

## Matters of Perspective (Part 2 – ppm, ppb, and ppt)

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In matters of chemical concentration in water, just how much is one part per million (ppm)? How does that compare to parts per billion (ppb) or to parts per trillion (ppt)? To many people, especially non-technical people who read the test results of their drinking water or see references to environmental results in their local newspapers, the ppm, ppb, and ppt units of measurement may not be understood at all. Not only may the math not be understood, but the concepts of these measurements may not be grasped either. This became especially evident to me years ago when someone took the oil from his truck's backyard oil change and dumped it out in the woods. "How much harm can such a small amount of oil do?" I was asked. A lot, actually.

In the right circumstances, a small amount of oil can contaminate a drinking well from years to almost forever. This is just one example; there are thousands of others. It doesn't take much of a pollutant to create health or environmental problems, and the levels of concern are usually in the concentration range of ppm or less.

Parts per million, parts per billion, and parts per trillion can easily be visualized when compared to amount of time.

Parts per million (ppm) is often written as milligrams per liter (mg/L). While these two terms are not absolutely the same by definition, they are frequently used interchangeably in the water and wastewater fields.

One million seconds is about eleven and a half days. Pick one second out of 11 ½ days and that will be 1 ppm. Drinking water limits for copper are usually measured in the ppm range. In Massachusetts, the copper limit for drinking water is 1.3 ppm. If a liter of tap water were 11 ½ days long, and 1.3 seconds of it was copper, then your public water drinking supply would be in violation of a health limit.

Most NPDES permit limits are also measured in ppm. The most common parameters are total suspended solids (TSS), BOD, ammonia-nitrogen, and phosphorus.

Parts per billion (ppb) is often written as micrograms per liter (ug/L). Likewise, ppb and ug/L are often used interchangeably in the water and wastewater fields.

About 32 years contains a billion seconds. Pick one second out of 32 years and that will be 1 ppb. Organic pollutants like MTBE (used years ago as a gasoline additive), trichloroethylene (once widely used as a degreaser), and pesticides residues, are usually measured in the ppb range. NPDES permits are starting to get total residual chlorine and metal discharge limits in the ppb range, too.

Parts per trillion (ppt), or nanograms per liter (ng/L), is the equivalent of one second out of about thirty-two thousand years. Mercury and PFAS (Per- and Polyfluoroalkyl Substances) in aqueous environmental samples are often measured in ppt range.

At levels such as these, it isn't hard to exceed environmental or health-related limits. Whether it is from oil poured in the woods, copper leaching from household pipes, a leaking underground gas tank, or a pesticide that is washed off bolts of cloth in a textile mill, it doesn't take much of a pollutant to create a problem.

The information in this article is very general. As usual, check your federal, state, and local regulations. You may have additional regulations or requirements that you must meet.

### References:

*Standard Methods for the Examination of Water and Wastewater* 23<sup>rd</sup> edition 2017, part 1050 Expression of Results, section 1050 A. Units.

[https://www.mass.gov/guides/drinking-water-standards-and-guidelines#-massachusetts-maximum-contaminant-levels-\(mmcls\)-](https://www.mass.gov/guides/drinking-water-standards-and-guidelines#-massachusetts-maximum-contaminant-levels-(mmcls)-)

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