

# **Data Quality, Management and Validation Through the Eyes of a LIMS**

**Robert Benz**

**Sales & Marketing Director**

**Khemia**  
software



A lush green forest with a small waterfall cascading over mossy rocks. The scene is filled with dense foliage, including ferns and moss-covered rocks, creating a serene and natural environment.

# A laboratory's task:

Produce quality data under proper management oversight with appropriate validation criteria in place...

while realistically...

operating under time constraints, understaffed, working for demanding clients/managers who want everything done perfectly no later than yesterday and see no reason a BOD cannot be run within 24 hours.



# Mistakes Happen

“err is human” - *errāre hūmānum est.*

Simple typo

Temporary dyslexia

Right samples, wrong test assigned

Wrong column of data on the right line

Careless blunders on a tired day...

We all made mistakes – sometimes caught and corrected, sometimes not.





# Data Quality, Management and Validation from an IT perspective...



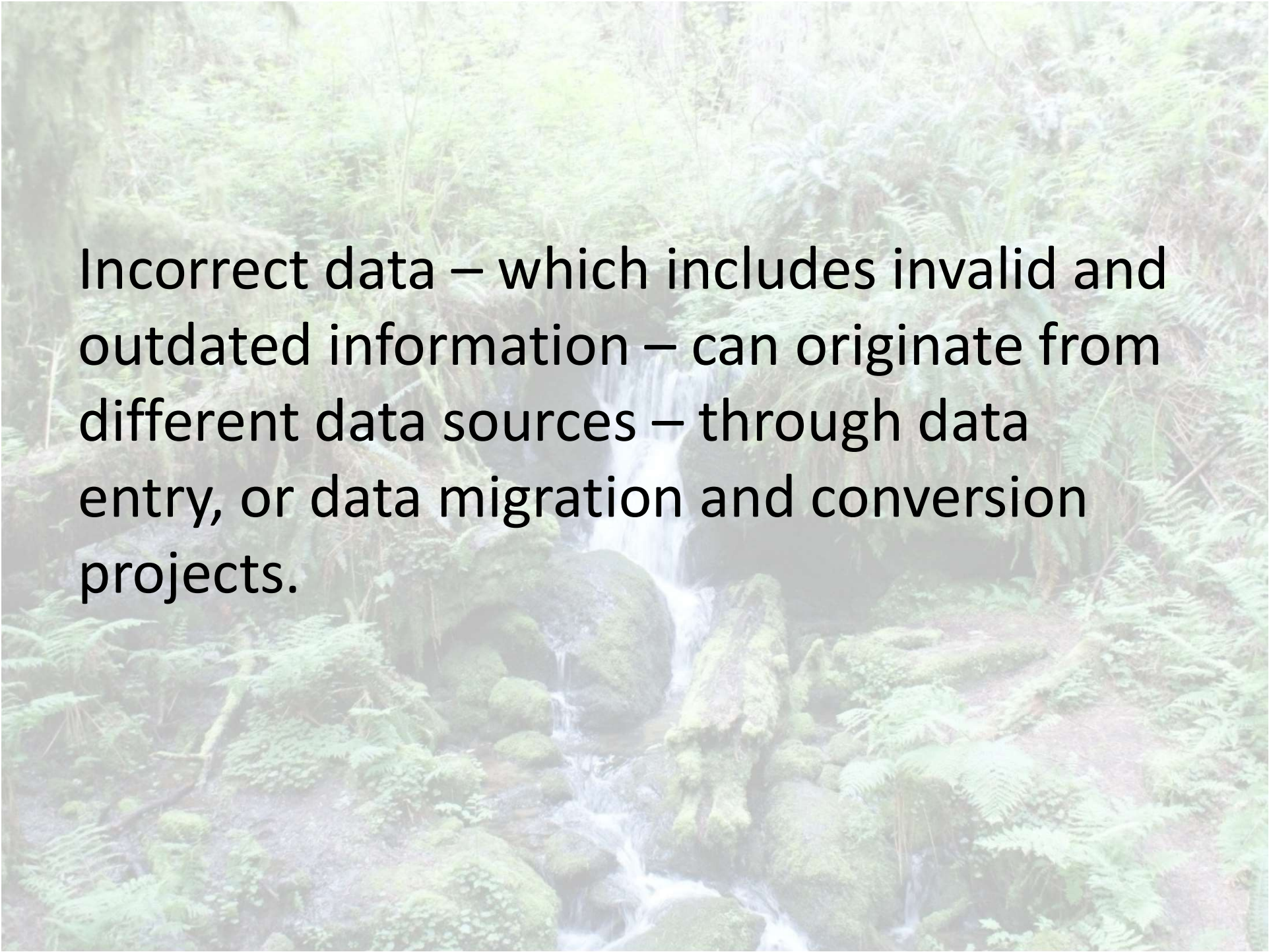
# Data Quality

This list is taken from the online book "Data Quality: High-impact Strategies".

