2007/08 Water Quality Database Maintenance Report
Project 15

Prepared for

Deloitte & Touche

(in its capacity as Interim Receiver of Anvil Range Mining Corporation)

Submitted by

Gartner Lee Limited

March, 2008

Gartner Lee

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Reference: **GLL 70548**

Distribution:

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2+e Faro Mine Project Management Team

Gartner Lee

Gartner Lee Limited

April 30, 2008

Valerie Chort
Deloitte and Touche Inc.
Via email: *vchort@deloitte.ca*

Dear Ms. Chort:

Re: GLL 70548 – 2007/2008 Database Maintenance Report, Project 15

Please find enclosed our *2007/2008 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,
GARTNER LEE LIMITED

H. Badry

Heather Badry, B.Sc.
Senior Environmental Scientist

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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. Since that time Gartner Lee Ltd. has managed the database on behalf of Deloitte and Touche.

This report provides a summary of database maintenance activities and upgrades performed throughout 2007 and the first quarter of 2008.

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 future expansion 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 including:

- During 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). In addition, the newly developed charge balance calculation performed upon data entry flags data with charge balances greater than +/- 10%, providing a precursory indication of analytical errors;
- During review of monthly report data by the Project Manager; and
- Through graphical identification – visual screening of water quality trend lines (typically done during annual reporting phase).

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. Review of other site data is also being carried out to investigate possible sources of extreme values. 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.

4. Database Maintenance Activities

Throughout 2007 and the first quarter of 2008, 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:

- Standardization of parameter names;
- Rounding of values to remove non-significant digits;
- Input of additional groundwater lab data;
- Select groundwater well ID's changed to inactive (decommissioned or compromised wells);
- Update of groundwater field data;
- Correction of improper units;
- Import of select 2006 data excluded from original import;
- Import of historic groundwater chemistry data not previously entered;
- Update of well construction details; and
- Replacement of water quality data due to 2006/2007 sample re-runs (most samples re-run to obtain lower zinc detection limits than originally reported).

The majority of database maintenance modifications were related to parameter standardization, removal of non-significant figures, unit correction, and replacement of chemistry data due to sample re-runs. A summary of these changes completed in 2007/2008 is compiled in Table 1.

Table 1. 2007/2008 Database Maintenance Activity Summary

Parameter ID	Measurement Units	Update Date	Update Notes	No. of Records
COND-L	µS/cm	23-Jan-07	COND reassigned to COND-L by B. Hutchinson	2324
COND-L	µS/cm	23-Jan-07	COND reassigned to COND-L by B. Hutchinson	1
TEMP-F	°C	23-Jan-07	TEMP reassigned to TEMP-F by B. Hutchinson	2
ZN-D	mg/L	08-Jan-07	Changed from 0.051 mg/L to <0.001 mg/L to reflect a re-run of the sample due to external laboratory error (StationV2)	1
ZN-T	mg/L	08-Jan-07	Changed Zn-T value from 0.12 mg/L to 0.013 mg/L to reflect re-run of sample due to external lab error (Station V2)	1
WL-M	m	24-Jan-07	Values rounded to 2 significant digits to remove non-significant figures	1284
PURGE VOL	L	23-Jan-07	VOLUME P reassigned to PURGE VOL	166
PURGE VOL	L	23-Jan-07	VOLUME P reassigned to PURGE VOL and converted to L from mL	2
PURGE VOL	L	24-Jan-07	VOLUME P reassigned to PURGE VOL and converted to L from mL	55
LAB DATA	mg/L	13-Aug-07	Added additional lab data for X14 and X5 sampled on June 5th, 12th and 19th, 2007	2 stations / 3 events
TOTAL / DISS. METALS	mg/L	28-Sep-07	Updated various total and dissolved metal concentrations for X14 sampled 21-Aug-07 due to laboratory re-calculation of analytical results.	9 total / 6 dissolved
ACTIVE/INACTIVE	Status	3-Nov-07	P03-02-06, P03-03-07, X24B-96, and X24C-96 to inactive	4
SO4	mg/L	9-Jan-08	Replaced sulphate concentrations for select 2007 GW samples due to lab re-calculation of analytical results (detected from erroneous charge balance values)	10
DISS. METALS	mg/L	9-Jan-08	Switched dissolved metals analysis for X24A-96 and X24B-96 for Nov. sampling as directed by ALS (from re-run)	58
WL-M	m	21-Jan-08	Updated P03-01 multilevel well water levels for October 2007	9
ZN-D	mg/L	28-Jan-08	Updated all 2007 zinc concentrations due to re-calculation of analytical results by ALS to obtain lower detection limits	138
HG-T	mg/L	Jan-08	Updated surface water mercury units for select stations (2005-2007) from µg/L to mg/L	164
ZN-D	mg/L	Feb-08	Updated all 2006 zinc concentrations due to re-calculation of analytical results by ALS to obtain lower detection limits	78
LAB ANALYSIS	mg/L	13-Feb-08	Import of X21A-96, P01-03, BH12A, DP4, DP5 complete analysis for 2006 (excluded from original import)	5 stations
ZN-D	mg/L	14-Feb-08	Update for ZN-D at P03-09-08 sampled 2-Oct-07	1
LAB ANALYSIS	mg/L	25-Feb-08	Import of historic groundwater chemistry data (2004/2005)	18 stations
WELL DATA	various	27-Feb-08	Update of well construction details as provided by RGC	208
			TOTAL	**4546**

5. Database Upgrades

Upgrades to the WATER database were completed during the first quarter of 2008. These upgrades included streamlining of the database, incorporation of a statistical analysis tool to facilitate annual reporting, and the development of a mass balance calculation to further enhance QA/QC measures. A summary of these activities, performed in conjunction with Stoneleigh Associates Ltd., is outlined below:

5.1 Database Streamlining

Streamlining of the database consisted of various tasks to remove redundancy within the database. Tasks included removing stations which are no longer sampled, deleting parameters which are no longer analyzed, amalgamating duplicated parameters, and changing the heading “Nutrients” to “Other Parameters” to allow for a better representation of the parameters included within this category. The original database will be archived for future reference, while the streamlined database will be the warehouse for all future data imports. A summary of the tasks performed is outlined in Appendix A.

5.2 Statistical Analysis Tool

A newly developed statistical analysis tool will facilitate annual reporting for both the surface water and groundwater sampling programs. Tables can now be quickly generated from the WATER database to include various representative statistics for each program. The tool includes the capability to generate statistics for individually selected stations within a specified date range, and the incorporation of desired benchmark criteria. Additional options include focusing the statistics generated by sample class and/or statistical parameter. Data export capabilities include viewing the original statistics generated, viewing the ‘base data’ (chemistry values) for the statistics generated, in addition to viewing ‘base data’ with values less than method detection limit (MDL) represented as ½ MDL for use in annual reporting requirements.

5.3 Charge Balance Calculation

A charge balance calculation has been incorporated into the WATER database in order to enhance QA/QC of all imported chemistry data. Capabilities include the generation of charge balance values for all chemistry data imported, including ‘flagging’ (red text) values which have charge balances greater than +/- 10%. This will allow for a preliminary scan of all data imported, where secondary measures can then follow for those values that have been flagged. The implementation of this tool followed QA/QC issues with the external laboratory (ALS Environmental, Vancouver)

concerning reporting of groundwater chemistry data (see Appendix B for further details). It should be noted that application of this tool requires complete analyses of the full suite of major cations and anions.

6. 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 Gartner Lee's 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 Gartner Lee 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 file "User Water_*Date*.mde" to system hard drive.
3. Open MDE file using the Microsoft Access application.

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 GROUNDWATER Database,* updated in 2008 and found in Appendix D.

7. Database Management

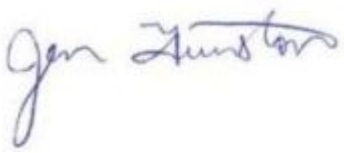
The database Project Manager is responsible for the overall management of the database and retains authority within Gartner Lee to authorize changes to the database. The database manager is responsible for data management and posting of the database to ftp.

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

The "master" database files reside in Gartner Lee'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 Gartner Lee'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.

8. Closing Signature Blocks

Report Prepared By:



Jennifer Funston, B.Sc.
Hydrogeologist

Report Reviewed By:

Heather Badry, B.Sc.
Senior Environmental Scientist

Appendix A

Streamlined Database – Summary of Tasks

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(705) 645-2979

Stoneleigh Associates Inc.

March 19, 2008

Heather and Jen;

I've complete the 'streamline' of the WATER database… removing stations and parameters as noted on a provided reference EXCEL file. I have also recoded various parameters as instructed. An intact archival version of WATER before this record update was provided to you. This version should be stored in a safe location for future reference. The streamlined version will be used as the MASTER version of the corporate data store going forward. Note that any changes to the procedures in this master version will not be available to the archival version.

A summary of the data record update follows:

- 107 stations of the 393 given in the STATION table were marked for removal. These stations included 979 field samples with 18,141 records in the results table, and 9,231 records in the parameter guideline review table. These stations and their results have been removed. An accompanying EXCEL file displays the list of stations removed.
- 34 parameters were marked for removal (29 of these representing extractable metals). This represented 18,703 records in the result table and 3,802 records in the parameter guideline review table. These parameters and their related sample records have been removed.

Remove Parameter List

Parameter Code	Units	Parameter Description	Proposed Action	Records Affected
AG-E	mg/L	SILVER: EXTRACTABLE Ag	Remove	446
AL-E	mg/L	ALUMINUM: EXTRACTABLE Al	Remove	463
AS-E	mg/L	ARSENIC: EXTRACTABLE As	Remove	463
BA-E	mg/L	BARIUM: EXTRACTABLE Ba	Remove	463
B-E	mg/L	BORON: EXTRACTABLE B	Remove	314
BE-E	mg/L	BERYLLIUM: EXTRACTABLE Be	Remove	463
CA-E	mg/L	CALCIUM: EXTRACTABLE Ca	Remove	463
CD-E	mg/L	CADMIUM: EXTRACTABLE Cd	Remove	463
CO-E	mg/L	COBALT: EXTRACTABLE Co	Remove	463
CR-E	mg/L	CHROMIUM: EXTRACTABLE Cr	Remove	463
CU-E	mg/L	COPPER: EXTRACTABLE Cu	Remove	463
FE-E	mg/L	IRON: EXTRACTABLE Fe	Remove	463
HARD-CA	mg/L	HARDNESS (CALCIUM)	Remove	664

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Remove Parameter List				
Parameter Code	**Units**	**Parameter Description**	**Proposed Action**	**Records Affected**
HARD-D	mg/L	HARDNESS: DISSOLVED	Remove	22
K-E	mg/L	POTASSIUM: EXTRACTABLE K	Remove	411
LAB	no Unit	Laboratory Used	Remove	1897
MG-E	mg/L	MAGNESIUM: EXTRACTABLE Mg	Remove	463
MN-E	mg/L	MANGANESE: EXTRACTABLE Mn	Remove	463
MO-E	mg/L	MOLYBDENUM: EXTRACTABLE Mo	Remove	463
NA-E	mg/L	SODIUM: EXTRACTABLE Na	Remove	463
NI-E	mg/L	NICKEL: EXTRACTABLE Ni	Remove	463
PB-E	mg/L	LEAD: EXTRACTABLE Pb	Remove	463
P-E	mg/L	PHOSPHORUS: EXTRACTABLE P	Remove	463
SB-E	mg/L	ANTIMONY: EXTRACTABLE Sb	Remove	463
S-D	mg/L	SULPHUR: DISSOLVED S	Remove	1999
S-E	mg/L	SULPHUR: EXTRACTABLE S	Remove	116
SE-E	mg/L	SELENIUM: EXTRACTABLE Se	Remove	463
SI-E	mg/L	SILICON: EXTRACTABLE Si	Remove	414
SN-E	mg/L	TIN: EXTRACTABLE Sn	Remove	430
SR-E	mg/L	STRONTIUM: EXTRACTABLE Sr	Remove	463
TI-E	mg/L	TITANIUM: EXTRACTABLE Ti	Remove	463
V-E	mg/L	VANADIUM: EXTRACTABLE V	Remove	456
W-D	mg/L	TUNGSTEN: DISSOLVED W	Remove	2034
ZN-E	mg/L	ZINC: EXTRACTABLE Zn	Remove	455

- An additional 7 parameters were marked for re-assignment. This list is shown below with the number of affected records in the results table. The affected records number was derived after removal of some of these parameters by station. 128 parameters remain in the MEASUREMENT TECHNIQUE table. Affected parameters in the RESULTS table have been marked by an update date and note.

Parameter Code	**Units**	**Parameter Description**	**Proposed Action**	**Records Affected**
ACID8.3	mg/L	ACIDITY at pH 8.3	Data renamed Total Acidity, parameter removed	242
ACID-C	mg/L	ACIDITY (CaCO3)	Data renamed Total Acidity, parameter removed	114
CNTHIO	mg/L	CYANIDE THIO ????	Named changed to Cyanide Thiocyanate	88
FLOWEP	unknown	FLOW - need to check units	Parameter renamed to FLOWLS (units for these data are L/s)	309
SO4-D	mg/L	SULPHATE: DISSOLVED SO4	All Sulphate results will be pooled. Renamed SO4	9973
SO4-T	mg/L	SULPHATE: TOTAL SO4	All Sulphate results will be pooled. Renamed SO4	150
TEMP-C	°C	TEMPERATURE - what does C mean? LAB?	Renamed to TEMP-L	4284

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- The renaming of Sulphate to SO4 required adjustment of the related parameter ID in the Lookup Benchmark and Lookup CHARGE Balance table.
- The parameter class 'NUTRIENTS' was renamed to 'OTHER PARAMETERS'. All available parameter classes (there are 8) now display in the selection window of the 'View Data by Multiple Stations and Parameters' form. A summary report listing the parameters as grouped by class can be reviewed both on this screen and from the Data Reports and Summaries tab on the main screen.
- The station status was updated using the provided station list. A value of 'inactive' protects a station from edit/delete using the sample review form. It does not protect it when viewing the raw data table.
- 5 Station tables in the Groundwater database used to prepare field sheets contain some of the removed stations. These have also been deleted.
- The record count summary in the principle sample data tables is summarized below, before, during and after the record removal process. A single station K8-REP remains in the STATION table with no samples.

