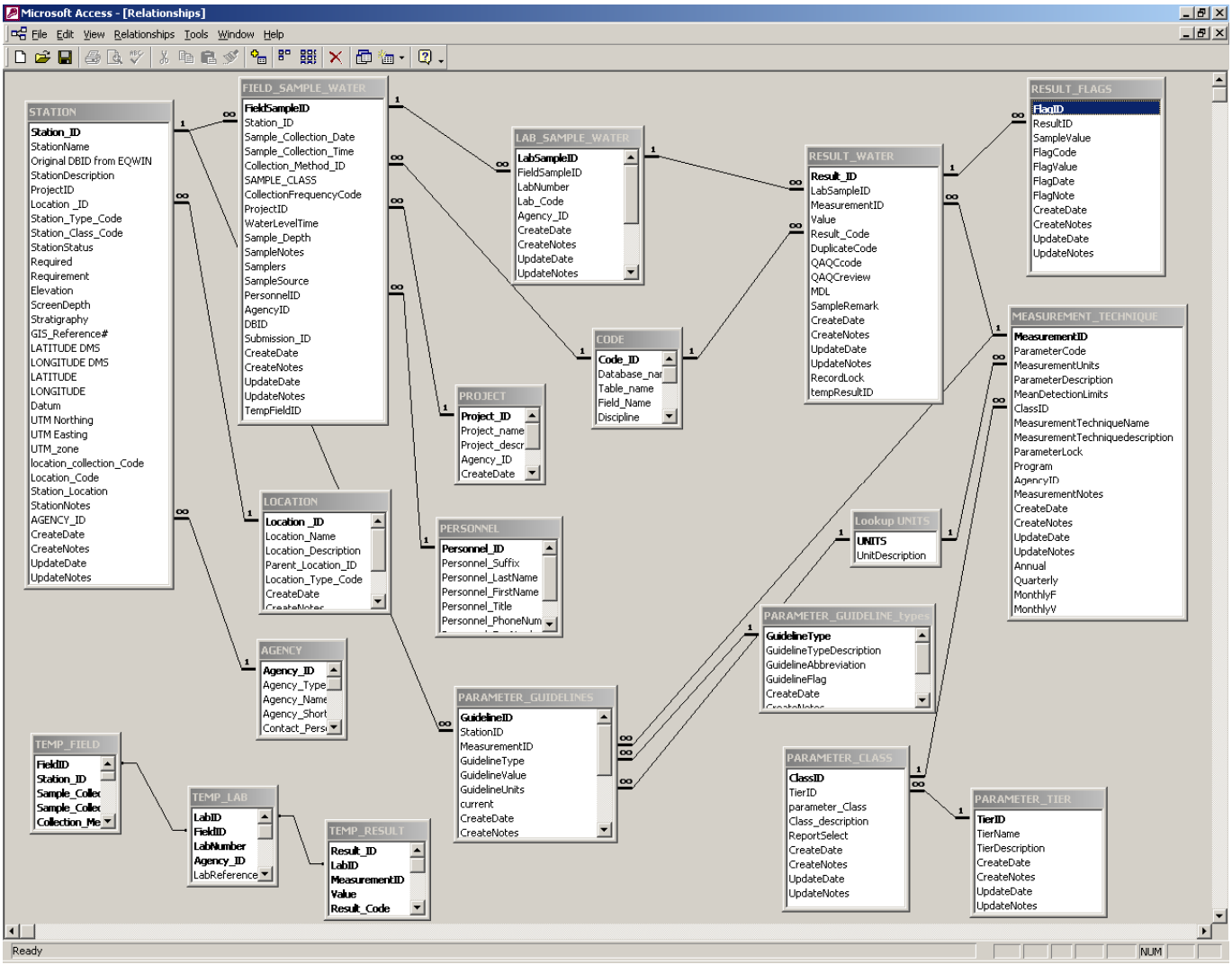
Table of Contents

Introduction

This database application warehouses water quality measures and can be in turn linked to other associated monitoring and assessment type databases. This application can include multi project water chemical measures including both surface and groundwater. The design will also accommodate other types of chemical analysis and thus has broad applications for data storage and display. The database file is called WATER and should be located on a LAN to make the fullest use of this results database. The database form views are both read-only and read-write, depending on the access procedure. Data is typically added using batch append procedures.

The relationships between the tables in the database are shown in Figure 1 below.

Figure 1 Database Table Relationships



The database opens to a main switchboard screen. The tabbed form and command buttons direct the user to all features of the application. This manual can be linked to this form using a hyperlink for easy availability to all users.

Database Design

This database is a relational database, with tables constructed to third normal design. Simply put, each table has a unique primary key, and contains no redundant data values. Station information is in the station table and is not replicated elsewhere. Any other data table that requires a relationship (or link) to the station table will contain the unique Station ID and be constrained to only values found in the station table… thus enforcing referential integrity.

A review of each of the tables (and content of each of the fields) follows. The primary key (unique field) is identified in bold font. Any required fields are shown with gray shading. Audit fields with create date and text and update date and text have been added to all tables. The create date and text are added on import of all data records. The update date is added during import and will be updated along with the associated text when any values are changed for a record. This can be readily accomplished using event procedure code on any read-write data forms.

A 'streamlined' version of the WATER database was generated in March 2008 and is the master version of the database used by all staff. Various stations and parameters were marked as historic and were recoded in some cases, or otherwise removed from this master version. The archival copy of WATER with all historic stations and parameters (along with current data only to March 2008) can be used for historic reference. 107 stations of the 393 were removed, along with their data (including Elevation). Additionally, 34 parameters were removed (29 of these were extractable metals), and the related results removed from the master version.

Core Database Tables

There are several data stores used as part of this data application. The first are data tables that contain all sample values by Station, date, time, parameter and collection method. The other groups include those data tables used during batch appends processes and all reference values related to data tables.

Table 1: FIELD_SAMPLE_WATER

The design of this table incorporates the unique station, date, time and collection method combination. Samplers then typically submit multiple samples for analysis (often at different labs). The link to results then is by the Field Sample ID and then the Lab Sample ID.

Field Name	***Content***	***Type***	***Size***
FieldSampleID	Unique field sample number and is assigned by the db as an auto number	Long Integer	4
Station_ID	Required Station ID – found in STATION	Text	50

Sample_Collection_Date	Required sample date (dd-MMM-yy)	Date/Time	8
Sample_Collection _Time	Required sample time (hh:mm), default of 00:00	Long Integer	4
Collection_Method_ID	Required collection method, default value for PWQ samples (CODE 358)	Long Integer	4
Sample_Class	Required sample class, default of M	Long Integer	4
WaterLevelTime	Water level recorded time	Long Integer	4
CollectionFrequencyCode	Collection freq, select from list of choices	Long Integer	4
ProjectID	Project identification from PROJECT	Long Integer	4
Samplers	List of samplers	Text	50
SampleSource	Source of data – file, database	Text	255
DBID	Original EQWIN sample ID – this can be deleted in future	Text	255
SampleNotes	Sample notes	Memo	-
Sample_Depth	Depth of the sample	Long Integer	4
SampleID	Optional sample number	Text	50
Submission_ID	Optional submission number	Text	50
Personnel_ID	Person who collected the sample	Long Integer	4
AgencyID	Agency who collected the sample	Long Integer	4
CreateDate	Date the record was created (default of system date on append)	Date/Time	8
UpdateDate	Date the record was updated (default of system date on append)	Date/Time	8
UpdateNote	Notes about updates to the record	Text	255
CreateNote	Notes about the record creation – no edits possible	Text	255
TempFieldID	Used during import routine in code	Long Integer	4

Table 2: LAB_SAMPLE_WATER

The design of this table allows for multiple labs for a single field sample, though often for regular sampling protocol a single lab is used (or assumed).

Field Name	***Content***	***Type***	***Size***
LabSampleID	Unique lab sample number and is assigned by the db as an auto number	Long Integer	4
FieldSampleID	Relationship to the Field Sample table	Long Integer	4
LabNumber	Provided by lab	Text	50
Lab_Code	Selected from CODE – required	Long Integer	4
AgencyID	Lab sample agency identification	Long Integer	4
CreateDate	Date the record was created (default of system date on append)	Date/Time	8

UpdateDate	Date the record was updated (default of system date on append)	Date/Time	8
UpdateNotes	Notes about updates to the record	Text	255
CreateNotes	Notes about the record creation, no edits	Text	255
TempLabID	Used during import routine in code	Long Integer	4
LabReference	Lab reference numbers	Text	50
LabAnalyst	Name of the analyst	Text	50
Analysis_Date	Date of the analysis	Date/Time	8
Analysis_Time	Analytical code – see CODE table	Long Integer	4
LabSampleInfo		Text	255

Table 3: RESULT_WATER

This table contains all sample results not sampled using Hydrolab™ sampling protocol. Multiple result values are typically obtained for a single field sample visit and are stacked in this table by measurement ID (the unique parameter and unit combination). Hydrolab™ sampling produces multiple samples on a frequent time scale, making the format of the field-lab-result tables cumbersome and redundant. A different data storage table (and view/selection procedures) are required for data obtained in this format.

Field Name	***Content***	***Type***	***Size***
ResultID	Unique result number and is assigned by the db as an auto number	Long Integer	4
LabSampleID	Relationship to the Lab Sample table	Long Integer	4
MeasurementID	Parameter and unit identification	Long Integer	4
Value	Numeric result value, Null possible	Double	8
Result_Code	Remark code for the result – the default is valid sample (CODE 361), required	Long Integer	4
DuplicateCode	Duplicate code - optional	Long Integer	4
QAQCcode	FK to CODE for QA/QC STD guideline assigned code - default CODE 'unknown'	Long Integer	4
QAQCreview	FK to CODE for QA/QC user assigned data review code - default CODE 'unknown'	Long Integer	4
MDL	mean detection limit as reported - may differ from Measurement Technique advertised value	Double	8
SampleRemark	ANMETH method code from PWQ file	Text	255
UpdateDate	Date the record was updated	Date/Time	8
CreateDate	Date the record was created	Date/Time	8
UpdateNote	Update notes	Text	255
CreateNote	Create notes – cannot be edited	Text	255
RecordLock	Is the record locked against edits/deletes	Yes/No	1
TempResultID	Used during import routine in code	Long Integer	4

Update/Append Database Tables

There are several data tables used as part of regular updates to this data application. These temporary tables are used first as a template to append pre-defined format EXCEL data files to. Various update and append action queries (executed in CODE) via the import switchboard are then used in sequence to process, format and add any new data to the WATER database tables. These follow the design and sampling protocol path of field samples submitted to various labs, which then report results for a variety of parameters.

Table 4: RAW LAB DATA

This table used to process an EXCEL lab file. Required fields are shown in gray.

Field Name	*Content*	*Type*	*Size*
F1	Station ID	Text	255
F2	Lab ID	Text	8255
F3	Sample Date in accepted date format	Date/Time	
F4	Sample Time in accepted time format	Date/Time	
F5	Time water level recording made	Date/Time	
F6	Sample Class – abbreviation found in CODE tables	Text	255
F7	Sample Notes	Text	255
F8	Samplers – initials or names	Text	255
F9	Collection method	Text	255
F10	First of 190 possible water chemistry analysis fields, values interpreted as text due to possible presence of remark codes – numeric values parsed from code and added to separate fields in RESULT table	Text	255
F11..F200	As for F10… etc.	Text	255

Sample data after import from EXCEL will appear like the following:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
					Sample Class	Sample Notes	Sampler	Collection Method	Conductivity (uS/cm)	Hardness CaCO3
									COND-L	HARD
									uS/cm	mg/L
P03-04-02	ALSW212201	25-Dec-05	10:00		M	dry	JF/EC	pp/assist	1500	748
P03-04-04	ALSW212202	26-Dec-05	10:33		M		JF/EC	pp/assist	1170	448
P03-04-06	ALSW212203	27-Dec-05	10:45		M		JF/EC	pp/assist	5180	1640
P03-04-08	ALSW212204	28-Dec-05	10:52		M		JF/EC	pp/assist	8860	1340

This format is required for the import routine to function properly. Several of the fields are protected by lookup validation in the EXCEL template. This template should always be used.

Table 5: RAW NORMALIZED LAB DATA

This table contains normalized sample results processed from the RAW LAB DATA table. Multiple result values are typically obtained for a single field sample visit and are stacked in this table by StationID, LabID, date, time, class and collection method. The unique parameter and unit combination are processed separately during the import and append process.

Field Name	*Content*	*Type*	*Size*
StationID	Station ID value found in STATION	Text	4
LabID	Lab assigned ID	Text	4
SampleDate	Sample date	Date/Time	8
SampleTime	Sample time	Date/Time	8
WaterLevelTime	Time water level recorded	Date/Time	8
SampleClass	Class of sample – abbreviation	Text	50
SampleNotes	Sample notes	Text	255
AgencyID	Agency ID number – found in AGENCY	Long Integer	4
CollectionMethod	Collection method abbreviation	Text	50
ParameterCode	Parameter code abbreviation – used in lookup during import	Text	255
Units	Parameter units – found in Lookup UNITS	Text	255
RawValue	Sample raw value – with remark code prefix – that will be eventually parsed	Text	50
ParameterName	Name of the parameter provided in data file – not used in lookup during import	Text	255
Measurement_ID	Parameter and unit identification	Long Integer	4
Remark_Code	Remark code for the result – the default is valid sample (CODE 361)	Long Integer	4
Value	Numeric result value	Double	8
StationFound	ANMETH method code from PWQ file	Text	255
SampleRemark	Sample notes	Text	255

The following three tables are used to temporarily store all sample data processed from the RAW NORMALIZED LAB DATA table. These tables mimic the design and content of the base data tables Field Sample Data, Lab Sample Data and Result Water.

Table 6: TEMP_FIELD

This table contains field sample data processed from the RAW NORMALIZED LAB DATA table. The unique combination of Station, date, time, collection method and sample class is enforced in this table. Data will eventually be appended to the Field Sample Water table.

Field Name	*Content*	*Type*	*Size*
FieldID	Database assigned autonumber	Long Integer	4
Station_ID	Station ID value found in STATION	Text	50
Sample_Collection_Date	Sample date	Date/Time	

Sample_Collection_Time	Sample time	Date/Time	
Collection_Method_ID	Collection method	Long Integer	4
Sample_Class	Sample class	Long Integer	4
WaterLevelTime	Time water level recorded	Date/Time	
ProjectID	Project identifier from PROJECT	Long Integer	
Sample_Depth	Depth of sample	Number	
CollectionFrequencyCode	Collection frequency code – see CODE	Long Integer	4
SampleNotes	Detailed notes about this sample – up to 64,000 characters may be entered	Memo	
Samplers	Listing of samplers	Text	
SampleSource	Source of the sample file – or database	Long Integer	4
PersonnelID	Personnel Identification	Long Integer	4
AgencyID	Agency Identification	Double	8
Submission_ID	Sample Submission ID	Text	255
UpdateDate	Date the record was updated	Date/Time	8
CreateDate	Date the record was created	Date/Time	8
UpdateNote	Update notes	Text	255
CreateNote	Create notes – cannot be edited	Text	255

Table 7: TEMP_LAB

This table contains lab sample results processed from the RAW NORMALIZED LAB DATA table. Typically there is a 1:1 match between field and lab sample records, unless multiple labs are used (and so noted) for processed sample data. Data will eventually be added to the Lab Sample Water table.

Field Name	***Content***	***Type***	***Size***
LabID	Unique lab sample number and is assigned by the db as an auto number	Long Integer	4
FieldSampleID	Relationship to the Field Sample table	Long Integer	4
LabNumber	lab sample number assigned by analysis lab - may be duplicated if replicate sampling	Text	255
AgencyID	Lab sample agency identification	Long Integer	4
LabReference			
LabAnalyst			
LabCode			
Analysis_Date	Date of the analysis	Date/Time	8
Analysis_Time	Analytical code – see CODE table	Long Integer	4
LabSampleInfo	Notes about the analysis	Text	255
UpdateDate	Date the record was updated	Date/Time	8
CreateDate	Date the record was created	Date/Time	8
UpdateNote	Update notes	Text	255
CreateNote	Create notes – cannot be edited	Text	255

Table 8: TEMP_RESULT

This table contains sample results processed from the RAW NORMALIZED LAB DATA table. Data is first added to the temp field and then temp lab table during the import. Data will eventually be added the Result Water table.

Field Name	*Content*	*Type*	*Size*
Result_ID	Unique result number and is assigned by the db as an auto number	Long Integer	4
LabID	Relationship to the Lab Sample table	Long Integer	4
MeasurementID	Parameter and unit identification	Long Integer	4
Value	Numeric result value, Null possible	Double	8
Result_Code	Remark code for the result – the default is valid sample (CODE 361), required	Long Integer	4
DuplicateCode	Duplicate code - optional	Long Integer	4
QAQCcode	FK to CODE for QA/QC STD guideline assigned code - default CODE 'unknown'	Long Integer	4
MDL	mean detection limit as reported - may differ from Measurement Technique advertised value	Double	8
SampleRemark	ANMETH method code from PWQ file	Text	255
CreateDate	Date the record was created	Date/Time	8
CreateNote	Create notes – cannot be edited	Text	255
UpdateDate	Date the record was updated	Date/Time	8
UpdateNote	Update notes	Text	255
RecordLock	Is the record locked against edits/deletes	Yes/No	1

Reference Lookup Database Tables

These tables all function as reference lookups to the core data tables. Data within tables is read-write, though all user views to this data are read-only. Typically only the primary key field and perhaps several other descriptive fields are displayed to the user in the application.

Table 9: AGENCY

This table is used to store all agency related information used in both the collection and analysis of data.

