



INTRODUCTION TO  
DRINKING WATER QUALITY TESTING

Interpreting and  
Reporting Drinking  
Water Quality  
Test Results





**Goal 6 of the 2030 United Nations Development Programme (UNDP) Agenda for Sustainable Development aims to “ensure availability and sustainable management of water and sanitation for all” and includes targets for universal access to safe drinking water (Target 6.1). Despite some progress, the world is not on track to achieving target 6.1, and according to the WHO/UNICEF Joint Monitoring Programme for Water Supply report (JMP 2021), meeting this effort will require a quadrupling of current rates of progress in safely managed drinking water services.**

Monitoring drinking water quality plays an important role in the effort to ensure availability of safe drinking water. CAWST (Centre for Affordable Water and Sanitation Technology) has developed introductory information and resources on eight key drinking water quality topic areas intended for water, sanitation and hygiene (WASH) practitioners in developing countries where there is limited access to resources:

- Sanitary Inspections
- Aspects of Drinking Water Quality
- Water Sampling
- Testing for Microbiological Aspects in Drinking Water
- Quality Control in Drinking Water Quality Testing
- Testing for Acceptability Aspects in Drinking Water
- Testing for Chemical Aspects in Drinking Water
- Interpreting and Reporting Drinking Water Quality Test Results

### **LEARNING AND TRAINING RESOURCES**

This document is part of a collection of resources for learning and training about introductory drinking water quality testing. To access CAWST’s other water, sanitation and hygiene resources, visit [cawst.org/resources](https://cawst.org/resources).

## TECHNICAL BRIEF: INTERPRETING AND REPORTING DRINKING WATER QUALITY TEST RESULTS

1	Introduction	3
2	Steps for Data Interpretation	3
	2.1 Collect Data for Analysis	4
	2.2 Check the Data Quality	4
	2.3 Choose an Appropriate Analysis	5
	2.3.1 Comparison Analysis	5
	2.3.2 Trend and Correlation Analysis	5
	2.3.3 Statistical Analysis	7
	2.4 Interpret Data in Relation to the Objectives	7
	2.4.1 Removal Effectiveness Calculation	8
	2.5 Report the Results	8
3	Interpreting Laboratory Reports	8
4	Key Points	10
5	Glossary	11
6	Additional Resources	12
7	References	12
8	Appendix: Sample Data Recording Forms	13

## 1 INTRODUCTION

Data interpretation allows you to learn from the water quality test results, helps you improve your sampling program and is really the reason you collected the data in the first place. You will need to take a good look at the results and try to understand them to develop your final conclusions and recommendations. Besides providing a report of the analysis for given contaminants, most commercial laboratories or portable test kits provide little explanation of the test results. The information provided in this brief will help you understand and interpret your water quality test results.

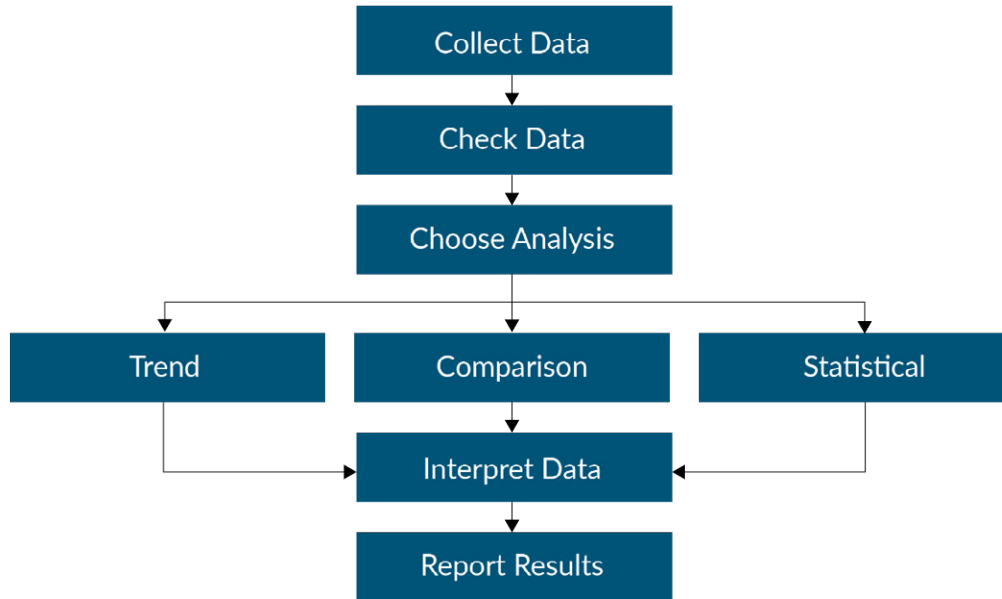
Although we have separated acceptability, chemical and microbiological aspects testing, it is useful to compare the results to determine any correlations.