Table name	Records before streamline (now found in ARCHIVE WATER version)	After removal of records by STATION	After removal or records by PARAMETER
STATION	393	286	286
FIELD	14,205	13,226	13,226
LAB	14,131	13,159	13,159
RESULTS	450,655	432,514	413,811
PARAMETER GUIDELINES	90,826	81,595	77,793
ELEVATIONS	708	619	619

A vital part of this streamline process is to both properly warehouse the Archival version and ensure that it remains protected against changes. Of critical importance is to ensure that all staff uses only the current Master version of the corporate data. Transfer of current versions to and from Whitehorse using either the FTP site or courier must always be accompanied with removal of the previous master version to an archive backup directory and replacement of the new update. Previously, the master version was always called WATER.mdb so that shortcuts and links to the related Groundwater would continue to work. The update date and version number is visible only from within the file on the main switchboard form. The modified date for the file as viewed from an operating system window is never a good indicator of the file version as this date can be altered merely by moving or opening the file. Subsequent versions of master data files will be labeled with both a version number and date. The current master version of WATER shipped with this update is called WATER v2 2008-03-19.mdb

Barb

Table 1. Stations Included in Streamlined Database

ACTIVE GW
ACTIVE SW
in the water licence, but not sampled within last year
in the water licence, but no longer sampled

Station ID	Station Name	Number of Samples
96-1	Grum underground	105
A25	A25	465
A26-7	Upper Pit Wall Area	139
A30	Upper Pit Wall Zone	1078
A31	Upper Pit Wall near	38
A8	MP Sump Zone MPC1	30
BH05-9B-R	BH05-9B-R	76
BH1	BH1 (5.18m)	1420
BH12A	W of Zone II	772
BH12B	W of Zone II (8.05m)	629
BH13A	W of Zone II	111
BH13B	W of Zone II	307
BH14A	W of Zone II (6.22m)	652
BH14B	W of Zone II (10.00m)	801
BH2	BH2 (5.55m)	1570
BH4	BH4 (3.20m)	1109
BH6	W of Zone II (6.55m	217
DP4	DP4	35
DP5	DP5	34
DP6	DP6	1
ETA-05-4	ETA-05-4	78
FAROCR	Faro Creek by R7	3058
FC	Faro Creek at FC	348
FCD	FCD, Faro Creek Div.	663
FCO	FCO, Old Faro Creek	1000
FCOB	FCOB, Inlet to upstream of pond	68
FDL	FDL	545
FDU	FDU, Faro Creek Div.	1118
FDU2	FDU2, Faro Creek Div.	36
FWSD1	FWSD1	877
FWSD5	FWSD5	860
FWSD6	FWSD6	165
GCULV	GCULV	2727
GD1	GD1, Grum Dump toe	33
GD2	GD2, Grum Dump toe	33
GHCWD	Guardhouse Ck @ WD	9
GHSCR1	Guardhouse Creek #1	799
GHSCR2	Guardhouse Ck #2	285
IDSEEP1	IDSEEP, Int Dam Seep	282
IDSEEP2	IDSEEP2, Int. Dam Seep near West Abutment	135
INSPOND	Inflow Sheep Pad Pond	74
K8	K8	2780
K8-REP	K8-REP	0
LCD	LCD, Little Creek Dam	754
MOOSESP	Moose Seep	1573
MOOSEw2	Moose Well Number 2	2099
NE1	NE1, flow to N.Fork	1031

Table 1. Stations Included in Streamlined Database

ACTIVE GW
ACTIVE SW
in the water licence, but not sampled within last year
in the water licence, but no longer sampled

Station ID	Station Name	Number of Samples
NE2	NE2, flow to N.Fork	995
NE3	NE3, flow to N.Fork	149
NF1	NF1, u/s rock drain	1120
NF2	NF2, d/s rock drain	1397
NWI	North Wall Interceptor	214
NWINT	NWINT	299
OUTSPOND	Outflow Sheep Pad Pond	11
P01-01A	d/s. of cross valley Dam	388
P01-01B	d/s. of Cross Valley Dam	389
P01-02A	toe of Cross Valley	505
P01-02B	toe of Cross Valley	480
P01-03	toe of Intermediate	382
P01-04A	toe of Intermediate	348
P01-04B	toe of Intermediate	390
P01-11	toe of Cross Valley	387
P03-01-01	P03-01-01	303
P03-01-02	P03-01-02	265
P03-01-03	P03-01-03	265
P03-01-04	P03-01-04	265
P03-01-05	P03-01-05	265
P03-01-06	P03-01-06	265
P03-01-07	P03-01-07	270
P03-01-08	P03-01-08	196
P03-01-09	P03-01-09	245
P03-02-01	P03-02-01	265
P03-02-02	P03-02-02	265
P03-02-03	P03-02-03	265
P03-02-04	P03-02-04	302
P03-02-05	P03-02-05	264
P03-02-07	P03-02-07	187
P03-02-08	P03-02-08	191
P03-02-09	P03-02-09	185
P03-03-01	P03-01-01	359
P03-03-02	P03-03-02	347
P03-03-03	P03-03-03	348
P03-03-04	P03-03-04	310
P03-03-05	P03-03-05	345
P03-03-06	P03-03-06	303
P03-03-08	P03-03-08	216
P03-03-09	P03-03-09	110
P03-04-01	P03-04-01	277
P03-04-02	P03-04-02	530
P03-04-03	P03-04-03	345
P03-04-04	P03-04-04	530

Table 1. Stations Included in Streamlined Database

ACTIVE GW
ACTIVE SW
in the water licence, but not sampled within last year
in the water licence, but no longer sampled

Station ID	Station Name	Number of Samples
P03-04-05	P03-04-05	308
P03-04-06	P03-04-06	462
P03-04-07	P03-04-07	309
P03-04-08	P03-04-08	309
P03-04-09	P03-04-09	123
P03-05-01	P03-05-01	272
P03-05-02	P03-05-02	272
P03-05-03	P03-05-03	272
P03-05-04	P03-05-04	234
P03-05-05	P03-05-05	351
P03-05-06	P03-05-06	267
P03-05-07	P03-05-07	266
P03-05-08	P03-05-08	264
P03-06-01	P03-06-01	265
P03-06-02	P03-06-02	305
P03-06-03	P03-06-03	265
P03-06-04	P03-06-04	265
P03-06-05	P03-06-05	264
P03-06-06	P03-06-06	115
P03-06-07	P03-06-07	3
P03-07-01	P03-07-01	3
P03-07-02	P03-07-02	152
P03-07-03	P03-07-03	41
P03-07-04	P03-07-04	39
P03-07-05	P03-07-05	79
P03-07-06	P03-07-06	1
P03-07-07	P03-07-07	1
P03-07-08	P03-07-08	3
P03-08-01	P03-08-01	305
P03-08-02	P03-08-02	459
P03-08-03	P03-08-03	571
P03-08-04	P03-08-04	464
P03-08-05	P03-08-05	486
P03-08-06	P03-08-06	358
P03-08-07	P03-08-07	291
P03-08-08	P03-08-08	304
P03-09-01	P03-09-01	310
P03-09-02	P03-09-02	495
P03-09-03	P03-09-03	309
P03-09-04	P03-09-04	494
P03-09-05	P03-09-05	347
P03-09-06	P03-09-06	495
P03-09-07	P03-09-07	536
P03-09-08	P03-09-08	246

Table 1. Stations Included in Streamlined Database

ACTIVE GW
ACTIVE SW
in the water licence, but not sampled within last year
in the water licence, but no longer sampled

Station ID	Station Name	Number of Samples
P03-09-09	P03-09-09	494
P05-01-01	P05-01-01	79
P05-01-02	P05-01-02	79
P05-01-03	P05-01-03	79
P05-01-04	P05-01-04	79
P05-01-05	P05-01-05	79
P05-01-06	P05-01-06	118
P05-02	P05-02	78
P05-03	P05-03	76
P05-04	P05-04	116
P2001-02A	P2001-02A (27.3m) aka P01-52A	390
P2001-02B	P2001-02B (13.9m) aka P01-52B	306
P2001-03	P2001-03 (61.6m) aka P01-51	307
P81-4D	2ND IMPOUNDMENT	365
P96-6	Toe Int Dump (20.85m	915
P96-7	Toe Main Dump (9.90m	745
P96-8A	Old Faro chan (4.87m	855
P96-8B	Old Faro chan (9.30m	714
P96-9A	g/w @ Toe Grum dump	843
P96-9B	g/w @ Toe Grum dump	375
R1	R1	982
R10	N Fork u/s rck drain	5351
R11	R11	589
R2	R2	1075
R3	R3	1043
R4	Rose Ck u/s Anvil Ck	1405
R5	Anvil Ck d/s Rose Ck	1332
R6	Anvil Ck u/s Rose Ck	1391
R7	North Fork at R7	6111
R8	N Fork 900m below R7	5312
R9	R9,N Fork by BH1 & 2	5538
S1A	S Sulph dump (12.80m	840
S1B	S Sulph Dump (5.37m)	802
S2A	S Sulph Dump (8.04m)	766
S2B	S Sulph Dump (10.60m	833
S3	S Sulph Dump (6.56m)	837
SP5-6	SP5-6, seep ditch	1236
SRK04-3A	SRK04-3A	155
SRK04-3B	SRK04-3B	78
SRK04-5A	SRK04-5A	75
SRK04-5B	SRK04-5B	75
SRK05-05C	SRK05-05C	37
SRK05-06	SRK05-06	72
SRK05-07	SRK05-07	40

Table 1. Stations Included in Streamlined Database

ACTIVE GW
ACTIVE SW
in the water licence, but not sampled within last year
in the water licence, but no longer sampled

Station ID	Station Name	Number of Samples
SRK05-08	SRK05-08	78
SRK05-09	SRK05-09	78
SRK05-ETA-BR1	SRK05-ETA-BR1	78
SRK05-ETA-BR2	SRK05-ETA-BR2	78
SRK05-SP-1A	SRK05-SP-1A	78
SRK05-SP-1B	SRK05-SP-1B	78
SRK05-SP-2	SRK05-SP-2	78
SRK05-SP-3A	SRK05-SP-3A	82
SRK05-SP-3B	SRK05-SP-3B	78
SRK05-SP-4A	SRK05-SP-4A	78
SRK05-SP-4B	SRK05-SP-4B	117
SRK05-SP-5	SRK05-SP-5	78
SRK05-SP-6	SRK05-SP-6	0
TH86-17	TH86-17	349
TH86-26	TH86-26	42
V1	V1, Vangorda Ck U/S	4080
V10	Unknown Vangorda station	158
V11	Unknown Vangorda station	73
V14	V14, Grum Dump sump	598
V15	V15, Grum Dump sump	7017
V16	Grum Dump sump	1034
V17	Grum Dump, NW ditch	13
V17A	Runoff from ore transfer pad	1950
V18	Grum Dump, SE ditch	1423
V19	Vangorda pit, NW ditch	776
V19CULVERT	Vangorda Cr below haul rd	348
V2	V2, Grum Creek	7464
V20	Vangorda, NE ditch	1145
V21	Vangorda dump, sump	442
V21A	VG Dump Collector	186
V22	Vangorda pit water	3394
V23	V23, Grum Pit Water	2298
V23A	Grum pit water	1000
V24	Inf. treatment plant	3155
V25	Eff from treatment plant	5243
V25AF	Eff treatment plant	552
V25BF	Eff from treatment	189
V25BSP	Weir below Sheep Pond	8742
V25DS	Downstream of V25?	27
V26	Little Creek	31
V27	Vangorda Creek	2369
V28	Vang Dump drain #1	2254
V29	Vang Dump drain #3 #2???	1388
V2A	Grum Creek Diversion to Moose Pond	4324

Table 1. Stations Included in Streamlined Database

	ACTIVE GW
	ACTIVE SW
	in the water licence, but not sampled within last year
	in the water licence, but no longer sampled

Station ID	Station Name	Number of Samples
V30	Vang Dump drain #3	2698
V31	Vang Dump drain #4	314
V32	Vang Dump drain #5	1417
V33	Vang Dump drain #6	1185
V34	groundwater well	1433
V35	groundwater well	1467
V36	groundwater well	1137
V37	groundwater well	1286
V38	groundwater well	222
V39	P-94-01A	217
V4	V4,Shrimp Creek	2289
V40	P-94-01B	180
V41	P-94-02A	215
V42	P-94-02B	23
V43	P-94-02C	244
V44	P-94-03A	23
V45	P-94-03B	17
V46	P-94-04A	23
V47	P-94-04B	17
V5	Vangorda Creek, west fork	9557
V6A	AEX Creek	4855
V8	Vagorda Ck in Faro	11710
VG1	VG dump ditch	34
VGMAIN	VGMAIN, Main Fork	7293
VGSEEP	VG pit ramp ditch/seepage	70
VXX	CALC. MAIN FORK	154
W10	W10, GHC u/s NW Dump	1103
W11	South Main Waste Dump	24
W2	East Waste Dump Toe	19
W3	East Waste Dump Toe	76
W5	East Waste Dump Toe	511
W8	W8, GHCk d/s NW dump	1231
WEIR3	WEIR3, mid X-Vdam	1582
X1	Tailings Pond at X1	1441
X10	X10, Rose Ck Div.	10298
X11	X11, N Toe Seepage	10363
X12	X12, S. Toe Seepage	9362
X13	X13, CVD tot seepage	21317
X14	X14, Rose Cr	17745
X16A	d/s CVDam (5m)	1393
X16B	d/s CVDam (30m)	1471
X17A	d/s CVdam (5m)	1462
X17B	d/s CVDam (20m)	1436
X18A	N of CVDam (10m)	1353

Table 1. Stations Included in Streamlined Database

ACTIVE GW
ACTIVE SW
in the water licence, but not sampled within last year
in the water licence, but no longer sampled

Station ID	Station Name	Number of Samples
X18B	N of CVDam (20m)	1152
X19A	X19A, d/s CVDam	556
X19B	X19B, d/s CVDam	372
X2	X2, N Fork Rose Cr	12002
X20	d/s CVDam	20
X21A-96	Toe 2nd Imp (9.22m)	474
X21B-96	Toe 2nd Imp (15.43m)	1199
X22	Faro Pit dewatering	2429
X22B	X22B, Faro Pit water	8125
X23	X23, Old Cr channel	13045
X24D-96	N abut Int (28.22)	1306
X25A-96	S abut Int (9.65m)	1433
X25B-96	S abut Int (19.80m)	1421
X26	Zone II Pit Water	2807
X3	X3, Pumphouse Res.	11447
X4	X4, Int. Dam decant	16372
X5	X5, CVD decant	20859
X5P	X5P	2061
X7	Old Faro Creek at X7	1194

