

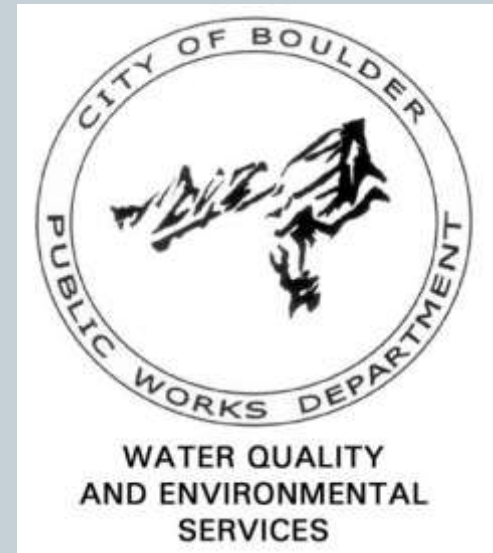


Laboratory QA/QC: Basic Concepts



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**CIPCA CONFERENCE
OCTOBER 15, 2015**



What's the point?



Quality: ability of methods to produce precise and accurate results

- Ensures validity, reliability, and repeatability of data
- Quantifies areas of analytical uncertainty
- Allows for laboratory certification
- Nearly all regulatory decisions are based on DATA

If it's worth doing, it's worth documenting.

Quality Assurance vs Quality Control



- QA:

- Broad plan to ensure quality throughout program
- Failure PREVENTION
- The SYSTEM
- Establishes the need for QC

- QC:

- The steps that are taken to ensure quality
- Failure DETECTION
- The TOOLS
- **The “how” we achieve QA**

QA/QC includes all steps from project development and sampling through data reporting

Quality Assessment



- Process of assessing the quality of data
 - Proper implementation of QA policies
 - Analyzing QC data
- Example: Performance Evaluation (PE) samples