Field Name	*Content*	*Type*	*Size*
Agency_ID	Unique agency number, db auto number	Long Integer	4
Agency_Type_CODE	Type of agency – selected from CODE	Text	50
Agency_Name	Name of the agency	Text	50
Agency_ShortName	Short name of the agency (abbreviation)	Text	50
Contact_Personnel	Contact name	Text	50
Agency_Street_ Address	Contact address	Text	50
Agency_City_Address	Contact city	Text	50
Agency_Country	Contact country	Text	50
Agency_PostalCode	Contact postal code	Text	7
Agency_TelephoneNumber	Contact phone number	Text	10
Agency_FaxNumber	Contact fax number	Text	10
Agency_Email	Contact email	Text	50
UpdateDate	Date this record first added or updated	Date/Time	8
UpdateNote	Note on updates to this record	Text	255
CreateDate	Date this record first added – no edits	Date/Time	8
CreateNote	Note on creation of this record – no edits	Text	255

Table 10: CODE

All codes for WATER, HYDROLOGY and METEOROLOGY are now stored in this single table. Code values are related to a variety of tables and fields by the numeric CODE ID, and there are restrictions in both the table and form view restricting the code values shown by the name of the database, table and field. As such these are required fields.

Field Name	*Content*	*Type*	*Size*
Code_ID	Unique code number, db auto number	Long Integer	4
Database_Name	Name of the database the code valid for	Text	50
Table_Name	Name of the table the code valid for	Text	50
Field_Name	Name of the field the code valid for	Text	50

Discipline	Discipline value used to restrict code view	Text	50
Code_Name	Name (or symbol) of the code	Text	50
Code_description	Description of the code	Text	255
UpdateDate	Date this record first added or updated	Date/Time	8
UpdateNotes	Note on updates to this record	Text	255
CreateDate	Date this record first added – no edits	Date/Time	8
CreateNotes	Note on creation of this record – no edits	Text	255

Table 11: LOCATION

There are a number of ways to designate regions or geographical areas aside from a specific station location. These may include catchments or watersheds, and larger locations or regions. A generic LOCATION table is used to fit any of these criteria This table contains no geographic location coordinates.

Field Name	*Content*	*Type*	*Size*
Location _ID	Unique location number, db auto number	Long Integer	4
Location_Name	Name of the location	Text	50
Location_Description	Description of the location	Text	50
Parent_Location_ID	Reference back to Location ID	Long Integer	4
Location_Type_Code	Type of location code – found in CODE	Text	50
UpdateDate	Date this record first added or updated	Date/Time	8
UpdateNotes	Note on updates to this record	Text	255
CreateDate	Date this record first added – no edits	Date/Time	8
CreateNotes	Note on creation of this record – no edits	Text	255

Several tables are used to ‘lookup’ a textual value for a table with a format that is not conducive to central storage in the CODE table.

Table 12: Lookup CODE

Field Name	*Content*	*Type*	*Size*
Field_Name	Name of the Field	Text	50
CodeDescription	Full description of the code value	Text	50
UpdateDate	Date this record first added or updated	Date/Time	8
UpdateNote	Note on updates to this record	Text	255
CreateDate	Date this record first added – no edits	Date/Time	8
CreateNote	Note on creation of this record – no edits	Text	255

Table 13: Lookup MONTHS

Field Name	*Content*	*Type*	*Size*
MonthNumber	Numeric Month number	Long Integer	4
Month	Full Month name	Text	50

Table 14: Lookup UNITS

Field Name	*Content*	*Type*	*Size*
UNITS	Unit value – often symbols	Text	50
UnitDescription	Full description of the unit value	Text	50
UpdateDate	Date this record first added or updated	Date/Time	8
UpdateNote	Note on updates to this record	Text	255
CreateDate	Date this record first added – no edits	Date/Time	8
CreateNote	Note on creation of this record – no edits	Text	255

Several linked tables are used to store parameter measurement technique and reference guideline information. There is one central table (Measurement Technique) that houses all parameter, unit and analytical technique combinations. Unit variances for a parameter may be strictly classed as a measure qualifier and not a change in technique. Storing the unit value here in this central table, rather than in all related result tables fulfills the design criteria avoiding redundancy. It also makes data analysis more straightforward as users can chart only measures with the same units (or readily see those results where the units are misidentified) and statistics can also be confined to a single parameter, technique and unit combination. A previous upper PARAMETER table was removed in March 2005. All related parameter information (such as groups and guidelines) is now related to the central Measurement Technique ID value.

The following group of tables is used in the generation of summary stats

Table 15: Summary Stats Date Range

Field Name	*Content*	*Type*	*Size*
Well ID	BH name	Text	50
Stats Start Date	Begin stats on or after this date	Date/Time	8
Stats End Date	End stats on or before this date	Date/Time	8

This table is used to store both the stations and their start date to be used in derivation of summary stats. The stats are in turn stored in a temporary table. This is for performance so that a cross-tab query by stations and parameters can be easily generated and exported to EXCEL as desired

Table 16: Summary Stats

Field Name	*Content*	*Type*	*Size*
Class	Parameter Class	Text	50
Station_ID	Station ID	Text	50
Parameter	Parameter code (like AG-T)	Text	255
Statistic	Statistic generated (see Lookup Statistic)	Text	255
Value	Stat value generated	Text	50
N	Stat value generated	Integer	4
Data Value	Stat value generated	Single	8
Data Code	Stat value generated – aka remark code	Text	50

This table is used to store both the stations and their start date to be used in derivation of summary statistics.

Table 17: Lookup STATISTIC

Field Name	*Content*	*Type*	*Size*
Statistic	Name of the Statistic	Text	50
StatsSortOrder	Stats Sort order is resulting summaries	Long Integer	4
IncludeSTATS	Users can check which stats to include	Yes/no	8

This table is used in the derivation of summary statistics and allows users to pick which stats are generated, and the order that they are displayed in subsequent reports and data sheets. Current content of the table is shown below. A hidden 4th field houses the append query SQL used to derive the values. This field should never be altered by any users.

When users request benchmark statistics, they should also select the benchmark value itself, so that this reference value can be stored along with the statistic… particularly if further stats are generated with different benchmark values.

Lookup STATISTIC		
STATISTIC	**STATSortOrder**	**IncludeSTATS**
Total # samples	1	Yes
MEAN	2	Yes
STD	3	No
MINIMUM	4	No
MAXIMUM	5	No
# samples < MDL	6	No
% samples < MDL	7	No
Maximum MDL	8	No
Median	9	No

Lookup STATISTIC		
STATISTIC	**STATSortOrder**	**IncludeSTATS**
95th Percentile	10	No
5th Percentile	11	No
# samples > BM	12	No
% samples > BM	13	No
# samples < MDL and > BM	14	No
% samples < MDL and > BM	15	No
Benchmark	16	No

Table 18: Lookup Benchmarks

Field Name	*Content*	*Type*	*Size*
P CODE	Parameter code value (e.g. AG-T)	Text	50
Unit	Unit value – often symbols	Text	50
Parameter	Parameter Description	Text	50
UpperBenchmark	Upper Benchmark value	Single	8
LowerBenchmark	Lower Benchmark value (only for pH)	Single	8

This table is used in the derivation of summary statistics and stores upper and lower benchmark values that sample results (by parameter) are compared to. Typically, comparison is made as to whether a measured value is greater than an upper benchmark value. pH is the only parameter that is evaluated outside a range (less than a lower or greater than an upper benchmark. These values can be overwritten (edited) as required when deriving benchmark comparison statistics. The benchmark value should always be displayed (so select it too) for these stats.

Table 19: Lookup CHARGE BALANCE

Field Name	*Content*	*Type*	*Size*
ParmeterName	Parameter code value (e.g. AG-T)	Text	50
ParameterDescription	Parameter Description	Text	50
ParameterClass	Upper Benchmark value	Single	8
CurrentUse	Denotes whether this value is current	Yes/No	8
ClassCode	Used in sorting and grouping for derivation	Long Integer	4
MolecularWeight	Parameter molecular weight	Single	8
Charge	Parameter charge value	Long Integer	4

This table is used in the derivation of charge balances, and uses the molecular weights and charges to derive ANION and CATION sums. Current content of the table is shown below.

Lookup CHARGE BALANCE						
ParameterName	ParameterDescription	ParameterClass	CurrentUse	ClassCode	MolecularWeight	Charge
AG-D	Silver (Ag)-Dissolved	CATIONS	Yes	2	107.868	1
AL-D	Aluminum (Al)-Dissolved	CATIONS	Yes	2	26.982	3
ALK-T	Alkalinity, Total (as CaCO3)	ANIONS	Yes	1	100.089	2
AS-D	Arsenic (As)-Dissolved	CATIONS	Yes	2	74.922	3
BA-D	Barium (Ba)-Dissolved	CATIONS	Yes	2	137.327	2
B-D	Boron (B)-Dissolved	CATIONS	Yes	2	10.811	3
BE-D	Beryllium (Be)-Dissolved	CATIONS	Yes	2	9.012	2
CA-D	Calcium (Ca)-Dissolved	CATIONS	Yes	2	40.078	2
CD-D	Cadmium (Cd)-Dissolved	CATIONS	Yes	2	112.411	2
CL-D	Chloride (Cl)-Dissolved	CATIONS	Yes	2	35.453	1
CO-D	Cobalt (Co)-Dissolved	CATIONS	Yes	2	58.933	3
CR-D	Chromium (Cr)-Dissolved	CATIONS	Yes	2	51.996	3
CU-D	Copper (Cu)-Dissolved	CATIONS	Yes	2	63.546	2
FE-D	Iron (Fe)-Dissolved	CATIONS	Yes	2	55.847	3
HG-D	Mercury (Hg)-Dissolved	CATIONS	Yes	2	200.59	2
K-D	Potassium (K)-Dissolved	CATIONS	Yes	2	39.098	1
LI-D	Lithium (Li)-Dissolved	CATIONS	Yes	2	6.941	1
MG-D	Magnesium (Mg)-Dissolved	CATIONS	Yes	2	24.305	2
MN-D	Manganese (Mn)-Dissolved	CATIONS	Yes	2	54.938	2
MO-D	Molybdenum (Mo)-Dissolved	CATIONS	Yes	2	95.94	4
NA-D	Sodium (Na)-Dissolved	CATIONS	Yes	2	22.99	1
NI-D	Nickel (Ni)-Dissolved	CATIONS	Yes	2	58.693	2
PB-D	Lead (Pb)-Dissolved	CATIONS	Yes	2	207.2	2
SB-D	Antimony (Sb)-Dissolved	CATIONS	Yes	2	121.757	3
SE-D	Selenium (Se)-Dissolved	CATIONS	Yes	2	78.96	4
SN-D	Tin (Sn)-Dissolved	CATIONS	Yes	2	118.71	2
SO4-D	Sulfate (SO4)	ANIONS	Yes	1	96.066	2
TI-D	Titanium (Ti)-Dissolved	CATIONS	Yes	2	47.88	4
TL-D	Thallium (Tl)-Dissolved	CATIONS	Yes	2	204.383	1
U-D	Uranium (U)-Dissolved	CATIONS	Yes	2	238.029	3
V-D	Vanadium (V)-Dissolved	CATIONS	Yes	2	50.942	3
ZN-D	Zinc (Zn)-Dissolved	CATIONS	Yes	2	65.39	2

Table 20: MEASUREMENT_TECHNIQUE

The contents of this table require continual careful review to update the units and technique descriptions. There are many parameters listed with no related result values in any corporate data store. They were added from historical listings (typically MOE labs) and may be considered for deletion. This table is perhaps the key reference lookup table

Field Name	*Content*	*Type*	*Size*
Measurement_ID	Unique measurement technique ID – combination of parameter, units and technique, db auto number assigned	Long Integer	4
ParameterCode	Parameter code name – may be lab assigned, or periodic table based	Text	20
MeasurementUnits	Units the parameter is reported in	Text	50
ParameterDescription	Parameter descriptive name	Text	50
DoParameterSTATS	mark for parameters to include in stats	Yes/No	1
MeanDetectionLimits	Mean detection limits	Single	4
ClassID	Class this parameter belongs to, lookup value in Parameter_Class table	Long Integer	4
MeasurementTechniqueName	Name of the technique	Text	50
MeasurementTechniqueDescription	Description of the technique	Text	50
ParameterLock	Is the parameter locked against edits	Yes/No	1
Program	Program division by parameter	Text	50
AgencyID	Agency Identification	Long Integer	4
MeasurementNotes	Detailed notes about the measure	Memo	
UpdateDate	Date this record first added or updated	Date/Time	8
UpdateText	Note on updates to this record	Text	255
CreateDate	Date this record first added – no edits	Date/Time	8
CreateText	Note on creation of this record – no edits	Text	255
Annual	Original EQWIN flags	Yes/No	1
Quarterly	Original EQWIN flags	Yes/No	1
MonthlyF	Original EQWIN flags	Yes/No	1
MonthlyV	Original EQWIN flags	Yes/No	1

Table 21: PARAMETER_CLASS

This table contains the names of parameter classes. A parameter may only belong to one class.

Field Name	*Content*	*Type*	*Size*
ClassID	Name of the parameter class	Long Integer	4
TierID	Required FK to parameter tier table	Long Integer	4
Paremeter_class	Name of the parameter class	Text	255
Class_Description	Description of the parameter class	Text	255
ReportSelect	Select report by class	Yes/No	1
UpdateDate	Date this record first added or updated	Date/Time	8
UpdateNote	Note on updates to this record	Text	255
CreateDate	Date this record first added – no edits	Date/Time	8
CreateNote	Note on creation of this record – no edits	Text	255

Table 22: PARAMETER_GUIDELINE_Type

This table contains the guideline type values. This information is a required entry for the parameter guideline reference table.

Field Name	*Content*	*Type*	*Size*
GuidelineType	Unique type of guideline/reference	Text	50
GuidelineTypeDescription	Description of the guideline/reference	Text	255
GuidelineAbbreviation	Abbreviation	Text	50
GuidelineFlag	Guideline flag – single value	Text	1
UpdateDate	Date this record first added or updated	Date/Time	8
UpdateNote	Note on updates to this record	Text	255
CreateDate	Date this record first added – no edits	Date/Time	8
CreateNote	Note on creation of this record – no edits	Text	255

Table 23: PARAMETER_GUIDELINES

This table used to store all reference value guidelines for a parameter/unit combination. There is no limit to the number of guidelines for a parameter, though only one value per guideline type can be valid at any one time. Various charts and summary reports can then select a parameter and guideline value (by type) to compare data against.

Field Name	*Content*	*Type*	*Size*
GuidelineID	Unique guideline/reference number	Long Integer	4
MeasurementID	Measurement the guideline refers to	Long Integer	4
GuidelineType	Type of guideline	Text	50
GuidelineValue	Numeric guideline value	Double	8
GuidelineUnits	Units for the guideline value	Text	15
Reference	Reference information for this guideline	Text	255
Current	Is the guideline current – yes is default	Yes/No	1
ValidGuidelineDate	Date the guideline became valid	Date/Time	8
UpdateDate	Date this record first added or updated	Date/Time	8
UpdateNote	Note on updates to this record	Text	255
CreateDate	Date this record first added – no edits	Date/Time	8
CreateNote	Note on creation of this record – no edits	Text	255
Source	Source for the guideline value	Text	255
AgencyID	Agency responsible for the guideline	Long Integer	4

Table 24: PARAMETER _TIER

This table contains the names of parameter tiers. A parameter class may only belong to one tier.

Field Name	*Content*	*Type*	*Size*
TierID	Tier identification – autonumber as assigned by the database	Long Integer	4
TierName	Name of the parameter tier	Text	255
TierDescription	Description of the parameter tier	Text	255
UpdateDate	Date this record first added or updated	Date/Time	8
UpdateNote	Note on updates to this record	Text	255
CreateDate	Date this record first added – no edits	Date/Time	8
CreateNote	Note on creation of this record – no edits	Text	255

Table 25: ParameterClassMatch

This table used as part of data summary analysis and should not be altered otherwise. A single value in the one field is used as a selection and match in procedural query to both select and view a group of parameters.

Field Name	*Content*	*Type*	*Size*
ParameterClassName	Name of the parameter class for display	Text	50

Table 26: PERSONNEL

Field Name	*Content*	*Type*	*Size*
Personnel_ID	Unique person ID, db auto assigned	Long Integer	4
Personnel_LastName	Last name	Text	50
Personnel_FirstName	First name	Text	50
Personnel_Title	Title	Text	50
Personnel_Suffix	Suffix (like degrees)	Text	50
Personnel_PhoneNumber	Phone number	Text	50
Personnel_FaxNumber	Fax number	Text	50
Personnel_Email	email	Text	50
UpdateDate	Date this record first added or updated	Date/Time	8
UpdateNote	Note on updates to this record	Text	255

CreateDate	Date this record first added – no edits	Date/Time	8
CreateNote	Note on creation of this record – no edits	Text	255

Table 27: PROJECT

This table contains the identification and names of programs.

Field Name	*Content*	*Type*	*Size*
Project_ID	Project identification – autonumber as assigned by the database. Stations are typically assigned by project.	Long Integer	4
Project_Name	Name of the parameter tier	Text	255
Project_Description	Description of the parameter tier	Text	255
Agency_ID	Agency responsible for this project	Long Integer	4
UpdateDate	Date this record first added or updated	Date/Time	8
UpdateNote	Note on updates to this record	Text	255
CreateDate	Date this record first added – no edits	Date/Time	8
CreateNote	Note on creation of this record – no edits	Text	255

Table 28: STATION

The central STATION table is linked to all corporate data stores. Keeping this table up-to-date and complete is obviously an important consideration. The key fields are the descriptive name of the station; it's location within the watershed/sub-watershed boundaries and the station type. The station type code is often used to restrict station lists within databases. That said the same station could be used for multiple sampling disciplines – and a field for that information exists.