Table 2. Stations Removed From Streamlined Database

ACTIVE GW

in the water licence, but no longer sampled

Station ID	Station Name	Number of Samples
BH05-01	BH05-01	0
BH10A	W of Zone II (34.17m)	182
BH10B	W of Zone II (52.92m)	181
BH11	W of Zone II (54.80m	46
BH15A	By SP5/6 (13.70m)	109
BH15C	By SP5/6 (damaged)	70
BH3	BOREHOLE - damaged	25
BH5	W of Zone II (8.33m)	183
BH7A	W of Zone II (9.00m)	207
BH7B	W of Zone II (6.78m)	177
BH7D	BH7D	1
BH7S	BH7S	39
BH8	W of Zone II (21.00m	164
BH83-4B	2ND IMPOUNDMENT	79
BH83-4C	2ND IMPOUNDMENT	79
BH88-2.2A	2ND IMPOUNDMENT TAILINGS	111
BH88-2.2B	2ND IMPOUNDMENT TAILINGS	68
BH88-2.2C	2ND IMPOUNDMENT TAILINGS	71
BH88-2.5	2ND IMPOUNDMENT TAILINGS	144
BH9	W of Zone II	45
BXLPOND	Holding Pond at BXL/Stanchem Plants	102
CVDC-4D	CV-D CREST NORTH	13
CVDC-7D	CV-D CREST CENTER	15
CVDC-7S	CV-DCREST CENTER	15
CVDC-9D	CV-D CREST SOUTH	15
CVDC-9S	CV-D CREST SOUTH	15
CVDT-1	CV-D TOE NORTH	14
CVDT-2	CV-D TOE CENTER	13
D1	Upper Pit Wall Area	58
D2	Upper Pit Wall Area	61
D3	Upper Pit Wall Area	62
D4	Upper Pit Wall Area	58
D5	Upper Pit Wall Area	63
D6	Upper Pit Wall Area	59
DI	Distilled Water	1
DSRESWEIR	d/s Reservoir weir	1
F-ROCK	F-ROCK From seep survey	35
FVW	Faro Valley Intercept	51
FWSD5-REP	FWSD5-REP	0
ID4-D	INT-D CENTER	13
MPA8	Upper Pit Wall Area	12
MPA8-13	Upper Pit Wall Area	12
MPA8-14	Upper Pit Wall Area	9
MPA8-16	Upper Pit Wall Area	9
MPA8-16F	Upper Pit Wall Area	9
MPA8-17	Upper Pit Wall Area	12
MPA8-18	Upper Pit Wall Area	9
MPA8-19	Upper Pit Wall Area	9
NA05-11A	NA05-11A	37
NA05-2D	NA05-2D	38

Table 2. Stations Removed From Streamlined Database

ACTIVE GW

in the water licence, but no longer sampled

Station ID	Station Name	Number of Samples
NA05-2S	NA05-2S	38
NA05-9D	NA05-9D	38
NA05-9S	NA05-9S	0
P01-05A	Intermediate Impoundment	418
P01-05B	Intermediate Impoundment	412
P01-06	toe of Second Dam	273
P01-07A	Second Impoundment	274
P01-07B	Second Impoundment	311
P01-07C	Second Impoundment,	430
P01-07D	Second Impoundment,	418
P01-07E	Second Impoundment,	307
P01-08A	Original Impoundment	294
P01-08B	Original Impoundment	224
P01-08C	Original Impoundment	125
P01-09A	Second Impoundment	294
P01-09B	Second Impoundment	242
P01-09C	Second Impoundment	240
P01-09D	Second Impoundment,	247
P01-10A	Original Impoundment	312
P01-10B	Original Impoundment	306
P03-02-06	P03-02-06	229
P03-03-07	P03-03-07	114
P81-5	1974 DAM	78
P81-9	U/S TAILINGS IMPOUNDMENT	15
P96-1	S crest Int (23.00m)	5
P96-2	N crest Int (20.87m)	5
PW3	PUMPING WELL	93
PW4	U/S TAILINGS IMPOUNDMENT	95
PW5	PW5 WELL	120
PW6	PUMPING WELL	96
RES.WEIR	Reservoir weir	8
ROSESTVREC	Rose Cr D/S Stevens	2
SFORKROSE	S Fork of Rose Cr	36
SLOT	Slot Cut Water	113
V3	Unknown Vangorda station	144
V7	Grum explor. portal	532
VAN-1	Unknown Vangorda station	68
VAN-2	Unknown Vangorda station	69
VAN-3	Unknown Vangorda station	69
VANGCK	Various locations	49
VGGR	VG Creek at Grum turn	6
WE16	Seep Monitoring ????	6
X10A	just u/s X13/X5	66
X10B	just d/s of X13/X5	66
X13B	just u/s of Rose Ck	66
X21C-96	Toe 2nd Imp (30.18m)	1118
X22A	Faro Pit dewatering	1169
X22L	X22L, Faro Pit Deep	75
X24A-96	N abut Int (5.88m)	1263
X24B-96	N abut Int (10.80m)	322

Table 2. Stations Removed From Streamlined Database

ACTIVE GW
in the water licence, but no longer sampled

Station ID	Station Name	Number of Samples
X24C-96	N abut Int (15.87m)	1089
X4A	X4 After Lime	31
X5C	X5, no rinse	2
X5L	X-V Pond at Depth	70
X7A	X7A, Seep	38
X9	Tailings Slurry	2429
X9F	Tailings Slurry	108

Appendix B

ALS QA/QC Issues Memo

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

December 21, 2007

Gartner Lee Limited
2251-22nd Avenue
Whitehorse, Yukon
Y1A 5W1

ATTENTION: Mr. Martin Guilbeault

Dear Mr. Guilbeault

RE: Faro Mine Project

This letter is in response to the concerns raised by Gartner Lee with respect to ALS Environmental data reported over the last year for the Faro Mine Project (project # 60601).

The concerns and ALS Environmental responses are summarized below.

1. Detection limits were raised sporadically for Total Zinc (Zn), and other metals, and they were not always the lowest that could have been achieved. There are a several factors that can lead to an increased detection limit, most notably is sample dilution during analysis. Unfortunately during our switch over to our new Laboratory Information Management System (LIMS), we lost some important information and the ability to recognize these samples as samples that require a low level Zn detection limit of 0.005 mg/L for the pristine samples belonging to this project.

   Now recognizing the special need for these samples, we will create a new "product group" for the Metals analysis to be requested when submitting these samples. This will enable the analyst to recognize these samples as samples with a special need and they will not increase the Zn detection limit unless there is a direct analytical interference with the Zn.

   Additionally, if possible, ALS Environmental would like to request that Gartner Lee submit the highly contaminated samples within the Faro Mine Project on a separate Chain of Custody from the pristine water samples from the same project. This will reduce the likelihood of having to re-analyse some of the pristine water samples due to the potential for carryover contamination produced by the highly contaminated samples.

2. ALS Environmental incorrectly reported some Sulfate results for samples analysed in 2007 for the Faro Mine project. Specifically, for the three samples identified by Gartner Lee with imbalanced anions and cations and another four identified by ALS Environmental. When

the Sulfate results for the first three samples were questioned and the imbalanced ions were brought to our attention, we re-checked the data and identified that the bench level dilution factors were missed during the sulfate data calculations. Subsequently, ALS Environmental has carried out an ion balance for all samples submitted for this project in the year 2007 and identified seven other samples with imbalanced anions and cations. Of these seven samples, four had incorrect sulfate results reported, two had had their metals results flipped (due to a labeling error) and for the last one no identifiable error could be identified. In all of these instances, except the last, the data was corrected and the reports were re-issued.

Unfortunately, these samples were analyzed for only one major anion (i.e. sulfate) and as a result an ion balance could not be automatically preformed. To address and resolve this issue, ALS Environmental will manually calculate the ion balance on all future submissions and provide Gartner Lee with the ion balance reports in an e-mail to the applicable Gartner Lee Project Manager.

Further more, a Corrective Action Report (CAR) has been initiated for the errors in reporting and these are the actions ALS Environmental is taking to prevent these kinds of errors occurring in the future:

- Peer review for all bench level dilution factors being manually transferred into the database (i.e. LIMS).
- Revised work sheets that will include a designated space for bench level dilution factors.
- Improving the Sulfate method to reduce the number of the bench level dilutions required.

With all these steps taken we would like to ensure you that these issues have been resolved. We apologize for the inconvenience our errors and omissions have caused, and we look forward to providing the quality of service you expect from us.

We value your business and appreciate you bringing these issues to our attention.

Should you have any questions, please do not hesitate to contact any of our staff members.

Yours sincerely,

Natasha Markovic-Mirovic
Account Manager

Blair Easton
Laboratory Manager

Appendix C

WATER Database Manual

User Manual for the

WATER database

Updated: May 2005
November 2005
March 2008

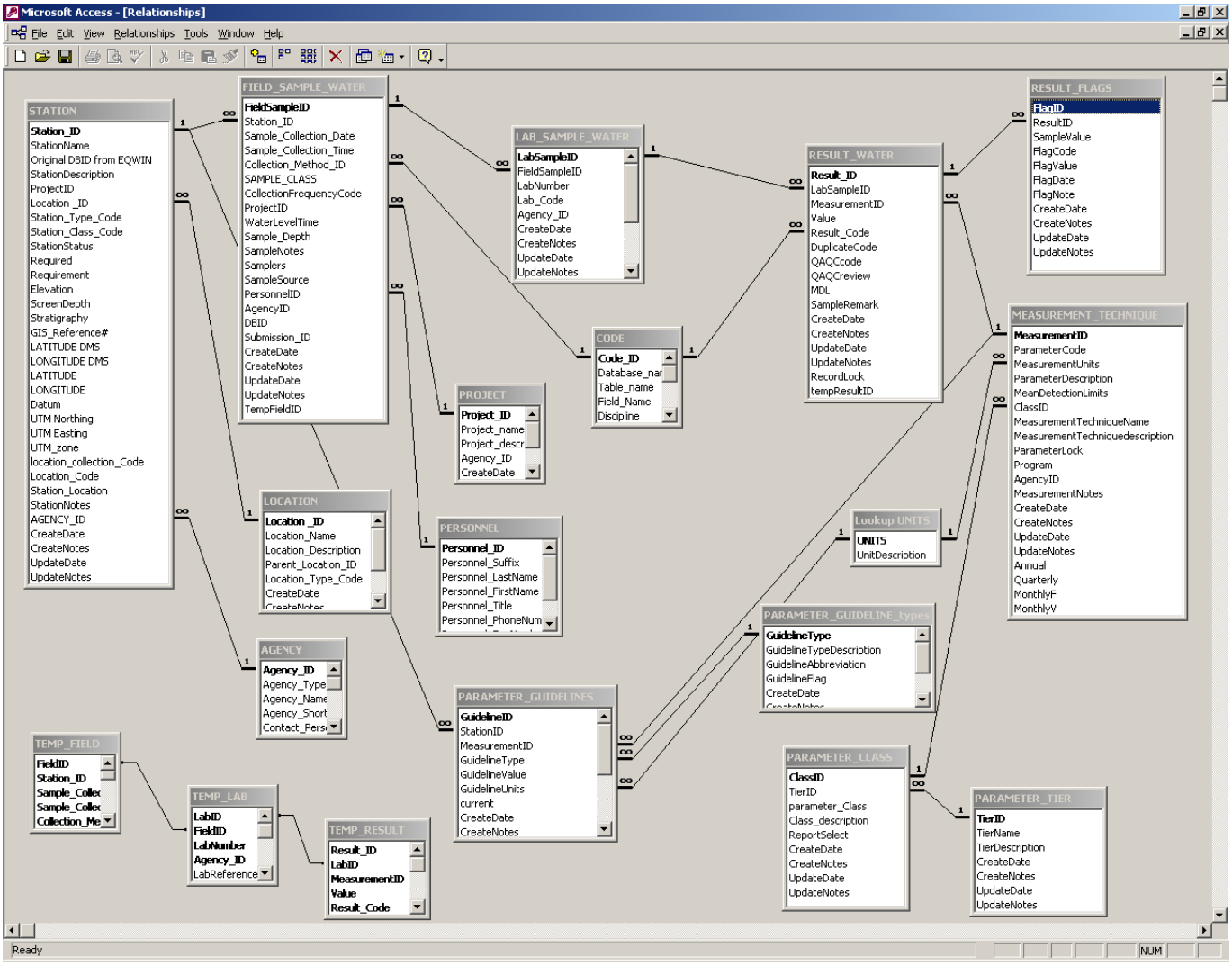
Barbara A. Hutchinson
Stoneleigh Associates Inc

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.



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: 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: 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: 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: 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	Agency ID – value found in AGENCY table	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	Agency ID	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	31	pp/assist	1500	748
P03-04-04	ALSW212202	26-Dec-05	10:33		M		31	pp/assist	1170	448
P03-04-06	ALSW212203	27-Dec-05	10:45		M		31	pp/assist	5180	1640
P03-04-08	ALSW212204	28-Dec-05	10:52		M		31	pp/assist	8860	1340

This format is required for the import routine to function properly.

Table: 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: 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: 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: 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: 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: 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: 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: 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: Lookup MONTHS

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

Table: 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: 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: 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

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

Table: 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.

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
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: 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, compares 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).