- Degree of excellence exhibited by the data in relation to the portrayal of the actual scenario.
- The state of completeness, validity, consistency, timeliness and accuracy that makes data appropriate for a specific use.
- The totality of features and characteristics of data that bears on its ability to satisfy a given purpose; the sum of the degrees of excellence for factors related to data.
- The processes and technologies involved in ensuring the conformance of data values to business requirements and acceptance criteria.
- **Complete, standards based, consistent, accurate and time stamped.**

In the ISO 9000:2015 definition of quality is applied, **data quality can be defined as the degree to which a set of characteristics of data fulfills requirements.** Examples of characteristics are: completeness, validity, accuracy, consistency, availability and timeliness. Requirements are defined as the need or expectation that is stated, generally implied or obligatory.





Incorrect data – which includes invalid and outdated information – can originate from different data sources – through data entry, or data migration and conversion projects.



# Data management

"Data management is the development, execution and supervision of plans, policies, programs and practices that control, protect, deliver and enhance the value of data and information assets."





# Data Validation

Data validation is intended to provide certain well-defined guarantees for fitness, accuracy, and consistency for any of various kinds of user input into an application or automated system. Data validation rules can be defined and designed using any of various methodologies, and be deployed in any of various contexts.



# LIMS have the “computer advantage”

- LIMS do not require sleep
- LIMS do not suffer from bad moods
- LIMS do not make erroneous calculations unless programmed incorrectly
- LIMS do not call out sick
- Never has a LIMS suffered from a hangover on a Tuesday morning after a big Monday night game!





# Insurance of Assurance: Data through LIMS

“Cradle through grave tracking”

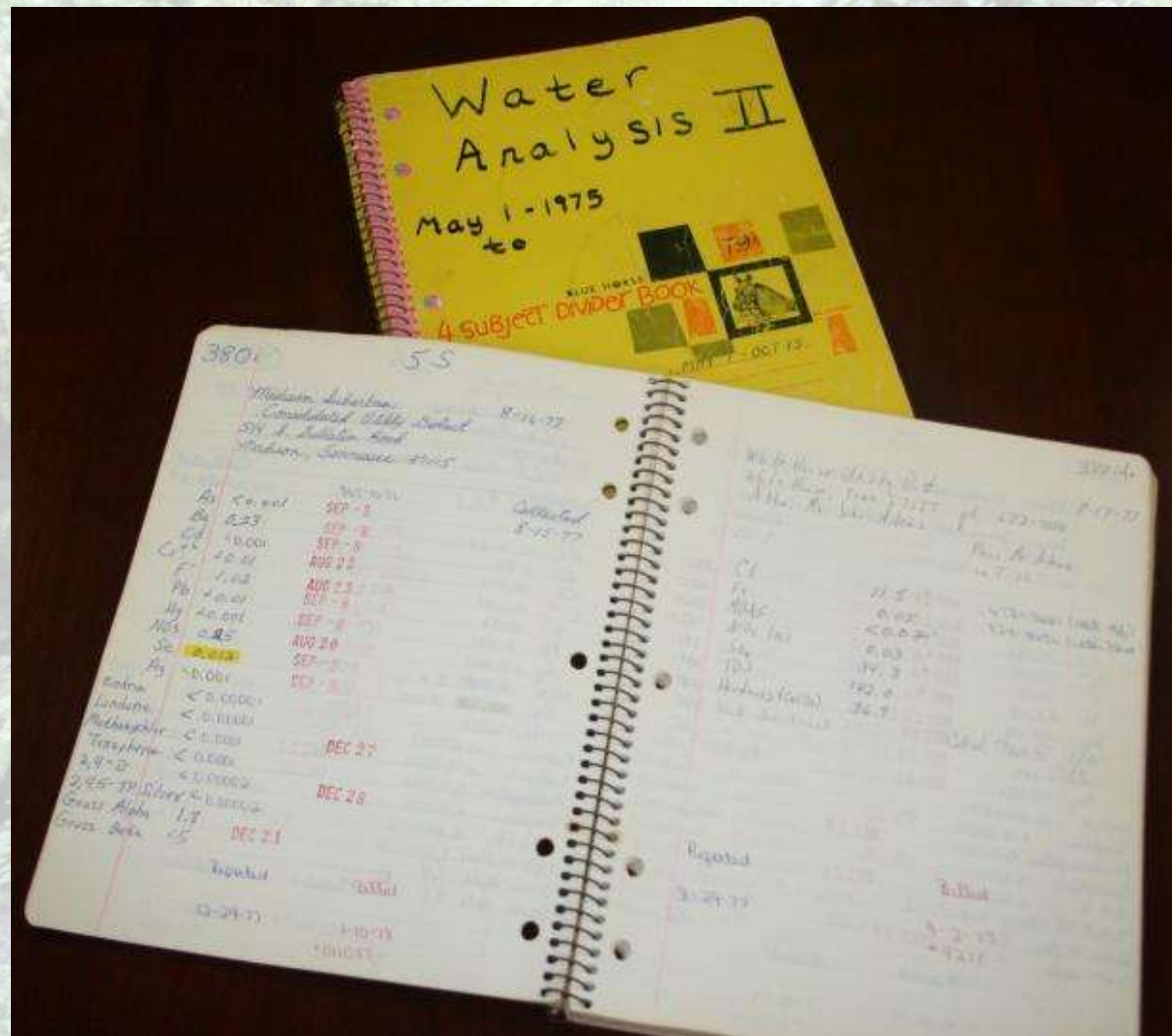
No gaps or black holes

Every step can/may be documented (i.e.  
internal CoCs)