Field Name	*Content*	*Type*	*Size*
Station_ID	Unique textual Station ID	Text	50
Station_Name	Name of the Station	Text	100
StationSortOrder	Sort order – so that R10 comes after R9	Long Integer	4
Do Stats	Mark with a check to do stats – used in summary stats procedure	Yes/No	1
StationStatisticalGroup	Used for generation of group stats	Text	50
StationStatisticalGroupORDER	Used to order groups by name in stats	Long Integer	4
StationStatus	Protected by Lookup Station Status table	Text	50
Station_Description	Description of the Station	Text	255
Project _ID	Station project identification	Long Integer	4
Location _ID	Location of the station – see LOCATION	Long Integer	4

Station_Type_Code	Type of location – see CODE	Long Integer	4
Station_Class_Code	Listing of disciplines at this site	Text	50
Station_Status	Is the station active, if not will be protected against edits	Yes/No	1
Required	Is the station monitoring required	Yes/No	1
Requirement	Currently used to group GW well stations for field data sheet generation	Text	255
Elevation	Station elevation – not used - remove	Single	8
ScreenDepth	Screen depth – not used - remove	Single	8
Stratigraphy	screen stratigraphy – not used - remove	Single	8
GIS_ReferenceNumber	Cross-reference to GIS reference ID	Text	50
LATITUDE	Latitude in decimal degrees	Double	8
LONGITUDE	Longitude in decimal degrees	Double	8
LATITUDE DMS	Latitude in DMS (degree/minute/second)	Text	50
LONGITUDE DMS	Longitude in DMS	Text	50
Datum	Lat/Long datum (NAD 83 is the default)	Text	50
UTM Northing	Northing value (with suffix N)	Text	50
UTM Easting	Easting value (with suffix E)	Text	50
UTM Zone	UTM zone (default is 17)	Long Integer	4
UTM_Datum	UTM datum (NAD 83 is the default)	Text	50
Location_collection_Code	How was the station identified?	Long Integer	4
Location_Code	How were station coordinates established?	Long Integer	4
StationLocation	instructions on how to get to the site	Text	255
AGENCY_ID	Agency responsible for this site	Long Integer	4
StationNotes	Descriptive notes on this site	Text	255
UpdateDate	Date this record first added or updated	Date/Time	8
UpdateNote	Note on updates to this record	Text	255
CreateDate	Date this record first added – no edits	Date/Time	8
CreateNote	Note on creation of this record – no edits	Text	255
Original DBID from EQWIN	Kept for legacy cross reference only	Text	50

Flag Result Tables

There are a group of tables used during the review of data against previously recorded values. Each value is appraised against all previously entered values by station and parameter. Values that are either greater or less than +/- 3 standard deviations about the mean value are flagged and marked appropriately. The +/- 3 std value is continually re-derived from all data in the database and is thus a dynamic comparative reference value.

Table 29: FLAG RESULTS

This table contains the link to the Result water table record by result ID and the paired QAQC code as derived automatically using the either Import procedure or by design using the Review/Mark/Edit RESULT data by these defined Reference Limits... procedure on the QAQC tab from the main switchboard.

Field Name	*Content*	*Type*	*Size*
Result_ID	FK to Result Water table	Long Integer	4
QAQCcode	QAQC code found in CODE	Long Integer	4

Table 30: FLAG_VALUES_TEMP

This table contains the link to the Result water table record by result ID and the paired QAQC code as derived automatically using the either Import procedure or by design using the Review/Mark/Edit RESULT data by these defined Reference Limits... procedure on the QAQC tab from the main switchboard.

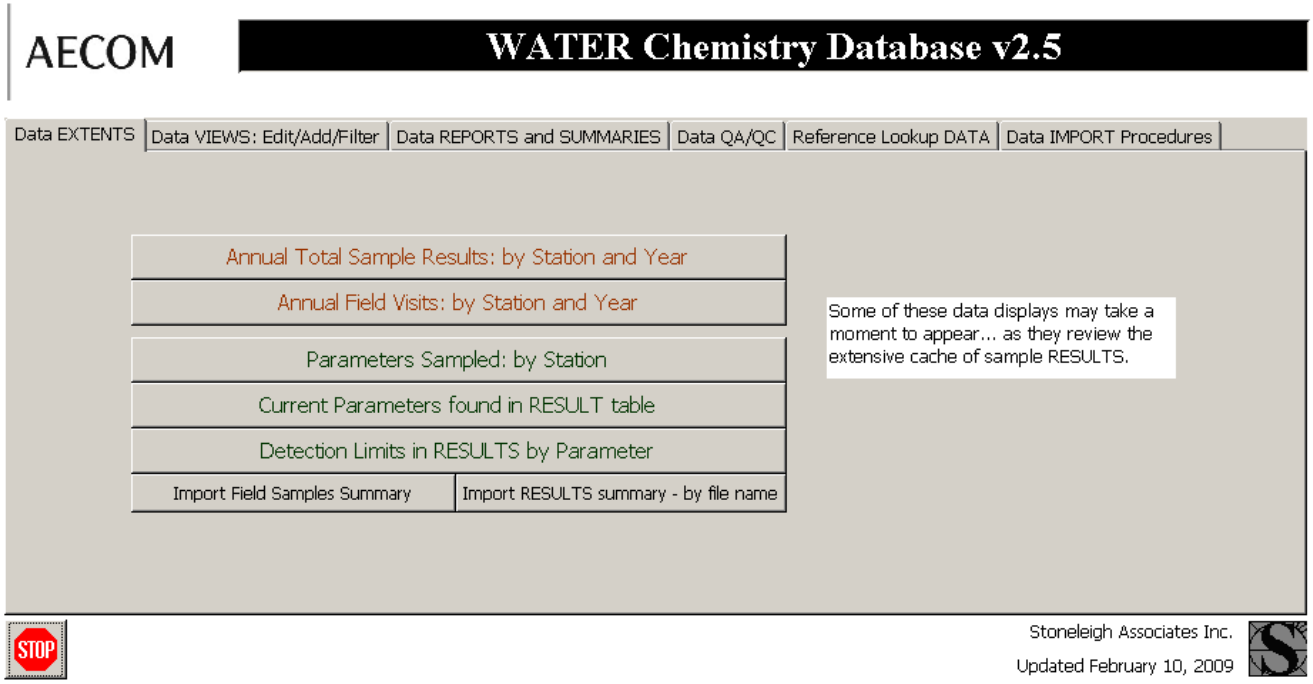
Field Name	*Content*	*Type*	*Size*
StationID	Station ID	Text	50
MeasurementID	Measurement ID – parameter/unit combination	Long Integer	4
ParameterCode	Parameter code	Text	50
MeasurementUnits	Measurement units	Text	50
MIN	Minimum value for this station, measure	Double	8
MAX	Maximum value for this station, measure	Double	8
MEAN	Mean value for this station, measure	Double	8
STD	Std dev value for this station, measure	Double	8
LOWER LIMIT	3 std below mean value for this station, measure	Double	8
UPPER LIMIT	3 std below mean value for this station, measure	Double	8
N	Number values for this station, measure	Long Integer	4

Using the Database

This database opens to a MAIN switchboard-type form (Figure 2) that directs the user to all features of the application. The database can be used as a stand alone application, and may also link to other related data monitoring disciplines in future (such as Hydrology or Meteorology). Multiple tabs on the form allow separation of different processes of the application.

This database is linked to the GROUNDWATER data application utilized for the same project.

Figure 2 Main Switchboard Screen



Data Extents

There are several pre-defined summaries on the main screen that can be used to asses the extent and scope of the data in the database. Displays are read-only and include:

- Annual field visits by Station
- Annual total samples by Station
- Parameters sampled by Station
- Parameters currently in RESULTS
- Detection Limits currently in RESULTS – by Parameter

Data Views: Add/Edit/Filter

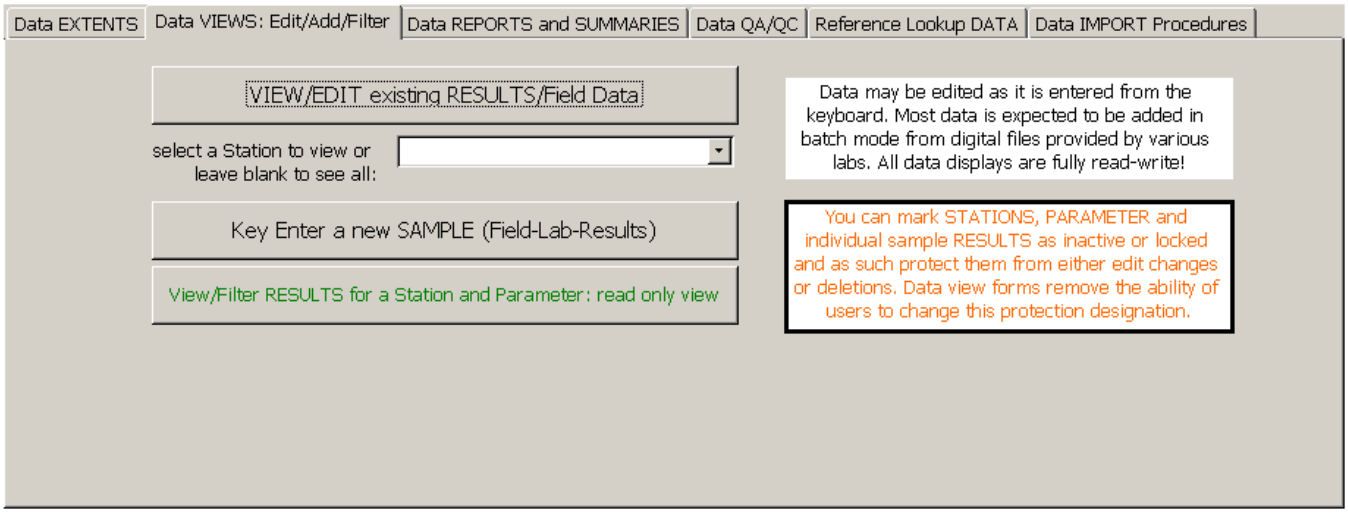


Figure 3 Data View Screen

Enter (via Keyboard) New Sample Data

Use the button on this form to add field, lab and sample results.

View / Edit Existing Data

Use the button on this form to edit field, lab and sample results for a station.

Filter (Find) Results Data

Use the button on this form to quickly filter sample results for a station and parameter.

Data Reports and Summaries

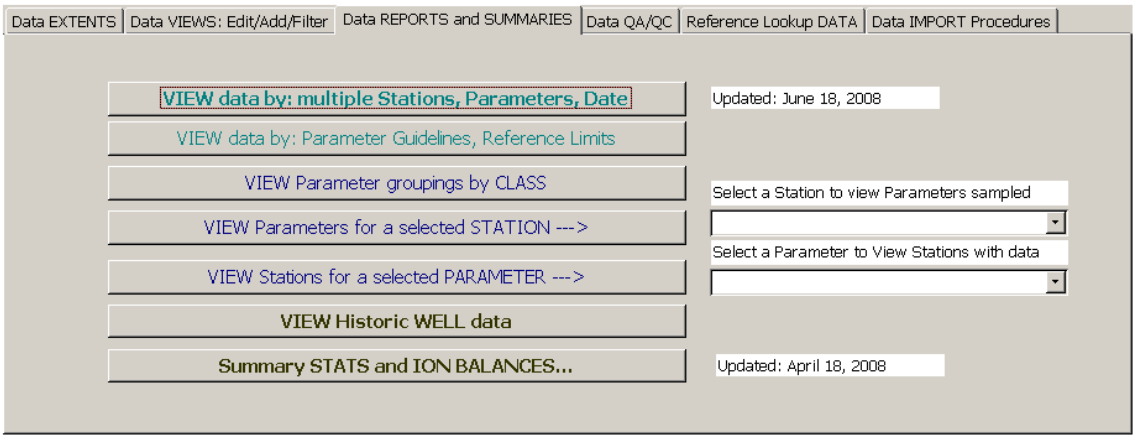


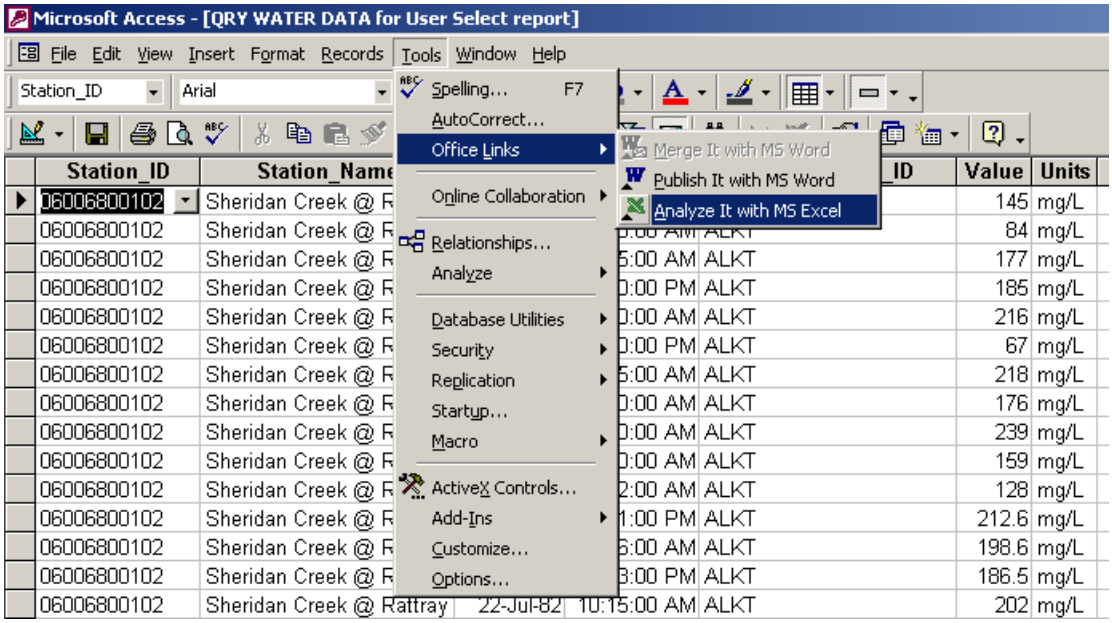
Figure 4 Data Reports and Summaries

Users can filter either the station or the parameter from the main screen using the selection boxes provided, or leave blank to view all data – using any of the command buttons that are coloured blue. All other command buttons open to reveal a new user screen.

There are several ways that the user can view and summarize the data. Some of the procedures produce the same output, though the user can arrive at the display using different means. Printable reports, sorted / filterable / exportable data displays and charts are all choices available to the user. Most of the data will be viewed via drop-down lists as user selected choices. **Any** data display can be readily sorted or filtered using the available buttons on the tool bar shown.

Users can quickly export to EXCEL using the command Tools – Office Links and then analyze with Excel (Figure 5). This will automatically create a new file (saved to the default folder) with both the file and worksheet name set as the database object (table or query) name. This command is available from any data view. Alternatively users can simply cut and paste data to any other program.

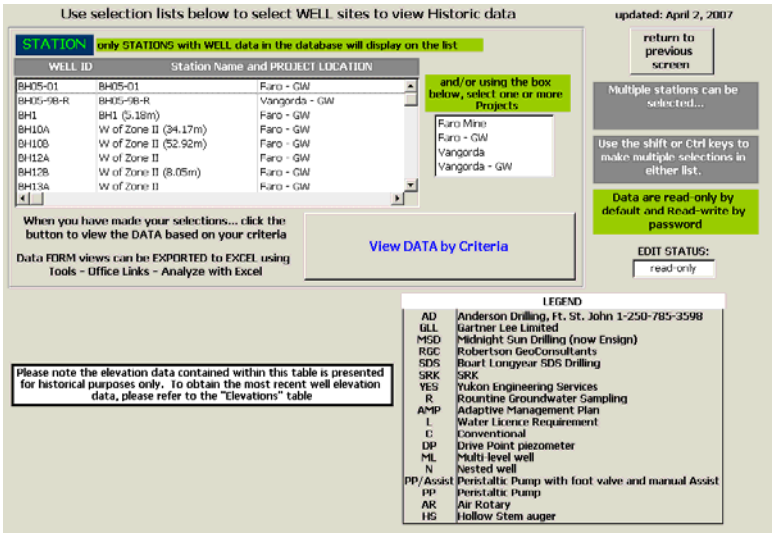
Figure 5 Exporting Data to EXCEL



The following sections describe buttons by the same name located on the main form. They access various methods to view and summarize data. **All data displays are read-write** unless as specifically stipulated for import data displays.

View Historic WELL data

Figure 6 Viewing Historic Well Data Screen



View data by multiple Stations, Parameters and Date

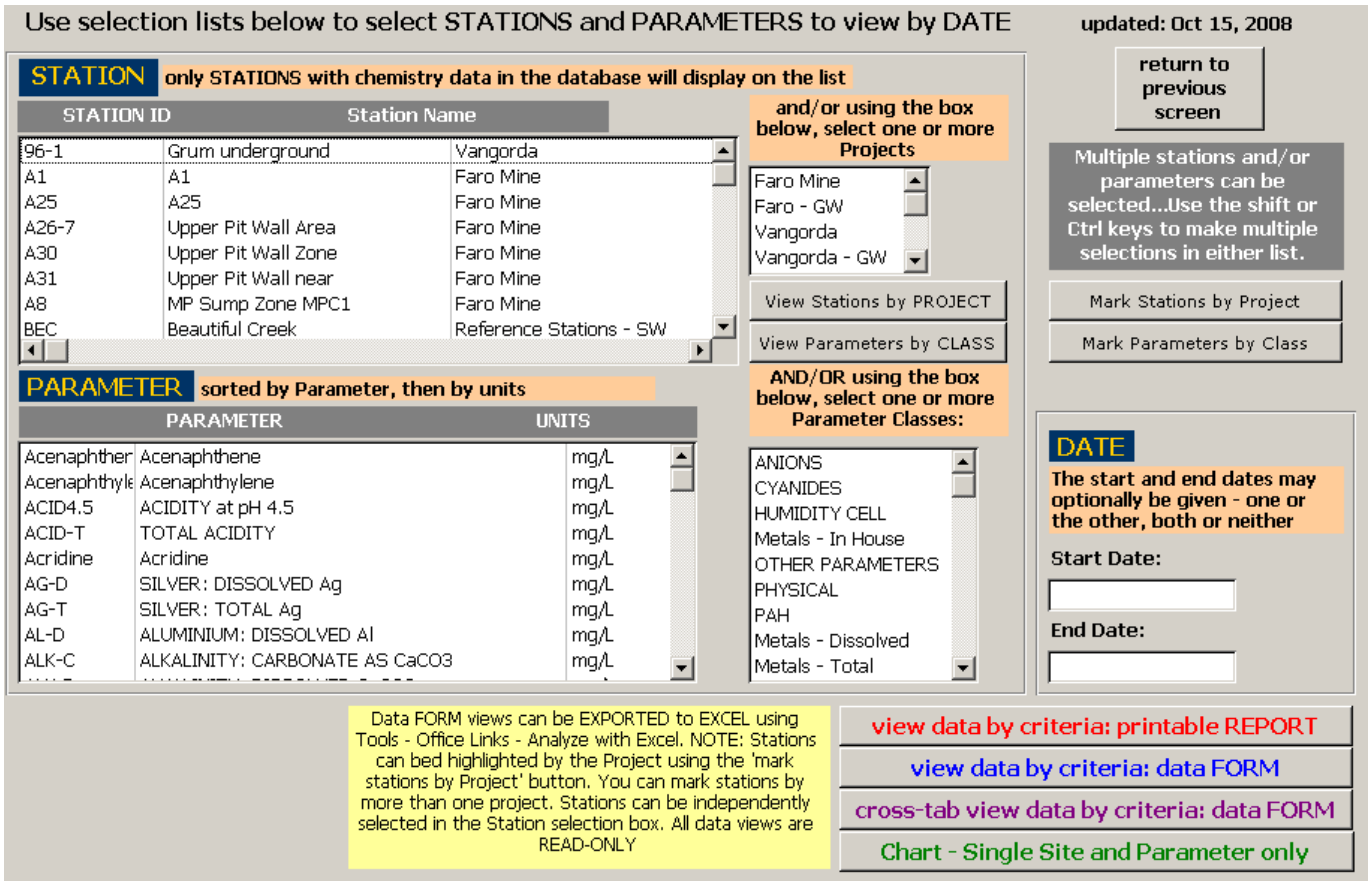


Figure 7 Multiple Station, Parameters and Date Selection Screen

The user can select a station, group of stations, parameter, class of parameters, start or end date to refine the choices. Users can also select a project and then use the 'mark stations by project' to see all of the stations in that project. This has no impact on the summary produced as all of the project stations will display if selected by a project. An input mask protects the date to entry as 'DD-MMM-YY A read-only data display, summary data report (with statistics) or a cross-tab read-only data display suitable for export to EXCEL are output options. This display option is primarily used for regular data reporting and is added to pre-formatted EXCEL files for publication. Groups of parameters are defined by their class grouping, and can be adjusted as required.

