QUESTIONS ABOUT ANIMALS AND ENVIRONMENT
Updated August 2010

Q: What are the impacts of chlorine and chloramine on fish and aquatic organisms?
A: Fish and other aquatic organisms are very sensitive to both chlorine and chloramine and may die if exposed to these oxidants. Concentrations of chloramine as low as 0.07 mg/L have been shown to be lethal to coho salmon in 96 hour studies.
Chloramine does not bioaccumulate or transfer up the food chain (Environment Canada, 2002). For fish-owners, the challenge with chloramine is twofold: it does not dissipate rapidly so letting the water sit for a day or two will not make it safe for fish, and the "chlorine neutralizers" are not effective for chloramine (Harms and Owen, 2004). The ammonia in the chloraminated water may be harmful to fish under certain conditions. Chloramine neutralizing chemicals are available in pet stores. Utilities dechlorinate water when discharging large volumes of chloraminated or chlorinated water to the environment.
The mechanism responsible for the toxicity of chloramine to fish differs somewhat from chlorine toxicity. Chlorine does not readily pass the permeable gill epithelium compared with chloramine. Chlorine destroys the cells of the gills by oxidation, causing an impairment of normal gaseous exchange. Affected fish exhibit labored respiration due to an inability to utilize available dissolved oxygen in the water. Chloramine crosses the gill epithelium with an insignificant amount of cellular damage as compared with chlorine. Once the chloramine has entered the bloodstream it chemically binds to iron in hemoglobin in red blood cells causing an inability of the cells to bind oxygen (Environment Canada, 2001; Kirmeyer et al., 2004). The toxicity of chloramine to aquatic organisms is dependent on biological species, chloramine compounds, presence of chlorine and organic chloramines, pH, temperature, exposure duration and life stage of the biological species (Environment Canada, 2001).
Two methods can be used to remove chloramine from water to be used in aquariums or ornamental fish ponds: addition of specific agents, which will remove chloramine and ammonia, or use of granular activated carbon (GAC) filter. A home test kit may be purchased to test the aquarium water for total chlorine and ammonia. Most pet stores sell dechlorinating agents and recommend their use. It may take more dechlorinating agent and more time to remove chloramine than chlorine. Ammonia can be toxic to fish, although all fish produce some ammonia as a natural by-product. Commercial products are available at pet stores to remove excess ammonia. Biological filters, natural zeolites and pH control methods are also effective in reducing the toxic effects of ammonia. Ammonia removal is especially important at high pH, because at a higher pH, ammonia is more toxic to fish. Chloramine can also be removed by using a GAC filter. It is important to allow the appropriate amount of contact time for chloramine removal using that method (Kirmeyer et al., 2004).

Q: What are the effects of ammonia on fish?
A: Ammonia is not toxic below pH 7, since ammonia is in the ionized ammonium ion form $NH4_o$ For example in water with a pH of 6.9 and at a temperature of 24 C, 99.58% of the ammonia is in the non-toxic ammonium ion form and 0.42% as potentially toxic unionized ammonia. However, at the same temperature but at a pH of 8, such as in marine aquarium, the percentage of ionized ammonia is 90.51%, and the unionized form 9.49% (Kirmeyer et al., 2004).
Ammonia can be toxic to fish above pH 7, although all fish produce some ammonia as natural byproduct. Ammonia is also released when chloramine is chemically removed. Although ammonia levels may be tolerable in individual tanks or ponds, commercial products are available at pet supply stores to remove excess ammonia. Also, biological filters, natural zeolites and pH control methods are effective in reducing the effects of ammonia (Kirmeyer et al 2004). In established aquaria and pond systems with properly functioning biological filter beds, the nitrifying bacteria will remove the ammonia produced during dechloramination in a fairly short period of time. Therefore it may not be necessary to use zeolites under such conditions. However, they should be used whenever setting up new aquariums, when the water is alkaline, and where there is insufficient biological filtration. It is also important to note that zeolites can only be used for the

removal of ammonia in fresh water. In salt water, zeolites are unable to function properly due to the high concentration of sodium chloride.

Q: Will chloramine dissipate when watering the lawns and how will runoff impact environment?

A: Watering lawns releases low volumes of water and disinfectant and is considered an incidental discharge. Chloramine will dissipate as a result of lawn watering because chloramine will be neutralized by the soil particles (this process is termed “chloramine demand”). The small amount of chloramine should not have any effect on plants of any type. Based on the available evidence, adverse effects on soil microorganisms and associated soil processes from inorganic chloramine are considered unlikely (Environment Canada, 2001).

Incidental discharges should not pose a direct risk to fish. Most of the water that is used for landscape irrigation percolates into the ground. As this water gradually runs off landscaping, soil or pavement, the "chloramine demand" consumes the residual chlorine or chloramine, effectively neutralizing any residual before it enters the storm sewer or bay. There will be no effect on estuarine or marine organisms. Before water leaves any Bay Area wastewater treatment plant, the chlorine or chloramine are neutralized. This applies to combined sewer overflows as well.

A high volume direct discharge of chloraminated water to the environment can result from pipeline breaks or flushing fire hydrants. As with chlorinated water, this needs to be avoided because chlorine residual in the chloraminated water may pose a direct acute health risk to fish in creeks and streams. Water companies use dechlorinating agents to remove chloramine from the water during high volume discharges and while flushing fire hydrants.

Q: What are the impacts of chloramine on pets?

A: Chloramine is safe for all mammals and birds and most reptiles. Chloramine is not expected to cause any health problems for dogs or cats. Some people have been worried because trichloramine has been associated with a disorder called "canine hysteria" in dogs. However, this disorder is associated with trichloramine, not monochloramine; trichloramine is not present in the SFPUC chloraminated drinking water.

Harms and Owen (2004) interviewed several veterinarians in a local chloraminated system about impacts to pets and no issues or concerns were identified. With the exception of one reptile group (turtles) and amphibians, no known adverse effects are reported in the literature for exposure to or consumption of chloraminated water. Turtles and amphibians spend a significant amount of time in water and, based on recommendations of a local zoological garden, it was recommended that both chlorine and chloramine be removed from their water. No adverse impacts on any pets have been reported to the utility.

Q: If cows drink chloraminated water will chloramine be in their milk?

A: No, chloramine does not enter cows’ milk. Monochloramine is broken down in the digestive process and it is "not expected to enter the systemic circulation" (Hankin 2001). Additionally, it is rare for cows to be supplied with treated drinking water. Most livestock drink untreated well water or water from streams, not tap water. Even if they were exposed to monochloramine, chloramine would be broken down in their digestive process.