Table: 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

Lookup CHARGE BALANCE						
ParameterName	ParameterDescription	ParameterClass	CurrentUse	ClassCode	MolecularWeight	Charge
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: 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
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: 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: 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: 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: 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: 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: 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: 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: 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
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	What is the requirement	Text	255
Elevation	Station elevation	Single	8
ScreenDepth	Screen depth	Single	8
Stratigraphy	screen stratigraphy	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	Keep 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: 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

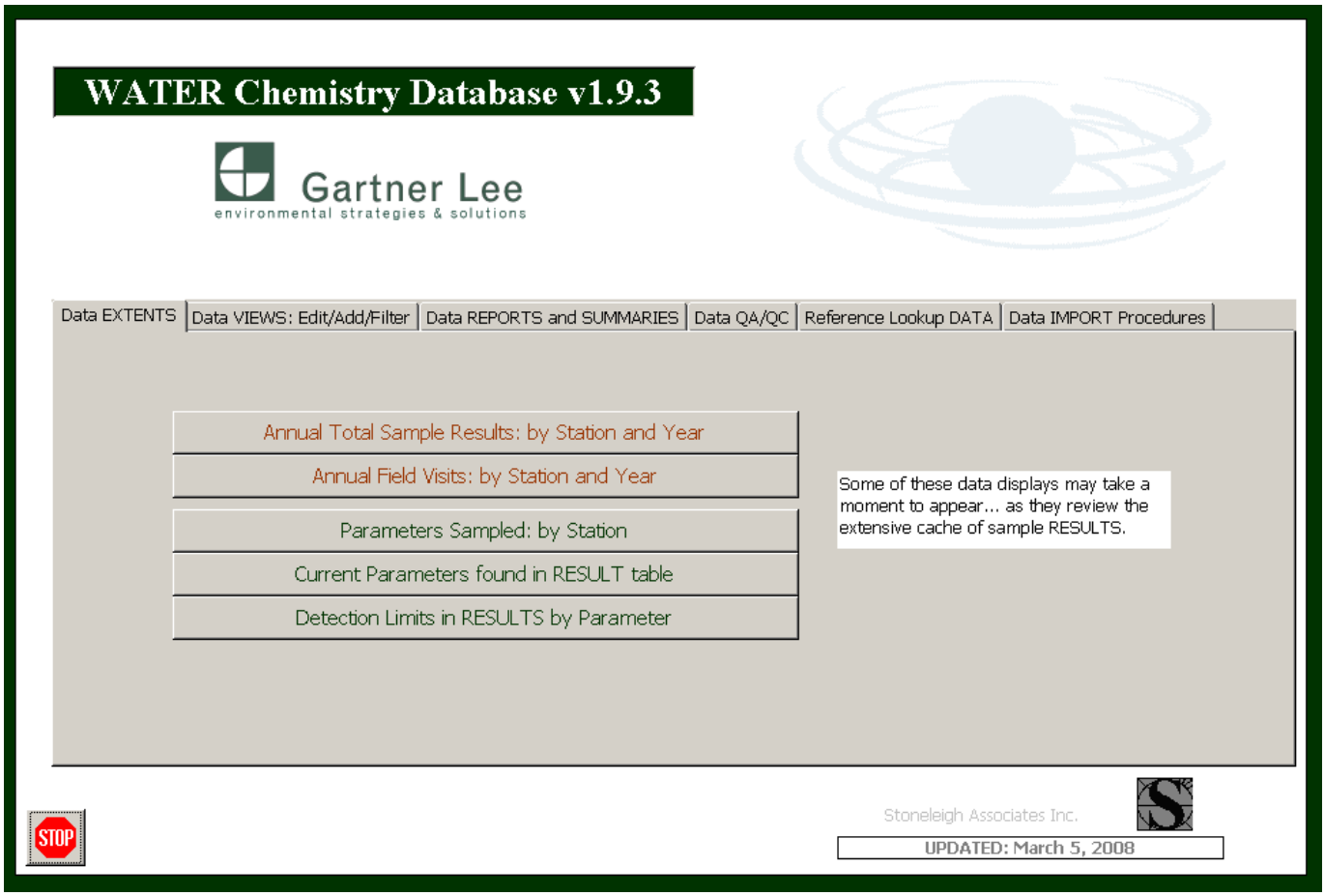
Table: FLAG_VALUES_TEMP

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 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

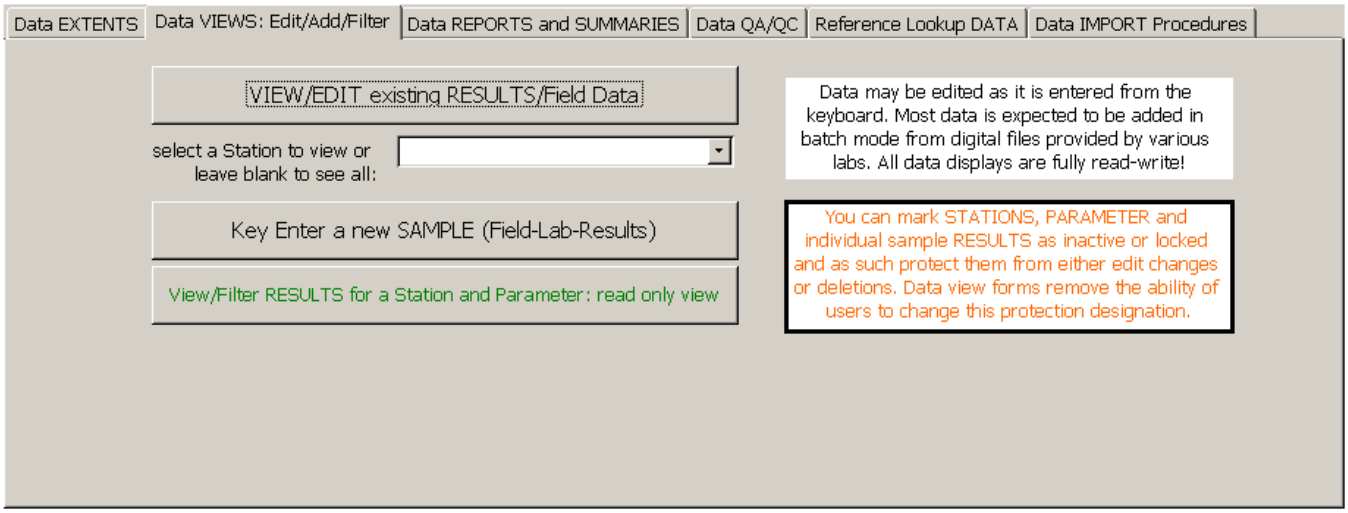


Data Extents

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



Most data will be added during batch process from lab-provided EXCEL spreadsheets. There may be occasions when a record may be added or edited from the keyboard.

Add New Data

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

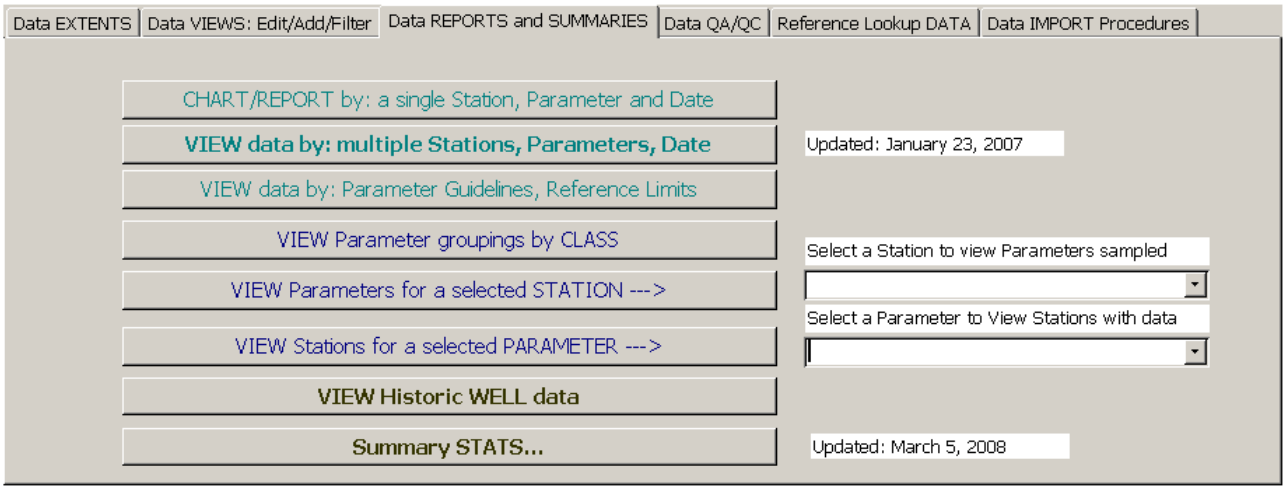
Edit Existing Data

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

Filter (Find) Data

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

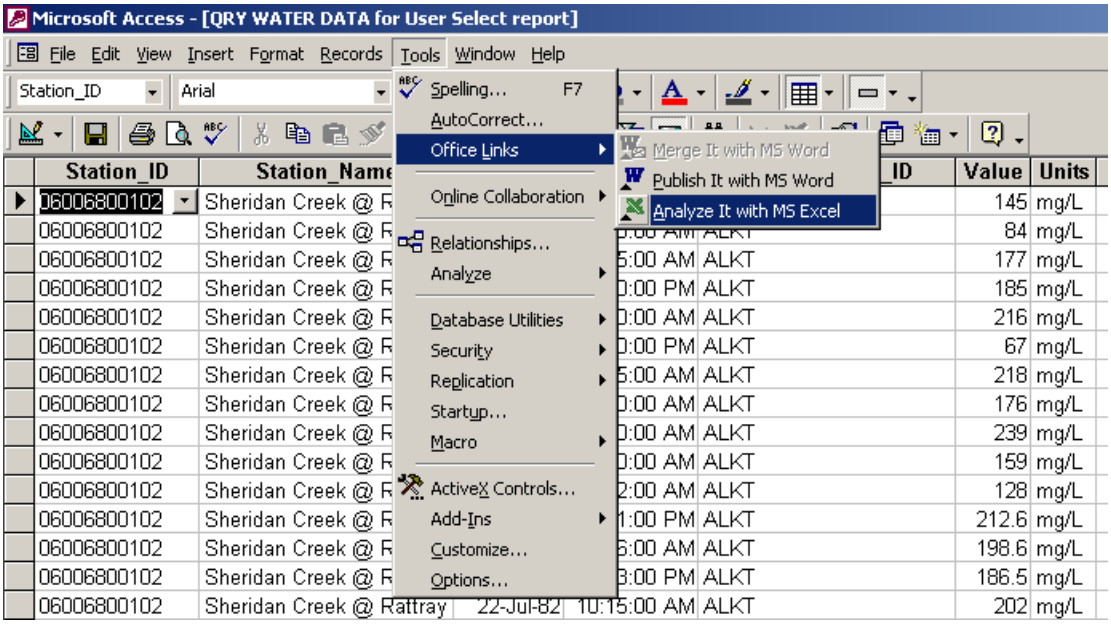
Data Reports and Summaries



Users can filter either the station or the parameter from the main screen, or leave blank to view all – using any of the blue font command buttons

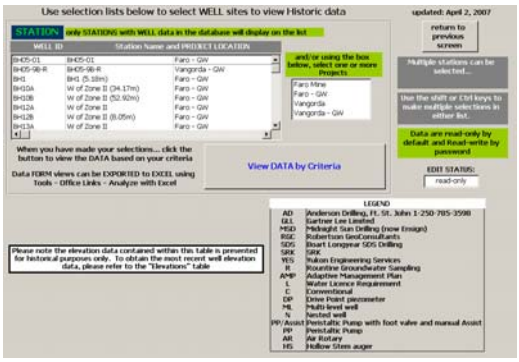
There are several ways that the user can view and summarize the data. Some of the procedures produce the same output, though the user can arrive at the display using different means. Printable reports, sortable/filterable/exportable data displays and charts are all choices available to the user. Most 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.

Additionally, users can quickly export to EXCEL using the command Tools – Office Links and the analyze with Excel.

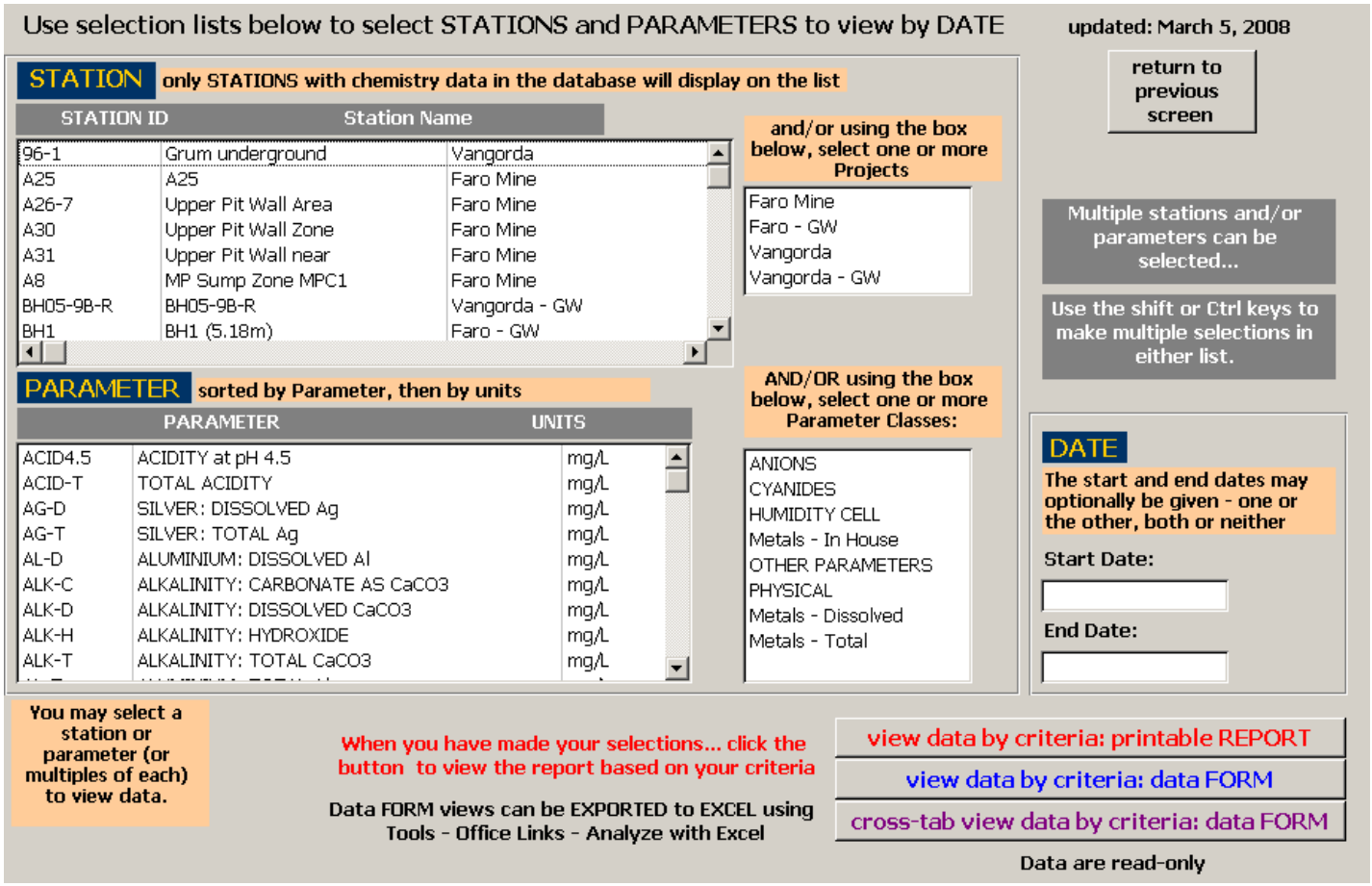


The following sections describe buttons by the same name located on the main form. They access various methods to view and summarize data. **All data displays are read-write** unless as specifically stipulated for import data displays.

View Historic WELL data



View data by multiple Stations, Parameters and Date



The user can select a station, group of stations, parameter, class of parameters, start or end date to refine the choices. 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.