There are three main approaches for interpreting the results from water quality tests which are discussed in the following sections:

1. The results can be compared to national water quality standards or the World Health Organization (WHO) Guidelines for Drinking Water Quality.
2. The results can be reviewed to see how they change over time and location to identify any trends or correlations.
3. Statistical analysis can be done for academic purposes and scientific research.

## 2 STEPS FOR DATA INTERPRETATION

1. **Collect** the data for analysis. Enter the data (test results) from the data recording forms into an appropriate table, spreadsheet or database.
2. **Check** the data quality. Address any unusual results. For example, if the number of E. coli is higher in the treated water compared to source water, it would be advisable to repeat the sampling.
3. **Choose** an appropriate analysis. Data analysis methods should be selected in advance, and there should be enough data to analyze. Sample size determinations are outside the scope of this brief. See WHO RADWQ, (2012) and UNICEF, (2008) for more information on assessment survey design.
4. **Interpret** the results so they are meaningful to the project objectives and situation in the local context. When generating results, keep in mind the quality control and reliability of the testing process.
5. **Report** the results. Results should be recorded in a simple, easy to read format (e.g., tables, graphs) appropriate for the audience. Develop conclusions and recommendations.



**2.1 COLLECT DATA FOR ANALYSIS**

Data recording forms should be used to document water samples and test results. For examples, see Appendix: Sample Data Recording Forms. These forms can be adapted to meet the specific needs of your project.

Many types of forms can be used, depending on how many samples are taken and the number of tests performed, so it is essential to choose appropriate forms for data entry.

It is important to collect all of the data recording forms each day while water is being sampled and tested. This helps to ensure the forms are not misplaced or lost and that the data is entered into a table, spreadsheet or database as soon as possible.

**2.2 CHECK THE DATA QUALITY**

The data record forms need to be checked thoroughly to ensure all information was recorded clearly, correctly and completely. If any data is missing or incomplete, steps should be taken to collect the needed information or repeat the sampling.

Common errors in recording data include the following:

- Using wrong units (e.g., writing ppb instead of ppm)
- Writing is not clear
- Missing or incomplete data
- Putting the decimal in the wrong place
- Recording data for the wrong sample
- Recording the result in the wrong place

If data is incorrect or missing, or if there are any unusual test results, another sample should be taken and the test should be repeated to get correct and complete data. If there continues to be unusual results then there may be problems with equipment calibration, expired test strips or culture media, or secondary contamination. Refer to CAWST: Technical Brief: Quality Control in Drinking Water Testing which explains how to reduce such errors.

## 2.3 CHOOSE AN APPROPRIATE ANALYSIS

There are three main approaches for analyzing the results from water quality tests:

1. Comparison analysis
2. Trend and correlation analysis
3. Statistical analysis

### 2.3.1 Comparison Analysis

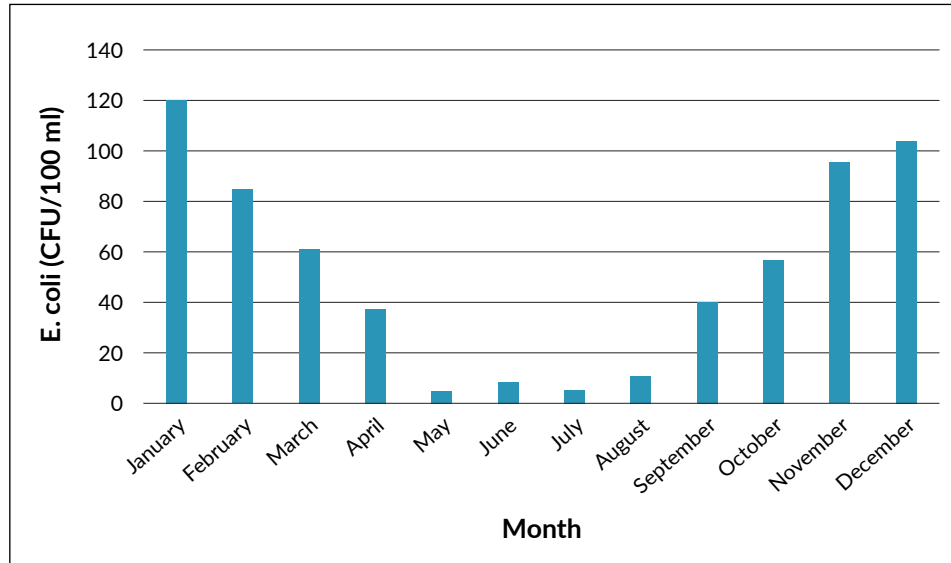
A comparison analysis is most commonly used to compare the existing situation with national standards or WHO guidelines. This type of analysis can be used to compare the water quality or effectiveness of water treatment between different locations or user groups, such as high, medium and low-income households.

### 2.3.2 Trend and Correlation Analysis

Trend analysis shows how a physical, chemical or microbiological parameter changes with time and location. Graphing is an excellent way to display the data and is very helpful when analyzing trends and correlations. There are many kinds of graphs and you are encouraged to find different ways of looking at data.

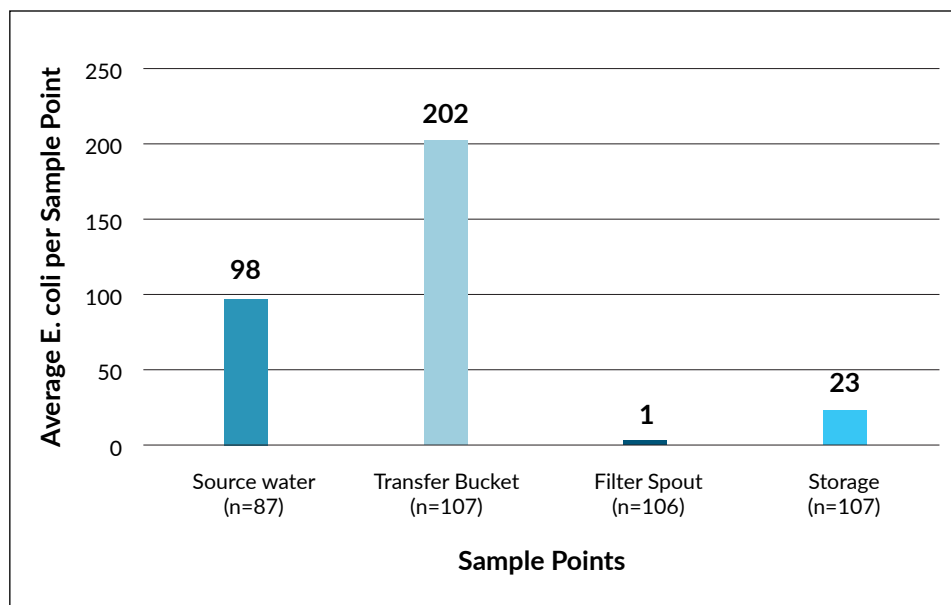
Time-history graphs can illustrate changes in water quality over a period of time (e.g., in hours, days, months or years). For example, the following line graph shows that average E. coli levels for a particular water source were gradually decreasing until May and then started increasing from August onward, suggesting seasonal changes (wet vs. dry) affecting contamination levels.