Quality Assurance Plan



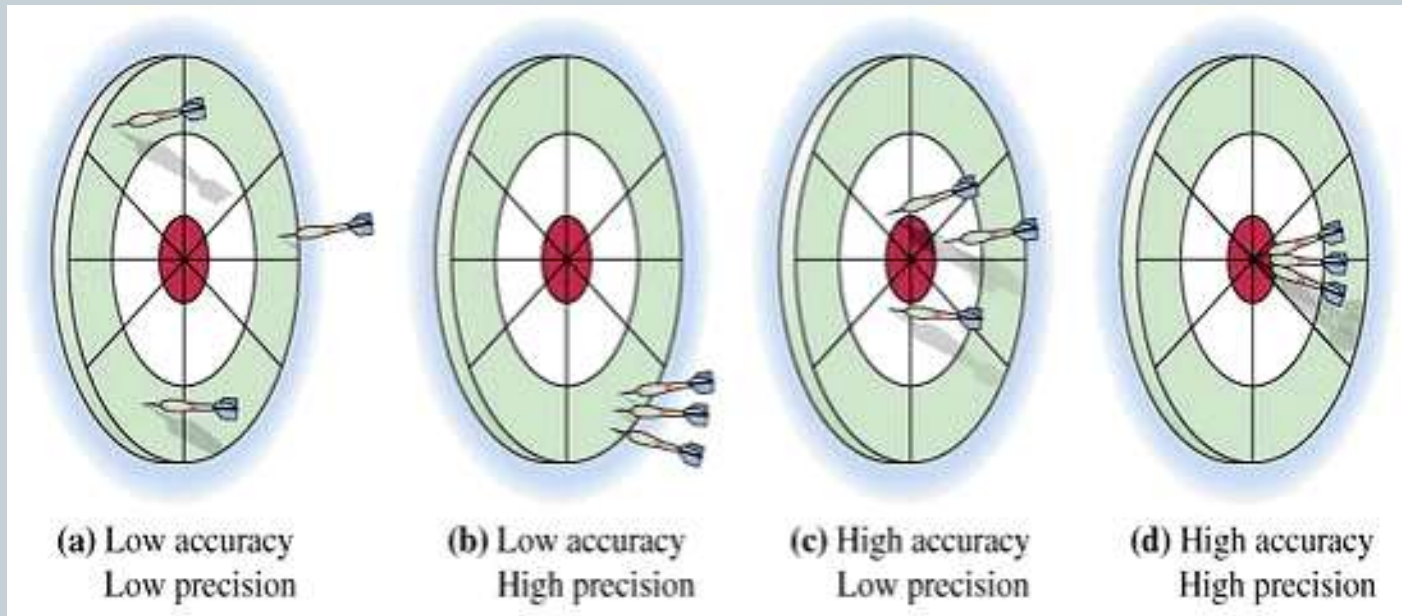
Documented commitment to quality

- Purpose or Quality Policy Statement
- Staff responsibilities and roles (qualifications, training)
- Sub-contracting, approved equipment, maintenance
- Process for non-conforming
- Control of records (document control, data management, traceability)
- Methods, detection limits, SOPs
- Internal audits
- Proficiency testing

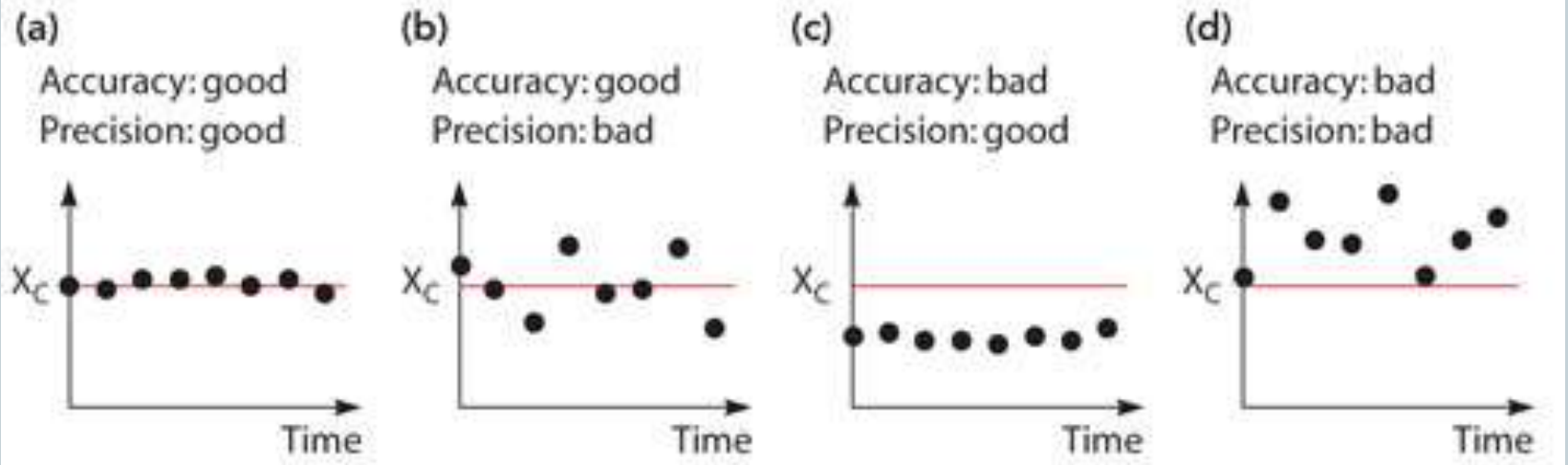
Precision vs Accuracy



- Accuracy: nearness of a measurement to true value
- Precision: closeness of two or more measurements to each other



