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Occurrence of Emerging Contaminants in Water and Bed Material in the Missouri River, North Dakota, 2007

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The U.S. Geological Survey (USGS), in cooperation with the Standing Rock Sioux Tribe, conducted a reconnaissance study to determine the occurrence of emerging contaminants in water and bed sediment within the Missouri River upstream and downstream from the cities of Bismarck and Mandan, North Dakota, and upstream from the city of Fort Yates, North Dakota, during September–October 2007. At each site, water samples were collected twice and bed-sediment samples were collected once. Samples were analyzed for more than 200 emerging contaminants grouped into four compound classes—wastewater compounds, human-health pharmaceutical compounds, hormones, and antibiotics. Only sulfamethoxazole, an antibiotic, was present at a concentration higher than minimum detection limits. It was detected in a water sample collected downstream from the cities of Bismarck and Mandan, and in bed-sediment samples collected at the two sites downstream from the cities of Bismarck and Mandan and upstream from Fort Yates. Sulfamethoxazole is an antibiotic commonly used for treating bacterial infections in humans and animals.

Introduction

Tribal members of the Standing Rock Sioux Reservation are concerned about the quality of water on the reservation and that some of the drinking water consumed on the reservation is adversely affecting human health (Damschen and Lundgren, 2007). Emerging contaminants are chemical and microbial materials that have the potential to enter the environment and cause known or suspected adverse ecological and (or) human-health effects but that are not commonly monitored in the environment. Emerging contaminants are materials commonly derived from municipal, agricultural, and industrial wastewater sources and pathways and can be various manufactured and natural organic compounds, such as pharmaceuticals, steroids, surfactants, flame retardants, fragrances, plasticizers and other chemicals (Focazio and others, 2008). Some of these materials entering the environment have known ecological and human health risks; however, the health risks for a large number of these materials individually and as mixtures are not currently known.

Sampling Locations

Water and bed-sediment samples were collected at three sites on the Missouri River: upstream and downstream from Bismarck and Mandan wastewater treatment plants, and upstream from the Missouri River Intake water treatment facility in Fort Yates, North Dakota (table 1 and figure 1). At each site, water samples were collected twice (September and October) and bed-sediment samples were collected once (October). Samples were analyzed for emerging contaminant materials that were grouped into the following categories: wastewater compounds in water, human-health pharmaceutical compounds in water, hormones in water, antibiotics in water, waste indicators in solids, hormones in solids, and antibiotics in solids.

Methods

Samples were collected and processed using standard USGS techniques (U.S. Geological Survey, variously dated). Where possible, water samples were collected using width- and depth-integrating procedures. The bed-sediment

Table 1. Sampling site information.

Sampling site	USGS station number	Site name
1	465245100530500	Missouri River above Bismarck/Mandan, North Dakota
2	464445100493500	Missouri River below Bismarck/Mandan, North Dakota
3	460533100371900	Missouri River above Fort Yates, North Dakota