**Microbiological Contamination of Open Well #3**



A spatial graph can be used to show how water quality varies according to the sampling locations. The following bar graph shows that water from the source and transfer bucket both have E. coli contamination, but the transfer bucket water has higher levels, probably due to secondary contamination. The filtered water is good in terms of water quality; however, the results show there is a recontamination problem in the storage water.

**Microbiological Contamination in Drinking Water**





### 2.3.3 Statistical Analysis

Statistical analysis can be done for academic purposes and scientific research. Computer software is available to process numerical data and perform statistical tests. Spreadsheets, such as Microsoft Excel, also have powerful graphical and statistical capability.

Statistical analysis for more rigorous research or for academic purposes is outside the scope of this brief.

## 2.4 INTERPRET DATA IN RELATION TO THE OBJECTIVES

The objectives of the overall project and the water quality testing program need to be kept in mind when interpreting test results. Different objectives can result in a different interpretation of the same test data. Following are some examples of objectives for water quality testing:

- Identify an appropriate drinking water source
- Identify the source of an outbreak of a drinking water-related disease
- Investigate seasonal changes in drinking water quality
- Increase user awareness on water quality issues
- Assess the effectiveness of household water treatment and safe storage (HWTS) in reducing turbidity and pathogens
- Assess the concentration of arsenic and fluoride in drinking water
- Provide troubleshooting as part of an ongoing monitoring program
- Monitor compliance with standards or guidelines
- Evaluate the effectiveness of a safe water project

Project implementers often carry out water quality testing to bring awareness in the community about the difference between contaminated water and treated water. (E.g., using a simple presence-absence test to indicate microbiological contamination). In such situations, results may be presented immediately to the community without complete interpretation of the overall data. This situation can sometimes go wrong if you generate an unexpected test result in front of the community without the ability to explain the result or perform any quality control to verify the test. This can easily create a negative impression about the project implementation and should be avoided if possible. If it is necessary to distribute early results, it is important to emphasize they are incomplete and full results will be available after the data has been interpreted.



### 2.4.1 Removal Effectiveness Calculation

Removal effectiveness, or treatment effectiveness, is a measure of how well a household water treatment technology (HWT) treats water. It can be expressed as the percentage of specific contaminants that is removed from the water, such as “98.5% of bacteria.”

#### How to Calculate the % Removal Effectiveness of Water Treatment

$$\frac{\text{Source water E. coli colony count} - \text{Treated water E. coli colony count} \times 100}{\text{Source water E. coli colony count}} = \% \text{ Removal Effectiveness}$$

This same formula can be used to calculate the treatment removal effectiveness of turbidity or chemical parameters (e.g., arsenic, fluoride) from drinking water.

## 2.5 REPORT THE RESULTS

The primary purpose of a report is to share your results, conclusions and recommendations to an audience. This information should be assembled in a well-organized and easy to read format. It is particularly important to include graphs and tables to help make the report easy to understand.

Reports should be made as early as possible so corrective actions can be taken to ensure safe drinking water. It is important to share the results with the users and/or community so they are aware of their drinking water quality and understand if corrective actions need to be taken.

Reporting the results also gives feedback to improve project implementation and to influence regulators to improve water supplies at a higher level.




As drinking water quality is a sensitive topic, providing test results without guidance and interpretation could lead to misunderstandings and inappropriate action (especially if the report is disseminated outside of the organization). Water quality testing can be a great awareness raising and mobilization tool as long as the results are interpreted and presented properly

## 3 INTERPRETING LABORATORY REPORTS


If you send your water to a commercial laboratory for testing, they will send you a report with the results. Most laboratories provide little additional explanation of test results beyond the units used or possibly a footnote in the event a problem is identified.

A laboratory report will normally contain a table of physical, chemical and microbiological parameters for which your sample was tested, and the measured concentration of each. If you have any problems understanding the way information is presented in the report, you should contact the laboratory directly for an explanation.

The following is an example of a laboratory report that compares the sample results with Zambian Standards. It includes brief recommendations.



Reversing Poverty. Creating healthy homes in Africa.