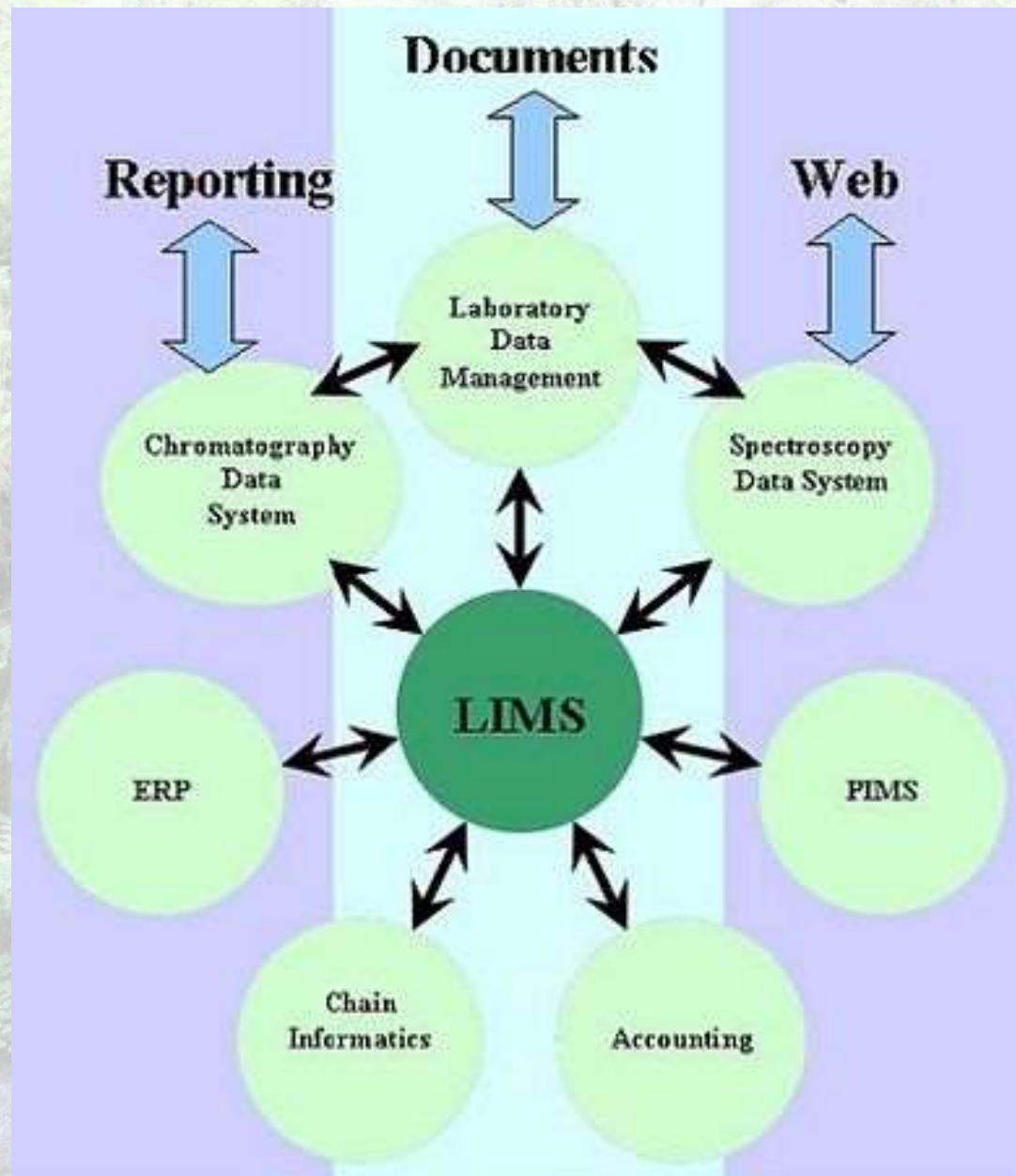
Integrated QA/QC



# “LIMS” - circa 1987









# “Building” the LIMS

A LIMS is only as good as the information plugged in.

## ALL values need to be added or imported

- ALL standards and reference materials need to be entered
- ALL regulatory criteria must be entered
- ALL clients, projects & methods must be entered, etc., etc.