View data by Parameter

The user can enter a parameter and optionally use a check box to include all unit combinations to refine the data selection.

A read-only data display is the output option. This view is especially useful to quickly review a large selection of data for possible unit misidentifications. In particular many metals periodically switch reported units from mg/L to µg/L. This causes problems in analysis and charting.

View data by Parameter Guidelines: Adding and Assigning

The user can enter a parameter guideline and optionally select a station (or group of stations) to refine the choices. All current guidelines will display. Ensure that you carefully select the parameter, the units and the guideline type before viewing the data comparisons.

A read-only data display or summary data report (with statistics) is the output option. Both summary displays derive various variance fields. If a value exceeds the guideline value, then the amount and % are derived. If the value is below detection, that is identified as well. If the value is below the guideline, that is identified. Landscape is the default format for the summary report. To print selected pages, use the command File – Print and then enter the page(s) to print in the boxes provided.

The WATER database application provides two basic mechanisms whereby parameters can be evaluated against reference values. During import all values are compared against previous values for that station and parameter. Any results that are either higher or lower than 3 standard deviations about the mean value are marked by a QA/QC flag code for later review. These guideline values are continually re-derived as new values are added. These flagged values should be reviewed as they are imported.

Figure 8 illustrates the screen to view, edit and add new parameter information. Many parameters also have a variety of reference guideline values that they can also be compared to, independent of a station location. These guidelines may include national water standards, mining closure guidelines and other related reference values. They are stored in the table PARAMETER_GUIDELINES and must include the following related information

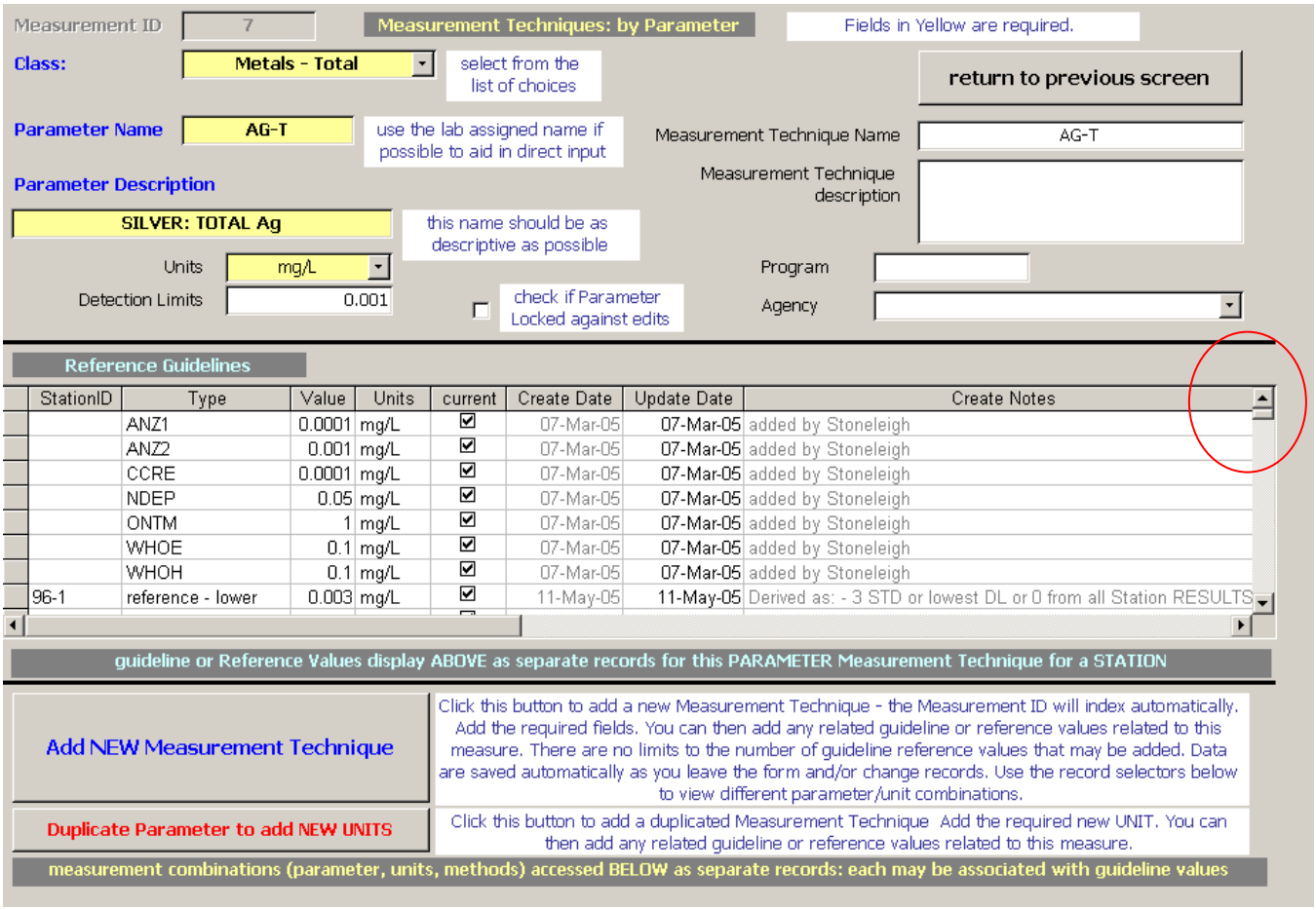


Figure 8 Parameter Measurement Technique and Guideline Information Screen

- Measurement ID – a valid parameter in the Measurement Technique table
- Guideline type – a valid type listed in PARAMETER GUIDELINE types
- Guideline value
- Units – that must match the measurement ID parameter units

Procedures to add new values to the database are described here. Values may be either added directly to the guideline table in table data view, or by using the user form accessed from the main switchboard screen.

From the user form view

1. From the Main switchboard screen, click on the tab marked Reference Lookup Data.
2. You can either select a parameter to add a guideline for, or open the form that displays all parameters. Either way, find the parameter to add a guideline to. Use the graphic shown on the next page for AG-T as your guide…

3. DO NOT change any of the parameter information in the yellow fields shown in the upper part of the screen.

   a. Using the vertical scroll bar shown in the red circle in the reference guideline table for the parameter, scroll to the bottom of the list.
   b. Click onto the next new line and add the 3 required fields. The guideline is automatically paired with the parameter shown in the top part of the screen. The create date is also added automatically. Add information to the Update notes as appropriate.
   c. Leave the Station ID field blank for these independent reference values.
4. Move to the next parameter to add another reference guideline as required.

From the table data view

1. Open the PARAMETER GUIDELINE types table in data view. Add the type of guideline, if it is not already in the table. All previous guideline values were added from the historic EQWIN data store and may no longer be relevant. The type and paired description are required. Close the table.
2. Open the table PARAMETER_GUIDELINES and add the 4 required fields as itemized above. The create date and note are also required. Leave the Station ID field blank for these independent reference values. Close the table when you are finished adding parameter guideline values. Batch entry of multiple values may use an append query for an imported table of values. The append query must also add all required fields.

Summary Statistics and Charge (Ion) Balances

The user can generate summary statistics or charge balances for user selected stations (either individually or grouped), each defined by its own start and end date range. Steps 1 and 2 (Figure 9) are the same for each process – select the stations, parameters and set the date restriction range. Step 3 allows users to view either the summary statistic lookup table or the charge balance reference table. Stats can be either included or excluded using a check box. Similarly, parameters can either be included or excluded in the ion balance – molecular weights and charges are assigned here.

Figure 9 Summary Statistics and Charge Balance Derivation Screen

There are two separate streams of stat derivation depending on whether the user is doing individual stations or groups of stations (enter group names in step 2). The buttons are colour coded on the form as you complete each step of the process. All previous groups can be removed by using the X button on the right of the step 2 button. Ensure that only the groups that

you want are selected. Having groups selected will have no impact on the individual station generated statistics.

Currently, the generation of the stations is done by entering a check in the Do STATS field in Step 2, and then by entering the start and end date for the station in Step 2. Only those stations with a check will display in Step 2. Select the stats you want in Step 3. Step 4 is only necessary if you are including benchmark comparisons.

Summary STATS – a description of the generation of each STATISTIC is described here. All stats including median and percentiles (if selected) are generated in one process.

A base query (QRY BASE DATA) displays all results with benchmarks and molecular weights if applicable. The value field is also displayed in several different ways for stats generation. The detection limit values are included as ½ the value for some stats (termed the STATS value), and are either counted separately or excluded for others. Users may require that DL values are interpreted as the value for certain summaries, or as 0 for charts. To interpret as the DL value, you must edit this query and alter the field [STATS Value]. Any other restrictions (such as values in the field Sample CLASS can also be made in the design view of this query). Future improvements will allow users to select this from the form. Typically (and by default), all sample classes are included and DL values are interpreted as ½ the value. This base query will display a 1 or 0 if the value is below detection, above a benchmark value (if applicable), and also if below detection and above a benchmark. The pH parameters are evaluated as well for a lower benchmark value. The statistics derived are listed in Table 31:

Table 31 Statistic Derivation Summary Information

STATISTIC	Derivation
Total # samples	Count of the STATS value
MEAN	Mean of the STATS value (so DL values evaluated as ½ their value)
STD	Standard deviation of the STATS value
MINIMUM	The minimum of all values is derived as well as the min of DL values. If the min DL value is less than or equal to the min of all values, then a < sign is appended to the value.
MAXIMUM	The maximum of all values is derived as well as the max of DL values. If the max DL values is greater than or equal to the max of all values then a < sign is appended to the value.
# samples < MDL	Count of the number of values below DL
% samples < MDL	Count of the number of values below DL divided by the count of all values and expressed as a percentage
Maximum MDL	If there are any DL values, find the max and display it, otherwise shown nothing
Median	This stat is derived in Access with separate code and is executed after the basic stats are created.
95th Percentile	This stat is derived in Access with separate code and is executed after the basic stats are created. The formula used is the same as EXCEL derivation
5th Percentile	This stat is derived in Access with separate code and is executed after the basic stats are created. The formula used is the same as EXCEL derivation
25th Percentile	This stat is derived in Access with separate code and is executed after the basic

STATISTIC	Derivation
	stats are created. The formula used is the same as EXCEL derivation
75th Percentile	This stat is derived in Access with separate code and is executed after the basic stats are created. The formula used is the same as EXCEL derivation
# samples > BM	Sum the 1's and 0's (thus a count) produced from the Base Query where the value (including DL as full and not ½ value) is greater than a given benchmark value
% samples > BM	Count of samples greater than a benchmark divided by the count of all values, expressed as a percentage
# samples < MDL and > BM	Sum the 1's and 0's (thus count) produced by the Base Query where the value was both less than detection and was greater than a benchmark
% samples < MDL and > BM	Count of the samples less than detection and greater than a benchmark divided by the count of all values, expressed as a percentage
Benchmark	Display the benchmark value if applicable, otherwise show nothing

Charge BALANCE – the derivation method is described in the following section

A base query (QRY BASE DATA) displays all results with molecular weights if applicable. The value field is also multiplied by the charge and divided by the molecular weight, separated by the two classes of parameters; anions and cations. A table called Lookup Charge Balance lists the parameters by class with the molecular weights and charges. This can be updated as required. The query QRY CHARGE BALANCE displays the sum of ANIONS and CATIONS derived in the QRY BASE DATA and matches the stations and date ranges given by the user in the table Summary STATS Date range. Only values above detection are used in this charge balance.

The output can either be shown as an exportable data view, or a printable/viewable data report. The data report employs conditional formatting to show change balances either above or below 10 %. The full report shows all values (even those below detection) and highlights in green shading the values above detection that were used in the derivation. A sample is shown in Figure 10.

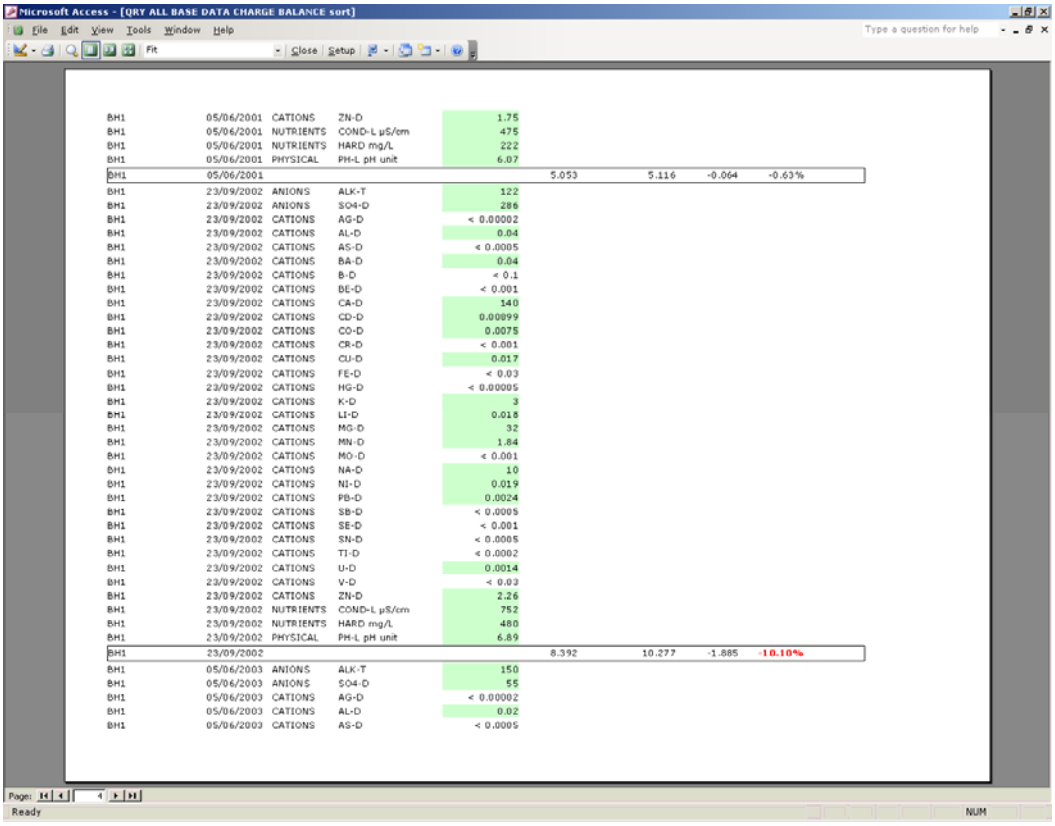
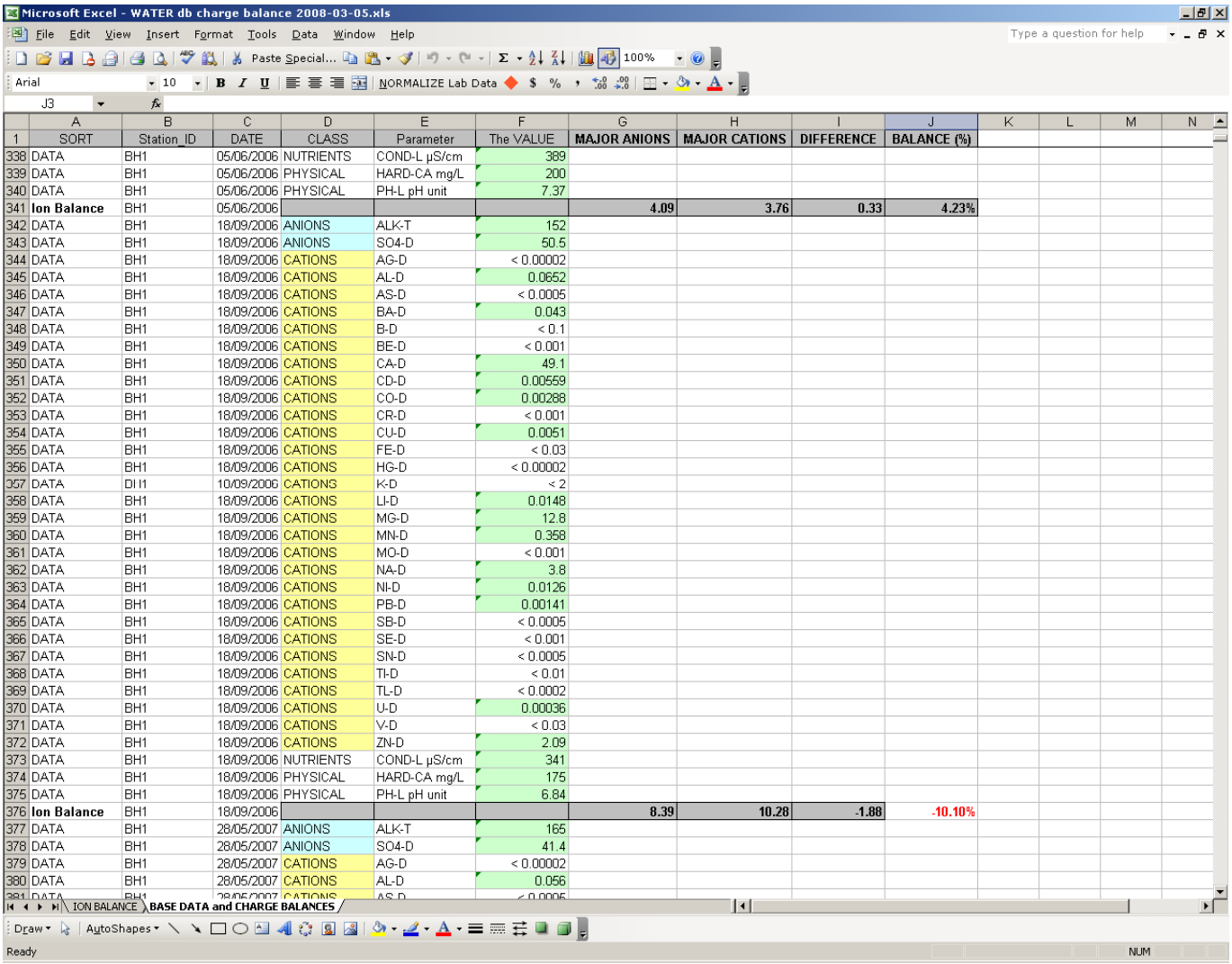