### Sample Water Quality Lab Report

Sample Description: Borehole w Hand Pump Date Sampled: 16/01/2019  
 Location: Kawama Ndola Date Tested: 16/01/2019- 17/01/2019

Parameter	Units	Results	Zambian Standard
E.coli (Faecal Coliforms)	CFU/100mL	Not detected	0
Total coliforms	CFU/100mL	Not detected	20
Conductivity(EC)	µS/cm	238	1500
Total dissolved solids	mg/L	159.46	1000
Turbidity	NTU	41*	5
pH	-	6.54	6.5- 8.0
Calcium Hardness (CaCO3)	mg/L	65	500
Chloride	mg/L	Not detected	250
Chlorine(free)	mg/L	0.006**	0.2-0.5
Magnesium	mg/L	Not detected	150
Copper	mg/L	Not detected	1.0
Fluoride	mg/L	0.41	1.5
Iron	mg/L	1.95*	0.3
Manganese	mg/L	0.009	0.1
Nitrate	mg/L	0.011	10
Nitrite	mg/L	Not detected	1.0
Sulphate	mg/L	Not Detected	400
Zinc	mg/L	Not Detected	3

(\*)= Above the recommended limit. (\*\*\*)= Below the recommended range

**Notes:** The water quality tested negative for both E.coli and Total Coliforms.  
 All other parameters tested fell within the Zambian Standard except for Turbidity, Free Chlorine and Iron.

**Recommendations;** Regular monitoring of the water quality.

Elijah Mutafya  
Deputy Manager  
Cc Program Manager AFMAC

Date: 17/01/2019

## 4

## KEY POINTS

- There are three main approaches for interpreting the results from water quality tests:
  1. Comparison analysis. The measured values of acceptability, chemical and microbiological aspects can be compared to national water quality standards or the WHO Guidelines for Drinking Water Quality.
  2. Trend analysis. The results can be reviewed to see how they change over time and location to identify any trends or correlations.
  3. Statistical analysis can be done for academic purposes and scientific research.
- Following are the general steps for data interpretation:
  1. Collect data for analysis
  2. Check data quality
  3. Choose an appropriate analysis
  4. Interpret data in relation to the objectives
  5. Report the results
- The primary purpose of a report is to share results, conclusions and recommendations. This information should be organized in a format appropriate to the intended audience.
- Most commercial laboratories provide limited explanations of test results beyond the units used, or possibly a footnote in the event a problem is identified.
- A laboratory report will normally contain a table of parameters for which your sample was tested and the measured concentration of each. Contact the laboratory directly for an explanation if the results are not clear.

**5** GLOSSARY

<b>Bacteria</b>	Single-celled microorganisms, typically a few micrometres (µm) in length. They can live in water, soil, in animals and on plants. Bacteria are usually too small to see with the human eye.
<b>Coliform</b>	A group of generally harmless bacteria which may come from feces or the natural environment.
<b>Colony (bacterial)</b>	A group of bacteria growing on the surface of culture media. A colony starts growing from a single bacteria and appears as a circular dot on the culture media.
<b>Community water supply</b>	The management and administration of the water supply usually handled by the local community. Community water supplies may include simple piped water systems, boreholes with mechanized or hand pumps, dug wells and protected springs.
<b>Concentration</b>	The ratio of the quantity of any substance present in a sample of given volume or a given weight compared to the volume or weight of the sample (e.g., mg/L, µg/L, ppm, and ppb).
<b>Contamination</b>	Pollution of water due to human or natural causes.
<b>Drinking water quality</b>	The chemical, physical, and microbiological parameters of drinking water.
<b>Eschericia coli</b>	E. coli is the preferred bacterial indicator to determine the presence of feces in water.
<b>Fecal bacteria</b>	Bacteria found in the feces of humans or warm-blooded animals. Their presence indicates fecal contamination of water and the possible presence of pathogens.
<b>Guideline</b>	A recommended limit that <b>should</b> not be exceeded.
<b>Implementation</b>	The process of carrying out a plan. The implementation phase of a project happens after the project plan has been created.
<b>pH</b>	A measure of the acidity or alkalinity of water.
<b>Quality control</b>	Aims to identify errors in the finished product. It is a reactive process.
<b>Removal Effectiveness</b>	A measure of ability of a treatment technology to remove contaminants (microbiological, chemical or turbidity).
<b>Sanitary inspection</b>	On-site visual inspection of a water supply system to identify actual and potential sources of contamination.
<b>Standard</b>	A mandatory limit that <b>must</b> not be exceeded; standards often reflect a legal duty or obligation.
<b>Turbidity</b>	The cloudiness or dirtiness of water. Turbidity is caused by suspended solids, such as sand, silt and clay, floating in water. Light reflects off these particles, which makes the water look cloudy or dirty. Turbidity is measured in nephelometric turbidity units (NTU).