# Defining the input

**Khemia Omega 11 - [Sample Field Information]**

Add Delete Copy Edit Refresh Requery Design Query Filter MainMenu

File Edit View Insert Format Records Tools Window Help

## Sample Field Information

| FidName                      | FidUnits | TestNo    | RLimit | Storet | FidType  | DefaultVal | Load | FidGroup | HasSQL                                   |
|------------------------------|----------|-----------|--------|--------|----------|------------|------|----------|--|
| EBLOT                        |          |           |        |        | Text     |            | 0    | AFCEE    | -1                                       |
| AirVol                       |          |           |        |        | Number   |            | 0    | IH       | 0  |
| Artifacts                    |          |           |        |        | Text     |            | 0    | CLP      | 0  |
| Batch No                     |          |           |        |        | Text     |            | 0    |          | 0  |
| Begin Depth                  | ft       | NA        |        |        | Number   | 0          | 0    |          | 0  |
| Bottom_Depth                 | feet     |           |        |        | Text     |            | 0    |          | 0  |
| ClarityAfter                 |          |           |        |        | Text     |            | 0    | CLP      | -1 TBL_Clarity                           |
| ClarityBefore                |          |           |        |        | Text     |            | 0    | CLP      | -1 TBL_Clarity                           |
| COC_ID                       |          |           |        |        | Text     |            | 0    |          | 0  |
| Collection Depth             | FT       |           |        |        | Text     | 25         | 0    |          | 0  |
| Color                        |          |           |        |        | Text     |            | 0    |          | 0  |
| ColorAfter                   |          |           |        |        | Text     |            | 0    | CLP      | -1 TBL_Colors                            |
| ColorBefore                  |          |           |        |        | Text     |            | 0    | CLP      | -1 TBL_Colors                            |
| Conductivity, EPA 120.1      | umhos/cm | E120.1    | 1.0    | 00094  | Number   |            | 0    |          | 0  |
| COOLER                       |          |           |        |        | Text     |            | 0    | AFCEE    | 0  |
| Depth To Water               | ft       | NA        |        |        | Number   |            | 0    |          | 0  |
| Dissolved Oxygen, SM4500-O G | mg/L     |           | 0.10   |        | Number   |            | 0    |          | 0  |
| EBLOT                        |          |           |        |        | Text     |            | 0    | AFCEE    | 0  |
| End Depth                    | ft       | NA        |        |        | Number   |            | 0    |          | 0  |
| Feescheduled                 |          |           |        |        | Text     |            | 0    |          | -1                                       |
| FieldSampler                 |          |           |        |        | Text     |            | -1   |          | -1 SELECT LabPersonnel.Name FROM LabPe   |
| FileType                     |          |           |        |        | Text     |            | 0    | IRDMIS   | 0  |
| Lat.                         | deg      |           |        |        | Text     |            | 0    |          | 0  |
| Long.                        | deg      |           |        |        | Text     |            | 0    |          | 0  |
| Lot No                       |          |           |        |        | Text     |            | 0    |          | 0  |
| LOTCTLNUM                    |          |           |        |        | Text     |            | 0    | AFCEE    | 0  |
| Material Specification:      |          |           |        |        | Text     |            | 0    |          | 0  |
| MediaID                      |          |           |        |        | Long Int |            | 0    | IH       | -1 SELECT MediaID, Media, MediaType FROM |
| pH, SM4500H+ B               | S.U.     | A4500-H+B |        |        | Text     |            | 0    |          | 0  |
| Point No.                    |          |           |        |        | Text     |            | 0    |          | 0  |

Record: 1 of 60

Form View

Start NUM 2:03 PM



# Recording of input

**Khemia Omega 11 - [Sample : Form]**

Add Delete Copy Edit Refresh Requery Change LabID Design Query Compact and Repair Database Filter MainMenu Close

File Edit View Insert Format Records Tools Window Help

**Turbo Login ADD Samp ADD Frac Create Sample Copy COPYFrac SUB COC LABELS Sample Detail Sample Test View Additional Info**

**FIX PRICING**

**VIEW SEL**

**Update Sample ID**

**INDEX**

1508001-001A  
1508001-001B  
1508001-002A  
1508001-002B

4 Records

Lab Sample ID: 1508001-001B

ClientSampleID: 001

DateReceived: 8/6/2015 4:14 PM

DateCollected: 8/6/2015 4:14 PM

Sampling Location:

Tag Number:

Matrix:

Bottle Code: PPRES\_HN03

# Containers: 2

SampleOnHold:

Comments:

BatchID:

LotNo:

Use Other Labs Data

| Test Groups | Group Name | List Price | Mult | Final Price | Hold Price | Remarks | SGN |
|-------------|------------|------------|------|-------------|------------|---------|-----|
|             |            |            |      |             |            |         |     |

Remove Filter

| Tests | Test Name    | Test Num   | Prep Num | SEL | MS | Hold | Rush | Sub | Due Date  | IAP     | List Price | Mult | Final Price | Hold Price |
|-------|--------------|------------|----------|-----|----|------|------|-----|-----------|---------|------------|------|-------------|------------|
| 200.7 | Metals - ICP | 185576     | 185578   |     |    |      |      |     | 8/14/2015 | \$15.00 | \$200.00   | 1    | \$200.00    | \$0.00     |
| *     |              | AutoNumber |          |     |    |      |      |     |           |         |            |      |             |            |

| Prep Code | Prep Name           | Test Num | MS | Hold | Rush | Sub | Due Date  | List Price | Mult | Final Price | Hold Price | GrpNu |
|-----------|---------------------|----------|----|------|------|-----|-----------|------------|------|-------------|------------|-------|
| 3010A     | AQPREP TOTAL METALS | 185578   |    |      |      |     | 8/14/2015 | \$100.00   | 1    | \$100.00    | \$0.00     | 0     |

