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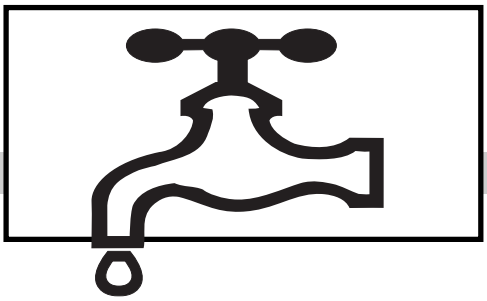

Interpreting Your Water Test Report

*Blake Ross and Kathleen Parrott**

Obtaining a water analysis from a testing laboratory is a necessary first step toward solving household **water quality**** problems. Before seeking testing, you may have had concerns about the safety of the water used in the household. Or you may have noticed objectionable symptoms when using the water for drinking, cooking, or other household purposes. Perhaps you have routinely monitored your household water quality through periodic testing and have recently noticed differing results between tests for one or more indicators. To positively identify the source of contamination problems, as well as to determine the type of corrective action to take, a properly interpreted water analysis report is essential.

Besides providing a laboratory report of the analysis for given **contaminants**, most water testing laboratories provide little additional explanation of test results beyond the units used and possibly a footnote or similar comment in the event that a problem contaminant is identified. The information provided below, along with a glossary of water testing terms, may assist you in understanding a water analysis report for some of the more common household water quality contaminants.

What Do the Numbers Mean?

Once a water testing laboratory has completed the analysis of your water, you may receive a report that looks similar to Figure 1. It will contain a list of contaminants tested for the measured **concentration** of each and will sometimes highlight any problem contaminants. The concentration is the amount of a given substance (weight) in a specific amount of water (volume). The most common concentration unit used is **milligrams per liter** (mg/L) which, in water, is approximately equal to one part per million (ppm), or one part contaminant to one million parts water. For many chemical compounds and toxic substances, the units used to measure concentration are even smaller. In these cases, parts per billion (ppb) is used. Some contaminants have units that are specific to the test like those used for **radon**, **hardness**, conductance, and **turbidity**. Others, such as **pH**, are expressed as an index number and not in terms of concentration, and therefore have no units.

Even with modern techniques and expensive equipment, there are limits to which a water testing laboratory may determine the amount of a given contaminant in water. If the amount of a substance is so small it cannot be measured, the laboratory will usually indicate that the result is "below **detection limit**" (b.d.l.) or "not detected" (n.d.), or it may provide the actual detection limit value for a given contaminant by using a "less than" (<) symbol.

How Much is too Much?

"**Pure**" water does not exist in nature and nearly all water contains contaminants. In most cases, the levels of these contaminants are minimal and of little consequence. When certain contaminant levels in household water are excessive, however, they may affect household activities and/or be detrimental to human **health**. Evaluating what levels of contaminants are acceptable and understanding the nature of problems caused by these contaminants are the basic considerations in interpreting a household water analysis report.

Acceptable limits for evaluating the suitability and safety of a **private** water source, such as a backyard well, are available for many contaminants. Some established standards are set by nuisance (taste, odor, staining, etc.) considerations, while many are based on health implications and are legally enforceable with respect to **public water systems**. These acceptable limits should

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***Words in bold type are defined in WATER TESTING TERMS at the end of this publication.*

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be used as guidelines for your own water supply when evaluating your test results.

Whether you have the results of specific tests that you requested, or you simply instructed the laboratory to conduct general or routine household water quality tests, you can use the following tables as a general guideline for the most common household water quality contaminants. These are divided into three categories: general indicators, nuisance impurities, and health contaminants. (Note: Some contaminants are evaluated on the basis of both nuisance and health criteria.) The limited discussion accompanying each contaminant will provide you with acceptable limits and some information about symptoms, sources of the problem, and the resultant effects.

General Indicators

General water quality indicators are parameters used to indicate the possible presence of other harmful contaminants. Testing for indicators may eliminate costly tests for specific contaminants. Generally, if the indicator is excessive, the supply may contain other contaminants as well, and further testing is recommended. For example, you are probably familiar with **coliform bacteria**. These harmless bacteria are present in the air, soil, vegetation, and all warm-blooded animals. A positive total coliform bacteria test result may be followed by a fecal coliform or E. coli bacteria test which, if present, would confirm that sewage or animal waste is contaminating the water. The pH value is also considered a general water quality indicator which, along with **total dissolved solids** (TDS), should not change appreciably over time. The tests listed in Table 1, with a test for **nitrate** (See Table 4), provide a good routine (as often as once a year) analysis for most rural water supplies, unless there is a reason to suspect other contaminants.