Precision vs Accuracy



PARCC Parameters



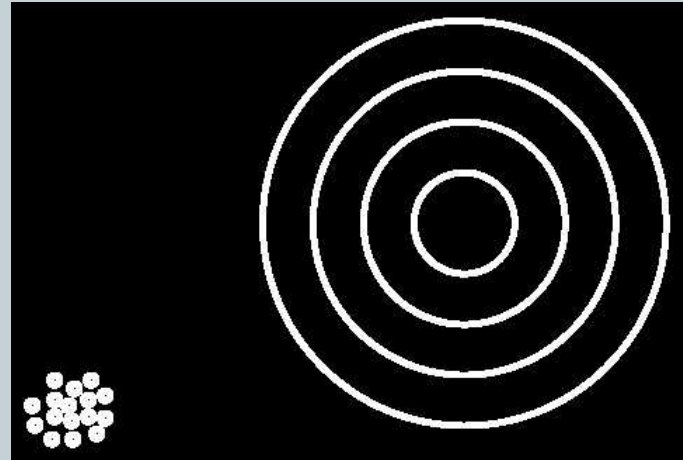
- **Precision**
- **Accuracy**
- **Representativeness**
- **Completeness**
- **Comparability**

- **Sensitivity** and **Selectivity** also important

Precision



- Expression of the mutual agreement between duplicate measurements of the same property taken under similar conditions



- Can be expressed quantitatively with RSD (relative standard deviation) or RPD (relative percent difference)

Accuracy

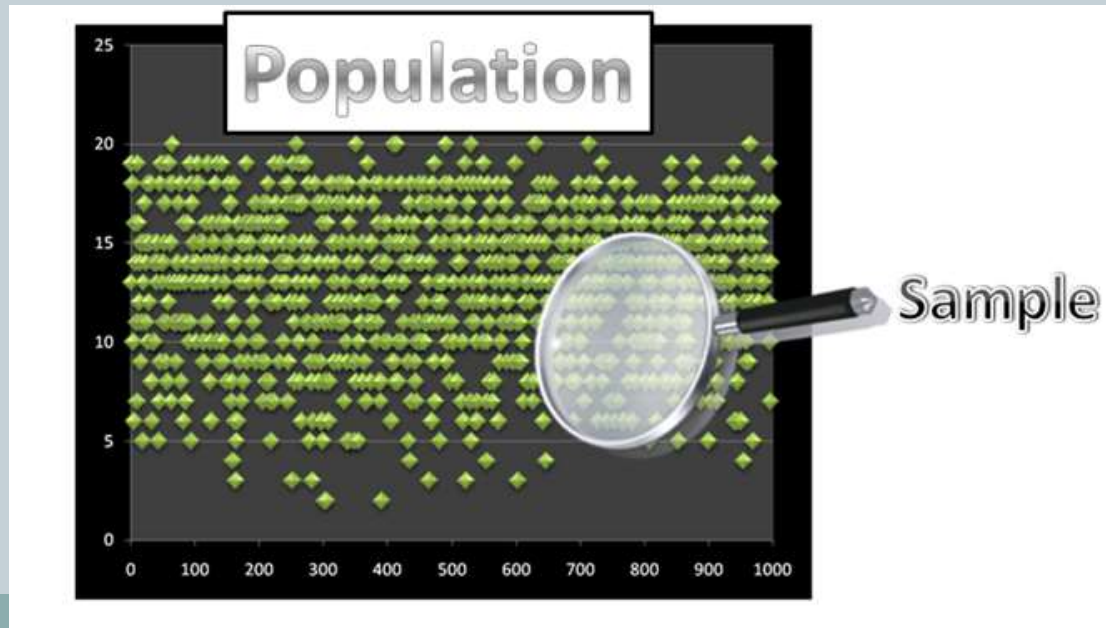


- Degree of agreement for a measurement with an accepted reference or true value
- Measures bias
- Can be measured with % Recovery of known standard