Figure 10 Charge Balance Summary Report

The base data and the charge balance values can be exported separately to EXCEL and then merged and sorted to show the information as it is displayed in the Access report. The same conditional formatting can also be applied here. The merging of the data is done in several stages, as each of the base data and the charge balance values are exported separately, and

then pasted to a single EXCEL worksheet (Figure 11). Copy the base data first and then paste the charge balance information below it. Remove the field headers from the charge balance rows and ensure that the data block is contiguous. Sort the entire block of base data and charge balances by Station, Date and then the first field marked SORT. This will cause the ION BALANCE information to display below the DATA values – sorted first by station and date. The parameter list already sorted by anions, cations and physical parameters (NOT included in the charge balance) should remain sorted as before.

Figure 11 Charge Balance EXCEL Output



Microsoft Excel - WATER db charge balance 2008-03-05.xls

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	SORT	Station_ID	DATE	CLASS	Parameter	The VALUE	MAJOR ANIONS	MAJOR CATIONS	DIFFERENCE	BALANCE (%)				
338	DATA	BH1	05/06/2006	NUTRIENTS	COND-L µS/cm	389								
339	DATA	BH1	05/06/2006	PHYSICAL	HARD-CA mg/L	200								
340	DATA	BH1	05/06/2006	PHYSICAL	PH-L pH unit	7.37								
341	**Ion Balance**	BH1	05/06/2006				4.09	3.76	0.33	4.23%				
342	DATA	BH1	18/09/2006	ANIONS	ALK-T	152								
343	DATA	BH1	18/09/2006	ANIONS	SO4-D	50.5								
344	DATA	BH1	18/09/2006	CATIONS	AG-D	< 0.00002								
345	DATA	BH1	18/09/2006	CATIONS	AL-D	0.0652								
346	DATA	BH1	18/09/2006	CATIONS	AS-D	< 0.0005								
347	DATA	BH1	18/09/2006	CATIONS	BA-D	0.043								
348	DATA	BH1	18/09/2006	CATIONS	B-D	< 0.1								
349	DATA	BH1	18/09/2006	CATIONS	BE-D	< 0.001								
350	DATA	BH1	18/09/2006	CATIONS	CA-D	49.1								
351	DATA	BH1	18/09/2006	CATIONS	CD-D	0.00559								
352	DATA	BH1	18/09/2006	CATIONS	CO-D	0.00288								
353	DATA	BH1	18/09/2006	CATIONS	CR-D	< 0.001								
354	DATA	BH1	18/09/2006	CATIONS	CU-D	0.0051								
355	DATA	BH1	18/09/2006	CATIONS	FE-D	< 0.03								
356	DATA	BH1	18/09/2006	CATIONS	HG-D	< 0.00002								
357	DATA	BH1	18/09/2006	CATIONS	K-D	< 2								
358	DATA	BH1	18/09/2006	CATIONS	LI-D	0.0148								
359	DATA	BH1	18/09/2006	CATIONS	MG-D	12.8								
360	DATA	BH1	18/09/2006	CATIONS	MN-D	0.358								
361	DATA	BH1	18/09/2006	CATIONS	MO-D	< 0.001								
362	DATA	BH1	18/09/2006	CATIONS	NA-D	3.8								
363	DATA	BH1	18/09/2006	CATIONS	NI-D	0.0126								
364	DATA	BH1	18/09/2006	CATIONS	PB-D	0.00141								
365	DATA	BH1	18/09/2006	CATIONS	SB-D	< 0.0005								
366	DATA	BH1	18/09/2006	CATIONS	SE-D	< 0.001								
367	DATA	BH1	18/09/2006	CATIONS	SN-D	< 0.0005								
368	DATA	BH1	18/09/2006	CATIONS	TI-D	< 0.01								
369	DATA	BH1	18/09/2006	CATIONS	TL-D	< 0.0002								
370	DATA	BH1	18/09/2006	CATIONS	U-D	0.00036								
371	DATA	BH1	18/09/2006	CATIONS	V-D	< 0.03								
372	DATA	BH1	18/09/2006	CATIONS	ZN-D	2.09								
373	DATA	BH1	18/09/2006	NUTRIENTS	COND-L µS/cm	341								
374	DATA	BH1	18/09/2006	PHYSICAL	HARD-CA mg/L	175								
375	DATA	BH1	18/09/2006	PHYSICAL	PH-L pH unit	6.84								
376	**Ion Balance**	BH1	18/09/2006				8.39	10.28	-1.88	-10.10%				
377	DATA	BH1	28/05/2007	ANIONS	ALK-T	165								
378	DATA	BH1	28/05/2007	ANIONS	SO4-D	41.4								
379	DATA	BH1	28/05/2007	CATIONS	AG-D	< 0.00002								
380	DATA	BH1	28/05/2007	CATIONS	AL-D	0.056								

ION BALANCE | BASE DATA and CHARGE BALANCES

Ready NUM

A sample EXCEL file for the same data as shown above is shown on the following page, with additional information about the conditional formatting applied. Conditional formats can be applied for the first column and then copied for all other cells in the field using the format painter.

The EXCEL conditional formats are shown below to match the graphic above… class field first. Formats are also applied to Parameter Field (column) and then The VALUE – format all shaded as light green, then exceptions will show as above, and then Major ANIONS, CATIONS and DIFFERENCE conditional format and finally Balance (%) field conditional format as shown in the sample previously.

View a Chart by Station, Parameter and Date

The user can enter a station, parameter, start or end date to refine the choices. The station and parameter are required entry. The station selection will then restrict the parameter measurement choices to those found in the database for that station. The parameter selected will then restrict the guideline values. If there is no guideline value for a parameter, none will display on the chart. Warning messages will also display if the user has failed to enter a guideline for a parameter (a default one should always display) or has entered a guideline type for a parameter that does not exist in the reference table. Parameters with more than one valid guideline (or different types) will display as separate chart pages. An input mask protects both the start and end date to entry as 'dd-mmm-yyyy' though the date selection is valid only for the data report.

A summary data report (with statistics) or a chart is the output option. If no dates are entered for either of the charts then all data will display. A station and parameter must be specified for charts, but are optional for the data view. Use the chart close button to close the chart. Any of the charts may be printed – landscape is the default format.

View Parameters for a selected Station

The user can select a station (or leave blank to see all) and then see all the parameters sampled for it.

View Stations for a selected Parameter

The user can select a parameter (or leave blank to see all) and then see all the stations with sample data.

View Parameters by Class: Adding and Assigning

The user can view a parameter list by class, and will then be able to see which results will display when grouping by class distinction. Users may Add and Assign Parameter Classes to the WATER application using the following procedures.

The WATER database application provides two grouping levels for parameters. An upper parameter TIER is currently not used in any pre-defined user procedures. The parameter CLASS is used to select groups of parameters and includes the Classes shown in Table 32:

Parameter Classes in WATER Results Table				
Tier ID	**Tier Name**	**Tier Description**	**Parameter Class**	**Number of Parameters**
1	INSITU	field in situ sampling parameters	HUMIDITY CELL	1
1	INSITU	field in situ sampling parameters	PHYSICAL	15
2	GENERAL	general class of parameters	ANIONS	10
3	NUTRIENT	nutrient class of parameters	CYANIDES	3
3	NUTRIENT	nutrient class of parameters	OTHER PARAMETERS	18
4	METAL	suite of metal parameters	Metals - Dissolved	38
4	METAL	suite of metal parameters	Metals - In House	1
4	METAL	suite of metal parameters	Metals - Total	42

Table 32 Parameter Classes in the WATER database

The parameter CLASS is the grouping level used to both output and display parameters for user selected specific and routine reports. There are 64 different classes (though only 8 are used currently to group the 128 parameters). The class groups were imported to WATER from the historic EQWIN data store, and should be reviewed for relevancy. The present design dictates that a parameter may only belong to one class and a class may only belong to one tier. Parameters may however change classes as required for customized output, though users should be aware when these changes are made as they will affect previously stored procedures such as reports with pre-designed field names. You can view the parameter in each class using a report accessed from the Data Reports and Summaries tab.

Procedures to add new class values and assign parameters to these classes for the WATER database are described here. Values may be either added directly to the parameter class and measurement technique table in table data view (shown in Figure 12), or by using the user form accessed from the main switchboard screen.

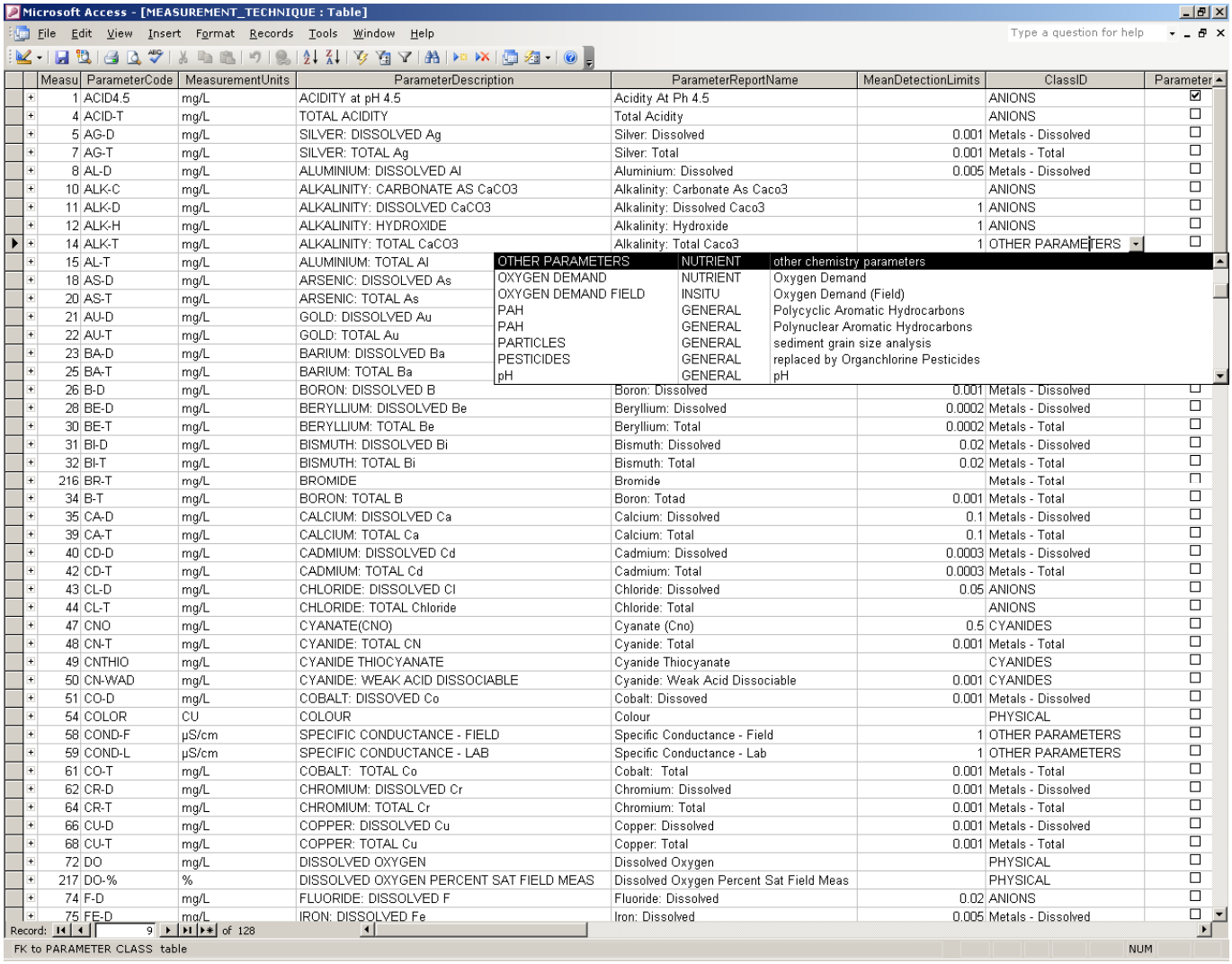


Figure 12 Table Data View of Measurement Technique

From the table data view

3. Open the PARAMETER CLASS table in data view. Add the class name, if it is not already in the table. All previous classes were added from the historic EQWIN data store and may no longer be relevant. The class MISCELLANEOUS contains little information. The parameter tier is required and must be selected from the list of current values. Close the table.
4. Open the Measurement Technique table in data view. Find the parameter you wish to assign or re-assign a class to. Using the drop-down box select the Class ID for the parameter – as shown in the graphic below

From the user form view

5. From the Main switchboard screen, click on the tab marked Reference Lookup Data.

6. You can either select a parameter to add a guideline for, or open the form that displays all parameters. Either way, find the parameter to add a guideline to. Adjust the Class as required, selecting from the list of choices (Figure 13)

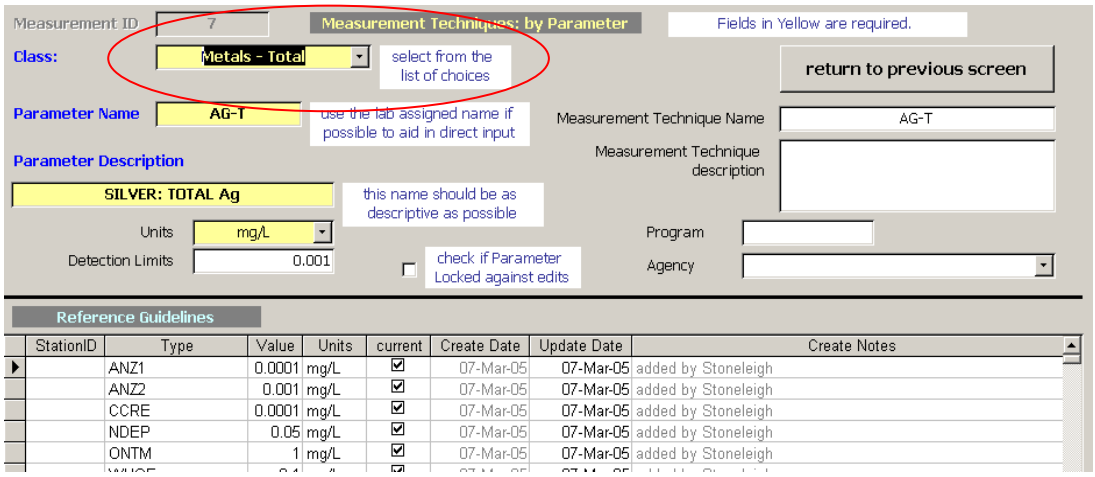
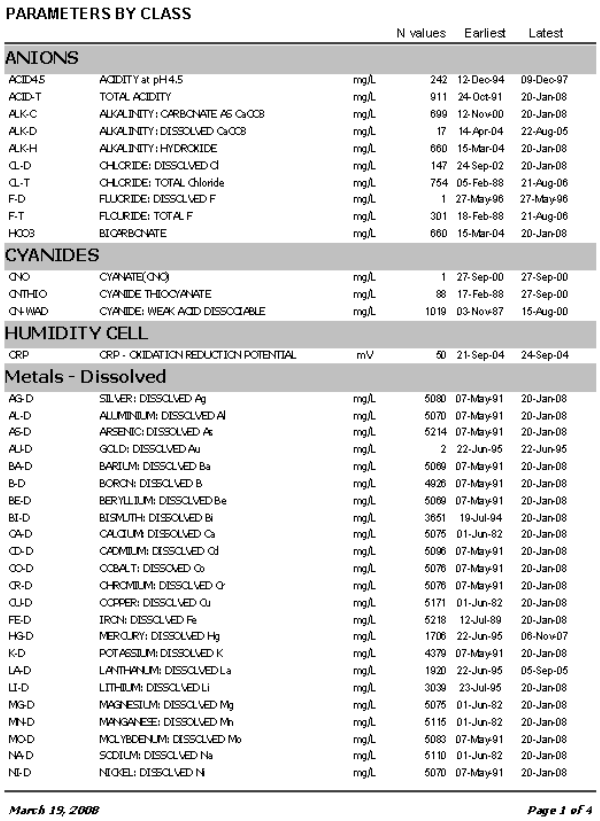


Figure 13 Measurement Technique Table in User Screen (Form) View

A list of parameters in classes (and the names assigned) can be seen in a report accessed both from the Data Reports and Summaries tab on the Main screen or from the View Multiple stations and parameters screen. A view of the report is shown in Figure 14.