Nuisance Contaminants

Nuisance contaminants are another category of contaminants. While these have no adverse health effects at low levels, they may make water unsuitable for many household purposes. Nuisance contaminants may include iron, bacteria, chloride, and **hardness**. Table 2 lists some typical nuisance contaminants you may see on your water analysis report. Acceptable limits for nuisance contaminants come from the **EPA Secondary Drinking Water Standards**

Hardness is one contaminant you will also commonly see on the report. Hard water causes white, scaly deposits on plumbing fixtures and cooking appliances

Table 1: General Water Quality Indicators

Indicator	Acceptable Limit	Indication
Coliform Bacteria	<1 coliform/100ml	Possible bacterial or viral contamination (absent) from human sewage or animal waste
pH Value	6.5 to 8.5	An important overall measure of water quality, pH can alter corrosivity and solubility of contaminants. Low pH will cause pitting of pipes and fixtures and/or a metallic taste. This may indicate that metals are being dissolved. At high pH, the water will have a slippery feel or soda taste.
Total Dissolved Solids (TDS)	500 mg/L	Dissolved minerals, like iron or manganese. High TDS also may indicate hardness (scaly deposits) and cause staining, or a salty, bitter taste.

Table 2: Common Nuisance Contaminants and Their Effects

Contaminant	Acceptable Limit	Effects
Chlorides	250 mg/L	Salty or brackish taste; **corrosive**; blackens and pits stainless steel
Copper (Cu)	1.0 mg/L	Blue-green stains on plumbing fixtures; bitter, metallic taste
Iron (Fe)	0.3 mg/L	Metallic taste; discolored beverages; yellowish stains on laundry, reddish-brown stains on fixtures
Manganese (Mn)	0.05 mg/L	Black specks on fixtures; bitter taste
Sulfates (SO_4)	250 mg/L	Bitter, medicinal taste; **corrosive**; offensive odor
Iron Bacteria	———	Orange- to brown-colored slime in water

and decreased cleaning action of soaps and detergents. Hard water can also cause buildup on hot water heaters and reduce their effective lifetime. Table 3 will help you interpret your water hardness parameters.

Table 3: Hardness Classifications

Concentration of Hardness		
In Grains per Gallon (gpg)	In Milligrams per Liter (mg/L)	Relative Hardness Level
Below 3.5	Below 60	Soft
3.5 to 7.0	60 to 120	Moderately Hard
7.0 to 10.5	120 to 180	Hard
10.5 and above	180 and above	Very Hard

Hardness may be expressed in either milligrams per liter (mg/L) or grains per gallon (gpg). A gpg is used exclusively as a hardness unit and equals approximately 17 mg/L or ppm. Those water supplies falling in the hard-to-very hard categories may need to be softened. However, as with all water treatment, you should carefully consider the advantages and disadvantages of softening before making a purchase.

Health Contaminants

The parameters in Table 4 are some common contaminants that have known health effects. The table lists acceptable limits, potential health effects, and possible uses and sources of the contaminant. In public water systems, these contaminants are regulated under the EPA Primary Drinking Water Standards. Except for nitrates, tests for these contaminants are usually only done when a specific contamination is suspected.

Table 4: Standards, Sources, and Potential Health Effects of Common Regulated Contaminants

Contaminant	Acceptable Limit	Sources/Uses	Potential Health Effects at High Concentration
Atrazine	3 ppb	Used as a herbicide; surface or groundwater contamination from agricultural runoff or leaching	Heart and liver damage
Benzene	5 ppb	Gasoline additive; usually from accidental oil spills, industrial uses, or landfills	Blood disorders, like aplasticaremia; immune system depression; acute exposure affects central nervous system causing dizziness, headaches; long-term exposure increases cancer risks.
Fluorides	4.0 mg/L	Additive in treatment process; also used in manufacturing processes and insecticides.	Mottling of teeth and bones
Lead	15 ppb	Used in batteries; lead gasolines and pipe solder; may be leached from brass faucets, lead caulking, lead pipes, and lead soldered joints.	Nervous disorders and mental impairment especially in fetuses, infants, and young children; kidney damage; blood disorders and hypertension; low birth weights
Nitrates	10 mg/L nitrate-N	Soil by-product of agricultural fertilization; human and animal waste leaching to groundwater.	Methemoglobinemia (blue baby disease) in infants (birth-6 months); low health threat to children and adults
Radon	300 pCi/l	Naturally-occurring gas formed from uranium decay can seep into well water from surrounding rocks and be released in the air as it leaves the faucet.	Breathing gas increases chances of lung cancer; may increase risk of stomach, colon and bladder cancers.
Trihalo-methanes	0.100 mg/L	Results from residual chlorine in treated water that combines with organic matter in water.	Cancer; heart, lung, kidney and liver damage.