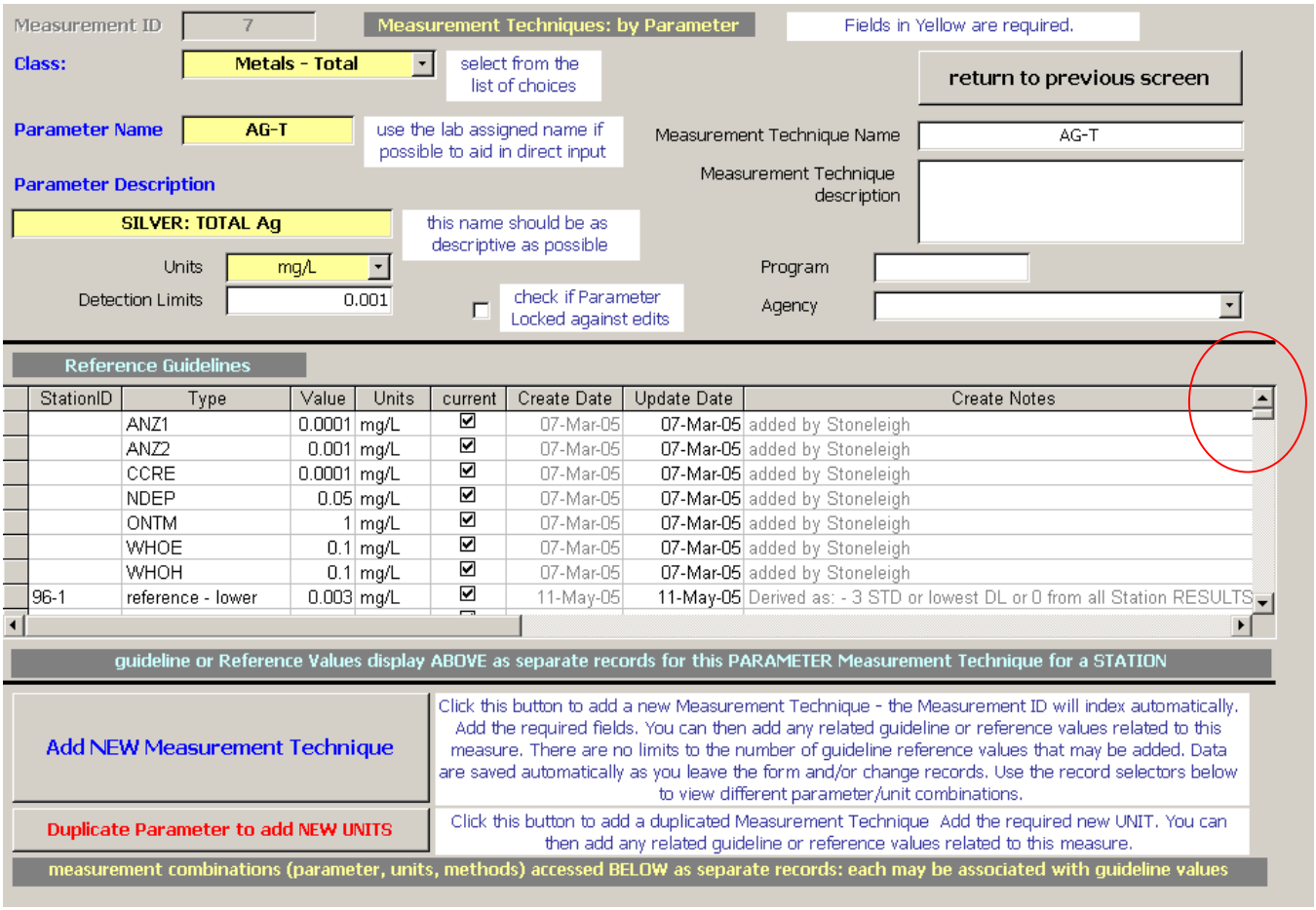
The WATER database application provides two basic mechanisms whereby parameters can be evaluated against reference values. During import all values are compared against previous values for that station and parameter. Any results that are either higher or lower than 3 standard deviations about the mean 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.
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

- 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.

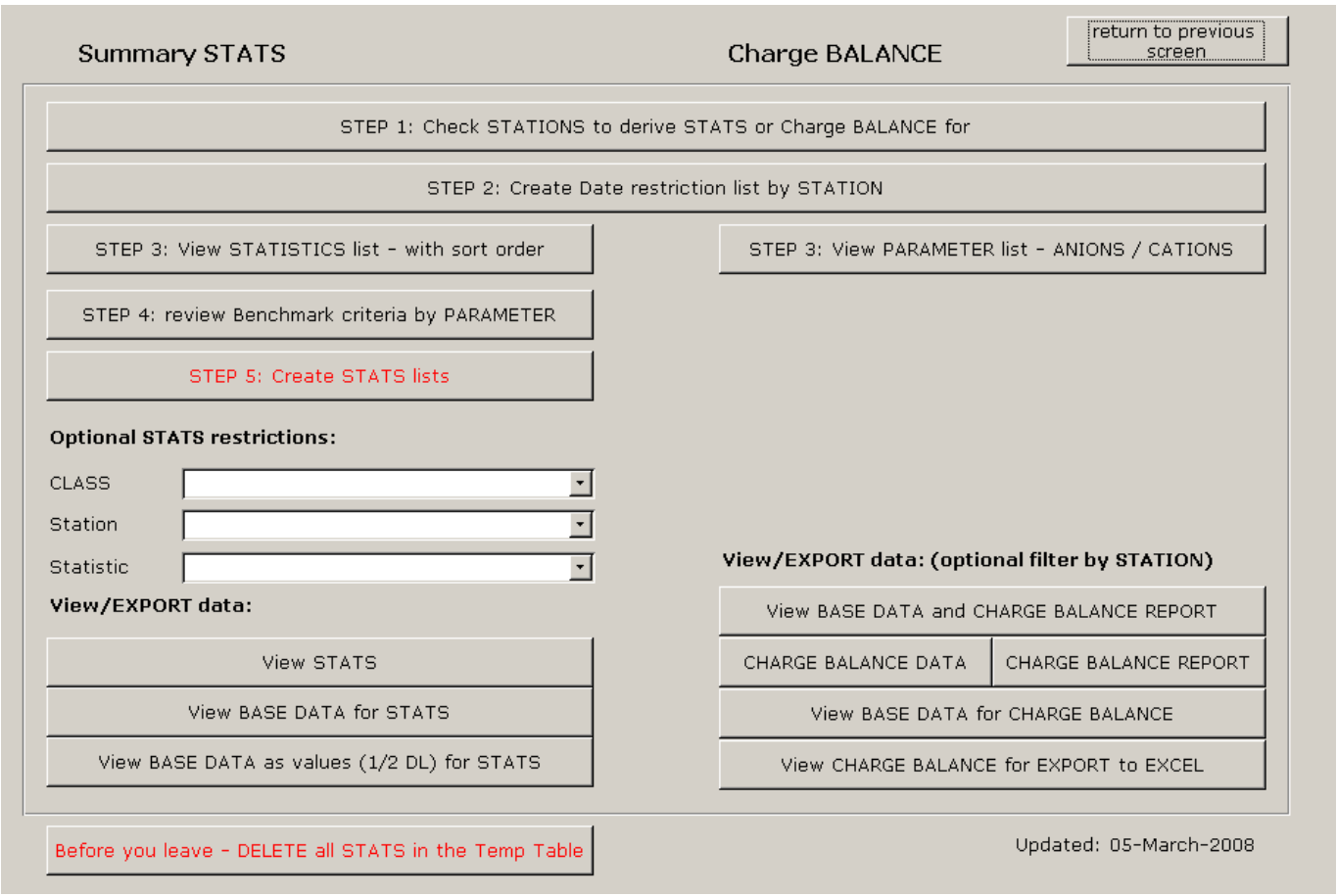
From the table data view

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

The user can generate summary statistics or charge balances for a group of stations, each defined by its own start and end date range. Steps 1 and 2 (illustrated below) are the same for each process – select the stations 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.



Summary STATS – a description of the generation of each STATISTIC is described here.

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. 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 below:

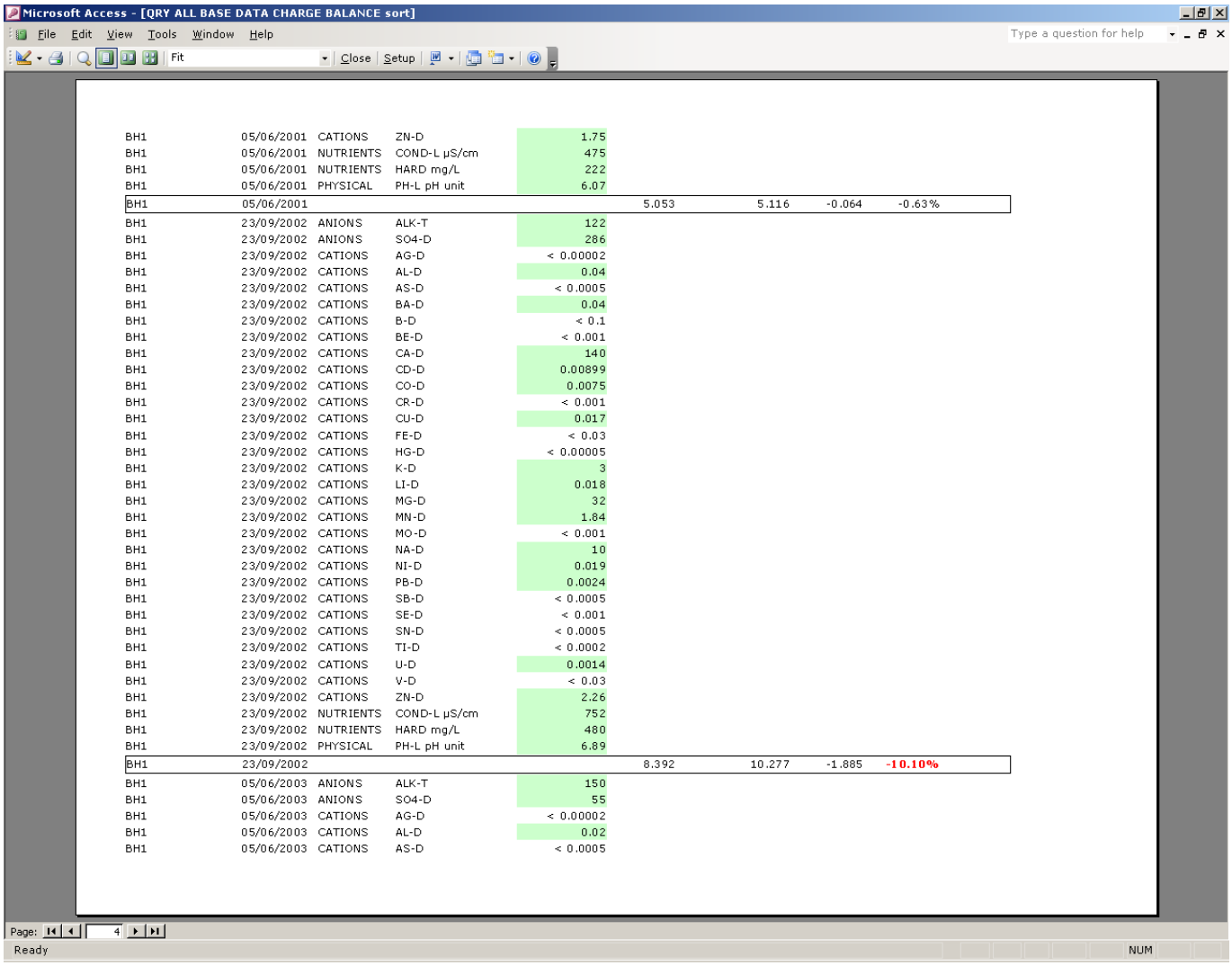
STATISTIC	Derivation
Total # samples	Count of the STATS value
MEAN	Mean of the STATS value (so DL values evaluated as ½ their value)
STD	Standard deviation of the STATS value
MINIMUM	The minimum of all values is derived as well as the min of DL values. If the min DL value is less than or equal to the 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 cannot be derived in Access without separate code, but a placeholder is shown in the display for export to EXCEL
95th Percentile	This stat cannot be derived in Access without separate code, but a placeholder is shown in the display for export to EXCEL
5th Percentile	This stat cannot be derived in Access without separate code, but a placeholder is shown in the display for export to EXCEL
# 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

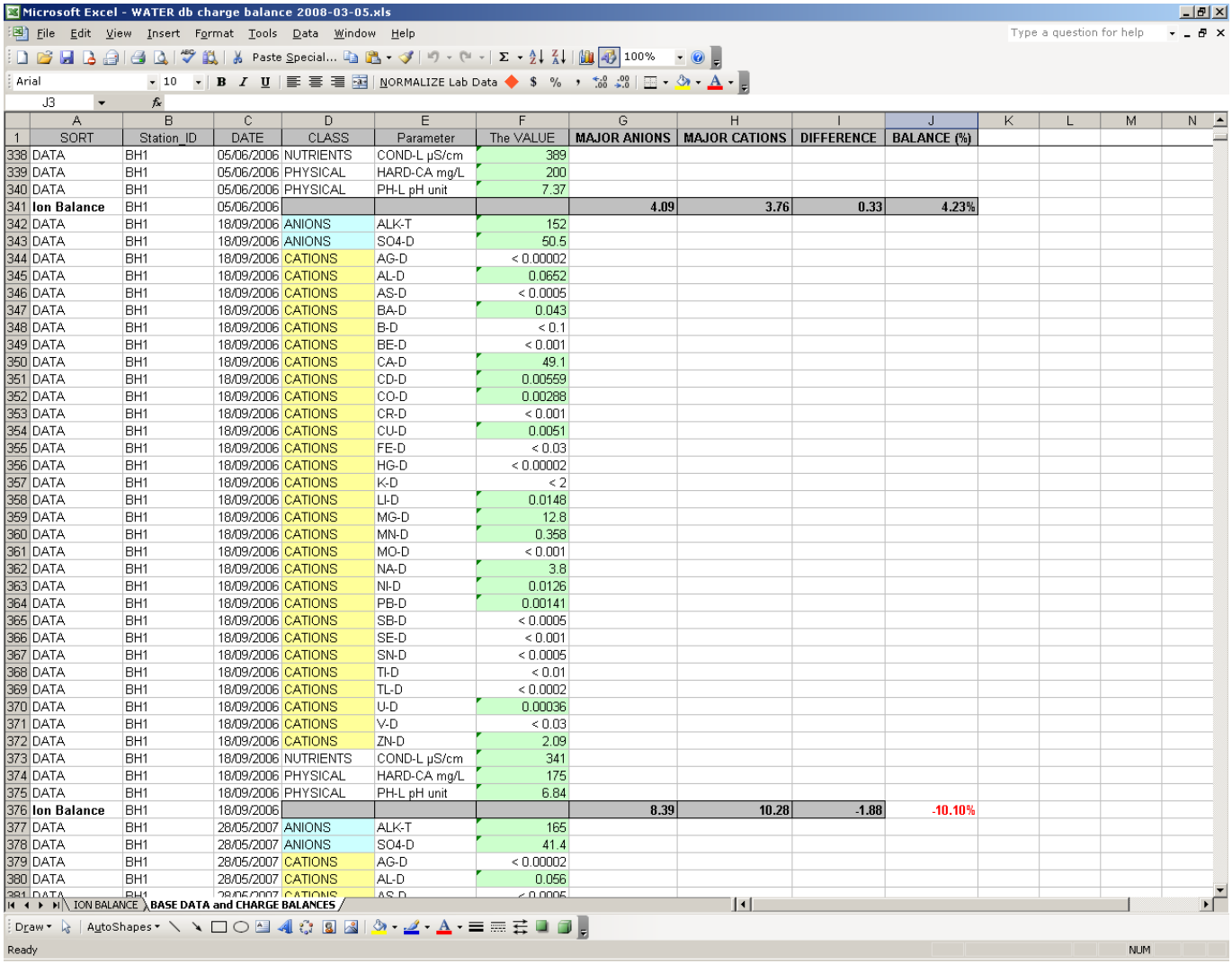
10 %. The full report shows all values (even those below detection) and highlights in green shading the values above detection that were used in the derivation. A sample is shown below