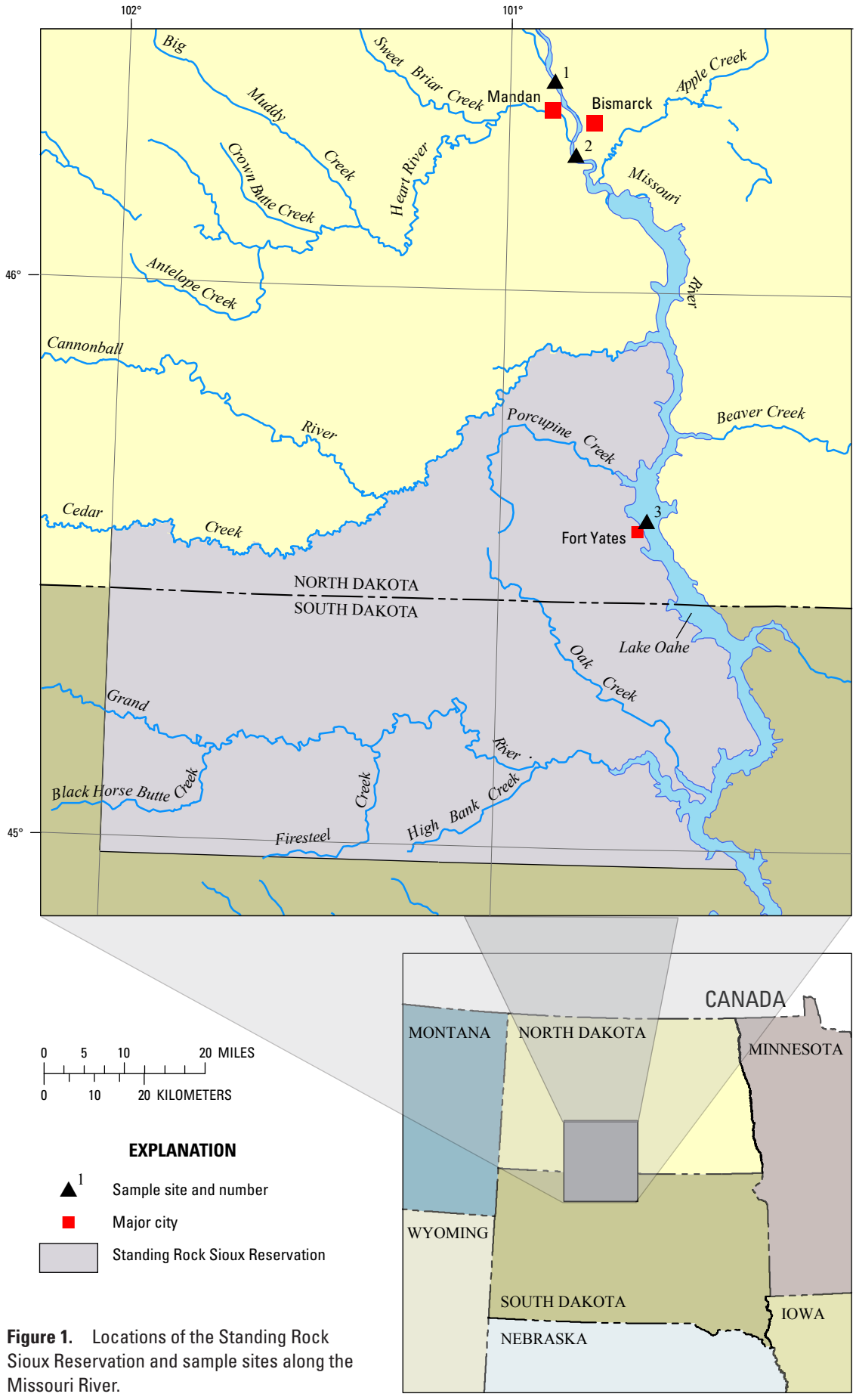

Figure 1. Locations of the Standing Rock Sioux Reservation and sample sites along the Missouri River.

Aerial photograph of Fort Yates, North Dakota.

samples were collected from locations that adequately represented the water body of interest. Special procedures, such as avoiding use of insect repellents, sunscreen, tobacco, caffeine, and pharmaceutical drugs by the sampling team, were adhered to during sample collection (U.S. Geological Survey, variously dated).

Analyses for 68 wastewater compounds in water, 16 human-health pharmaceutical compounds in water, 32 hormones in water, 61 waste indicators in solids, and 32 hormones in solids were performed at the USGS National Water Quality Laboratory in Denver, Colorado (Zaugg and others, 2002; Burkhardt and others, 2006; Furlong and others, 2008). Analyses for 33 antibiotics in water and solids were performed at the USGS Organic Geochemistry Research Laboratory in Lawrence, Kansas, using methods modified from Meyer and others (2007) and Jacobson and others (2004).

Analytical Results

Analytical results indicated no compound concentrations higher than minimum detection limits with the exception of one antibiotic compound concentration. Sulfamethoxazole was detected in three separate samples: one water sample collected from site 2 (0.014 micrograms per liter), a bed-sediment sample from site 2 (28 micrograms per kilogram), and a bed-sediment sample from site 3 (2.3 micrograms per kilogram). Sulfamethoxazole is an antibacterial sulfonamide that is used to treat diseases such as bronchitis, middle-ear infection, urinary tract infection, conjunctivitis, malaria, toxoplasmosis, and traveler's diarrhea. It is also a widely prescribed veterinary antibiotic used to treat diseases and infections and is included in feed additives to promote growth and weight gain of food animals (National Research Council, 1999).

The data from this study are stored in the USGS National Water Information System database and are available online at *http://nwis.waterdata.usgs.gov/nd/nwis/qw*

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