Record: 1 of 1

**Fraction Tests**

Form View

Start Release - R79E6 Datab... WorkOrder : Form Sample : Form

NUM 2:18 PM



# Instrument data import

Khemia Omega 11 - [ANALYTICAL RUNS]

Add Delete Copy Edit Refresh Query Change LabID Design Query Compact and Repair Database Filter MainMenu Close

File Edit View Insert Format Records Tools Window Help

Run ID: ICP-001A\_121203A RunNo: 13421 Use Other Labs Data Minimize Omega

LAB ID: Khemia01 Instr. ID: Lab ID: Khemia01 Instrument ID: INSTRON1 Run Start Date/Time: 12/3/2012 12:26 PM Analyst: M Bailey Ical: Ical RunNo: Column ID: Comments:

**Index**

|       |                  |
|-------|------------------|
| 13422 | ISE_1_121203A    |
| 13421 | ICP-001A_121203A |
| 13229 | BAL2_101129A     |

**Analytical Curve Equation** **Analytical Reports** **Analysis**

**FILE Import**

General IMPORT Import Troubleshooter SampType Matching

Specification ICP Optima

☒ USE Alternate IDs ☐ Attach Import File

Import Specification Type

Analyte ☐ TIC ☐ Combined

Defaults

TestCode/SampType/Analyte

EPA\_200.7

**RUN IMPORT**

☐ Use Logical Sample Type Matching ☐ Use TestCode Lookup for Samps

**VIEW / EDIT Data**

**SINGLE ANALYTE WorkSheet**

**View By ANALYTE**

**Data Import**

**Load Samples**

**LINK Sequence QC**

**QA Run** **UnQA Run**

**QA Authority**

| Prep Date | Pmoist | DF | SeqQual | PFac | SpkFac | OFac | File I |
|-----------|--------|----|---------|------|--------|------|--------|
|           |        | 1  |         | 1    | 1      |      |        |

