STATEMENT OF
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Madam Chairwoman and Members of the Subcommittee, thank you for the opportunity to provide the views of the U.S. Geological Survey, Department of the Interior, on emerging contaminants in the environment. The observed presence of emerging contaminants in the environment has prompted public interest regarding potential adverse ecological effects and potential contamination of drinking water. The interest has already increased public awareness of the ways we handle and dispose of chemicals we use every day to improve our health and quality of life and has resulted in interest by industries in improved waste treatment technologies and best management practices that are most effective at removing these trace organic chemicals from surface and ground waters and solid and liquid wastes.

The USGS studies a wide range of chemicals often referred to as emerging contaminants. These chemicals of emerging environmental concern include many chemicals used in our homes, businesses, and industries, such as human and veterinary pharmaceuticals, detergents, fragrances, fire retardants, disinfectants, plastics, and insect repellants. The chemicals currently of greatest interest include those that enter the environment via human and animal wastes. Many of these chemicals are a new focus for environmental research, because they are used in relatively small quantities and, therefore, were not expected to be of significant environmental concern. In recent years, they have been detected increasingly in the environment at very low levels (less than one part per billion). Despite these extremely low levels, investigation is warranted to determine if there are any potential adverse environmental and human health effects. The fact that we are looking for these chemicals or even detecting them in the environment alone does not

indicate that they are an environmental health concern. Although detection is an important component of the environmental assessment, ecological and human health assessments of the levels and mixtures observed in the environment are also essential.

To date, research and monitoring by the USGS and others have demonstrated that:

(1) the manner in which we handle and dispose of our wastes can concentrate these chemicals in some environmental settings to levels that may be an ecological health concern, and
(2) many of these trace organic chemicals associated with human and animal wastes have been entering the environment for as long as we have used them.

In 1998, the USGS broadened its water-quality science programs by initiating research on pharmaceuticals and other human- and animal-waste related chemicals. We were spurred by the findings of European colleagues, who, looking for a pesticide, detected a heart medication in the North Sea (Buser et al., 1998). The realization that chemical-use and waste-handling practices had resulted in detectable concentrations of a drug in such a large water body suggested the need for further research. By 2002, a USGS study (Kolpin et al., 2002; Barnes et al., 2002; and Buxton and Kolpin, 2002) had documented the presence of pharmaceuticals and other waste-associated chemicals in the Nation's streams and largely defined this issue in the United States.

Since 2002, the USGS has published more than 160 reports that:

- Document the occurrence, concentration, and mixtures of these chemicals in various environmental compartments, including stream water, well water, stream sediment, and soil amended with manure and biosolids (the solid byproduct of wastewater treatment plants);
- Demonstrate the comparative contributions from various sources, including wastewater treatment plants, livestock production and animal feedlot wastes,

aquaculture, onsite septic systems, combined sewer overflows, and other industrial discharges; and

- Demonstrate that some of these chemicals are assimilated by organisms (Kinney et al., 2008) or cause adverse ecological health effects (Vajda et al., 2008).

The bibliography of USGS reports that support these findings on emerging contaminants is available on the Internet at: *http://toxics.usgs.gov/bib/bib-Emerging.html*.

A recent example of USGS research is described in a series of reports on the levels and mixtures of human- and animal-waste related chemicals that are found in wastewaters, biosolids, and manures, and the soils to which they are applied for fertilization, as well as the earthworms found in those soils (Kinney et al., 2006a, 2006b, and 2008).

USGS investigations at a drinking water treatment facility in New Jersey described the changes in concentrations of emerging contaminants from the source water through multiple stages of the treatment process (Stackelberg et al., 2004, 2007). Additional investigations like this one will inform decisions on improving existing and developing new treatment works that are more efficient at removing these chemicals from source waters (the sources of drinking water).

Two USGS papers, published recently in the peer-reviewed journal *Science of the Total Environment,* summarize the occurrence of these chemicals in ground water (Barnes et al., 2008) and in raw (untreated) sources (streams and wells) of drinking water (Focazio et al., 2008). The paper surveying source waters includes results from 74 sites near drinking water intakes in 25 states and Puerto Rico. All data from these reports are available to the public in an accompanying data report.

The ecological effects of some emerging contaminants found in the environment have been documented in scientific literature For example, it was not a surprise when antibiotics, which are designed to act as antibacterials, were found to have adverse effects on soil microorganisms at concentrations found in the environment (Thiele-Bruhn and Beck, 2005). Some toxicological tests have found no effects on some species tested. In

one study, three freshwater invertebrates were exposed to an anticonvulsant drug commonly found in the environment. Only one of the three species demonstrated an adverse effect (Oetken et al., 2005). Furthermore, evidence suggests that chemical mixtures can act collectively to cause adverse effects, even when each component is below its individual effect level (Brian et al., 2007). These are examples of an increasing body of scientific knowledge on potential adverse health effects. Significant uncertainty remains regarding the effects of long-term exposure to levels found in environmental settings.