## 6 ADDITIONAL RESOURCES

**CAWST: Wash Resources. Interpreting Results.** Available at:

<https://washresources.cawst.org/en/resources/5e5fd682/interpreting-results>

- An e-learning module on interpreting results in water quality testing. It show how to make basic conclusions and recommendations, and to identify common errors in recording test data.

## 7 REFERENCES

Baker D.L. and W. F. Duke (2006). Intermittent Slow Sand Filters for Household Use - A Field Study in Haiti, IWA Publishing, London, UK. Available at: [https://www.survivalistboards.com/d3/downloads/81371-Slow\\_Sand\\_Filter.pdf](https://www.survivalistboards.com/d3/downloads/81371-Slow_Sand_Filter.pdf)

Seeds of Hope International Partnerships (2012). AFMAC Water Analysis Report. Ndola, Zambia.

UNICEF (2008). UNICEF Handbook on Water Quality. UNICEF, New York, USA. Available at: <https://www.unicef.org/media/91301/file/Handbook-Water-Quality.pdf>

World Health Organization (2012b). Rapid Assessment of Drinking-Water Quality: A Handbook for Implementation. WHO, Geneva, Switzerland. Available at: <https://www.who.int/publications/i/item/789241504683>

**8 APPENDIX: SAMPLE DATA RECORDING FORMS**

Location:						Sample Taken By:					
Date of Sampling:						Sample Tested By:					
Sample Description	Sample ID #	Turbidity (NTU)	pH	Chlorine (mg/L)	Iron (mg/L)	Manganese (mg/L)	Arsenic (mg/L)	Nitrate (mg/L)	Fluoride (mg/L)	E. coli Plate Count	x Dilution Factor
										(CFU/100 mL)	Total Count (CFU/100 mL)
Observations and Comments											





CAWST, the Centre for Affordable Water and Sanitation Technology, is a nonprofit organization that provides training and consulting to organizations working directly with populations in low and middle income countries who lack access to clean water and basic sanitation.

This document is open content and licensed under the Creative Commons Attribution-ShareAlike 4.0 International License (CC BY-SA 4.0). To view a copy of this license, visit: <https://creativecommons.org/licenses/by-sa/4.0/>

CAWST will produce updated versions of this document periodically. For this reason, we do not recommend hosting this document for download on your website.

CAWST's directors, employees, contractors and volunteers do not assume any responsibility for, and make no warranty with respect to, the results that may be obtained from the use of the information provided.

You are free to:

- Share – Copy and redistribute the material in any medium or format.
- Adapt – Remix, transform, and build upon the material for any purpose, even commercially.

Under the following terms:

- Attribution – You must give appropriate credit to CAWST, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests that CAWST endorses you or your use. Please include our website: [cawst.org](http://cawst.org)
- ShareAlike – If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original.



B12, 6020 – 2 Street SE  
Calgary, Alberta T2H 2L8  
Canada  
+1 (403) 243-3265  
[resources@cawst.org](mailto:resources@cawst.org)  
[cawst.org](http://cawst.org)

To stay up-to-date and get support on:

The latest updates to this document  
Other workshop and training related  
resources

Using this document in your work

Visit [resources.cawst.org](http://resources.cawst.org)