Representativeness



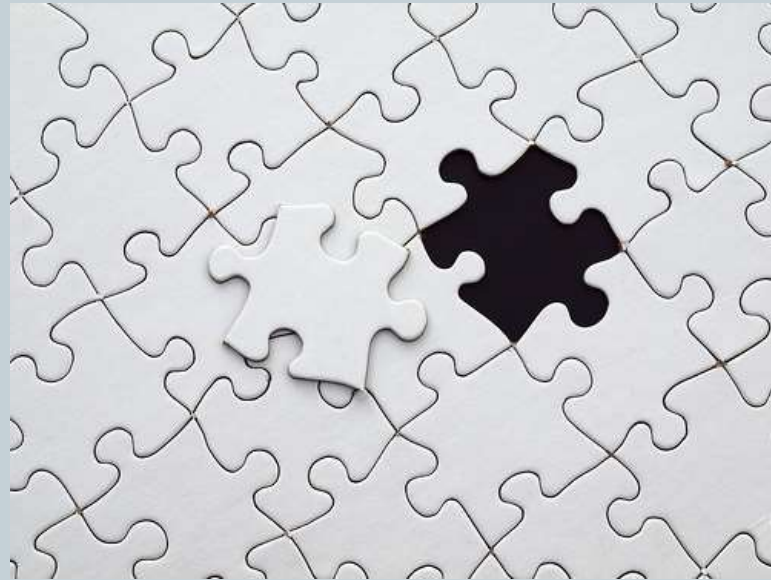
- Degree to which data accurately and precisely represent a characteristic of a population, a parameter variation at sampling point, a process condition, or an environmental condition
- Field duplicates a good indicator



Completeness



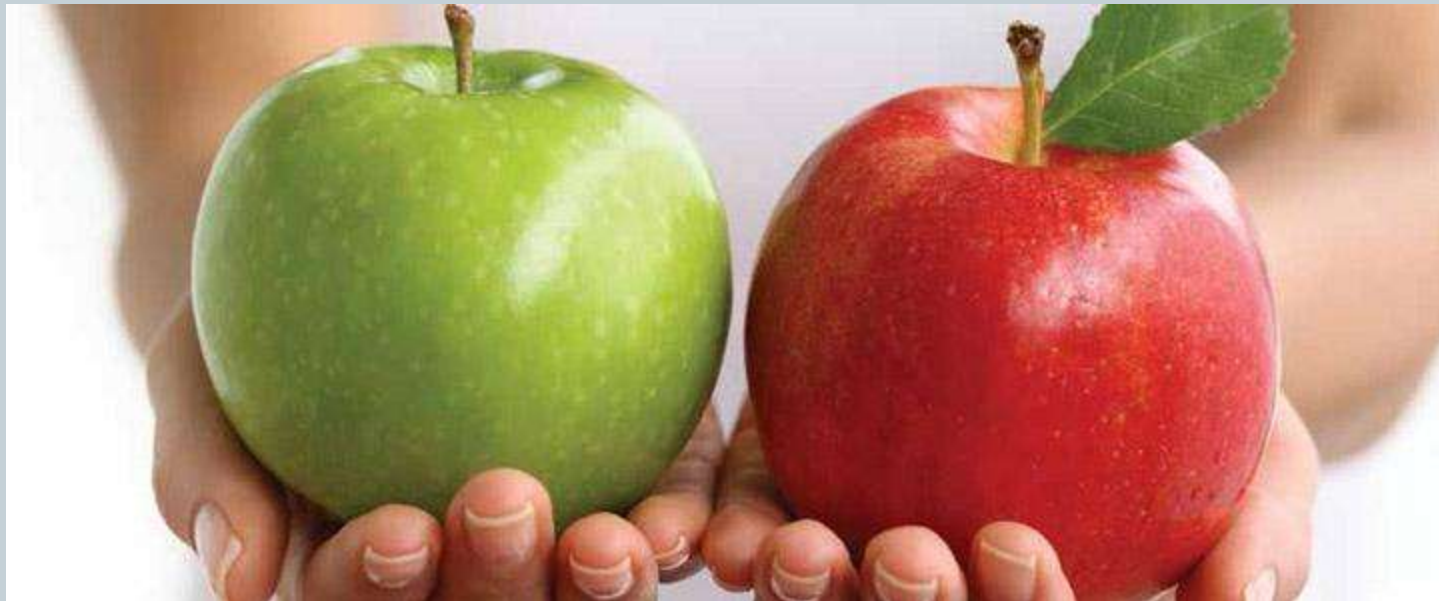
- Estimate of the number of valid measurements made as compared to total number of measurements
- May be expressed as the % of valid or acceptable data



Comparability



- Measure of the confidence with which one data set or method can be compared with another
- Qualitative parameter tied to consistency in the acquisition, handling, and analysis of samples