Figure 14 Summary Report of Parameters by Class



PARAMETERS BY CLASS

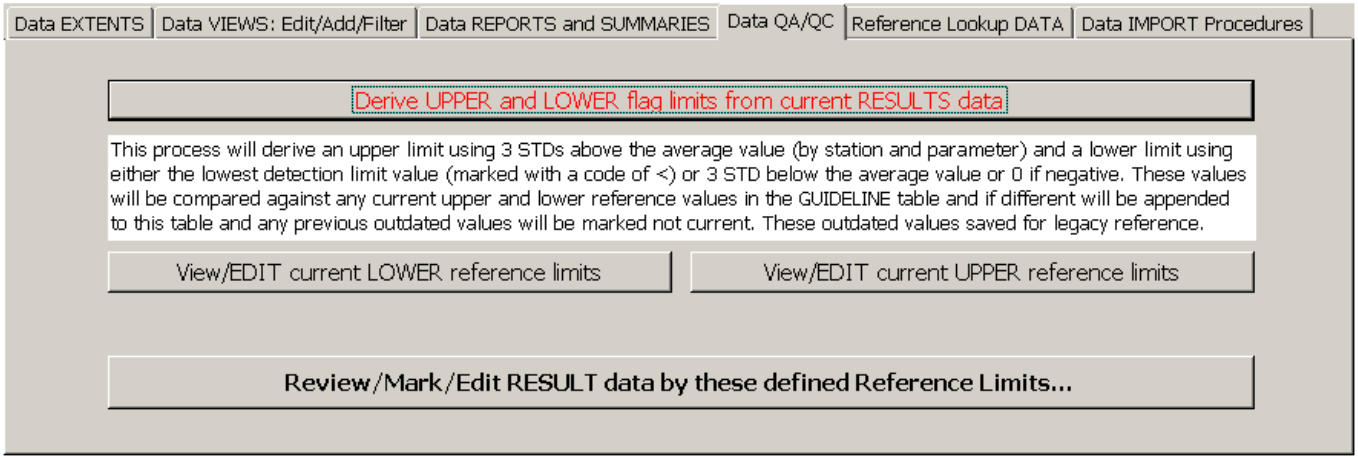
			N values	Earliest	Latest
ANIONS					
ACID4.5	ACIDITY at pH 4.5	mg/L	242	12-Dec-94	09-Dec-97
ACID-T	TOTAL ACIDITY	mg/L	911	24-Oct-91	20-Jan-08
ALK-C	ALKALINITY: CARBONATE AS CaCO3	mg/L	699	12-Nov-00	20-Jan-08
ALK-D	ALKALINITY: DISSOLVED CaCO3	mg/L	17	14-Apr-04	22-Aug-05
ALK-H	ALKALINITY: HYDROXIDE	mg/L	660	15-Mar-04	20-Jan-08
CL-D	CHLORIDE: DISSOLVED Cl	mg/L	147	24-Sep-02	20-Jan-08
CL-T	CHLORIDE: TOTAL Chloride	mg/L	754	05-Feb-88	21-Aug-06
F-D	FLUORIDE: DISSOLVED F	mg/L	1	27-May-96	27-May-96
F-T	FLOURIDE: TOTAL F	mg/L	301	18-Feb-88	21-Aug-06
HCO3	BICARBONATE	mg/L	660	15-Mar-04	20-Jan-08
CYANIDES					
CNO	CYANATE(CNO)	mg/L	1	27-Sep-00	27-Sep-00
CNTHIO	CYANIDE THIOCYANATE	mg/L	88	17-Feb-88	27-Sep-00
CN-WAD	CYANIDE: WEAK ACID DISSOCIABLE	mg/L	1019	03-Nov-87	15-Aug-00
HUMIDITY CELL					
ORP	ORP - OXIDATION REDUCTION POTENTIAL	mV	50	21-Sep-04	24-Sep-04
Metals - Dissolved					
AG-D	SILVER: DISSOLVED Ag	mg/L	5080	07-May-91	20-Jan-08
AL-D	ALUMINIUM: DISSOLVED Al	mg/L	5070	07-May-91	20-Jan-08
AS-D	ARSENIC: DISSOLVED As	mg/L	5214	07-May-91	20-Jan-08
AU-D	GOLD: DISSOLVED Au	mg/L	2	22-Jun-95	22-Jun-95
BA-D	BARIUM: DISSOLVED Ba	mg/L	5069	07-May-91	20-Jan-08
B-D	BORON: DISSOLVED B	mg/L	4926	07-May-91	20-Jan-08
BE-D	BERYLLIUM: DISSOLVED Be	mg/L	5069	07-May-91	20-Jan-08
BI-D	BISMUTH: DISSOLVED Bi	mg/L	3651	19-Jul-94	20-Jan-08
CA-D	CALCIUM: DISSOLVED Ca	mg/L	5075	01-Jun-82	20-Jan-08
CD-D	CADMIUM: DISSOLVED Cd	mg/L	5096	07-May-91	20-Jan-08
CO-D	COBALT: DISSOLVED Co	mg/L	5076	07-May-91	20-Jan-08
CR-D	CHROMIUM: DISSOLVED Cr	mg/L	5076	07-May-91	20-Jan-08
CU-D	COPPER: DISSOLVED Cu	mg/L	5171	01-Jun-82	20-Jan-08
FE-D	IRON: DISSOLVED Fe	mg/L	5218	12-Jul-89	20-Jan-08
HG-D	MERCURY: DISSOLVED Hg	mg/L	1706	22-Jun-95	06-Nov-07
K-D	POTASSIUM: DISSOLVED K	mg/L	4379	07-May-91	20-Jan-08
LA-D	LANTHANUM: DISSOLVED La	mg/L	1920	22-Jun-95	05-Sep-05
LI-D	LITHIUM: DISSOLVED Li	mg/L	3039	23-Jul-95	20-Jan-08
MG-D	MAGNESIUM: DISSOLVED Mg	mg/L	5075	01-Jun-82	20-Jan-08
MN-D	MANGANESE: DISSOLVED Mn	mg/L	5115	01-Jun-82	20-Jan-08
MO-D	MOLYBDENUM: DISSOLVED Mo	mg/L	5083	07-May-91	20-Jan-08
NA-D	SODIUM: DISSOLVED Na	mg/L	5110	01-Jun-82	20-Jan-08
NI-D	NICKEL: DISSOLVED Ni	mg/L	5070	07-May-91	20-Jan-08

March 19, 2008 *Page 1 of 4*

Flagging and Marking Data Values

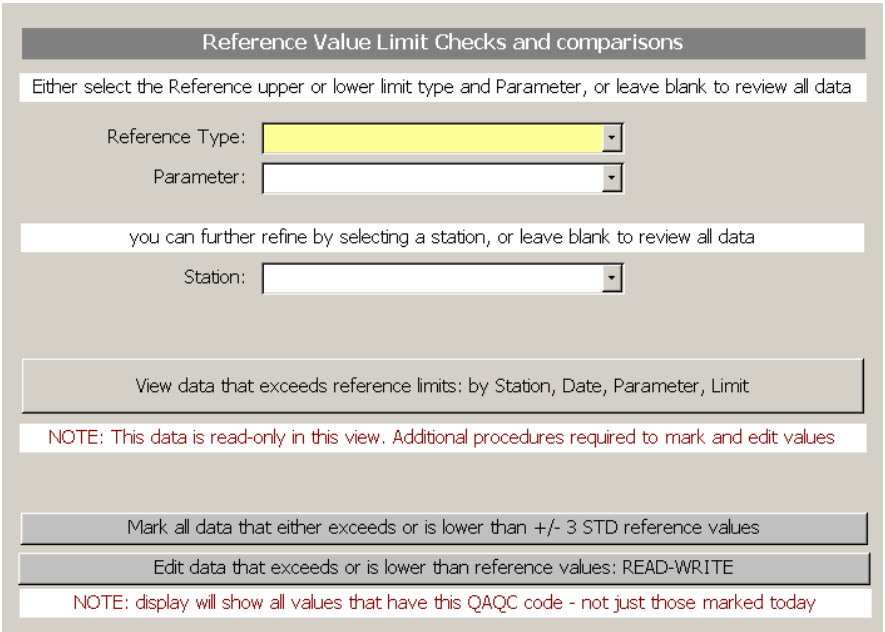
All values that are imported/appended to the database are appraised against all previously entered values by station and parameter. Values that are either greater or less than +/- 3 standard deviations about the mean value are flagged and marked appropriately. The +/- 3 std value is continually re-derived from all data in the database and is thus a dynamic comparative reference value. This procedure is run automatically during the import batch process, but can be run at any other time using the QAQC tab on the main switchboard form (Figure 15).

Figure 15 QAQC Upper and Lower Limit Procedures Screen



The lowest button on this form takes you to an additional screen (Figure 16) to allow the user to make further selections and constraints on the procedure.

Figure 16 QAQC Reference Value Limit Checks Screen



Appending (Importing) New Data

There are standardized methods for importing both new lab data to this application. A standard file format, provided by Gartner Lee is enshrined in an automated procedure. This file format is shown below. No deviation from this format is possible, or the procedure may fail.

Cells A1:E3 must be blank					Sample Class	Sample Notes	Samplers	Collection Method	Conductivity uS/cm	Aluminum D-Al
									COND-L	AL-D
									uS/cm	mg/L
P03-04-04	ALSV786712	5/3/2005	15:15	13:42	M		dc/ef	suction/ma	1080	<0.020
P03-04-02	ALSV786713	5/3/2005	14:37	13:37	REP		Crew	suction/ma	1370	<0.10
P03-05-05	ALSV786732	5/4/2005	11:20	10:16	SS		yl/mm	suction/ma	1570	<0.050
P03-09-01	ALSV786733	5/4/2005	13:55	13:34	M		crew	pp	1280	<0.050

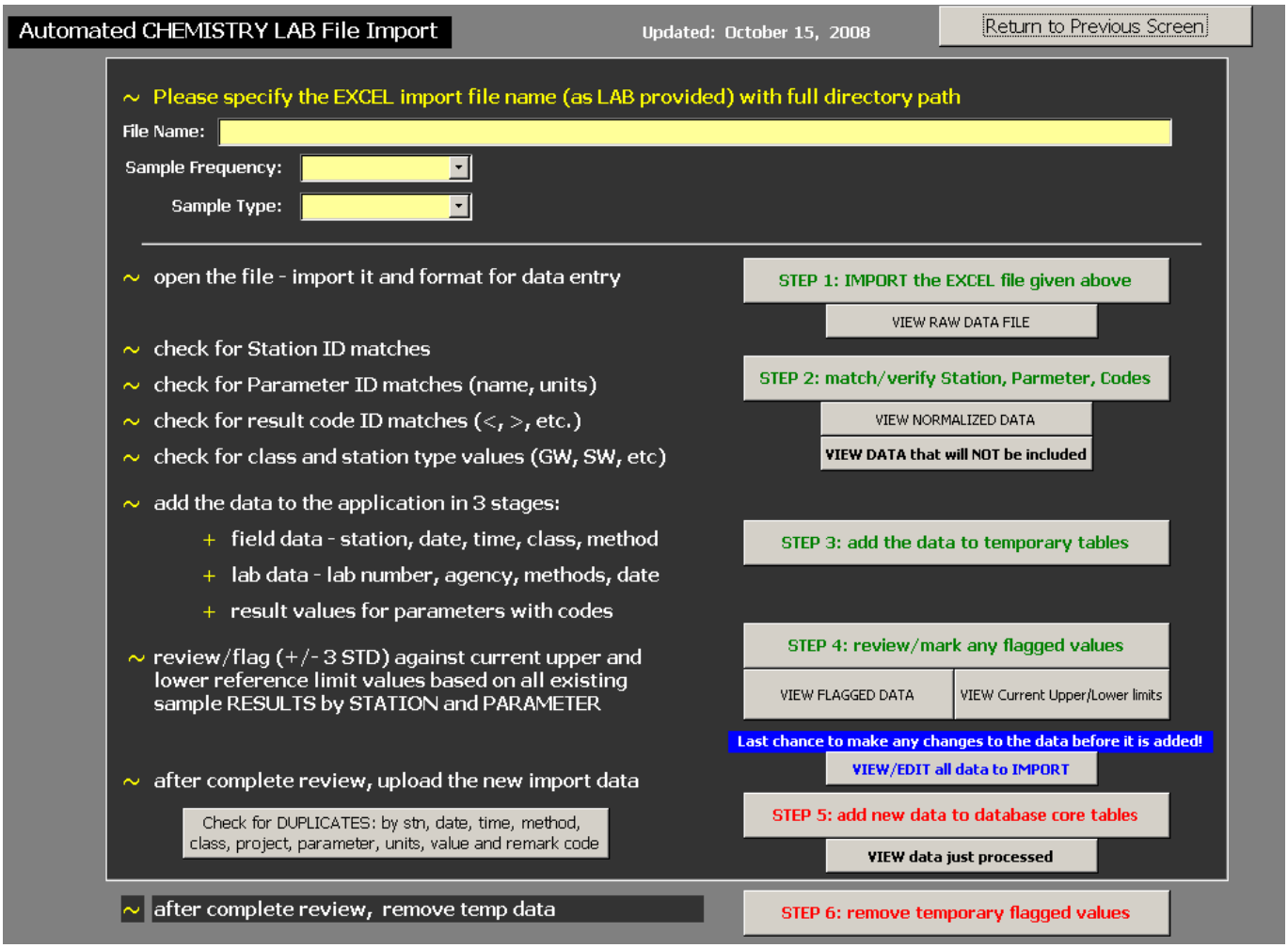
The EXCEL file must contain some required data fields. The first 5 fields (A1:E3) must have no data headers, so that the spreadsheet transfer can proceed correctly. If there is information above the date or times for instance, the database will not import the values properly, assuming they are textual. Each of the data fields are described in Table 32.

Table 32 Content of EXCEL Lab Chemistry Template Fields

Field (column) Number	Content	Description
1	**Station ID**	Required, and must first exist in the STATION table
2	**Lab ID**	Required and can be a combination of numbers and text
3	**Sample date**	Required and must be a valid date format
4	**Sample time**	Required and must be a valid time format – if this value is unknown (or was not measured) a place value of 12:00:01 AM can be entered
5	**Water Level time**	Not required, when entered must be a valid time
6	**Sample class**	Required and must be a valid class abbreviation found in CODE table
7	**Sample notes**	Optional note field up to 255 characters
8	**Samplers**	Optional listing of samplers – up to 10 characters
9	**Collection Method**	Required and must be a valid method abbreviation found in CODE table
10..200 or less	**Sample Results**	Up to 190 sample parameters can be appended to the database during the import routine. The format stipulates that there are 3 rows for identification of the analyzed parameter. The first row contains the description and can vary from that found in the MEASUREMENT_TECHNIQUE table. The next two rows must contain an abbreviation and unit combination found in this table

From the Main screen, click on the tab marked 'Data Import procedures' and then click on the button marked 'IMPORT'. A new screen will open as shown in Figure 17.

Figure 17 Data Import Switchboard Screen



The user must enter the name and full directory path of the EXCEL lab file. A template will assist in ensuring that the format for each import file is standardized in both content and format. This will be used both to find the file to import and as append note used for the Create Note field during the append process. The parameter names, abbreviations and units for three different labs can be viewed (and used to match) the import files to ensure that all parameters will be correctly identified. The choices are for:

- MAXXAM
- ALS
- CanTest

Select the sample frequency and the sample type from the list of choices. If an input file contains multiples of these values, you can either split the input file, or adjust these values after the import routine is complete.

The append process can be executed in five steps for each data file. At various steps the data can be viewed and perhaps updated with corrections. An example of an update is where new parameter/unit combinations are encountered. Values can be changed to standard units with the addition of corresponding codes. Use the command buttons on the Import screen to process the data as follows:

1. Import the EXCEL data file to a template table (RAW LAB DATA). You may then view the data to ensure completeness and accuracy. You can, for example, remove any blank rows below real data records.

2. Format the data for data entry. This will normalize the information, repetitively taking each new parameter data column and append it as new records to a template table (RAW NORMALIZED LAB DATA). The design of this table makes it impossible to add the same station, date, time and measurement combination. When this step is complete you can view both the entire data record, and those values that will be excluded. Exclusion may result following a check for existing:

    a. Stations (Station ID)
    b. Parameter and Unit combinations (Measurement ID)
    c. Parsing the data value from any result codes (like < or >)

3. Add the data to temporary tables for further review as:

    a. Field data (unique Station and date combinations)
    b. Lab data (unique Lab numbers provided for each Station/Date pair)
    c. Result data

4. Review the data against existing values for a general QA/QC by both station and parameter to flag any values that exceed +/- 3 standard deviations about the mean value. These values are first re-derived using all existing data, then stored in a parameter flag guideline table and then compared to this new data. The user can then review flagged values.

