Information Sheet: *Perfluorochemicals*

What are perfluorochemicals?
Perfluorochemicals (PFCs), also called per and polyfluoroalkyl substances, are manmade chemicals that resist heat, water, oil, grease, and stains. PFCs have been used in common household items such as nonstick pots and pans, stain-resistant carpets and fabrics, stain-resistant paints, flame-resistant clothing, as a part of fire-fighting foam, and can also be found in other common items such as fast-food cartons/containers and wrappers.

Some examples of PFCs are:

- Perfluorooctane sulfonate (PFOS)
- Perfluorooctanoic acid (PFOA)
- Perfluorohexane sulfonate (PFHxS)
- Perfluorohexanoic acid (PFHxA)
- Perfluoropentanoic acid (PFPeA)

Where are PFCs found in the environment?
PFCs are stable and ubiquitous in the environment. Potential sources of PFCs in the environment may include industrial sources, areas where PFCs are used frequently, and consumer products. Because PFCs have been used in a wide array of consumer products, most people have been exposed to them. Consequently, these compounds have been widely found in human blood (e.g., PFOA, PFOS, PFHxS, and PFNA are measurable in the serum of most US citizens, regardless of age). While consumer products and food are a large source of exposure for most people, drinking water can be an additional source in communities where PFCs have contaminated drinking water supplies.

How are PFCs in drinking water regulated?
Because they are emerging contaminants, there are currently no established federal maximum contaminant levels (MCLs) for PFCs in public drinking water. However, the USEPA set health-protective oral reference doses (RfDs) along with a health advisory level of 0.07 micrograms per liter (0.07 μg/L or ppb = 70 parts per trillion) for both PFOS and PFOA in May 2016. The TCEQ had previously derived very similar safe oral doses (RfDs) for PFOS and PFOA as well as for 14 other PFCs for which no other regulatory agency had derived health-protective remediation cleanup levels (e.g., drinking water, surface soil).

What if I drank water above the USEPA health advisory level and/or TCEQ cleanup levels?
Drinking water at a level above USEPA's health advisory level and/or TCEQ cleanup levels does not necessarily mean that adverse health effects are expected. Health-protective screening levels do not represent bright lines between safe doses and those where health effects would be expected. Rather, such levels are set by regulatory agencies using assumptions (e.g., a full lifetime of exposure) and methods (e.g., safety factors) designed to result in health-protective screening levels that are precautionary in nature. For example, the USEPA health advisory level for PFOS/PFOA only allows for 20% of the safe dose from drinking water. Additionally, as a cautionary measure, these types of health-protective values assume that humans are much more sensitive than even the most sensitive laboratory animal species for the most sensitive effect (e.g., the health advisory level for PFOS/PFOA conservatively assumes humans may be 30 times more sensitive) and screening levels may be lowered even further in consideration of some possibility of the existence of an even more sensitive effect (e.g., all TCEQ values were divided by an additional safety factor of 10 in consideration of this possibility). Screening levels developed by regulatory agencies would be significantly higher and might still be health protective without use of some of these precautionary assumptions/methods, but exactly how much higher a given screening level might be while still amply protecting human health cannot be accurately determined.

While USEPA's health advisory level and TCEQ cleanup levels are precautionary in nature, at some point over these levels the risk of health effects begins to increase with increasing dose, depending on actual exposure over time (e.g., the magnitude, frequency, and duration of the dose) along with a person's individual characteristics (e.g., disease status). *Therefore, if the sampling results for your drinking water indicate PFC concentrations above comparison levels, out of an abundance of caution it is important to follow advice about ways to reduce exposure, such as*:

- Not ingesting PFC-contaminated water.
- Using alternative, non-contaminated sources of water for drinking, food preparation/cooking, baby formula/food preparation, etc.
- Taking care not to accidentally ingest an appreciable amount of contaminated water while showering/bathing or using the water for another purpose (e.g., car washing, yard work).

Finally, any specific health concerns/conditions are best addressed by your personal primary care physician.

What health effects have PFCs caused in toxicity studies?
It is important to recognize that the standard precautionary assumptions and methods used by regulatory agencies in calculating health-protective levels result in doses significantly below those that have caused adverse health effects in toxicity studies. For example, even at 40 times the health advisory level for PFOA (2,800 parts per trillion (ppt)), drinking water doses are about 30-60 times below the PFOA dose associated with the most sensitive effects in the most sensitive species identified by USEPA. Similarly, at 15 times the health advisory level for PFOS (1,050 ppt), doses are about 20-50 times below the PFOS dose associated with the most sensitive effects in the most sensitive species. With this understanding in mind, at sufficiently high doses PFCs have been shown to have the ability to cause numerous effects in laboratory animals, including (but not limited to): liver effects (e.g., increased liver weight/damage), developmental effects (e.g., decreased pup body weight and bone effects, decreased/ increased motor activity, increased liver weight), kidney effects (e.g., increased kidney weight, changes to the kidney cells), blood effects (e.g., increased clotting time, decreased red and white blood cells), decreased body weight. Some human studies, for example, suggest these compounds may increase blood cholesterol levels, may increase uric acid levels (which may be associated with increased high blood pressure risk), and may cause liver effects, though these studies are not definitive. There is no conclusive evidence that these chemicals cause cancer. *Your family's health care provider is the best resource for discussing your general health as well as any particular health concerns.*

How can exposure to PFCs be reduced?
It is extremely difficult to completely avoid exposure to products that contain PFCs. However, consistent with the advice above, exposure can be reduced by eliminating the consumption of water known to be contaminated with PFCs and using alternative sources (e.g., bottled drinking water) for drinking water, food preparation/cooking, baby formula/food preparation, and any activity that might result in the ingestion of contaminated water.

Is bathing and/or showering a source of significant exposure?
Studies have shown very limited absorption of PFCs through the skin, and PFCs such as PFOS and PFOA do not readily volatilize out of water. Consequently, neither showering nor bathing in PFC-contaminated water (nor hand washing) are likely to be significant sources of exposures. While routine showering and bathing are not expected to be significant sources of PFC exposure through dermal absorption or inhalation, taking care not to ingest water while showering/bathing can potentially reduce exposure.