BH1	05/06/2001	CATIONS	ZN-D	1.75				
BH1	05/06/2001	NUTRIENTS	COND-L µS/cm	475				
BH1	05/06/2001	NUTRIENTS	HARD mg/L	222				
BH1	05/06/2001	PHYSICAL	PH-L pH unit	6.07				
BH1	05/06/2001				5.053	5.116	-0.064	-0.63%
BH1	23/09/2002	ANIONS	ALK-T	122				
BH1	23/09/2002	ANIONS	SO4-D	286				
BH1	23/09/2002	CATIONS	AG-D	< 0.00002				
BH1	23/09/2002	CATIONS	AL-D	0.04				
BH1	23/09/2002	CATIONS	AS-D	< 0.0005				
BH1	23/09/2002	CATIONS	BA-D	0.04				
BH1	23/09/2002	CATIONS	B-D	< 0.1				
BH1	23/09/2002	CATIONS	BE-D	< 0.001				
BH1	23/09/2002	CATIONS	CA-D	140				
BH1	23/09/2002	CATIONS	CD-D	0.00899				
BH1	23/09/2002	CATIONS	CO-D	0.0075				
BH1	23/09/2002	CATIONS	CR-D	< 0.001				
BH1	23/09/2002	CATIONS	CU-D	0.017				
BH1	23/09/2002	CATIONS	FE-D	< 0.03				
BH1	23/09/2002	CATIONS	HG-D	< 0.00005				
BH1	23/09/2002	CATIONS	K-D	3				
BH1	23/09/2002	CATIONS	LI-D	0.018				
BH1	23/09/2002	CATIONS	MG-D	32				
BH1	23/09/2002	CATIONS	MN-D	1.84				
BH1	23/09/2002	CATIONS	MO-D	< 0.001				
BH1	23/09/2002	CATIONS	NA-D	10				
BH1	23/09/2002	CATIONS	NI-D	0.019				
BH1	23/09/2002	CATIONS	PB-D	0.0024				
BH1	23/09/2002	CATIONS	SB-D	< 0.0005				
BH1	23/09/2002	CATIONS	SE-D	< 0.001				
BH1	23/09/2002	CATIONS	SN-D	< 0.0005				
BH1	23/09/2002	CATIONS	TI-D	< 0.0002				
BH1	23/09/2002	CATIONS	U-D	0.0014				
BH1	23/09/2002	CATIONS	V-D	< 0.03				
BH1	23/09/2002	CATIONS	ZN-D	2.26				
BH1	23/09/2002	NUTRIENTS	COND-L µS/cm	752				
BH1	23/09/2002	NUTRIENTS	HARD mg/L	480				
BH1	23/09/2002	PHYSICAL	PH-L pH unit	6.89				
BH1	23/09/2002				8.392	10.277	-1.885	**-10.10%**
BH1	05/06/2003	ANIONS	ALK-T	150				
BH1	05/06/2003	ANIONS	SO4-D	55				
BH1	05/06/2003	CATIONS	AG-D	< 0.00002				
BH1	05/06/2003	CATIONS	AL-D	0.02				
BH1	05/06/2003	CATIONS	AS-D	< 0.0005				

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. 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.

A sample EXCEL file for the same data as shown above is shown below.



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

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.

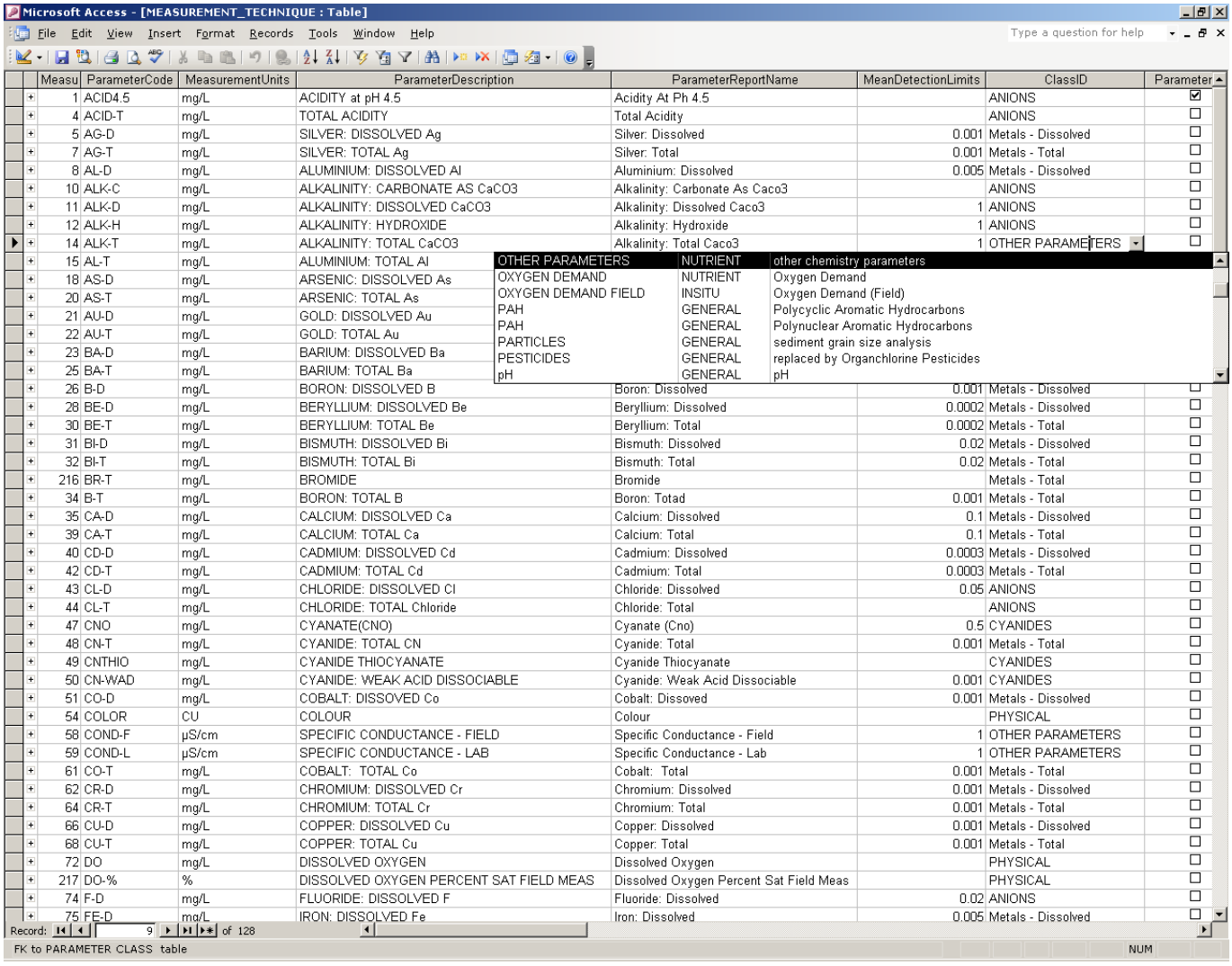
The WATER database application provides two grouping levels for parameters. An upper parameter TIER is currently not used in any pre-defined user procedures. The parameter CLASS is used to select groups of parameters and includes the following:

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

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, or by using the user form accessed from the main switchboard screen.

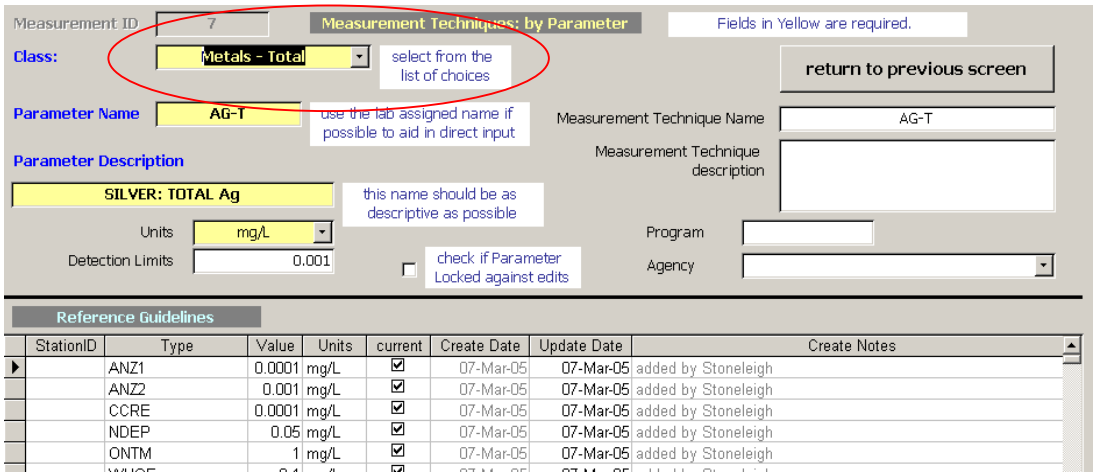


From the table data view

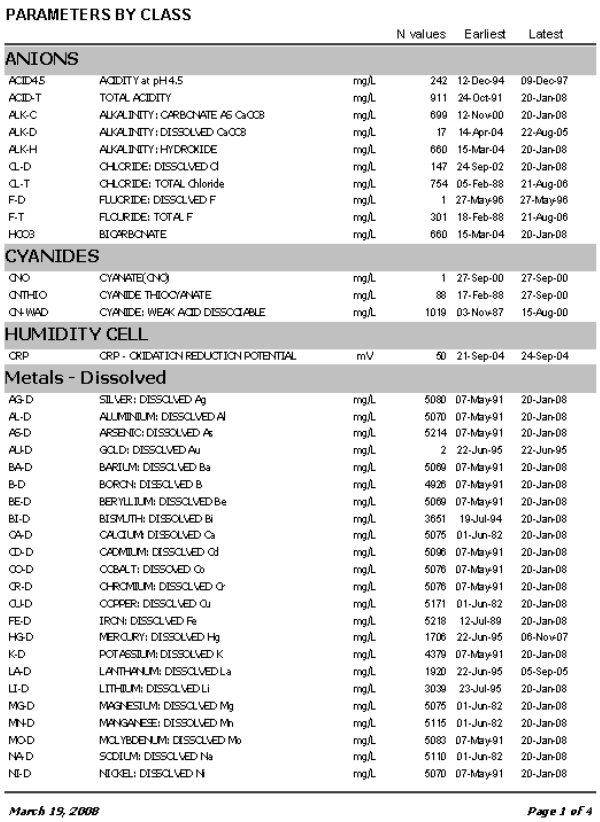
3. Open the PARAMETER CLASS table in data view. Add the class name, if it is not already in the table. All previous classes were added from the historic EQWIN data store and may no longer be relevant. The class MISCELLANEOUS contains little information. The parameter tier is required and must be selected 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



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 below.



PARAMETERS BY CLASS

			N values	Earliest	Latest
ANIONS					
ACID4.5	ACIDITY at pH4.5	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	06-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

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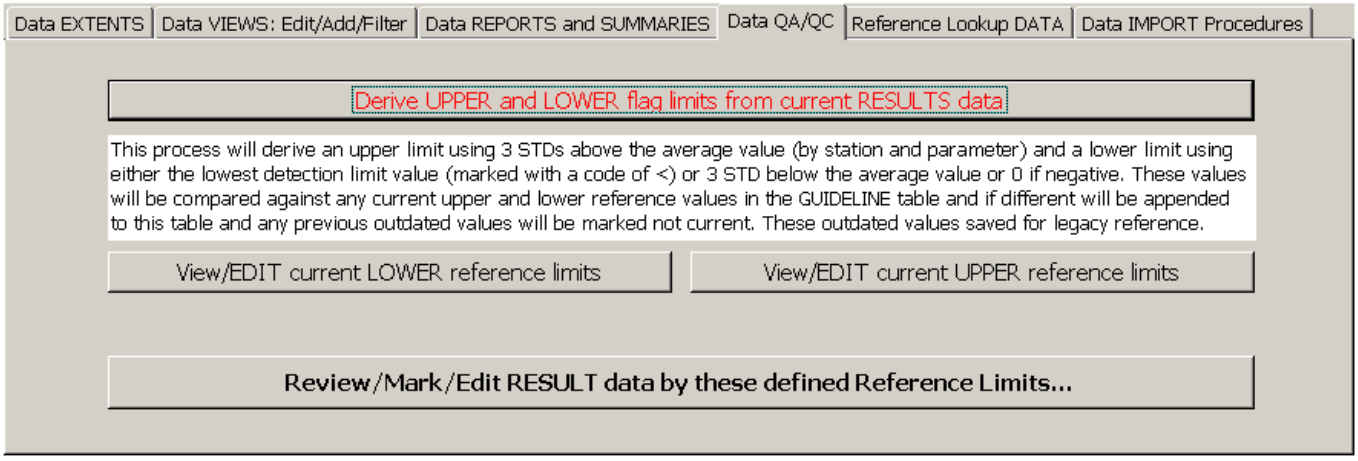
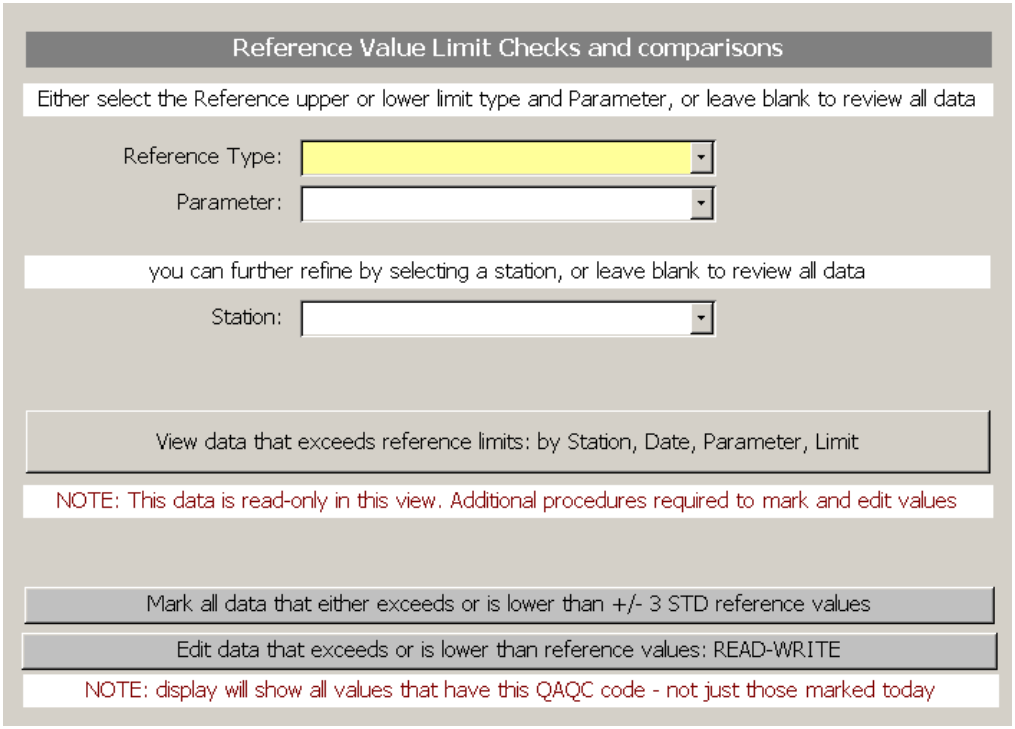
Flagging and Marking Data Values