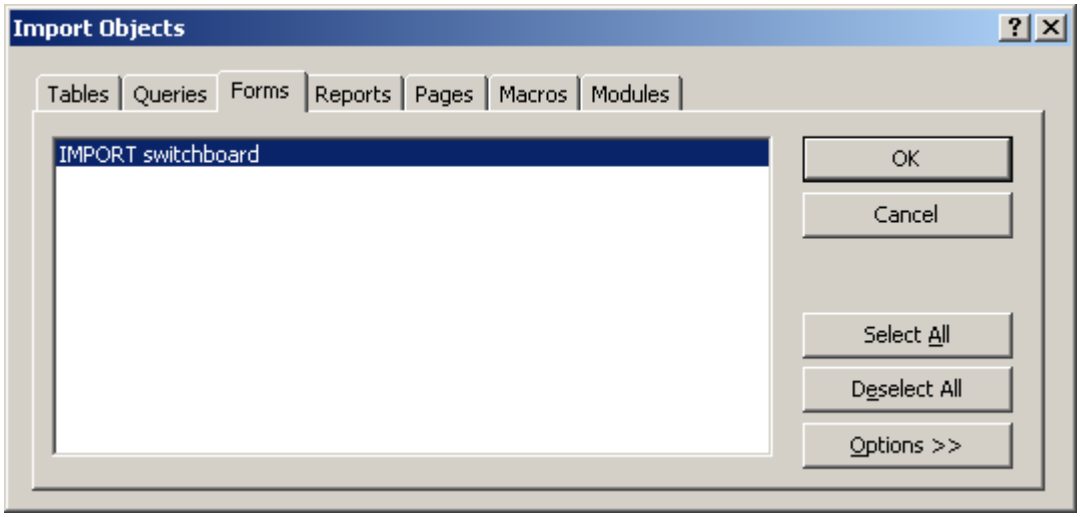
5. The final step is to append data to the core tables – in the 3 stages as described earlier for field, lab and results. The user can view the data record in one of two formats. The first format (using the button on top of the Step 5 button) will show the data by Field, then Lab then Results. Use the +/- buttons on the far left of the display to either expand or collapse the data view. This view is fully read/write and can be used to make any last data changes to the import data. Any changes to the permanent data record must be made BEFORE you press the Step 5 button. Changes to this data in this view made after the import will have no effect on the permanent record. You can view the data just added by using the command button below the Step 5 button. It uses the file name as a cue to

match to the Create Note. If you leave the form and then return to it, this procedure will not find the data just added. You must then return to the main screen and use the data view procedures accessible to the Data VIEWS tab.

Adding (Importing) New Database Objects

There may be occasions when updates to various database objects (reports, forms, procedural code, etc.) may be required. Rather than make a wholesale change to the database file, (which contains, not only data objects but data values), the updated object can be directly imported to the application file. The procedure to accomplish this is described below:

1. Make a backup copy of the database, making sure that no user has the database open at the time. This is a critical warning – a copied open database will be irreparably corrupted.
2. The database update will be a separate Access file. If it is attached to an email, save it to a folder. It is not necessary to open it.
3. Open the WATER database file. Click on Window and then select 1. WATER: Database. This will allow you to view the data objects.
4. Click on File – Get External Data – Import… and a dialogue box will open. Find and select the update database file that contains the new objects. Click on Import.
5. The Import dialogue box will open. Select the objects to import, moving through the tabs and selecting any/all as required. This will vary between updates and you should use the information provided by the database administrator responsible for the update. Click OK when all objects to import have been selected. The dialogue box will close when the import is complete.

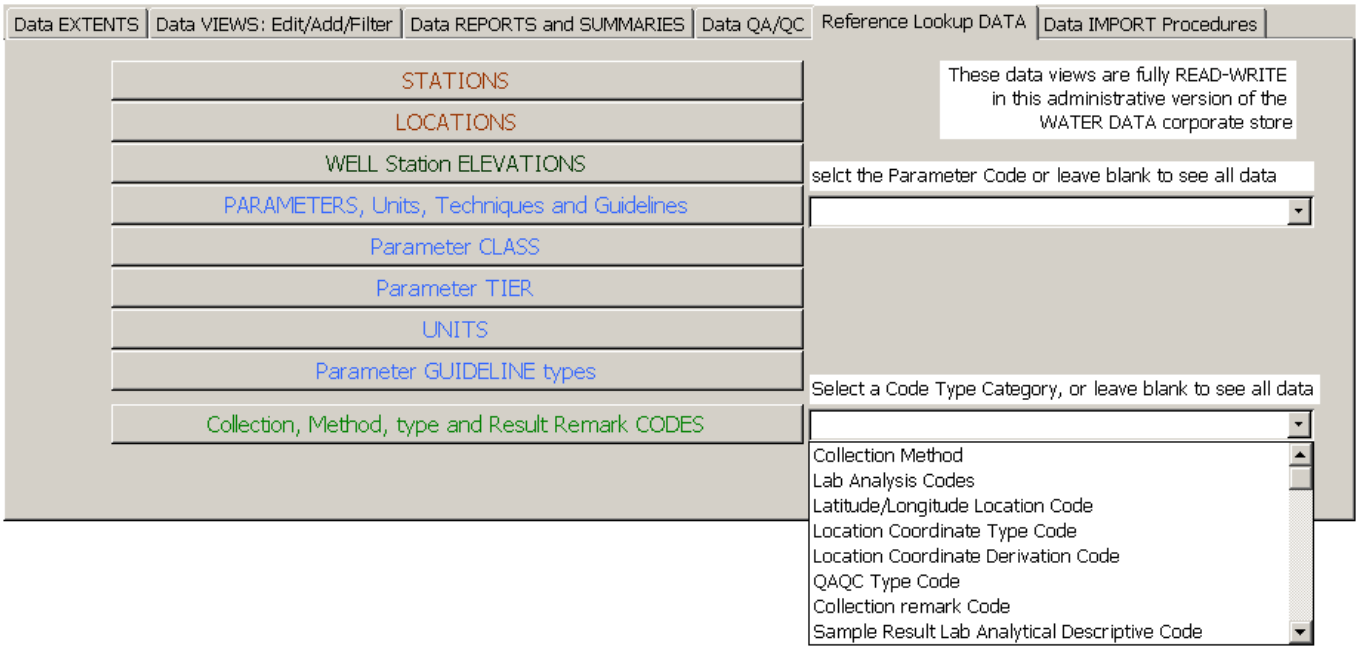


6. New objects will not require any further work, but replacement database objects will be added and the suffix ‘1’ added to their name. Again, using the documentation provided by the update you will need to delete the old object and then remove the 1 from the new object name (using the rename function). When all updated objects have been renamed, you should compact the file.
7. Click on Tools – Database Utilities and select compact and repair database. This process may take a moment to complete. The main switchboard form will open automatically when the compact is finished.
8. You may now use the database normally. You may wish to update the date on the main switchboard (if it has not been included in the update). Switch to design mode to do this and click in to the text field and make the change. Save and return to datasheet view.

Review of Reference Data

There are review and edit forms to access all reference data for this application. Use the tab on the main screen to access these forms. All data are fully read-write. A selection box can assist in finding a specific category of code values to review, edit or add to (Figure 18).

Figure 18 Reference Data Access Screen



Changing Parameter/Unit assignment for a value (values)

There are several ways to accomplish this – you may open the Result Water table directly or use some of the existing summary views accessed from the main screen. The best way for mass changes is to use an update query that will modify both the measurement technique identification but also adjust the update date, note and other related QAQC codes. No data should be changed without corresponding update notation for later reference.

Changing Station ID assignment for sample records

The easiest way to do this is to open the Field Sample table directly. Use the selection box for the Station ID field to reselect the Station ID value. Any new stations need to be added to the STATION table first. Large record changes may be accomplished using an update action query. Open a new Query. Add the Field Sample Data table. Add the Station ID. Enter the Station ID value that you wish to change in the criteria box and view the query in datasheet mode to see the records that will be affected. When you are satisfied that you are viewing only those records to change, alter the query type by clicking on Query and picking Update Query. The grid rows

change and allow you to enter the new Station ID in the 'Update To:' box. Enter the new Station ID and then execute the query using the **!** button on the toolbar.

Database Administration

There are several administrative (housekeeping) tasks that should be regularly run for this application. These tasks are described below. These tasks require exclusive use of the database, so you should ensure that there are no other users with the database open during any of these operations.

Compacting the database

Access database files grow as data and objects are added to the file. Unfortunately, when data or objects are deleted, the file often does not adjust properly, and the file can grow to a very large size. This impacts on performance and also increases the time and resources to copy and move the file. The database should be compacted regularly (say weekly) and after every major data import.

To compact the file – click on Tools – Database Utilities – Compact and Repair. As the file is large (~100 MB) this operation may take a while, but should complete in less than a minute. You can track the progress of the operation by the status bar in the lower left corner of the screen.

Import Errors

During the import routine, the format and content of the EXCEL files may cause an error during the process. The user has many chances to both review and determine the causes of these errors and to fix them. A consequence of these reported errors occasionally creates an error table that should be deleted after the error is solved. In some cases the data in the error table is helpful for tracking the error, though the actual error and the actual imported data tables are typically more helpful. The tables will have the suffix $_ImportErrors with the name of the EXCEL spreadsheet in front. Select the table and delete it.

Adjusting Table Relationships

All of the relationships between tables in the database have referential integrity enforced and have the cascade update check box set to yes. The cascade delete box is set to no for all tables. During data review it may occasionally be necessary to delete an entire data record for a station that includes the field samples, related lab records and all results. If you adjust the relationship between the Field Sample and Lab Sample and Result Water tables and set the cascade delete check box to yes, you may then delete related records in all three tables by deleting the field sample record only. This check box should be set back to no after the data deletes have completed.

To open the relationship screen you must be in the database window. Toolbars and Menu bars are specific to the database object that is open, and further the view of that object (data or design) that is displayed.

Creating a distributable version of the WATER application

Many stakeholders use the WATER database to view the current status of monitoring sites for the Anvil Range project. This data is warehoused in an Access application file called WATER. The file is uploaded to a shared (password access only) FTP site for distribution. An executable file has been created in the past that allows unrestricted views of the data, but read-only views of user screens and procedures. The file contains many procedures, temporary data tables and user views that are used for data administration. These are not relevant for shared use, and greatly add to the file size.

New procedures to remove these objects and present a simpler view of the database are described here. Each of the steps must be done in sequence.

1. Ensure that all users have exited WATER.

2. Backup the WATER database and store in the prescribed directory.

3. Make another copy of the WATER database application. Never copy an open database.

4. Rename the copied file – adopt a convention that includes the current date, such as USER WATER 2007-02-02.

5. Open the USER WATER copied file and close the main screen – do not simply switch to the database window. The main screen must be closed.

6. View the stored macros. Find the macro named ‘Prepare WATER for distribution - run ONLY from USE WATER copy’. Ensure once again that you are in the copied version of WATER. Double-click to execute the macro. In sequence:

    a. Remove tables
    b. Remove queries
    c. Remove reports
    d. Remove forms
    e. Remove macros
    f. Rename the old main switchboard form
    g. Rename the distributed version
    h. Remove all data values from the parameter guideline table
    i. Open the new main switchboard form
    j. Display a message indicating the procedure has completed

7. The database file is still the same size and must be compacted. Once the compaction has completed, create an executable MDE file. The file is now ready for distribution.

Appendix D

GROUNDWATER Database Manual

User Manual
For the
Anvil Range Project

GROUNDWATER database

February 2007
Updated: March 2008
June 2008
March 2009

Barbara A. Hutchinson
Stoneleigh Associates Inc

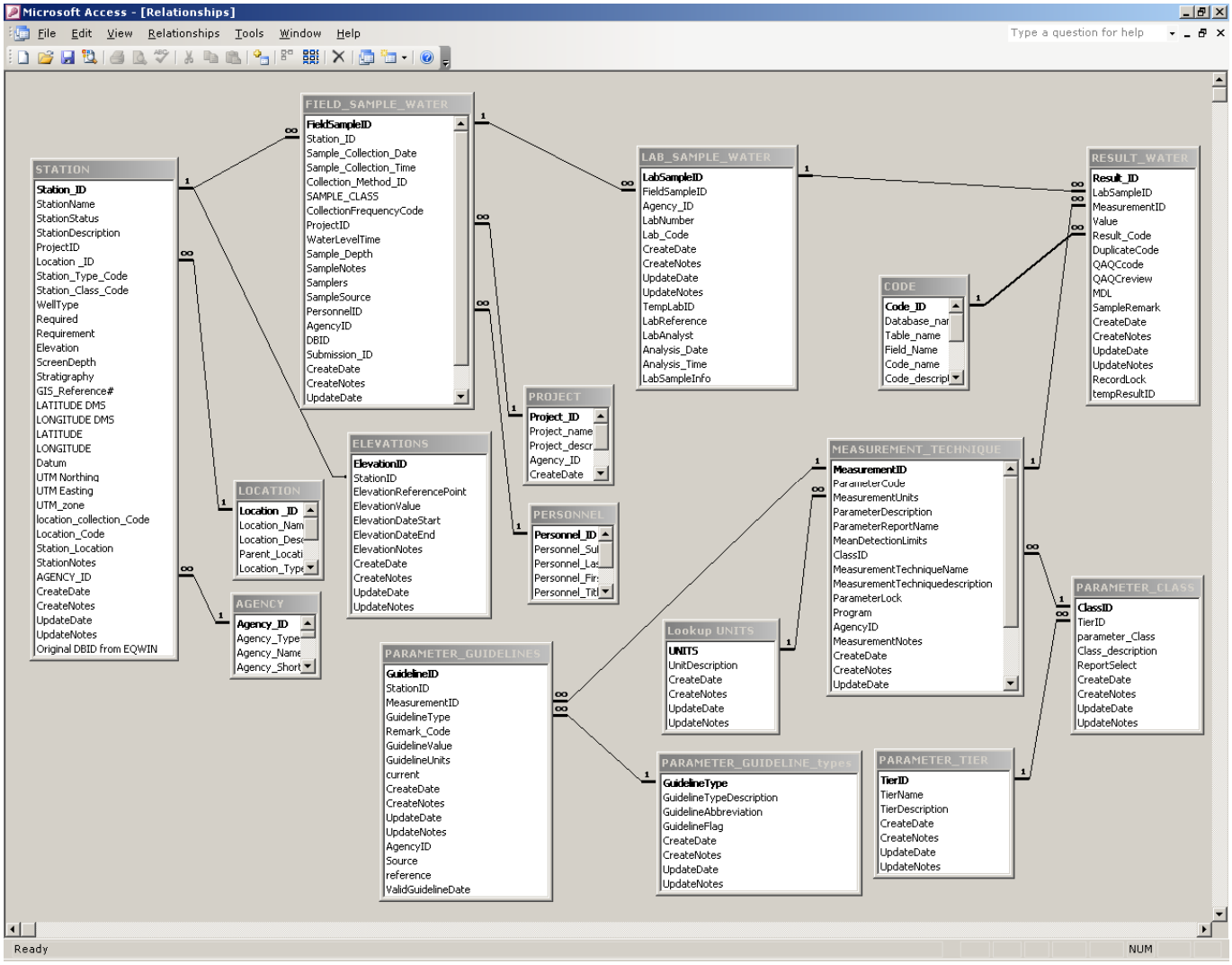
Table of Contents

Introduction

The WATER database application warehouses both surface and ground water quality measures. This application is in turn linked to another associated groundwater monitoring and assessment databases. This file is called GROUNDWATER and should be located on a LAN to make the fullest use of this results database. Data will continue to be added via the IMPORT procedures in WATER, while the specific requirements of the groundwater program dictated that many procedures be created separately from surface water processes. The database form views are both read-only and read-write, depending on the procedure.

The relationships between the tables in the database are shown in Figure 1 below.

Figure 1 Database Table Relationships



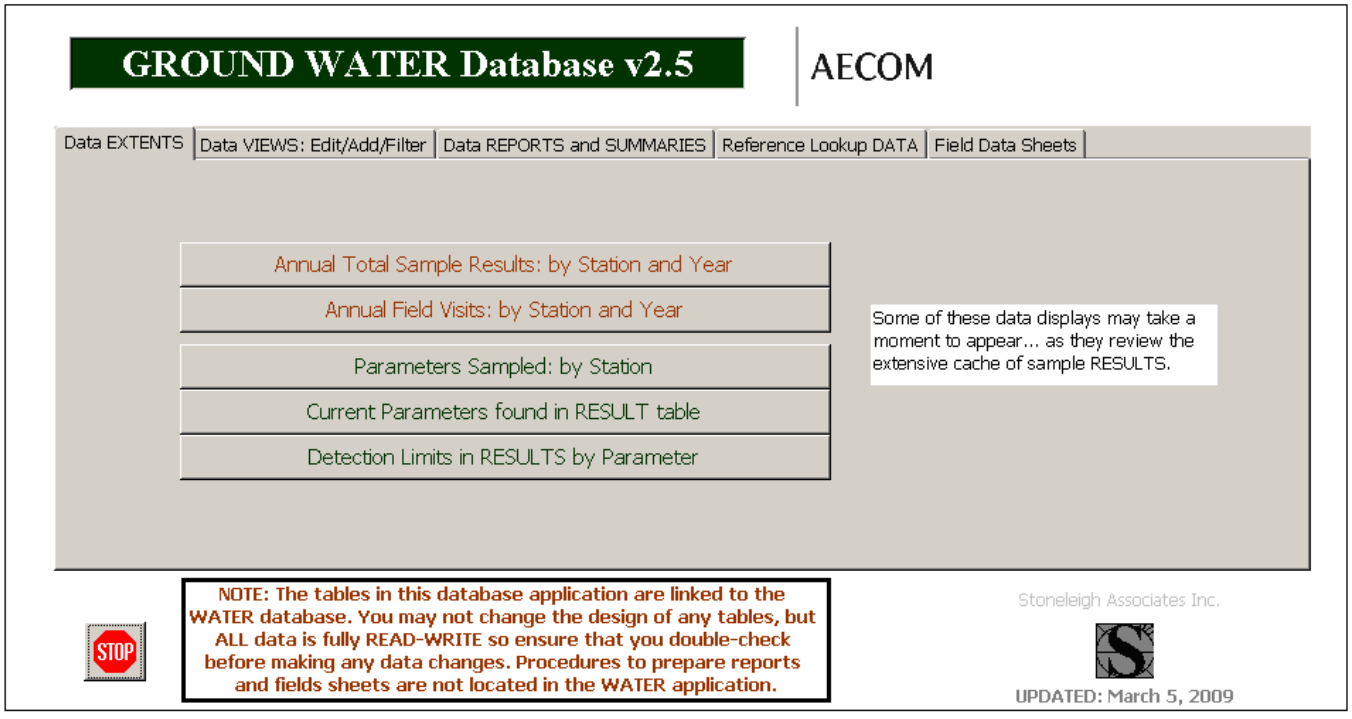
Database Design

This database is a relational database as is WATER, with tables constructed to third normal design. All tables except for 4 temporary summary tables are linked from WATER and inherit all design features. Linked tables are fully read-write, so any changes made from this application will also appear in the WATER database. For that reason, only groundwater data is principally displayed for review via forms. Any changes made in table data view are permanent as they are in WATER. A review of each of the tables (and content of each of the fields) is contained in the WATER user manual and is not repeated here. Documentation of the specialized summary procedures is described here and will augment the information contained in the associated WATER manual.