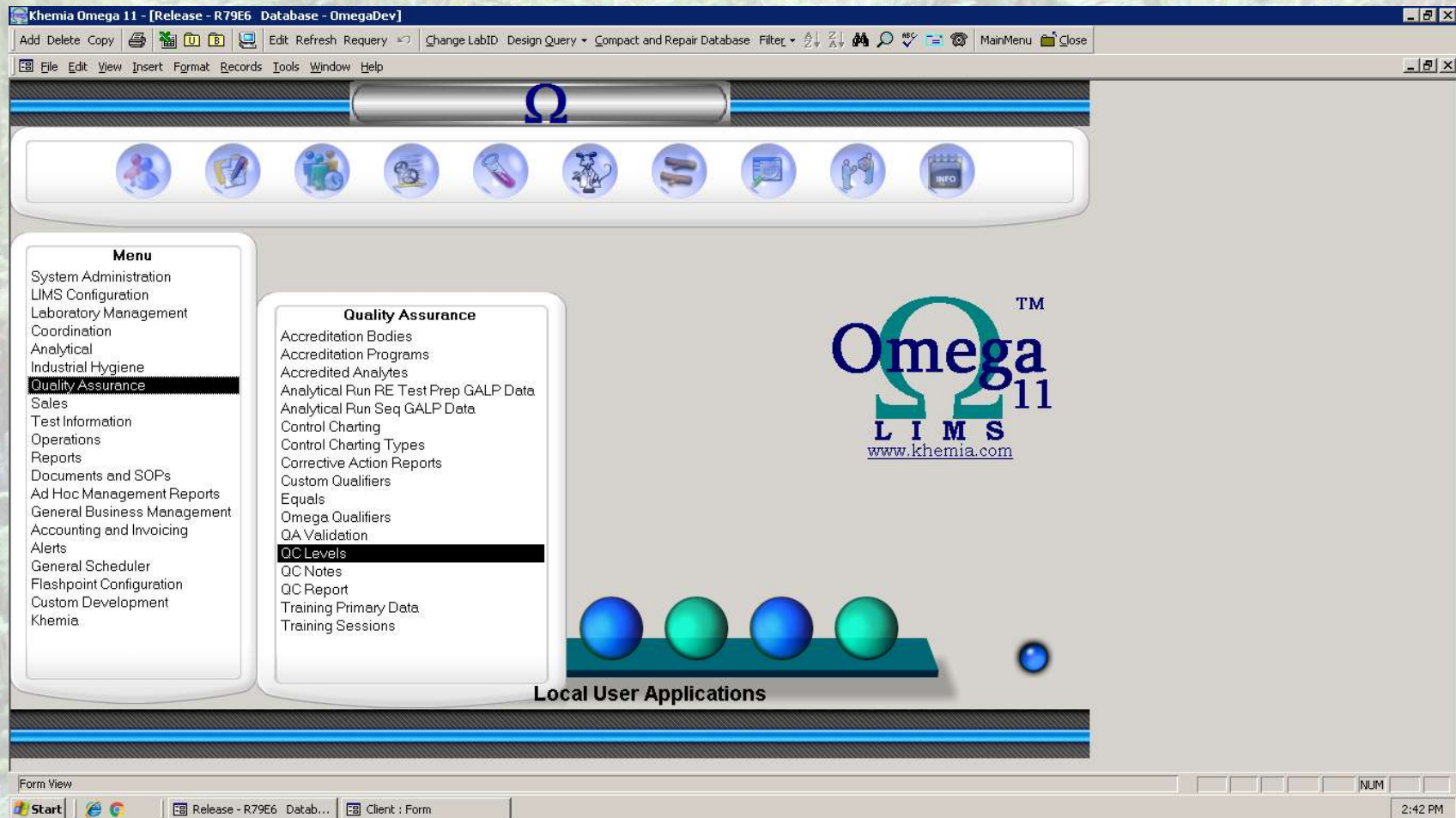
Record: 1 of 1

Specification to use as import template

Start Release - R79E6 Datab... ANALYTICAL RUNS 3:10 PM



# QA/QC data





# Where and how to apply QA/QC

Khemia Omega 11 - [QCLevel : Form]

Add Delete Copy Edit Refresh Query Change LabID Design Query Compact and Repair Database Filter MainMenu Close

File Edit View Insert Format Records Tools Window Help

QCLevel: LEVEL IV Description: Complete data package required

Requires Data Package ☒ HTVTSR ☐ Default ☐

| On                                  | RO | RptType            | RptName                    | RptText         | On                                  | QCType | On                                  | RO  | Comment Type             |
|-------------------------------------|----|--------------------|----------------------------|-----------------|-------------------------------------|--------|-------------------------------------|-----|--------------------------|
| <input checked="" type="checkbox"/> | 1  | CoverLetter        | CoverLetter                | Env. Cover Ltr. | <input checked="" type="checkbox"/> | CCB    | <input checked="" type="checkbox"/> | 10  | vWO Narrative-RptText    |
| <input checked="" type="checkbox"/> | 2  | SampleSummary      | SampleSummary              |                 | <input checked="" type="checkbox"/> | CCV    | <input checked="" type="checkbox"/> | 20  | vWorkOrder Comments      |
| <input checked="" type="checkbox"/> | 3  | CaseNarrative      | CaseNarrative              | CASE1           | <input checked="" type="checkbox"/> | CRA    | <input checked="" type="checkbox"/> | 30  | Sample Receipt           |
| <input checked="" type="checkbox"/> | 4  | Analytical         | BaseRpt-Consolidated       |                 | <input checked="" type="checkbox"/> | CRI    | <input checked="" type="checkbox"/> | 40  | Sample Container         |
| <input checked="" type="checkbox"/> | 6  | DatesReport        | DatesReport                |                 | <input checked="" type="checkbox"/> | DUP    | <input checked="" type="checkbox"/> | 50  | Analysis List Query Temp |
| <input checked="" type="checkbox"/> | 7  | QCReport           | QC_ByTestCodeRpt           |                 | <input checked="" type="checkbox"/> | ICB    | <input checked="" type="checkbox"/> | 60  | Sample Fraction          |
| <input checked="" type="checkbox"/> | 9  | Invoice            | InvoiceByTestTax           | UponReceipt     | <input checked="" type="checkbox"/> | ICSA   | <input checked="" type="checkbox"/> | 70  | Sample Test Subcontract  |
| <input checked="" type="checkbox"/> | 10 | vWO_RcptChklistRpt | vWO_RcptChklistRpt_Detailx |                 | <input type="checkbox"/>            | ICSAB  | <input checked="" type="checkbox"/> | 80  | Prep Batch               |
| <input checked="" type="checkbox"/> | 16 | COC                | Chain of Custody Image     |                 | <input checked="" type="checkbox"/> | ICV    | <input checked="" type="checkbox"/> | 90  | Prep Sample              |
| <input checked="" type="checkbox"/> | 17 | EDD                | Generic3                   |                 | <input type="checkbox"/>            | INDA   | <input checked="" type="checkbox"/> | 100 | Prep Sample CleanUp      |
| <input type="checkbox"/>            | 37 | CLP                | CLP Like                   |                 | <input type="checkbox"/>            | INDB   | <input checked="" type="checkbox"/> | 110 | Prep Sample QC           |

| On                                  | RptMod              | On                                  | QualName | On                                  | QualName  |
|-------------------------------------|---------------------|-------------------------------------|----------|-------------------------------------|-----------|
| <input type="checkbox"/>            | Rpt Internal Stds   | <input checked="" type="checkbox"/> | CCBAbo   | <input checked="" type="checkbox"/> | MB1/2RL   |
| <input checked="" type="checkbox"/> | Rpt Surrogates      | <input checked="" type="checkbox"/> | MS       | <input checked="" type="checkbox"/> | Equal foi |
| <input type="checkbox"/>            | Rpt TICs            | <input checked="" type="checkbox"/> | MSD      |                                     |           |
| <input checked="" type="checkbox"/> | J Qualifier On      | <input type="checkbox"/>            | PDS      |                                     |           |
| <input type="checkbox"/>            | ppm - All Tests     | <input type="checkbox"/>            | SD       |                                     |           |
| <input type="checkbox"/>            | ppb - All Tests     |                                     |          |                                     |           |
| <input type="checkbox"/>            | % - All Tests       |                                     |          |                                     |           |
| <input type="checkbox"/>            | ppm instead of mg   |                                     |          |                                     |           |
| <input type="checkbox"/>            | ppb instead of µg/l |                                     |          |                                     |           |
| <input checked="" type="checkbox"/> | RLimit = PQL        |                                     |          |                                     |           |
| <input type="checkbox"/>            | RLimit = LOQ        |                                     |          |                                     |           |

