TRAINING WORKSHOP "Training workshop & study tour for developing the capacity of prosecutors & investigators for the enforcement of water & environment legislations"
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4- Minimum acceptable QA/QC programs for water & environment monitoring & inspection systems.

A Story from USA

- Continental Airlines flight simulators flooded.
- Called for sampling & analysis and QA/QC
- Called to the court of law where to testify as an expert witness representing our client (Continental).
- Parties involved: Continental + Insurance Company (plaintiff) against Wane County, Ford Company & Fire sprinkler company.
- Attendance in court: One lawyer & one expert (water chemist) for each party involved.
- Lawyers strategy: 1- To raise doubt about credibility of evidences and 2- water not pollutants that caused the damage.

Lessons Learnt

- In evaluating evidences of noncompliance from water & environment monitoring laboratories, the court including the lawyers verified the credibility of the evidences by posing the following questions:

1. Does the lab strictly follow specified standard methods of analysis?
2. Does the lab use a QA/QC system?
3. Does the lab maintain a QC record on reagent preparation, instrument calibration & maintenance, purchase of supplies, etc.?
4. Does the lab undertake documented routine QC checks on supplies, equipment, instrument calibration and maintenance, analyses, and standard solutions?
5. Does the lab have standard operating procedures for daily operation of instruments and equipment which the staff follow them?

6. Are standards & blanks made available from suppliers to perform standard calibration procedures?
7. Did the lab keep records of each set of analysis performed including calibration, QA and analyzed samples (i.e., analysis run logs or instrument run logs)?
8. Does the lab maintain written troubleshooting procedures to identify common equipment malfunctions?
9. Does the lab follows written schedules for replacement, maintenance, cleaning, checking, and/or adjustment by service personnel?
10. Does the lab maintain documentation on equipment maintenance & service checks.
11. Does the lab have a sample custodian & an area that is secured & restricted to authorized personnel only?

12. Did the custodian receive all incoming samples, sign the chain-of-custody record sheet accompanying the samples & retain the sheet as a permanent record?
13. Did the custodian perform checks of proper preservation, container type, holding times & documented results?
14. Did the custodian ensure that samples are properly stored?
15. Did only the custodian distribute samples to personnel who are to perform analyses?
16. Does transfer of samples routinely documented by the sample custodian.
17. Are custody records for handling samples accurate and up-to-date?

Q: How Water & Environment Monitoring & Inspection Systems Can furnish Credible Evidences That Can Stand in Court of Law?

A: Through a QA/QC program & A Chain of Custody

What is QA in Water & Environment Monitoring?

- QA is a **management system** that refers to a total program for ensuring the reliability of data by utilizing administrative & technical procedures & policies regarding personnel, resources & facilities.

- QA programs have a main function of continually monitor the reliability (accuracy & precision) of reported results; i.e., to provide answers to the question "How good (accurate & precise) are the results obtained?"

What is QC in Water & Environment Monitoring?

- QC is a system of **technical** activities to control data quality (blanks, duplicates and spikes)

- QC is the routine application of technical procedures for controlling the accuracy & precision of the measurement process & includes the proper calibration of instruments & the use of the appropriate analytical procedures.
- The most important facet of quality control is a set of written directives describing the relevant laboratory-specific, technique-specific, sample-specific, method-specific & protocol-specific operations.

QA/QC

- QC & QA together help to produce trustworthy data of a known quality (e.g. precision, accuracy) & enhance the **credibility** of results.
- All sampling & analysis should be subject to a precise QA/QC programs for field & laboratory activities.
- In all cases, standard methods should be strictly followed & recorded.

PRACTICALLY SPEAKING
WHAT IS QA/QC?

Field QA/QC

- Field QA/QC checks during the actual sample collection process to determine the performance of sample collection techniques.
- The most common monitoring errors leading to court dismissal usually are improper sampling, improper preservation, inadequate mixing during compositing & splitting & excessive sample holding time.

How to Ensure Field QA/QC?

- **Field replicate** – field samples obtained from one sampling point, homogenized & divided into separate containers, treated as separate samples throughout the remaining processes – used to assess error associated with heterogeneity, methodology & analytical processes.
- **Field blank** – used to assess contaminant concentrations, collected upstream of contaminated areas.