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.



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



Appending (Importing) New Data

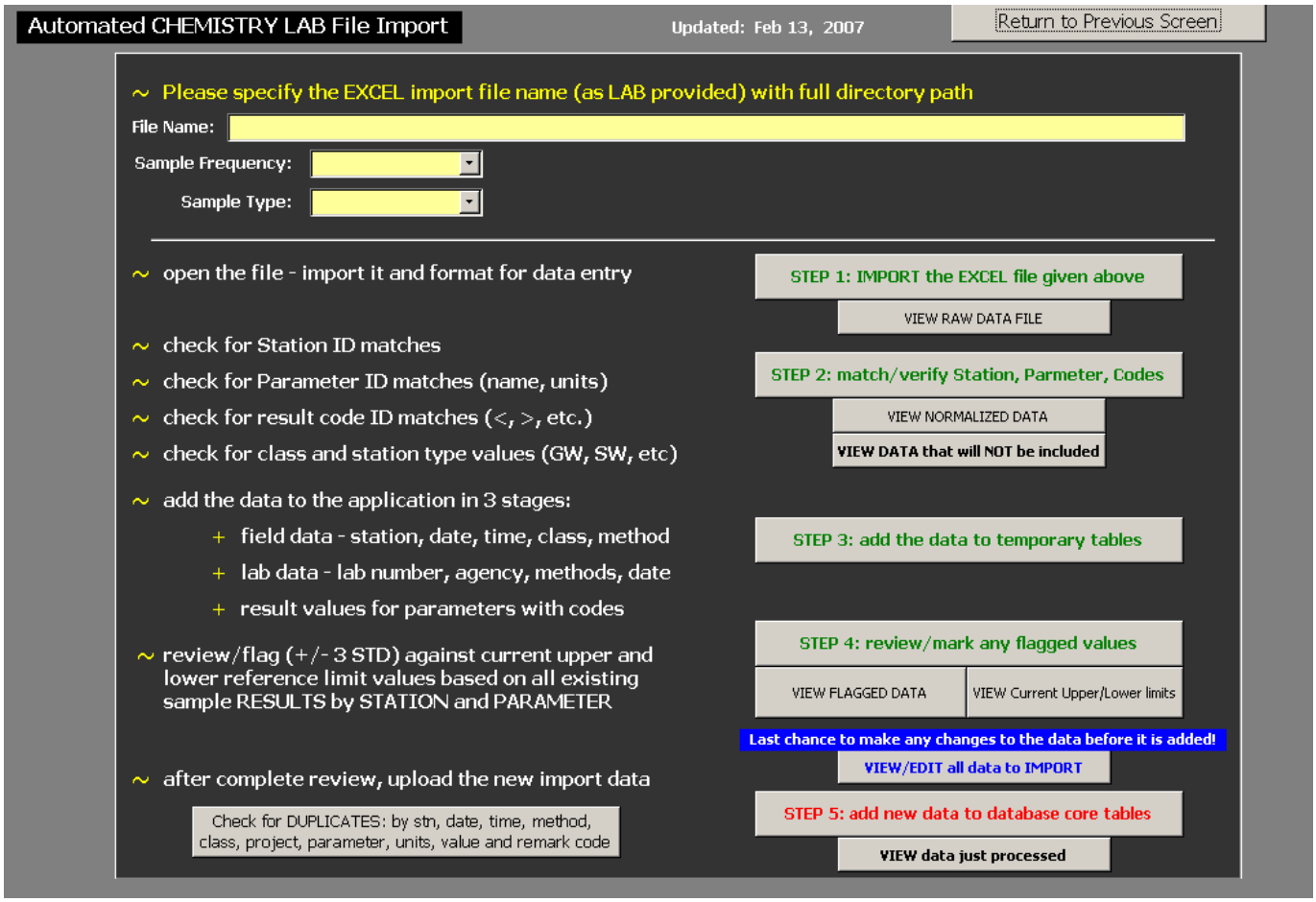
There are standardized methods for importing both new lab data to this application. A standard file format, provided by Gartner Lee is enshrined in an automated procedure. This file format is shown below. No deviation from this format is possible, or the procedure may fail.

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 below.

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. 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.



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

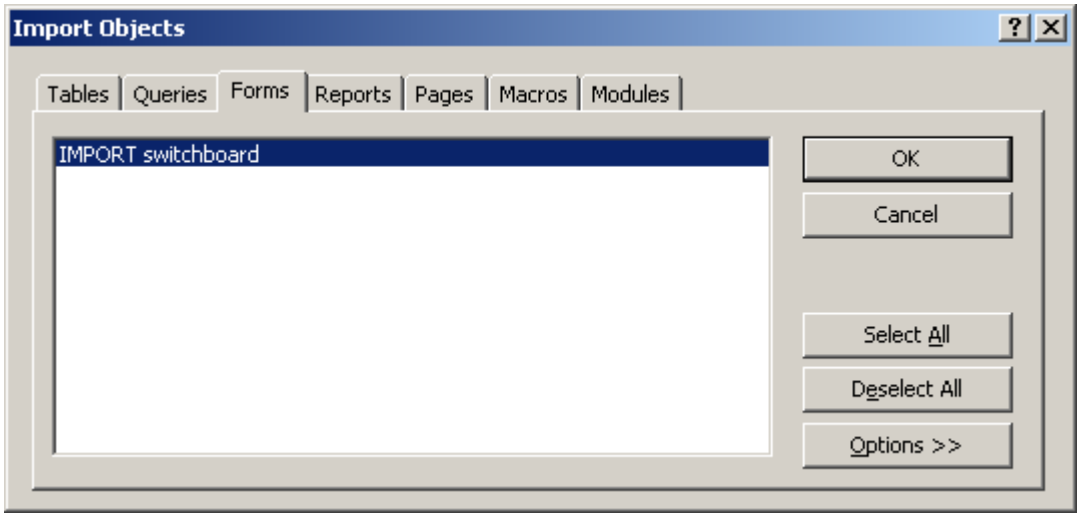
4. Review the data against existing values for a general QA/QC by both station and parameter to flag any values that exceed +/- 3 standard deviations about the mean value. These values are first re-derived using all existing data, then stored in a parameter flag guideline table and then compared to this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

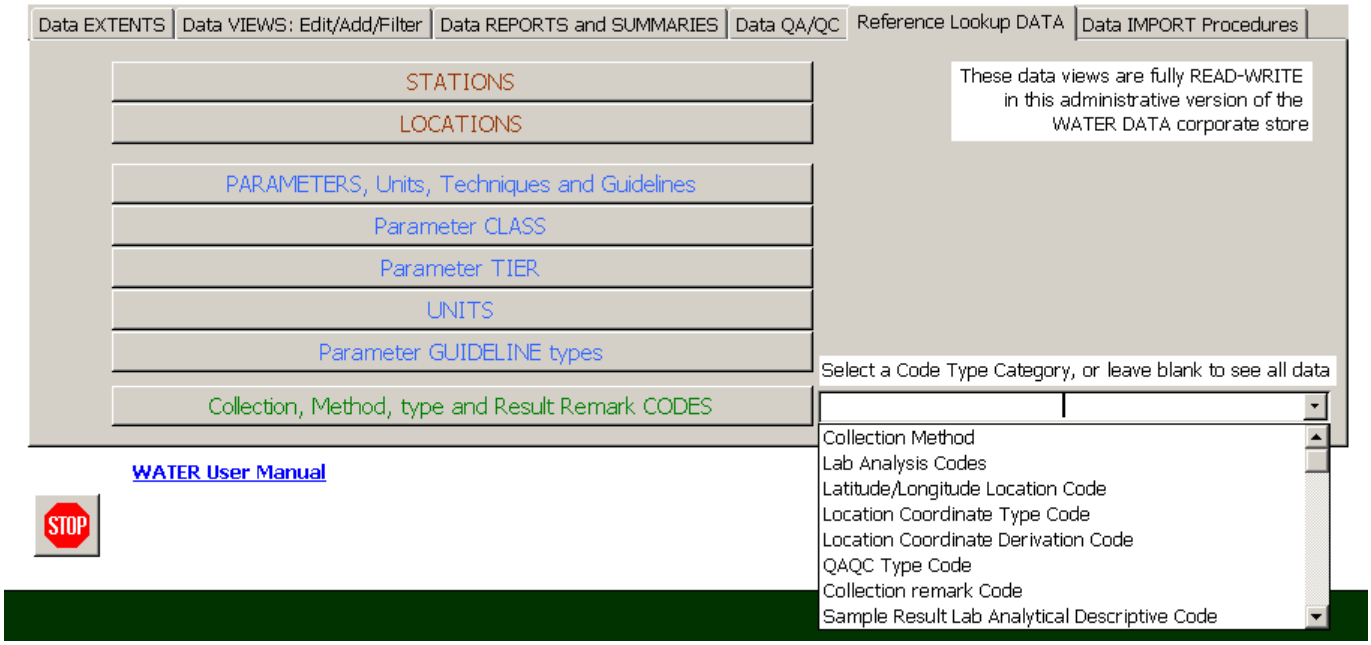
1. Make a backup copy of the database, making sure that no user has the database open at the time. This is a critical warning – a copied open database will be irreparably corrupted.
2. The database update will be a separate Access file. If it is attached to an email, save it to a folder. It is not necessary 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.



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.

5. Ensure that all users have exited WATER.

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

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

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

9. 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.

10. 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

11. 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

GROUNDWATER database

February 2007
Updated: March 2008

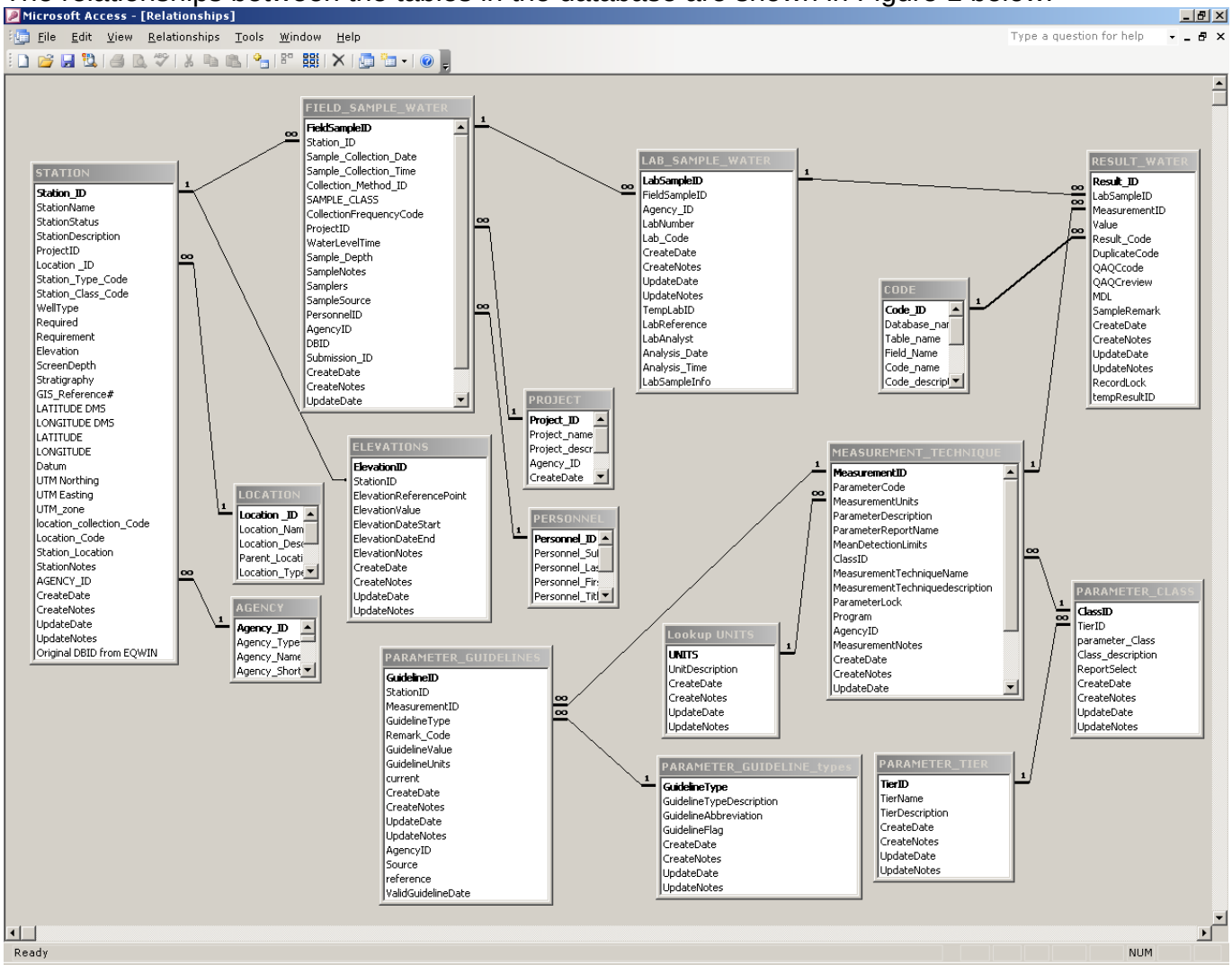
Barbara A. Hutchinson
Stoneleigh Associates Inc

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.