WATER TESTING TERMS

Acidic.

A descriptive term used in reference to water having a **pH** of less than 7; pertains to the **corrosiveness** of water.

Acute Health Effects (acute toxicity).

Any poisonous effect with a sudden and/or severe onset produced within a short period of time after using contaminated water, resulting in mild to severe biological harm or illness. Acute symptoms include, but are not limited to, upset stomach, loose stool, bowel upset, and gastrointestinal difficulties. If symptoms occur as a result of drinking contaminated water, medical attention should be sought promptly.

Aesthetic Characteristics.

The nonhealth-related characteristics of water which make it desirable for human use. Generally taste, color, odor, and **turbidity** are considered to be aesthetic characteristics.

Alkaline.

A water sample having a **pH** greater than 7 is alkaline (non-**acidic**).

Carcinogenic.

Capable of causing cancer.

Certified Testing Laboratory.

A lab listed by the Virginia Division of Consolidated Laboratory Services as qualified to test drinking water in Virginia. Information about local state-approved labs is available at local Virginia Cooperative Extension or Health Department Offices.

Chronic Health Effects.

Chronic means long-term. Chronic health effects occur and persist as a result of repeated or long-term use of contaminated water. Often, it takes a lifetime of exposure for chronic health effects to occur. Chronic health effects include irreversible damage to internal organs, and mutagenic effects (changes in the gene structure) which can result in cancer, birth defects, disabilities, and other problems.

Coliform Bacteria.

A type of bacteria found in large numbers in the intestinal tracts of humans and animals. Coliform bacteria are used as an indicator test—if the coliform count is unacceptable, it is an indicator that the water is polluted and that further tests for other bacteria or **pathogens** would be advisable.

Concentration.

The amount of a given substance (weight) in a specific amount of water (volume).

Contaminants.

Substances that make water unfit for drinking and/or other household uses; used interchangeably with **pollutants**.

Corrosive Water.

Water that is **acidic** and "soft" may be corrosive and may deteriorate plumbing and leach toxic metals such as lead and copper from pipes.

Detection Limit.

The minimum **concentration** of a substance that may be measured and reported in the given testing method. Many lab reports will state what the detection limit is for each **contaminant**.

Disinfection.

The destruction of all **pathogenic** organisms.

EPA

The abbreviation for the Environmental Protection Agency, properly called, "the United States Environmental Protection Agency." This agency has the responsibility of developing and enforcing **Primary** Drinking Water Standards. The EPA also develops, but does not enforce, **Secondary** Drinking Water Standards.

Grains per Gallon (gpg).

Apothecaries' weight of a chemical substance in one gallon of water used in the water-conditioning trade to indicate **hardness** of water. One gpg equals approximately 17 mg/L hardness.

Hardness.

A major water quality problem in western Virginia. Hardness is a relative term. It describes the content of the dissolved minerals, calcium and magnesium, and is reported as **grains per gallon.** Water with less than 3.5 grains per gallon is considered "soft"; while hard water above 7 grains per gallon may affect the appearance of plumbing fixtures, the lifespan of water heaters, and the effectiveness of detergents.

Health Risk.

The risk or likelihood that a chemical will adversely affect a person's health. Estimating health risks is a complex and inexact science.

Heavy Metals.

Elements with high molecular weights which are generally **toxic** in low concentrations to plant and animal life. Examples include mercury, chromium, cadmium, arsenic, and lead. Heavy metals are often found in runoff from industrial sites, hazardous waste disposal and landfills.

Hydrogen Sulfide.

A hazardous, suffocating gas that smells like rotten eggs when it escapes from water, and will result from sulfates in the water.

Iron Bacteria.