QA/QC During Sample Preparation

- Two types of 'spiking' QC samples are used for the QA/QC purpose to assess sample preparation procedures:
  - **Sample Spike**: a small sample of a known concentration of analyte solution is added to the sample before sample preparation. Results are evaluated based on % recovery.
  - **Surrogate spikes**: surrogates are organic compounds that are similar to analytes of interest but are not found in the environment. Used to trace organic determination methods such as GC/GCMS and HPLC

QA/QC During Analysis

1. Blank – To assess contamination
2. Spikes – To obtain percentage recovery (accuracy)
3. Replicates – To determine analytical precision
4. Calibration standards – To obtain calibration curves.
5. QC check standards – standard solutions with known concentrations. Used to verify that the standards & calibrations are accurate, also to confirm the calibration curve.

Inter-laboratory

- An inter-laboratory testing program is used to evaluate the consistency of test results obtained from a well defined test procedure **by different laboratories** testing the same controlled material.
- **Split Samples**. These are samples that have been divided into two containers for analysis by separate laboratories. These samples provide an excellent means of identifying discrepancies in the analytical techniques and procedures.
- An inter-laboratory testing program removes the material and sampling variability and provides information about the equipment and test procedure variability that can be expected between laboratories or within a laboratory.

Minimum QA/QC

1. 2 Standards to check on calibration (High & Low);
2. One laboratory/procedure blank;
3. Every 10 samples/ one duplicate for precision;
4. Every 10 samples/spike for accuracy;
5. One field blank;
6. One field replicate;
7. One blind sample;
8. Inter-calibration & regular periodic accreditation.

General Conditions:

- Records of qualification & training of field & laboratory staff should be kept current for verification by regulatory agency and/or for submission in court.
- Verified analytical results should be entered into a secured laboratory data management system. It should contain the 1- sampling data, 2- time & exact location, 3- analysis dates and times, 4- names of analysts, 5- analytical methods/techniques used, & 6- analytical results.
- Data are then reported to the inspector to examine & officially include into the compliance report.

CHAIN OF CUSTODY

- In order to make water & environmental analysis admissible to court of law and utilized in the legal proceedings, they should be subject to a very tight chain of custody.
- Proper chain of custody procedures allow the possession & handling of water & environmental samples (evidences) to be traced & identified at any moment, from the time that sample containers are initially prepared for sampling, to the final disposition of the sample.
- It is a form of proof used to establish the authenticity & integrity of the sample that can be used in lawsuit.

Chain of Custody Should Include the Following

1. A written record of the laboratory's source & manner of preparation of sample containers. This should include the laboratory QC procedures for assuring that a sampling container is clean, ready to accept a sample, properly labeled & of proper size & material, marked with indelible ink, & secured to the body of the sample container. They should contain the 1- sample number, 2- preservation technique if applicable, 3- date & time of sample collection & 4- initials of the collector.
2. A documented procedure for management of sample containers, both in the field & in the laboratory, to prevent either inadvertent contamination or potential opportunities for tampering.

3. A field supervisor to maintain a bound, page marked field logbook in a manner such that field activity can be completely reconstructed without reliance on the memory of the field crew. Items to be noted in the logbook should include the following:
   - Date and time of activity
   - Names of field supervisor and team members
   - Purpose of the sampling exercise
   - Description of the sampling site
   - Location of the sampling site
   - Sampling equipment used and their calibration records
   - Any deviation from standard operating procedures and the justifying reason.
   - Field observations

- Field measurements made
- Results of any field measurements
- Sample identification
- Type and number of samples collected
- Sample handling, packaging, labeling, and shipping information

4. A field logbook to be kept in a secure place until a unit effort or activity for which particular logbook is maintained has been completed, whereupon the logbook should be kept in a secure case file.

5. A custodian to make sure that chain-of-custody record accompanies each group of samples from the time of collection to their destination at the receiving laboratory. Each person who has custody of the samples at any time must sign the chain-of-custody form & ensure that the samples are not left unattended unless secured properly.
6. Gummed paper custody seals or custody tape should be used to ensure that the seal must be broken when the container is opened.

7. Within the laboratory, security & confidentiality of all stored material to be maintained at all times. This require that any analyst sign for any sample removed from the refrigerated storage area for purposes of performing analysis & note the time & date of returning a sample to storage.
8. Before releasing or reporting any analytical results, all information on sample labels, bar code, data sheets, tracking logs & chain-of-custody records should be crossed checked to ensure that data pertaining to a sample are consistent throughout the record.

مع خالص شكري وامتناني

Thank you for your attention

Merci pour votre attention

For additional information please contact:
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