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

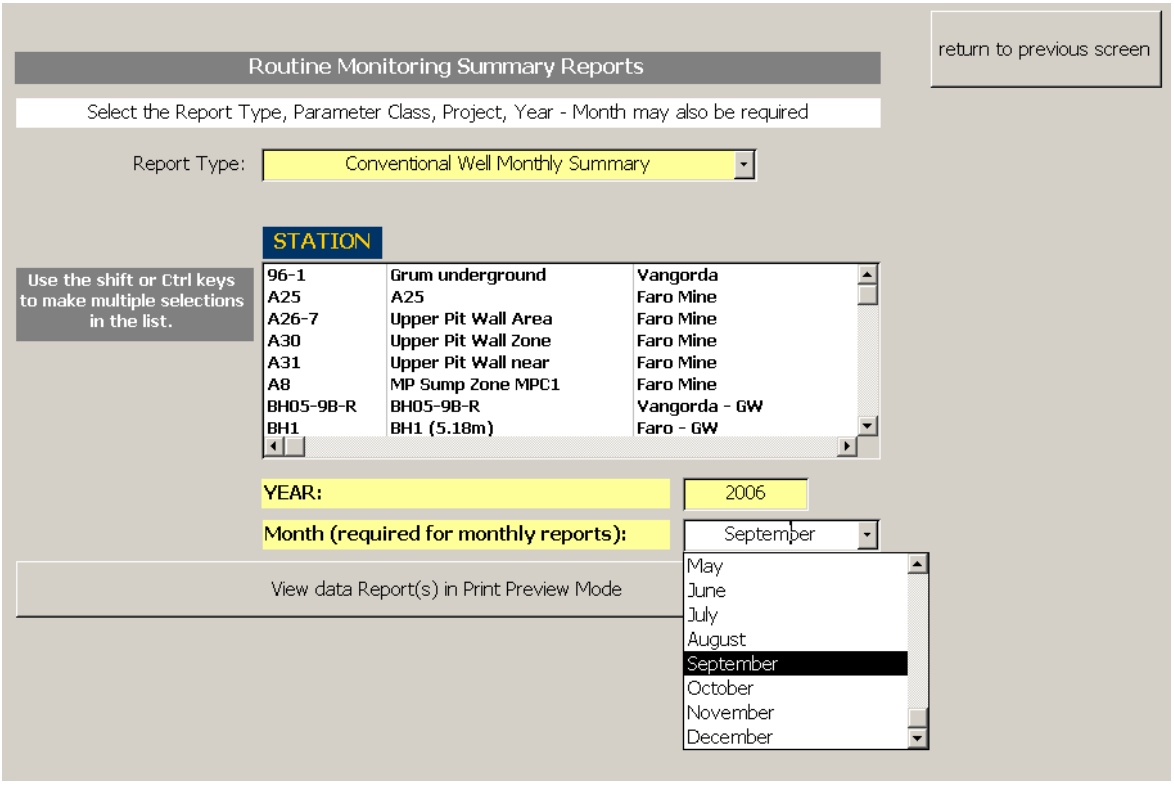
This database is a relational database as is WATER, with tables constructed to third normal design. All tables except for 4 temporary summary tables are linked from WATER and inherit all design features. Linked tables are fully read-write, so any changes made from this application will also appear in 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. 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.

Data Reports and Summaries

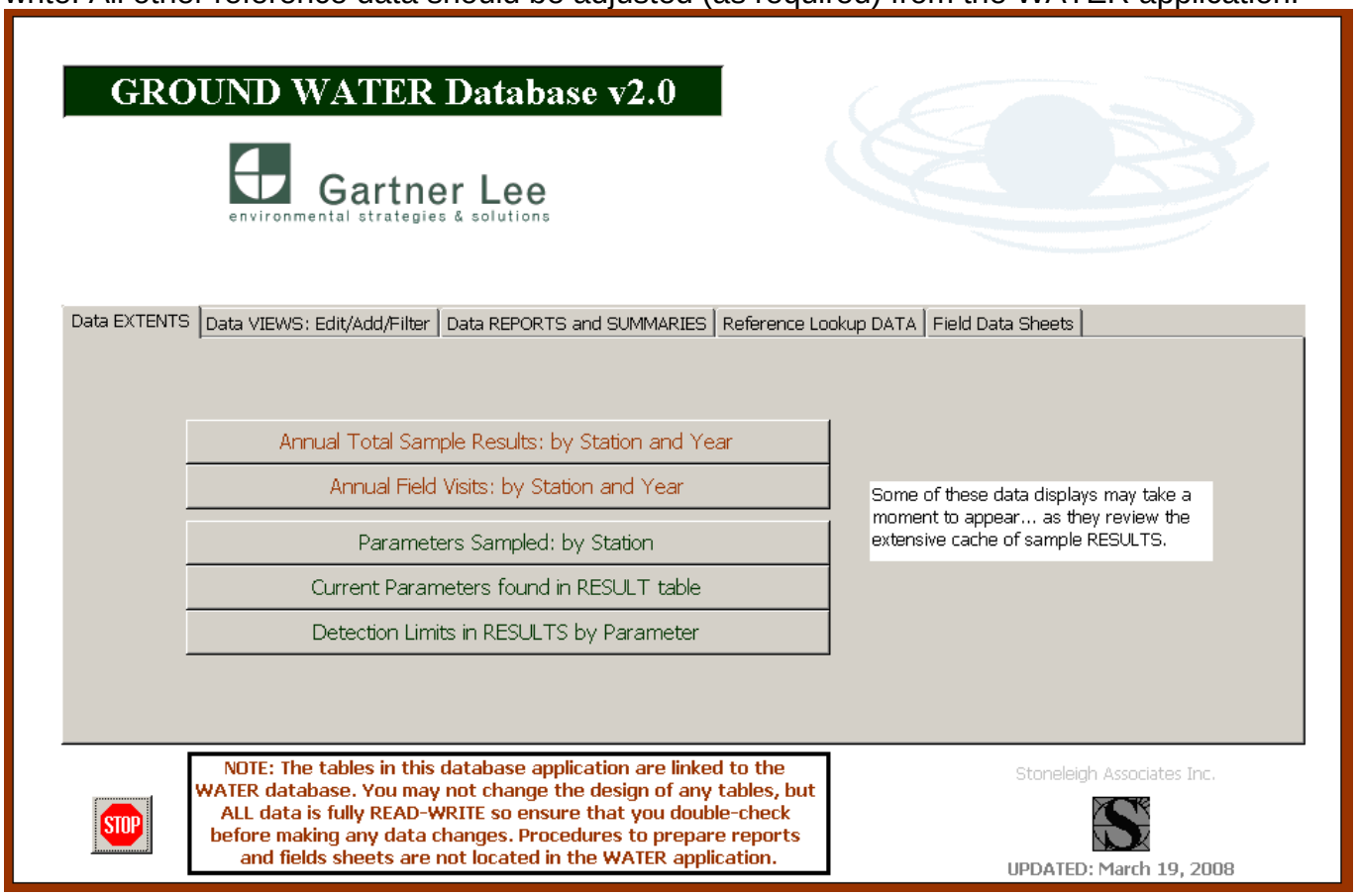
There are several pre-defined summaries accessed from the data reports and summaries tab on the main screen. Users may select from 9 different reports using a drop-down box. The year is required for all reports, and month is required only for monthly summaries.



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.

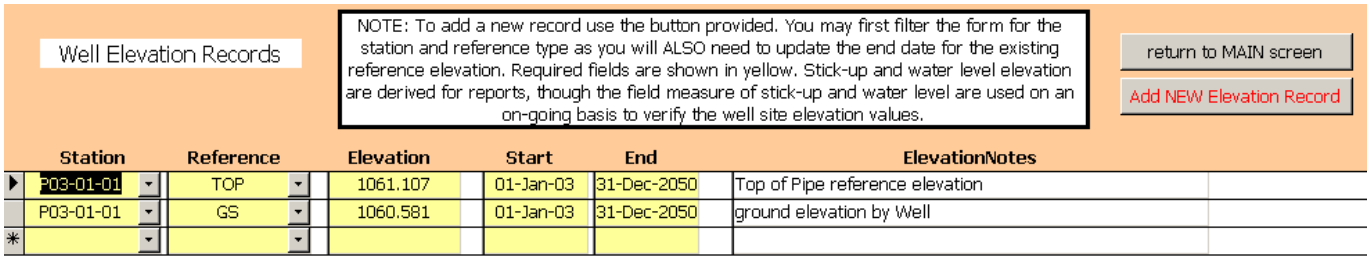
Review of Elevation Reference Data

There are review and edit forms to 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.



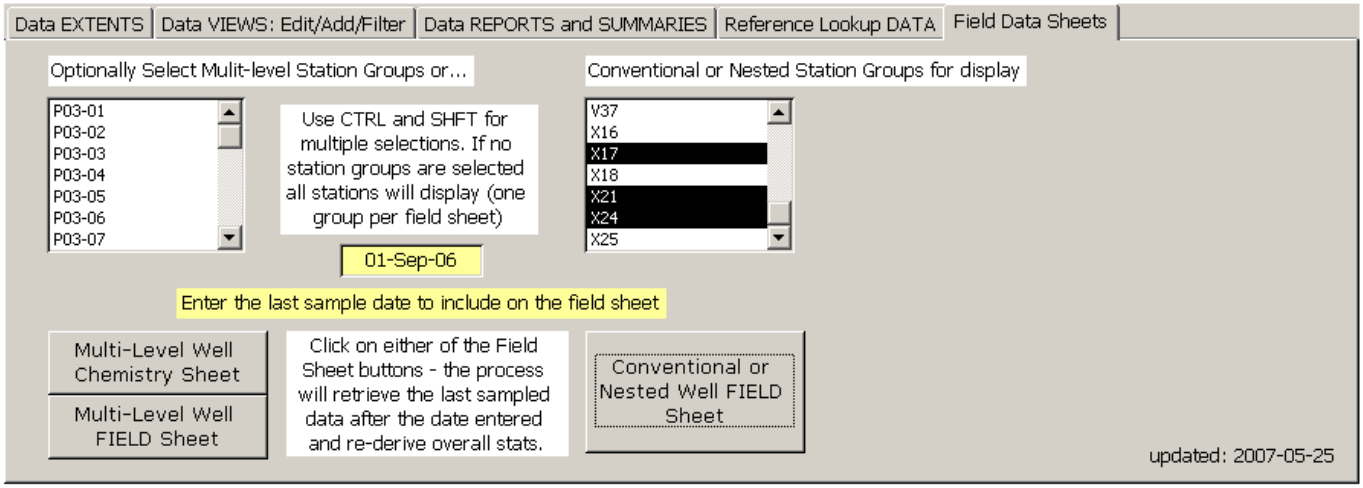
Field crews measure various elevation data during sampling visits. This includes water level and stick-up measures. The stick-up measure in particular will be later compared to the original surveyed ground and top-of-pipe elevations. The subtraction between these two surveyed values must equal the field 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 screen illustration below.



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.



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 a date so that the last sample date can be included on the field sheet display. Ensure that the date entered will capture all sample date collected for the group, as several dates over the course of a month may make up the monitoring visit. This date 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

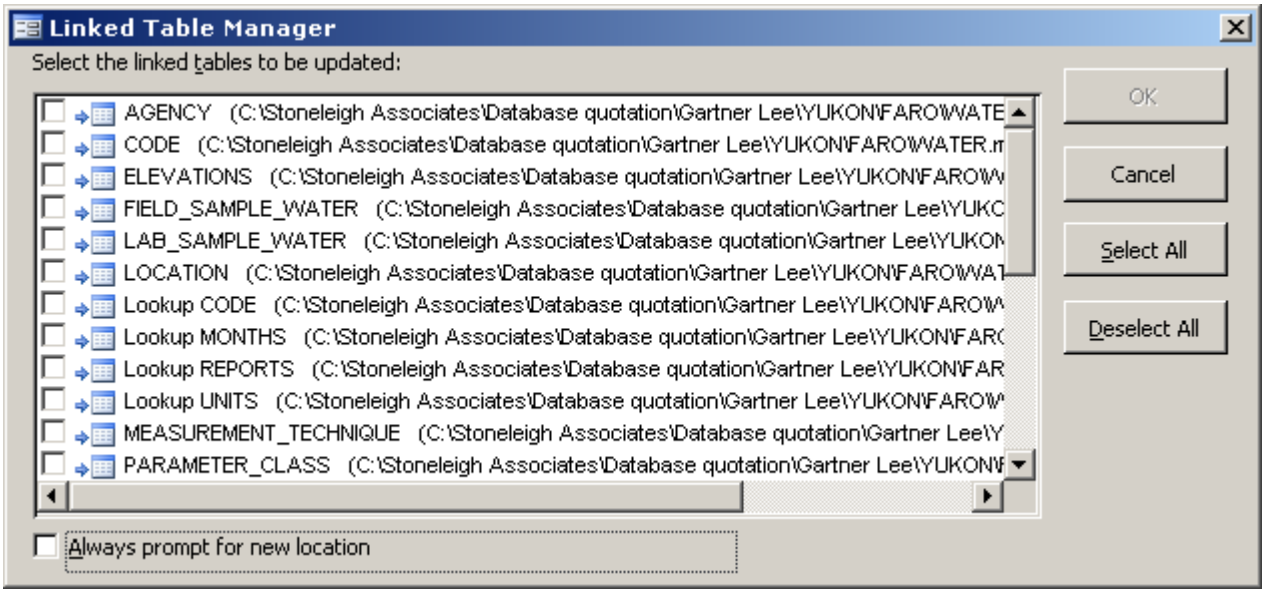
documentation provided by the database administrator responsible for the update. Click OK when all objects to import have been selected. The dialogue box will close when the import is complete.

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. This has been a problem for many Gartner Lee staff and is not uniform across all computers.



4. Select all using the command button, and also place a check at the bottom to prompt for a new location. Click OK
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.