Detection Limits



- **IDL (instrument detection limit)**
- **MDL (method detection limit)**
- **PQL (practical quantitation limit)**
- **RL (reporting limit)**
- LOD (limit of detection)
- LOQ (limit of quantitation)
- LCMRL (lowest concentration minimum reporting level)
- MRL (method reporting limit)
- ML (minimum limit of quantitation)
- LRL (laboratory reporting limit)

Method Detection Limit



- **“the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results”**
- Statistically calculated concentration where you **would expect to “qualitatively” identify the target analyte**
- EPA proposed changes to procedure (March 2016)

MDL Translation



- MDL: lowest amount that you are confident it has been detected
 - In the kitchen: a pinch
- PQL or RL: lowest amount you can measure with confidence in results
 - In my kitchen: 1/8 tsp
- Between MDL and RL = J Flag



Common Qualifiers (Flags)

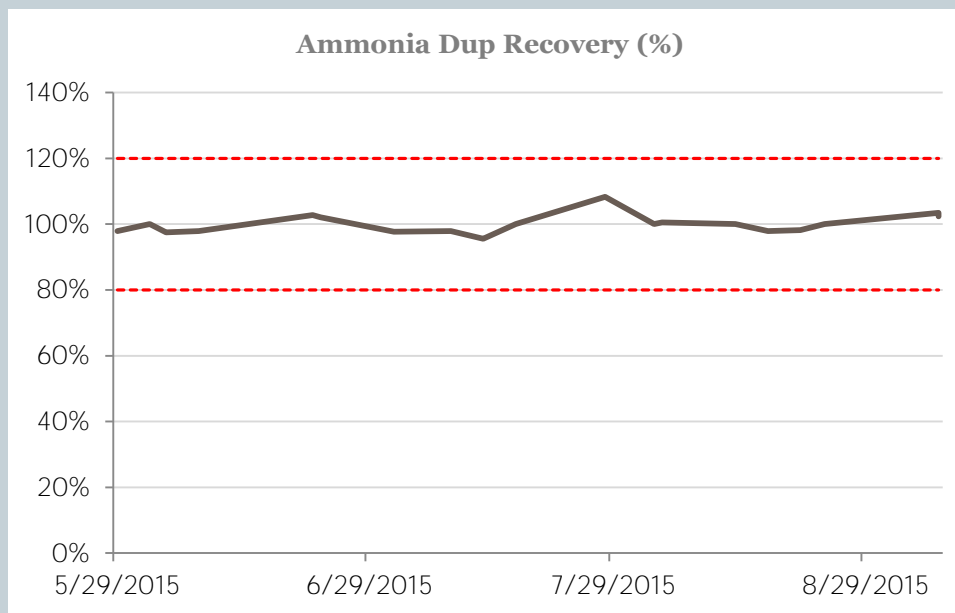


- J: Estimated value (above MDL, below RL)
- U or ND: Not detected
- B: Analyte found in the associated blank
- R: Results rejected
- E: Exceeds calibration range
- D: Sample was diluted
- H: Analysis performed past holding time
- Combinations of flags

Control Charts



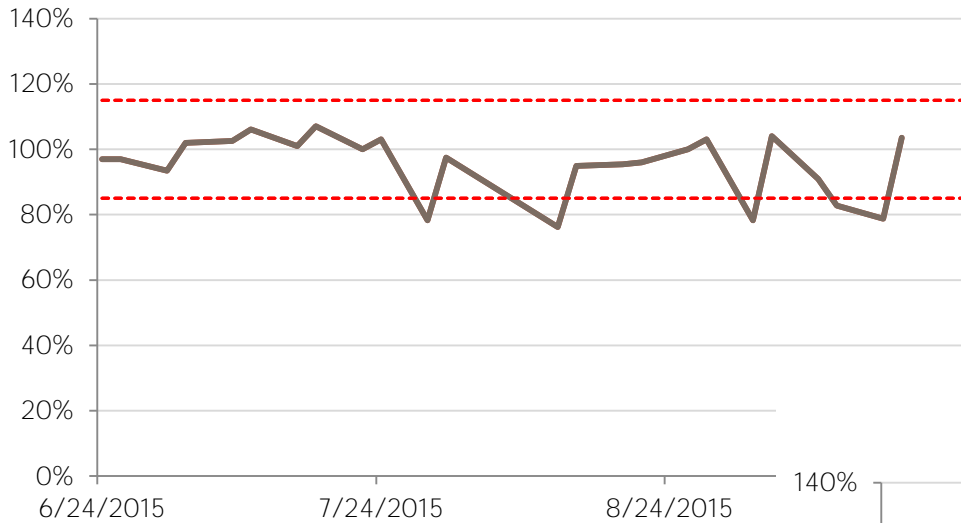
- Visual representation of QC data
- Useful for identifying trends
- Warning limits (2 standard deviations) and control limits (3 standard deviations)



