UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street, WTR-6
San Francisco, CA 94105

13 July 2011

Mr. Leroy Hunter
Kern Valley State Prison
3000 W. Cecil Ave
PO Box 5102
Delano, CA 93216-5102

Dear Mr. Hunter:

Thank you for your letters of 4 March and 3 May 2011 asking about the health effects of arsenic. You noted that you have been drinking water with arsenic at 0.022 mg/liter for over five years, so are concerned for the consequences of long-term exposures from drinking, bathing and washing clothes in this water.

It is said in the toxicology profession, "the dose is the poison." Virtually anything we ingest can be toxic if we take too much. (People can drink too much water, for example.) So I'll answer your question in two parts: what arsenic does to people and what you can expect from drinking water at the levels reported for your water system. I'll also try to explain EPA's drinking water Maximum Contaminant Level (MCL) for arsenic.

With respect to arsenic, it is definitely a poison and has several adverse physiological effects. At high enough levels (about 100-200 mg), it stops mitochondrial respiration, your cells can't generate energy, and they (and you) die. This is what is meant by acute toxicity. In addition, arsenic appears to cause oxidative damage and stimulates the formation of a variety of physiological stress-related proteins. At lower levels ingested chronically over a longer time (1-10 mg/day or so for months or years), this still goes on, but not enough to kill you outright. Your system is merely weakened to the point that it isn't as effective at fighting off other kinds of cellular damage, which can build up and lead to other problems. Adverse health effects may occur only after years of exposure to these lower levels. Some of these include circulatory, neurological and liver problems. For example, a variety of skin diseases (hyperkeratoses, blackfoot, hyperpigmentation) are known to occur at levels starting around 100-200 ug/day (0.1-0.2 mg/day).

You mentioned that you suffer from diabetes. While there is more than one form of diabetes and many possible causes, arsenic also has hormonal effects that can cause diseases such as diabetes. These appear to happen even at much lower levels, perhaps less than 100 ug/day (0.1 mg/day).

Arsenic is a known human carcinogen. It appears to cause broken and missing chromosomes and

other chromosomal abnormalities. It can cause lung, bladder, and skin cancers, and may cause liver, kidney and prostate cancers. Elevated cancer levels are seen in populations drinking water with arsenic levels of 100-200 ug/liter, which is about 200-400 ug/day. It usually takes many years of drinking water at these levels for cancers to occur. At higher levels (500-1000 ug/day), these cancers form faster.

So what does this all mean for the level of arsenic you receive (0.022 mg/liter = 22 ug/liter)? If you consume 2 liters of water by drinking it or from eating food cooked in this water, you get about 40 ug/day of arsenic. It may be a bit of a comfort that medical studies don't show much if any disease at these levels. However, for all of these diseases and adverse health effects, the research suggests that arsenic is causing something to happen biochemically even at very low levels. We just can't see medical problems. Why might that be? Most people have some physiological tolerance for arsenic. Even at higher doses, most people don't die or get sick from arsenic. Our bodies produce metallothionein (MT), a protein that can offset some of the damage caused by arsenic and other heavy metals. MT production is induced by low levels of arsenic. So it may be that MT is affording enough protection that the amount of biochemical damage from low arsenic doses is dealt with by the body before something more serious occurs. This would be like the body's healing of a wound, but at the cellular level. Because individuals vary in their physiology, some may have more intrinsic protection than others. At much higher arsenic exposures, the damage might be more than MT and all your other protective systems could handle, so the chance of disease would increase and be seen by the doctors.

Finally, what does this mean with respect to EPA's MCL for arsenic, which is 10 ug/L? The Safe Drinking Water Act tells EPA to set drinking water goals at levels at or below known or anticipated adverse effects on people with an adequate margin of safety. Because of the human variation, we set our levels to protect those that might be most vulnerable to the contaminant. Our risk assessments use conservative factors to address these more-vulnerable people. For cancer-causing contaminants like arsenic, that means that our MCLs are set as low as can be practically achieved. (Practical means that we can actually measure it, and water treatment systems can remove it.) Generally, our MCLs are many times lower than any level where disease is seen by the medical profession. We want the risk level at the MCL to be so low that even if your water is somewhat above the MCL, you should be safe.

I hope that this addressed your concerns. If not, you can reach me at the above address or at 415 972-3569.

Sincerely,

Bruce A. Macler, PhD
Regional Toxicologist
Drinking Water Program