Microorganisms that feed on iron in the water. They may appear as a slimy rust-colored coating on the interior surface of a toilet flush tank or as a glob of gelatinous material in the water.

Maximum Contaminant Level (MCL).

The maximum level of a **contaminant** which is permitted in **public** water supplies. Maximum contaminant levels are specified in the **Primary** Drinking Water Standards set by **EPA** for contaminants that affect the safety of public drinking water.

Milligrams per Liter (mg/L).

Metric weight of a substance in a liter of water. 1 mg/L = 1 ounce per 7,500 gallons. (1 mg/L = approximately 1 **ppm** in water).

Most Probable Number (MPN).

An index expression used in the multiple-tube fermentation-testing procedure to indicate the presence of **coliform bacteria** in a sample of water. MPN is a "most probable number," or estimate, rather than an actual count of microorganisms.

Nitrate.

A salt form of the chemical, nitrogen. The presence of nitrates in a water supply generally indicates contamination by human or animal waste, and/or commercial fertilizer.

Nuisance Contaminants.

Contaminants which affect **aesthetic** or functional aspects of water quality and have little or no impact on health. They are managed by setting **Secondary** Maximum Contaminant Level Standards.

Organic Chemicals.

Those chemicals which contain carbon. Historically, organic compounds were obtained from vegetable or animal sources. Today, many organic chemicals are synthesized in a laboratory. Organic chemicals which can contaminate water supplies include **trihalomethanes**, pesticides, and **volatile organic chemicals**.

Parts per Million (ppm).

Concentration of a substance on a weight basis in water. 1 ppm = 1 pound of a **contaminant** per million pounds of water (1 ppm in water = approximately 1 mg/L).

Pathogens.

Live organisms which contaminate water such as bacteria, viruses, and parasites.

pH.

A factor used to measure the **acidity** and **alkalinity** of water. Values for pH fall on a scale ranging from 0 to 14. Water that has a pH of 7 is neutral; water that is acid has a pH lower than 7 and water that is alkaline has a pH greater than 7. The **secondary** standard for drinking water is a pH between 6.5 and 8.5.

Pollutants.

Natural or man-made substances that make water unfit for human consumption or use.

Potable Water.

Water fit for drinking.

Primary Standards.

The Primary Drinking Water Standards are published, monitored, and enforced by the **EPA.** Primary standards regulate **contaminants** which pose serious health risks to the water user. The primary standards are only enforceable in **public water systems**.

Private Water Systems.

Any systems which do not meet the definition of **public water systems**, for example, a private/individual water source, such as a backyard well. Private water systems are not regulated by **VDEQ** or **EPA** standards.

Public Water System.

In Virginia, a public water system is one that serves at least 15 connections (for example households) or at least 25 individuals. **VDEQ** and **EPA** regulations apply to public water systems.

Pure.

Without **contaminants**.

Radon.

A tasteless, odorless, colorless radioactive gas formed from decay of radium in rocks that has been found dissolved in some groundwater supplies. Though it can be swallowed in a glass of water, it is most dangerous when inhaled. Activities that release radon as vapor from water include showering, bathing, and cooking. Radon is known to be **carcinogenic** and is linked with increased risk of lung cancer.

Safe.

The level of **contaminants**, if any, is low enough that no health problems will occur.

Saturation Index.

One of the methods (see **Stability Index**) for assessing the **scale**-dissolving (**corrosive**) or **scale**-forming potential of water. A positive number indicates a tendency to deposit calcium carbonate. If the result is negative, it is an indication that the water will dissolve calcium carbonate and enhance **corrosion**.

Scale.

Mineral deposits which build up on the inside of water pipes and water-using appliances, like coffee pots. Scale is primarily composed of calcium carbonate and usually associated with **hard** water.

Secondary Standards.

The Secondary Drinking Water Standards are published by the **EPA**. Secondary standards set desirable/acceptable levels for nuisance **contaminants** which affect taste, odor, color, and other **aesthetic** and functional qualities of the water supply. These secondary standards are not enforced by law, but rather are guidelines for municipal water treatment plants and state governments.

Stability Index.

One of the methods (See "**Saturation Index**") for assessing the **scale**-forming or **scale**-dissolving potential of water; an index of about 6.0 or less indicates **scale**-forming tendencies, an index of 7.5 to 8.0 shows **scale**-dissolving (**corrosive**) tendencies.

Total Dissolved Solids (TDS).