| On                                  | RO  | Comment Type             |
|-------------------------------------|-----|--------------------------|
| <input checked="" type="checkbox"/> | 10  | vWO Narrative-RptText    |
| <input checked="" type="checkbox"/> | 20  | vWorkOrder Comments      |
| <input checked="" type="checkbox"/> | 30  | Sample Receipt           |
| <input checked="" type="checkbox"/> | 40  | Sample Container         |
| <input checked="" type="checkbox"/> | 50  | Analysis List Query Temp |
| <input checked="" type="checkbox"/> | 60  | Sample Fraction          |
| <input checked="" type="checkbox"/> | 70  | Sample Test Subcontract  |
| <input checked="" type="checkbox"/> | 80  | Prep Batch               |
| <input checked="" type="checkbox"/> | 90  | Prep Sample              |
| <input checked="" type="checkbox"/> | 100 | Prep Sample CleanUp      |
| <input checked="" type="checkbox"/> | 110 | Prep Sample QC           |
| <input checked="" type="checkbox"/> | 120 | Analytical Run           |
| <input checked="" type="checkbox"/> | 130 | Analytical Seq Sample    |
| <input checked="" type="checkbox"/> | 150 | Analytical Seq Sample No |
| <input checked="" type="checkbox"/> | 160 | Analytical Seq QC        |
| <input checked="" type="checkbox"/> | 170 | Analytical Seq QC Notes  |
| <input checked="" type="checkbox"/> | 180 | Corrective Action        |
| <input checked="" type="checkbox"/> | 190 | Manual Entry             |

14 Records

Form View

Start Release - R79E6 Datab... Client : Form QCLevel : Form NUM 2:40 PM



# Reporting of entered data

**Khemia Omega 11 - [Client : Form]**

Add Delete Copy Edit Refresh Requery Change LabID Design Query Compact and Repair Database Filter MainMenu Close

File Edit View Insert Format Records Tools Window Help

1. Act 2. InAct Find Client A B C D E F G H I J K L M N O P Q R S T U V W X Y Z Use Other Labs Data

Khemia01

INDEX

ACM04  
ACT03

note

Client ID: ACM04 ☒ Active ☒ Exceedance Alerts ☐ CLIENT on CREDIT HOLD ☐ CLIENT APPROVED FOR CREDIT

