## Fact Sheet # 3: Pharmaceuticals & Personal Care Products (PPCPs) and Endocrine Disrupting Compounds (EDCs)

1) Pharmaceuticals and Personal Care Products (PPCPs) can originate from numerous sources, but primarily come from humans. When humans take medications only a portion is absorbed by the body. In addition, PPCPs can come from fragrances, shampoos, laundry and dishwashing detergents and other consumer products.

2) Endocrine Disruptors Compounds (EDCs) are chemicals, both natural and man-made, that at certain doses, can interfere with the endocrine (or hormone) system in mammals. Endocrine disruptors may be found in many everyday products– including plastic bottles, metal food cans, detergents, flame retardants, food, toys and cosmetics.

3) There are currently no Federal and/or Provincial regulations in Canada relating to the levels of PPCPs and EDCs in wastewater and/or drinking water. In addition, neither the US Environmental Protection Agency nor the equivalent agencies in Europe and Asia have any regulations for PPCPs and EDCs in wastewater and/or drinking water.

4) The effects of the PPCPs and EDCs on the environment continue to be investigated by the United States Environmental Protection Agency (US EPA) and many other scientists and organizations around the world to determine the levels that exist in our water systems and whether those levels, present any potential danger to the environment. To date the levels that have been found are extremely low concentrations (usually parts per trillion). One part per trillion is equal to one drop of water in 26 Olympic-size swimming pools.

5) PPCPs and EDCs are found throughout the world in all bodies of water influenced by human and/or animal wastewater, including rivers and streams, groundwater coastal marine environments, and many drinking water sources.

6) The detection of a compound in water does not mean that adverse health effects will or are likely to occur. In fact, no relationships have been established between PPCPs and EDCs in water and adverse effects in humans. Some studies indicate that there are endocrine-related effects on growth and development from environmental exposures in fish and wildlife. However, the US EPA and the Ministry of Environment and Climate Change (MOECC) have not established acceptable levels of PPCPs and EDCs in water or wastewater.

7) Given the very low concentrations in which they are generally found detection of PPCPs and EDCs is the major challenge. It is only due to recent advances in

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analytical techniques and instrumentation that have allowed for the reportable measurement of concentrations at such low levels.

8) In 2011 the World Health Organization (WHO) Undertook a Study on "Pharmaceuticals in Drinking Water." This Study was a working group of leading experts from USA, Switzerland, Australia, England, Canada, Singapore, Denmark, Japan and Italy. The Study the involved three human health risk assessments (USA, UK and Australia). The major findings of this Study were:

   a) Trace concentrations of pharmaceuticals in surface water impacted by wastewater discharges are extremely low (only detectable in last decade);

   b) Substantial margins of safety (more than 1000 fold) suggest adverse health impacts are very unlikely;

   c) From a treatment perspective, pharmaceuticals are not unusual organic chemicals. Therefore, treatment removal rates are reasonably predictable based upon the physical and chemical properties of the compounds;

   d) Conventional Biological Wastewater treatment processes with coagulation, filtration and chlorination can remove about 50% of these compounds, whereas advanced wastewater treatment processes (similar to what is being proposed in Midhurst), such as ozonation, membrane treatment and advanced oxidation, can generally achieve much higher removal rates (and in some cases up to 100%) compared with conventional treatment processes;

   e) Current levels of exposure do not warrant development of formal guidelines;

   f) There is also a lack of standardized sampling and analysis protocols to support monitoring studies.

   g) Consideration should be given to preventative measures such as "Take Back" programs, regulations, public education encouraging proper disposal to minimize pharmaceuticals in the environment.

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One of the main recommendations of the WHO study was:

*"The substantial margin of safety for consumption of very low concentrations of pharmaceuticals in drinking-water suggests that appreciable adverse impacts on human health are very unlikely. As such, concerns over pharmaceuticals should not divert attention and valuable resources of water suppliers and regulators from other priorities, such as pathogenic microbial water quality issues. The low risk to human health from current levels of exposure in drinking-water suggests that development of formal guideline values for pharmaceuticals in the WHO Guidelines for Drinking-water Quality and the installation of specialized treatment processes to reduce trace concentrations of pharmaceuticals are not warranted."*

9) A study on the "*Reduction of Intersex in a Wild Fish Population in Response to Major Municipal Wastewater Treatment Plant Upgrades" was* published in the "*Environmental Science and Technology"* magazine in December 2016 by team of researchers from the University of Waterloo, University of McMaster and Environment and Climate Change Canada. The study, which was based upon 10 years of data, found that the microorganisms used to remove ammonia in the wastewater treatment process also reduced the levels of endocrine disrupters in the water, which caused the intersex occurrences in fish to dramatically decline.

   Within the study, intersex in fish downstream of municipal Wastewater Treatment Plants (WWTPs) was studied in the Grand River, in southern Ontario. Consistent high rates of intersex in male rainbow darter have been reported for several years in the Grand River, in close proximity to two WWTPs. The larger WWTP (Kitchener) recently underwent significant upgrades that included the conversion from a carbonaceous activated sludge to nitrifying activated sludge treatment process. This created a unique opportunity to assess whether upgrades designed to improve effluent quality could also remediate the intersex previously observed in wild fish. Multiple years (2007−2012) of intersex data on male rainbow darter collected before the upgrades at sites associated with the WWTP outfall were compared with intersex data collected in post-upgrade years (2013−2015). These upgrades resulted in a reduction from 70 to 100% intersex incidence (pre-upgrade) to <10% in post-upgrade years. Although the cause of intersex remains unknown, indicators of effluent quality including nutrients, pharmaceuticals, and estrogenicity improved in the effluent after the upgrades.

   This study demonstrated that investment in WWTP upgrades improved effluent quality and was associated with an immediate change in biological responses in the receiving environment.

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Having long-term data of the fish population, before and after the wastewater treatment upgrades makes this a truly unique study," said Mark Servos, Canada Research Chair in Water Quality Protection in the University of Waterloo's Department of Biology. "The changes to Kitchener's wastewater treatment system have had a much larger positive impact then we had anticipated."

Upgrades to a wastewater treatment plant along Ontario's Grand River led to a 70 per cent drop in fish that have both male and female characteristics within one year and a full recovery of the fish population within three years, according to researchers at the University of Waterloo.

10) The advanced Wastewater Treatment process that is being proposed for Midhurst will provide one of the best barriers available in the industry and as such will significantly minimize PPCPs and EDCs within the wastewater, entering Willow Creek.

11) Inappropriate disposal practices, such as flushing unwanted or excess drugs down the toilets or discarding them into household waste, are very common and are a main contributor to pharmaceuticals in wastewater and other environmental media, such as surface waters and landfill leachate.

    As this issue is global in nature, organizations like the World Health Organization (WHO) have continued to stress the need for countries to develop programs for the retrieval and proper disposal of unused or expired pharmaceuticals.

    Therefore, it is important that policies promoting safe disposal or regulations governing disposal practices for unwanted or excess drugs be developed, at the Provincial and/or Federal level. Such programs or regulations would reduce the amount of pharmaceuticals entering water bodies. In addition, takeback programs, guidance and enhanced consumer education will support efforts for the proper disposal of medicines and reduce the impact of pharmaceuticals entering our water sources.