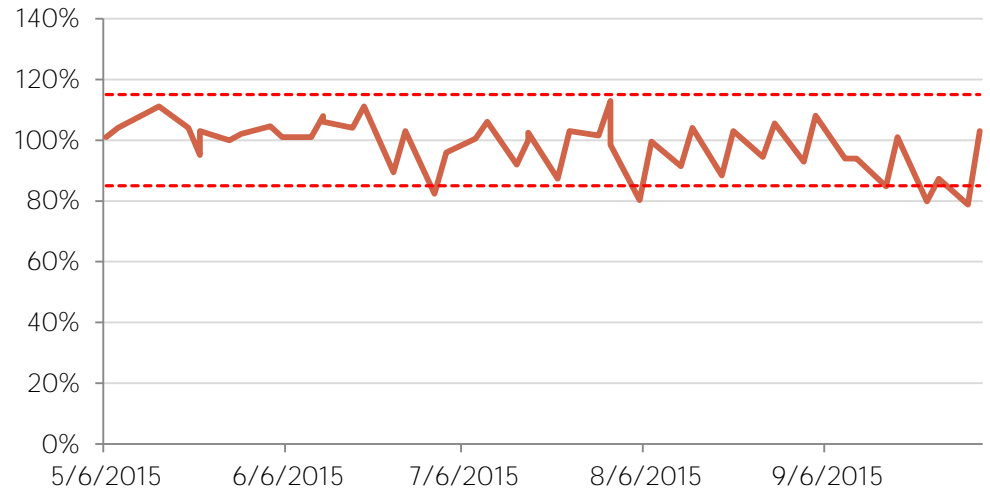
Control Charts



BOD Check Recovery Lab Chem (%)



BOD Check Recovery UWS (%)



Internal QC Checks



- Blanks
 - Method blank
 - Trip blank
 - Field blank
 - Equipment blank
 - Calibration blank
- Lab replicate
- Field duplicate
- Matrix spike/Matrix spike duplicate
- Reference/check standard/Laboratory Control Sample (LCS)
- Readback standard/CCV/drift check
- Internal standard