A good general indicator of water quality which measures the total amount of dissolved minerals, metals, and salts. Water with more than 500 milligrams per liter TDS is of poor quality and may contain undesirable amounts of calcium, magnesium, sulfates, chlorides, or other substances.

Toxic Metals.

Arsenic, barium, chromium, mercury, selenium, silver, and other toxic metals are regulated by **Primary** Drinking Water Standards. Toxic metals may be naturally occurring in rock and soil, or may contaminate water as a result of runoff or leaching from industrial or agricultural sites or hazardous waste disposal.

Toxicity.

The toxicity (poisonous effect) of a water **contaminant** depends on the **concentration** of the contaminant in the water and the period of time the contaminated water is consumed. Any chemical can be toxic, if you swallow enough of it. Also, people react differently to different toxic substances; some people may be harmed more than others. Pregnant and nursing women, the elderly, infants, ill or malnourished people, and people taking medication may be especially vulnerable to certain contaminants.

Trihalomethanes.

Organic chemicals which can form when residual chlorine from treated drinking water combines with traces of bromine and natural organic materials.

Turbidity.

A cloudy condition in water due to suspended silt or organic matter.

VDEQ.

The abbreviation for the Virginia Department of Environmental Quality. The VDEQ is responsible for developing, monitoring, and enforcing Virginia's water quality standards.

Volatile Organic Chemicals (VOCS).

Synthetic compounds which evaporate readily and are difficult and expensive to detect. **Primary** Drinking Water Standards set limits for several volatile organic chemicals, including the solvents such as trichloroethylene and carbon tetrachloride, and the gasoline component, benzene. Tests for synthetic organic chemicals are not routine and tend to be fairly expensive because of the difficult and precise laboratory work involved.

Water Quality.

Determined by these characteristics: **safety**, taste, color, smell, **corrosivity**, staining, and **hardness**.

Adapted from the following publications: *How to Interpret a Water Analysis Report* by P.D. Robillard, W. E. Sharpe, and K. S. Martin of Pennsylvania Cooperative Extension, and *Water Testing Terms* by M. A. Sward of Oregon Cooperative Extension.

Where Can I Get Additional Information?

Further assistance with interpretation of your household water quality test report is available. If you have any problems understanding the way the information is presented on the report, you should contact the testing laboratory directly for explanation. To assist you in evaluating the significance of your results, and any actions you should take to solve identified problems, or for further information on contaminants not discussed in this publication, your local Health Department or Cooperative Extension Office is available. If you wish to obtain more background information about the occurrence of contaminants and their effects on household water quality, particularly as it pertains to establishing drinking water standards, the EPA operates the Safe Drinking Water Hotline at (800) 426-4791.

The following publications deal with various aspects of household water quality and are available through your local Virginia Cooperative Extension Office.

Additional titles may be added in the future.

Household Water Testing, VCE Publication 356-485.

Home Water Quality Problems—Causes and Treatments, VCE Publication 356-482

Hydrogen Sulfide in Household Water, VCE Publication 356-488

Lead in Household Water, VCE Publication 356-483

Nitrates in Household Water,VCE Publication 356-484

Bacteria and Other Microorganisms in Household Water, VCE Publication 356-487

Household Water Treatment, VCE Publication 356-481

Questions to Ask When Purchasing Water Treatment Equipment, VCE Publication 356-480

Buying Bottled Water, VCE Publication 356-486

Figure 1. A Sample Water Analysis Report

Analytical Laboratory Report

Client: Client's Name
Collected by: KM
Project: Analytical Laboratory Services
Project Number: CL000001
Date Collected: 05/28/98
Time Collected: 7:35 a.m.
Sample Identification: Kitchen tap
Lab Number: 01000

Analysis	Results	Units
Total Coliform Bacteria	50	#/100ml
Nitrate-Nitrogen	4.55	mg/L
pH	7.50	
Iron	0.55	mg/L
Hardness as CaCo3	280	mg/L
Sulfate Sulfur	32.0	mg/L
Chloride	25.4	mg/L
Specific Conductance	344	umhos/cc

On the basis of the above test result(s), this water sample DOES NOT MEET EPA Drinking Water Standards.

The following notes apply to this sample:

The Total Coliform Bacteria exceeded the max.lev. of 1 colony/100ml.
The Iron level exceeded the limit of 0.3 mg/L.

Submitted by: _____

Laboratory Manager