Endocrine disruption is one adverse health effect of concern because it may occur as a result of exposure to very low levels of hormonally active chemicals. One form of endocrine disruption observed in environmental settings affects fish reproductive systems, where fish have been found to be "feminized" by exposure to a range of chemicals that act similarly to the natural hormone estrogen. Some ways in which feminization is observed in fish include: (1) a higher percentage of females in some fish populations than commonly expected,, (2) changes in behavioral characteristics, such as nesting behavior, or (3) the presence of male fish with female characteristics, such as the presence of female egg cells in testes or of a female egg protein in their blood. A recent study (Kidd et al., 2007) demonstrated that the addition of ethinylestradiol (one of the active ingredients in birth control pills) at observed environmental concentrations to an experimental lake in Canada caused feminization and near extinction of fathead minnows in the lake.

A wide range of hormonally active chemicals can contribute to endocrine disruption, including actual biogenic hormones, synthetic hormones (pharmaceuticals, such as ethinylestradiol), and other chemicals that mimic or block hormone function (including certain pesticides, detergents, metals, and other industrial chemicals). These chemicals have been found together in waters affected by human and animal wastes and can occur together in various environmental settings. This reinforces why these chemicals must be studied together and not as separate classes of contaminants.

The effects of long-term exposure to the low levels of emerging contaminants found in the environment on human health are not well understood and warrant continued study. The USGS has collected information on the occurrence, concentrations, and mixtures of these waste-related chemicals in source waters used for drinking water and, to a much more limited extent, in finished (treated) drinking water. However, whether or not there are adverse human health effects from cumulative lifetime exposures to the low concentrations and complex mixtures of emerging contaminants found in the environment remains a research priority, particularly the effects on sensitive subpopulations such as children, women of child-bearing years, the elderly, and people with suppressed immune systems.

In the past decade, the USGS has developed the capability to analyze for approximately 200 emerging contaminants at levels less than one part per billion in environmental samples. These chemicals include pharmaceuticals, personal care products, detergent byproducts, detergents, hormones, fragrances, fire retardants, disinfectants, plastics, and insect repellants. The vast majority of these chemicals are synthetic and indicate human sources. Some are naturally occurring, and the levels at which they are detected can help distinguish between human and natural sources. We have collected and analyzed samples from approximately 1,500 sites across the Nation. About a quarter of these sites were sampled in nationally-designed targeted surveys implemented by the USGS to assess the occurrence of emerging contaminants across a wide range of environmental settings. The majority of the 1,500 sites were sampled as parts of studies conducted by the USGS in cooperation with State and local governments. These cooperative studies were designed to provide information for local resource managers on conditions in their area, and the findings are available to the public.

California provides an example of an extensive State program. The USGS California Water Science Center, in collaboration with the California Water Boards, has designed and implemented the Groundwater Ambient Monitoring and Assessment (GAMA) Project to assess the quality of California's ground water. The Priority Basin Program, a part of GAMA, will sample approximately 2,500 wells in about 120 ground-water basins

in California over an 8-year period (2004-2012). From May 2004 through December 2007, we have sampled about 1,400 wells for a very large suite of emerging contaminants. About 1,000 wells are being evaluated for the presence of emerging contaminants.

The USGS is continuing to conduct research on emerging contaminants in the environment. Our research priorities will continue to include assessing:

- Chemical loads of various sources including wastewater treatment plants, Animal Feeding Operations, landfills, and other industrial facilities,
- Ecological effects, including fish endocrine disruption in streams enriched with wastewaters,
- The occurrence of emerging contaminants in waters that are the source of drinking water and, to a limited degree, in treated drinking water, and
- The comparative performance of varying water and waste treatment processes to remove emerging contaminants,

The USGS conducts this research with a number of partner Federal agencies, including the U.S. Environmental Protection Agency (USEPA), Centers for Disease Control and Prevention, Fish and Wildlife Service, and National Oceanic and Atmospheric Administration. The USGS, USEPA, and FDA co-chair the Federal Interagency Work Group on Pharmaceuticals in the Environment, and the USGS participates in the Endocrine Disruption Work Group, both under the auspices of the Committee on Environment and Natural Resources of the National Science and Technology Council. These Work Groups have further increased coordination of Federal research.

Thousands of potential emerging contaminants are used in our homes and places of work to improve our health and quality of life, The USGS is focusing environmental research on chemicals that are more likely to be of environmental concern, to increase the efficiency of research within the existing limited resources available. Similarly, investigations of adverse health effects must consider the actual levels and mixtures of chemicals that organisms are exposed to in the environment. Results of USGS studies of environmental occurrence are used by many scientists to guide both human and

ecological health-effects studies to assure that actual environmental conditions are being tested.

We welcome the opportunity to provide any further information or assistance to the Subcommittee. Thank you, Madam Chairwoman, for the opportunity to present this testimony, and I will be pleased to answer questions you and other Members might have.

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