External QC Checks



- External field duplicates
- Split samples
- Unknowns- PE Samples



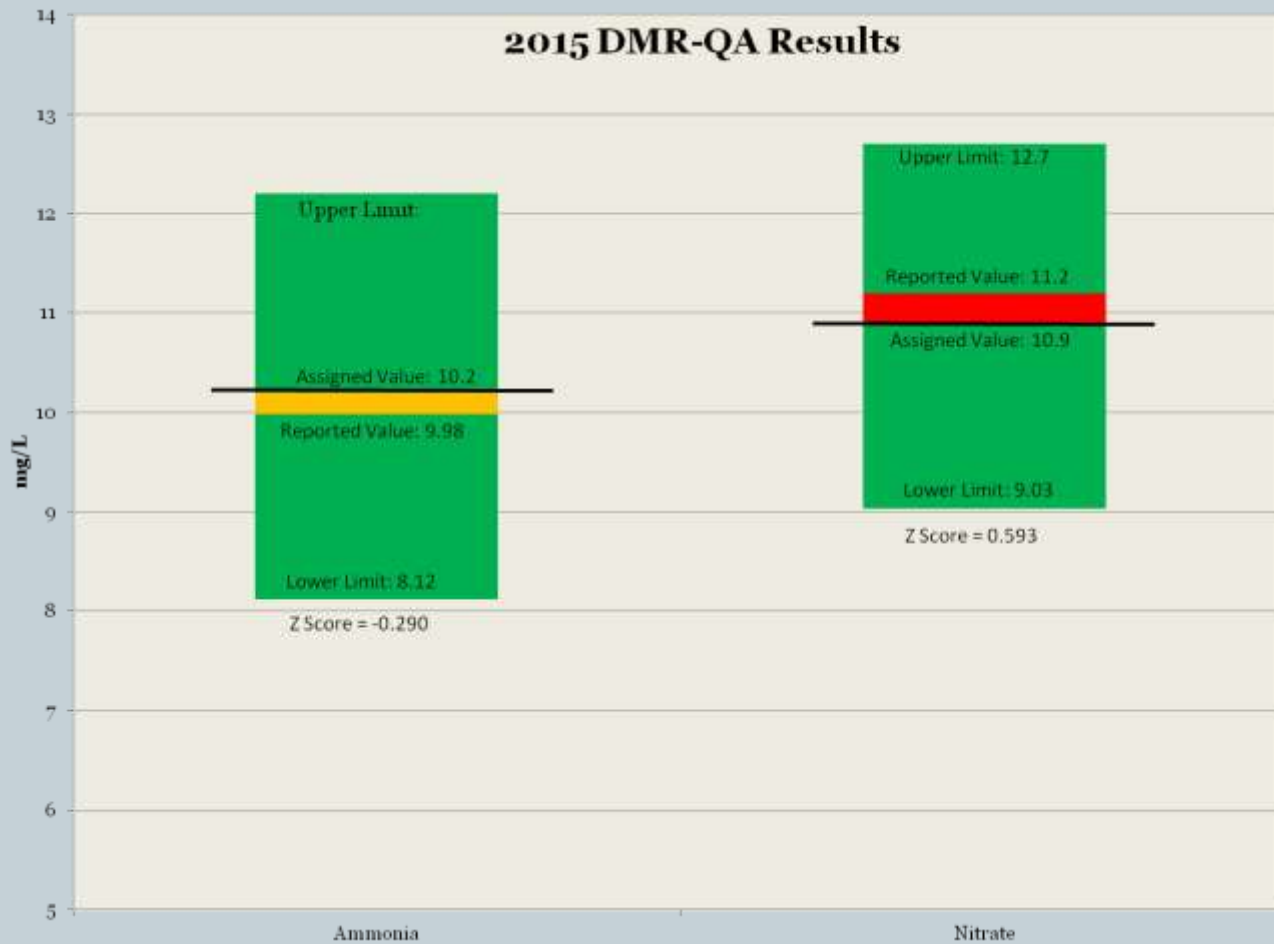
DMR-QA Study



- **Discharge Monitoring Report-Quality Assurance** study- evaluates the analytical ability of labs for major and selected minor permittees
- CO DMR-QA coordinator: Eric Mink