Main Invoice ReportOptions Linked Files Client Sites EMAIL SENT

| Report Options                      |    |                   |                        | QC Level:   | Report Watermark:                            | No Communication Required                 |   |
|-------------------------------------|----|-------------------|------------------------|---|--|---|---|
| <input checked="" type="checkbox"/> | 1  | CoverLetter       | CoverLetter            | LEVEL IV  |  | <input type="checkbox"/>                  |   |
| <input checked="" type="checkbox"/> | 2  | SampleSummary     | SampleSummary          | <input checked="" type="checkbox"/> Requires Data Package |  | <input type="checkbox"/>                  |   |
| <input checked="" type="checkbox"/> | 3  | CaseNarrative     | CaseNarrative          | <b>Report Modifications</b>                               | <b>Custom Qualifiers</b>                     | <b>QC Types</b>                           | <b>Comment Type Defaults</b>                                    |
| <input checked="" type="checkbox"/> | 4  | Analytical        | BaseRpt-Consolidated   | <input type="checkbox"/> Rpt Internal Stds                | <input checked="" type="checkbox"/> CCBAbove | <input checked="" type="checkbox"/> CCB   | <input checked="" type="checkbox"/> 10 iVO Narrative-RptText    |
| <input checked="" type="checkbox"/> | 6  | DatesReport       | DatesReport            | <input type="checkbox"/> Rpt Surrogates                   | <input checked="" type="checkbox"/> MB1/2RL  | <input checked="" type="checkbox"/> CCV   | <input checked="" type="checkbox"/> 20 iWorkOrder Comments      |
| <input checked="" type="checkbox"/> | 7  | QCReport          | QC_ByTestCodeRpt       | <input type="checkbox"/> Rpt TICs                         | <input type="checkbox"/> Uqual for P         | <input checked="" type="checkbox"/> CRA   | <input checked="" type="checkbox"/> 30 Sample Receipt           |
| <input checked="" type="checkbox"/> | 9  | Invoice           | InvoiceByTest          | <input type="checkbox"/> J Qualifier On                   |  | <input checked="" type="checkbox"/> CRI   | <input checked="" type="checkbox"/> 40 Sample Container         |
| <input checked="" type="checkbox"/> | 10 | iVO_RcptChklistRp | iVO_RcptChklistRpt_Det | <input type="checkbox"/> ppm - All Tests                  |  | <input checked="" type="checkbox"/> DUP   | <input checked="" type="checkbox"/> 50 Analysis List            |
| <input checked="" type="checkbox"/> | 16 | COC               | Chain of Custody Image | <input type="checkbox"/> ppb - All Tests                  |  | <input checked="" type="checkbox"/> ICB   | <input checked="" type="checkbox"/> 50 Analysis List Query Temp |
| <input checked="" type="checkbox"/> | 17 | EDD               | Generic3               | <input type="checkbox"/> % - All Tests                    |  | <input checked="" type="checkbox"/> ICSA  | <input checked="" type="checkbox"/> 55 Analysis and Prep        |
| <input type="checkbox"/>            |    |                   |                        | <input type="checkbox"/> ppm Instead of mg/L              |  | <input checked="" type="checkbox"/> ICSAB | <input checked="" type="checkbox"/> 60 Sample Fraction          |
|                                     |    |                   |                        | <input type="checkbox"/> ppb Instead of ug/L              |  | <input checked="" type="checkbox"/> ICV   | <input checked="" type="checkbox"/> 70 Sample Test Subcontract  |
|                                     |    |                   |                        | <input checked="" type="checkbox"/> RLlimit = PGL         |  | <input type="checkbox"/> INDA             | <input checked="" type="checkbox"/> 80 Prep Batch               |
|                                     |    |                   |                        | <input type="checkbox"/> RLlimit = LOQ                    |  | <input type="checkbox"/> INDB             | <input checked="" type="checkbox"/> 90 Prep Sample              |
|                                     |    |                   |                        | <input type="checkbox"/> RLlimit = LOD                    |  | <input checked="" type="checkbox"/> LCS   | <input checked="" type="checkbox"/> 100 Prep Sample CleanUp     |
|                                     |    |                   |                        | <input type="checkbox"/> RLlimit = MDL                    |  | <input checked="" type="checkbox"/> LCSD  | <input checked="" type="checkbox"/> 110 Prep Sample QC          |
|                                     |    |                   |                        | <input checked="" type="checkbox"/> QC: SEL List Only     |  | <input checked="" type="checkbox"/> MBLK  | <input checked="" type="checkbox"/> 120 Analytical Run          |
|                                     |    |                   |                        | <input type="checkbox"/> QC: Client Specific              |  | <input checked="" type="checkbox"/> MS    | <input checked="" type="checkbox"/> 130 Analytical Seq Sample   |
|                                     |    |                   |                        |   |  | <input checked="" type="checkbox"/> MSD   | <input checked="" type="checkbox"/> 140 A-B Comments            |
|                                     |    |                   |                        |   |  | <input type="checkbox"/> PDS              | <input checked="" type="checkbox"/> 140 A-B Comments Query Ter  |
|                                     |    |                   |                        |   |  | <input type="checkbox"/> SD               | <input type="checkbox"/> 150 Analytical Seq Sample No           |
|                                     |    |                   |                        |   |  |   | <input checked="" type="checkbox"/> 160 Analytical Seq QC       |
|                                     |    |                   |                        |   |  |   | <input type="checkbox"/> 170 Analytical Seq QC Notes            |
|                                     |    |                   |                        |   |  |   | <input type="checkbox"/> 180 Corrective Action                  |
|                                     |    |                   |                        |   |  |   | <input type="checkbox"/> 190 iWorkOrder                         |

| Act                                 | Alternate Contacts | Contact ClientID | Company        | Title     | Phone          | Ext | Cell Phone | Fax            | Email               | Rpt FP Alert             | Inv FP Alert                        | CC Rpt                   | Rpt Email                           | Rpt Mail R               |
|-------------------------------------|--------------------|------------------|----------------|-----------|----------------|-----|------------|----------------|---------------------|--------------------------|-------------------------------------|--------------------------|-------------------------------------|--------------------------|
| <input checked="" type="checkbox"/> | Buford Bogard      | ACM04            | Acme downriver |           | (734) 513-9940 |     |            | (734) 838-0045 | m Bailey@khemia.com | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> | Flint Marco        | ACM04            | Acme downriver |           | (734) 513-9940 |     |            | (734) 838-0045 | m Bailey@khemia.com | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> | Jason Bailey       | ACM04            | Acme downriver | Executive | (734) 513-9940 | 403 |            | (734) 838-0045 | m Bailey@khemia.com | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> | Reed Richards      | ACM04            | Acme downriver | Boss      | (734) 513-9940 |     |            | (734) 838-0045 | m Bailey@khemia.com | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> |

Form View

Start Release - R79E6 Dat... Client : Form

NUM 2:21 PM



# Weak Links

- Humans are human and still involved
- Every LIMS company has made a programming error
- Hardware/software upgrades (we all blame Microsoft sometimes!)
- Labs needs and LIMS are still evolving





# THANK YOU

Robert Benz

(843) 810-2075

[rbenz@khemia.com](mailto:rbenz@khemia.com)