Using the Database

This database opens to a MAIN switchboard-type form that directs the user to all features of the application and is shown in Figure 2. Many of the features are similar to that found in WATER, though there are no import or automated data flagging procedures. Nonetheless, all data has already been subject to the same scrutiny and is merely being viewed in a different way to allow for the specific reporting and summary procedures for the groundwater program.

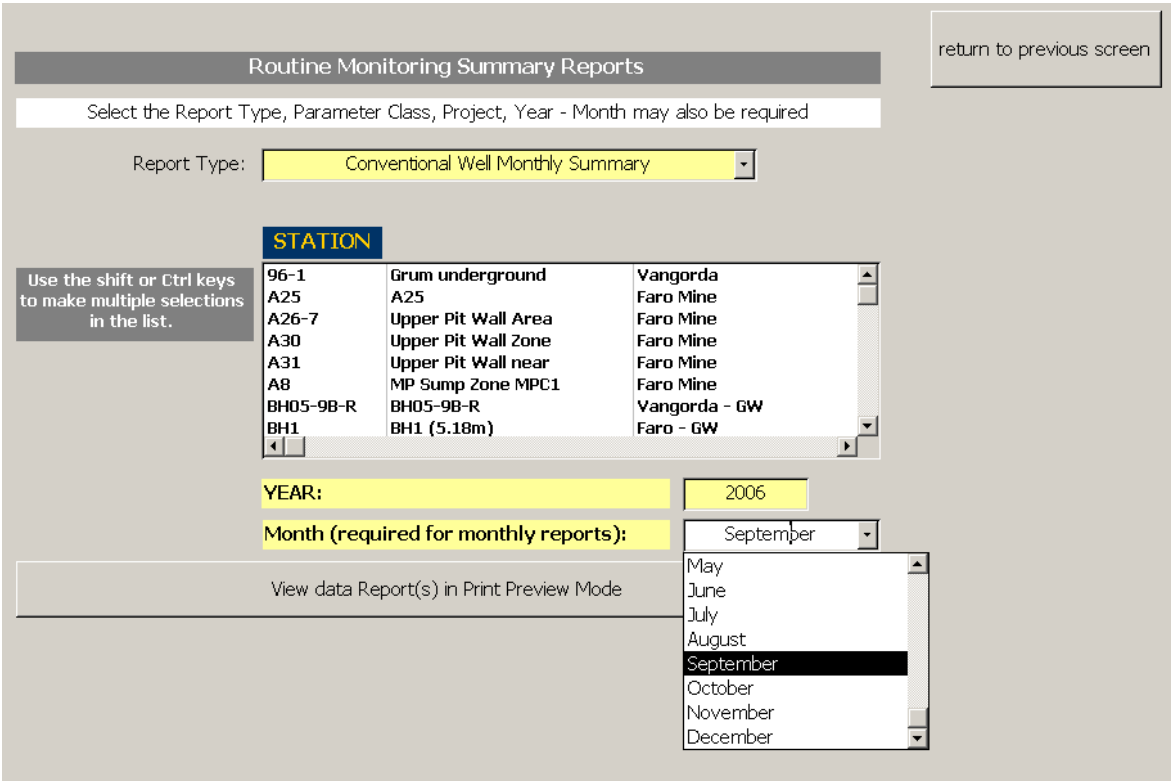
Figure 2. Main Switchboard Form



Data Reports and Summaries

There are several pre-defined summaries accessed from the data reports and summaries tab on the main screen. Users may select from 9 different reports using a drop-down box. The year is required for all reports, and month is required only for monthly summaries (Figure 3).

Figure 3 Routine Monitoring Reports



Users may optionally select stations, though for many reports, it is designed that all available station data should display. Access™ does have limits on the number of restrictive criteria that can be processed, and it is possible that selecting multiple stations may reach that limit. Some of the data reports may take a moment to display as they review the extensive cache of values.

Review of Elevation Reference Data

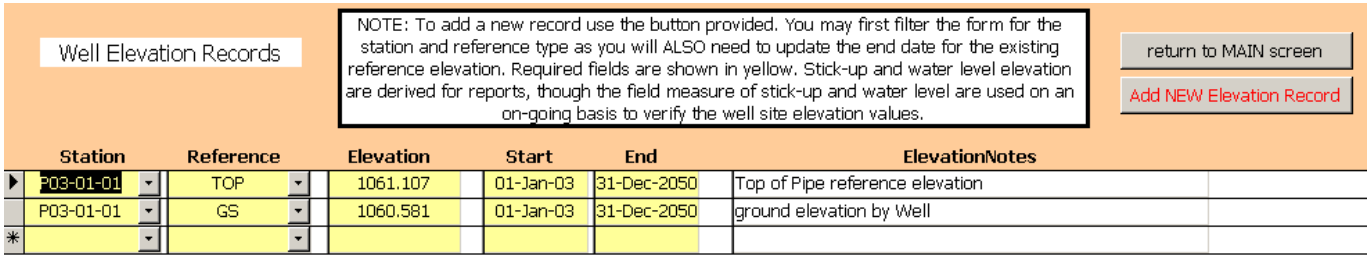
There are separate forms to both review and edit and access reference data unique for this application. Currently this includes a restricted view of station information and various elevation parameters for selected stations. Use the tab on the main screen to access these forms. Data views are read-write. All other reference data should be adjusted (as required) from the WATER application.

Field crews measure various elevation data during sampling visits. This includes water level and stick-up measures. The stick-up measure in particular will be later compared to the original

surveyed ground and top-of-pipe elevations. The subtraction between these two surveyed values must equal the field measured stick-up value. If it does not then new elevation measures must be entered to the database for that site. These elevations are marked by both a start and end date so that all other relevant field measures (like water level) can be date related and adjusted automatically. The current elevation data for any site is marked by a future arbitrary end date of 31-Dec-2050. The start and end dates for two elevation values should be one day apart (e.g. end date of 13-Feb-2007 corresponds to a start date of 14-Feb-2007).

Users can review (and edit/append) elevation measures using a form accessed from the main screen. You can either select a site to filter your view of the elevation form, or leave the station selection box blank to view all data. Derived stick-up measures (as TOP-GS elevation difference) can also be reviewed to ensure that field data continues to support surveyed values. New values can be added as described by the Figure 4.

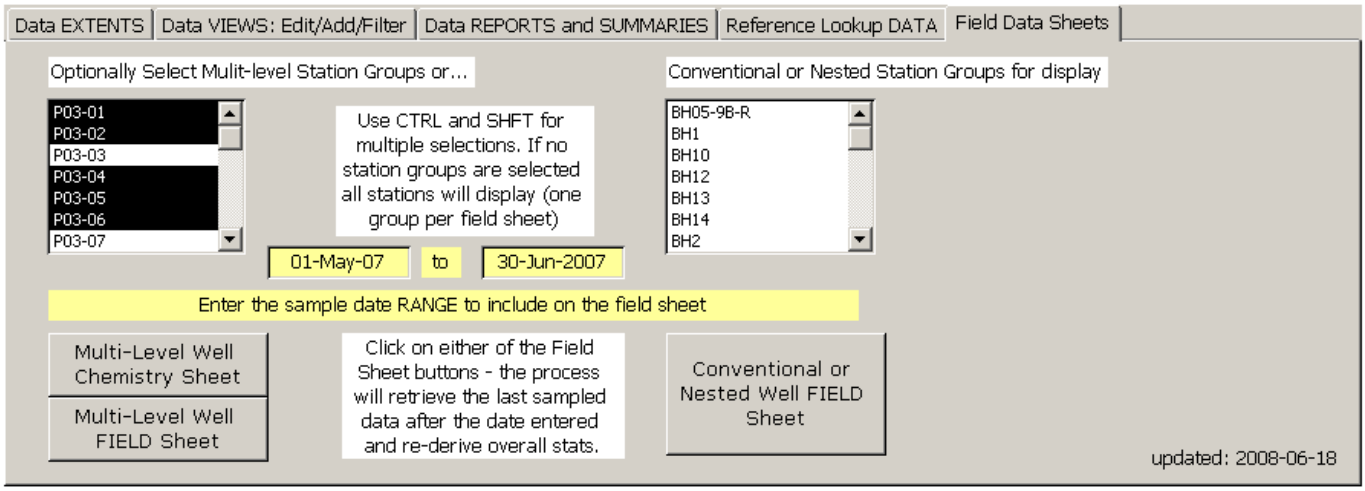
Figure 4 Elevation Data Screen



Creating Field Sheets

There is a specialized review form that staff can use to create field sheets unique for both multi-level and conventional well stations. Use the Field Data tab on the main screen to access the user selection screen (Figure 5).

Figure 5 Field Data Sheets Creation Screen



Both the multi-level and conventional well stations have their own customized field data sheet. Each of these processes allows users to select station groups to create field data sheets. The group selection for multi-level sites is defined as the first 6 characters of the site name, while the grouping of conventional well sites cannot be easily derived from the site name. Groups are defined in a separate field in the STATION table (called ‘Requirement’ as this field is currently not used for any other purpose). Stations that have no groups have the Station ID in this field, while others have the group name (X17 for example for both X17 A and B).

Users must enter both a start and end date so that only the relevant sample date(s) can be included on the field sheet display. Ensure that the dates entered will capture all sample data collected for the group, as several dates over the course of a month may make up the monitoring visit. These dates will be used to create a temporary data store of data values, formatted for field sheet data display. The range of values for specific field parameters (such as pH, conductivity and temperature) over all historic sampling is also continually re-derived for each site so that it continues to include all current data. These temporary data stores are overwritten each time the field sheets are produced and may take some time as the considerable data stores are reviewed. Conventional wells also include some descriptive elevation information. This data is stored in the ELEVATIONS table.

Database Administration

There are several administrative tasks that should be regularly run for this application. These tasks are described below. These tasks require exclusive use of the database, so you should ensure that there are no other users with the database open during any of these operations.

The based linked file WATER was 'streamlined' March 2008, removing historical stations and parameters. This affects the data accessible to the GROUNDWATER application, as these stations and parameters are no longer accessible to view. This data is contained in an archive file for future reference.

Compacting a Database

Access database files grow as data and objects are added to the file. Unfortunately, when data or objects are deleted, the file often does not adjust properly, and the file can grow to a very large size. This impacts on performance and also increases the time and resources to copy and move the file. The database should be compacted regularly (say weekly) and after every major data import.

To compact the file – click on Tools – Database Utilities – Compact and Repair. As the file is large (~25 MB) this operation may take a while, but should complete in less than a minute. You can track the progress of the operation by the status bar in the lower left corner of the screen.

Adding (Importing) New Database Objects

There may be occasions when updates to various database objects (reports, forms, procedural code, etc.) may be required. Rather than make a wholesale change to the database file, (which contains, not only data objects but data values), the updated object can be directly imported to the application file. The procedure to accomplish this is described below:

1. Make a backup copy of the database, making sure that no user has the database open at the time. This is a critical warning – a copied open database will be irreparably corrupted.
2. The database update will be a separate Access file. If it is attached to an email, save it to a folder. It is not necessary to open it.
3. Open the GROUND WATER database file. Click on Window and then select 1. GROUND WATER: Database. This will allow you to view the data objects.
4. Click on File – Get External Data – Import… and a dialogue box will open. Find and select the update database file that contains the new objects. Click on Import.
5. The Import dialogue box will open. Select the objects to import, moving through the tabs and selecting any/all as required. This will vary between updates and you should use the documentation provided by the database administrator responsible for the update. Click OK when all objects to import have been selected. The dialogue box will close when the import is complete.
6. New objects will not require any further work, but replacement database objects will be added and the suffix '1' added to their name. Again, using the documentation provided by

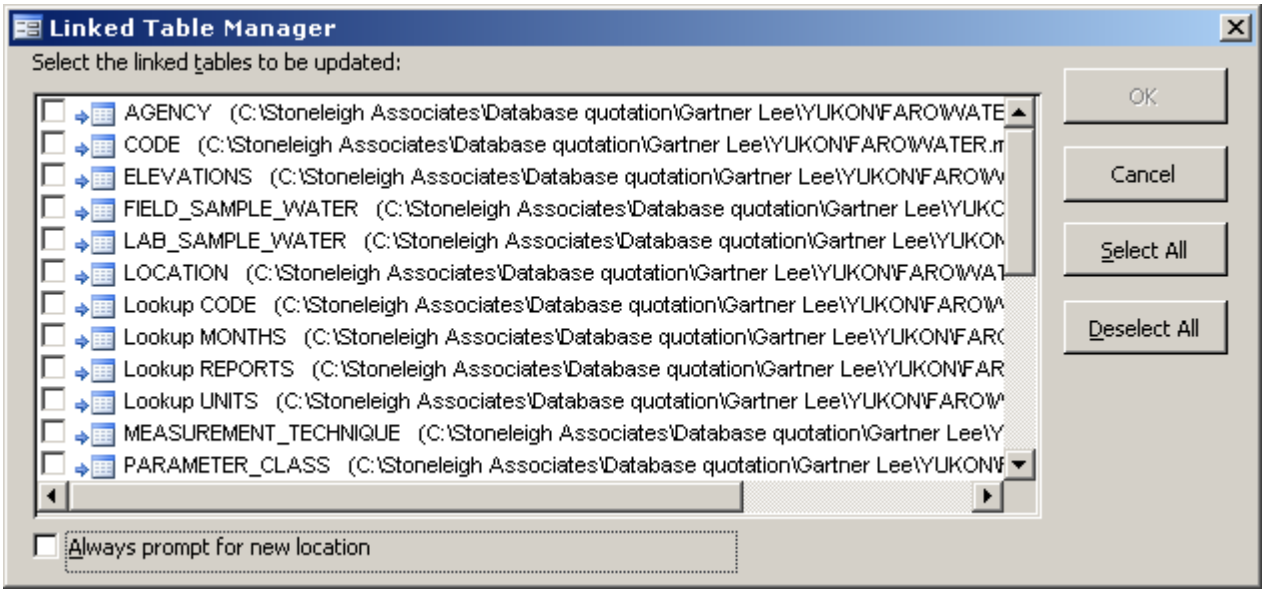
the update you will need to delete the old object and then remove the 1 from the new object name (using the rename function). When all updated objects have been renamed, you should compact the file.

7. Click on Tools – Database Utilities and select compact and repair database. This process may take a moment to complete. The main switchboard form will open automatically when the compact is finished.
8. You may now use the database normally. You may wish to update the date on the main switchboard (if it has not been included in the update). Switch to design mode to do this and click in to the text field and make the change. Save and return to datasheet view.

Linking Data Tables

There may be occasions when updates to the links of the tables is required,

1. Ensure that both WATER and GROUNDWATER are not being used and are closed.
2. Open GROUNDWATER.
3. Click on Tools – Database Utilities – Linked Table Manager. If you get an message telling you that this feature is not installed, then you must close the file and find another computer with a complete (and not typical) installation of Access.
4. Select all using the command button, and also place a check at the bottom to prompt for a new location. Click OK (see Figure below)



5. A dialogue box will now display asking you to find the location of the first table on the list (AGENCY). This table and all of the others are in the WATER database file that is located on the LAN shared drive (S:). Find the Water.mdb file and select it (ensure that it is not the shortcut) and then click open. All of the tables will now link, and a message telling you the process has completed will display.
6. This process need only be done once, there is nothing to save. All users may now use the file in shared mode.

Appendix E

2008/2009 Faro Database Agency Access

AECOM
2251 2nd Avenue, Whitehorse, YT, Canada Y1A 5W1
T 867.633.6474 F 867.633.6321 www.aecom.com

Memorandum

Date:	March 31, 2009
To:	Memo to File
From:	Jay Cherian
Project Number:	80656 – 6 Faro Database Project Management
Subject:	2008/2009 Agency Access

2008 Access to Database

Access to the monthly database postings was arranged for the following people and agencies in 2008 and the first quarter of 2009, on a read only basis, through an AECOM ftp site, that remains under the name of Gartner Lee Ltd.:

Nicole Autio – Denison Environmental
Access as of March 30, 2009, with the following access codes:
Username: aution
Password: w5kuradu
Folder: "ftp://ftps.gartnerlee.com/faro dbase"
Expires: 30/04/09

Cam Scott – SRK Engineering Consultants
Access as of January 27, 2009, with the following access codes:
Username: scottc
Password: 6e9rutre
Folder: "ftp://ftps.gartnerlee.com/faro dbase"

Christoph Wels – Robertson GeoConsultants
Access as of December 5, 2008, with the following access codes:
Account: welsc
Password: gam7wrax
Folder: ftp://ftps.gartnerlee.com/faro%20dbase
Expires: 31/03/09

David Petkovich – Access Consulting
Access as of December 5, 2008, with the following access codes:
Username: PetkovichD
Password: 9uhu7esw
Folder: "ftp://ftps.gartnerlee.com/faro dbase"

Harriet Phillips – SENES
Access as of December 5, 2008, with the following access codes:
Username: PhillipsH
Password: t4us6ufr
Folder: "ftp://ftps.gartnerlee.com/faro dbase"

Patti Orr – Minnow Environmental
Access as of December 5, 2008, with the following access codes:
Username: OrrP
Password: wremes5a
Folder: "ftp://ftps.gartnerlee.com/faro dbase"

Deidre Davidson – Yukon Government – Bureau of Statistics - Research Officer
Access as of November 13, 2008, with the following access codes:
Username: davidsond
Password: pr5zusuk
Folder: "ftp://ftps.gartnerlee.com/faro dbase"
Expires: 28/02/09
Access for D. Davidson was extended until the end of April 2009 on March 30, 2009.

In addition to the above, access to the database posting were maintained through 2008 for:

- **Leslie Gomm of Gomm Environmental Engineering Consulting, and member of the Technical Advisory Team for the Faro site**; and for

- **Doug Sedgwick of Deloitte and Touche**.

Secure access with read and write access was arranged for:

Barb Hutchinson of Stoneleigh Associates, who developed the database, and remained on contract with AECOM for on-going site maintenance and yearly statistical data summaries.