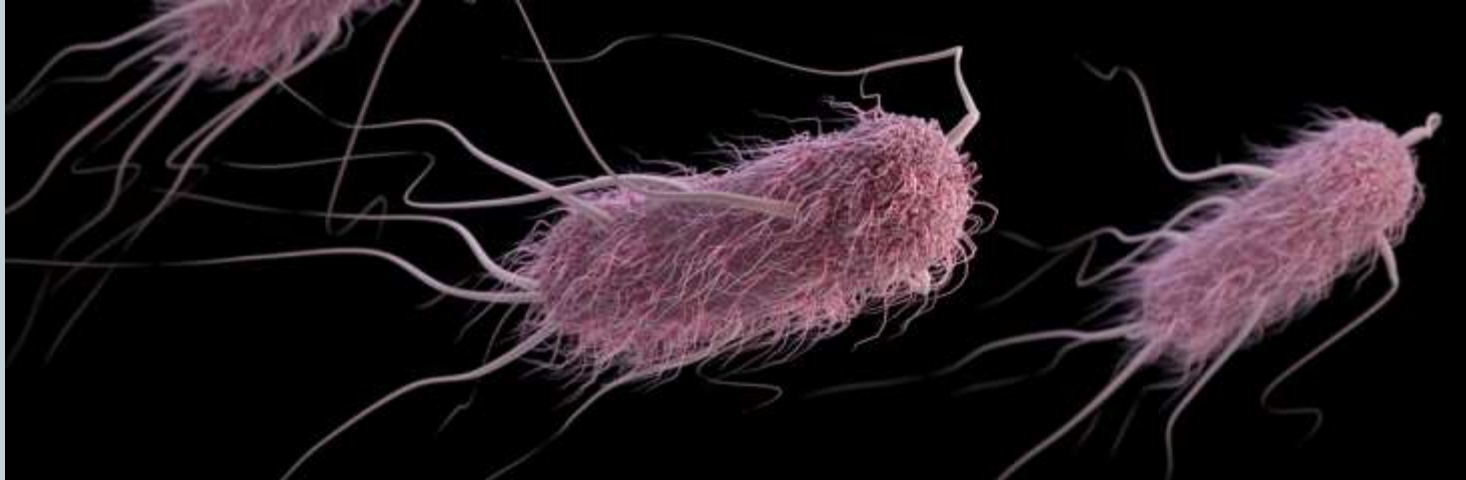
DMR-QA Study Data



QC more tricky with microbiology



- Microbiology QC data are subject to significant variability
- Positive and negative controls important



Other components of QA



- SOPs
- Analyst competency
- Sample control and documentation
- Chain of custody
- Balances
- Temperature
- Volumes
- Reagent water

Standard Operating Procedures



- Enough detail that an experienced analyst could obtain acceptable results
- SOPs for cleaning procedures, preventative maintenance, etc.



Analyst Competency



- Initial demonstration of competency (IDC)
- Demonstration of competency (DOC)
- Must demonstrate accuracy and precision
- Training records



Sample Control and Documentation




- Chain of Custody
- Sampling info (date, time, sampler, location)
- Lab info (result, units, analyst, date)
- Significant figures, rounding to whole
- Procedures for storage
- Holding times



Chain of Custody



- Documents the history of sample possession
- Ensures data is credible and defensible
- Custody:
 - In your possession or view
 - In your possession and you then locked or sealed the sample
 - In a secured area



City of Boulder
Wastewater and Environmental Lab
4049 N. 75th Street, Boulder, CO. 80301
303-413-7350

CHAIN OF CUSTODY

Client Information

Name to appear on report: _____ Copy to: _____

Attn: _____ Tel: _____ Attn: _____ Tel: _____
Email: _____ Email: _____

PROJECT INFORMATION Analysis Requested

Client Project Name: _____

Sample ID	Date/Time	Matrix	# of Containers																		

Matrix: SW (Surface Waste), GW (Ground Water), WW (Wastewater), DW (Drinking Water), SL (Sludge), SO (Soil), OL (Oil), Other (Specify)

Options: _____

Remarks: _____

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White - Receiving Lab Yellow - Customer Copy

Balances



- Location
- Check zero
- Self-calibrations
- Accuracy checks
- Service and recalibrate
- Records



Temperature



- Ovens, incubators, fridges, etc.
- Immersed in solution
- Reference thermometer (NIST-certified)
- Record-keeping (daily, hourly, etc.)
- Autoclaves- sterilization temperature



Volumes



- Pipettes:
 - Verify and service using vendor
 - Gravimetrically verify using calibrated balance



Quality of reagent water



- Blank analyses can help identify issues
- Monitor resistance, conductivity, turbidity, total residual chlorine, metals, or bacterial growth
- Monitor warning lights, regular maintenance schedule

Other Laboratory Tips



- Read the case narrative
- Communicate and check in with lab
 - Required preservation
 - Minimum volumes
 - Hold times
 - Proper methods
- Encourage sampling early and often

Questions?

