

## **Fecal-Indicator Samples**

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### *Sample Collection and Processing*

Water samples were collected from the Yukon River, Tanana River and Porcupine River August 6-14, 2001 for fecal-indicator analysis. Samples were collected near the shoreline, and when possible, from the center of the main channel of flow upstream and downstream from four villages: Circle, Eagle, Fort Yukon, Nenana, and Stevens Village (Figure 1). Water was collected as a grab sample in 1-L polypropylene bottles and filtered as described below within 6 hours of collection. Sediment cores were collected by coring of surface mud with sterile polypropylene sleeves (3.4-cm diameter).

Approximately 5 grams of sediment from the top 5 to 6 cm was removed, combined with 50 mL Phosphate Buffered Saline (PBS), and vortexed. Samples were processed according to established USGS protocols (U.S. Geological Survey, 1997-99).

Drinking-water source samples also were collected from each village. These sources include: non-treated wells, chlorine-treated wells, central water points, home with piped water, storage containers within the home collected from the central water point, and rainwater collection barrels. Samples from watering points and homes with a watering tap were collected by flushing the tap 4-5 minutes before collecting a sample in 1-L polypropylene bottles. Samples from storage barrels were collected as a grab sample in 1-L polypropylene bottles.

### *Sample Analysis and Results*

Fecal indicator bacteria were quantified using membrane filtration techniques (Franson and others, 1998; Parker, 2000) (tables 20-22). Water samples were filtered onto a 0.45- $\mu$ m gridded cellulose nitrate membrane filters (Advantec MFS, Inc., Pleasanton, CA) in 100-mL, 10-mL, and 1-mL volumes. Filters were placed on m-FC/Rosolic acid media (HACH, Loveland, CO) and incubated at 44.5°C for 24 hours, after which fecal coliforms (blue colonies) were counted. *E. coli* was distinguished from other fecal coliforms by transferring the filter membrane to a Nutrient Agar containing 4-methylumbelliferyl- $\beta$ -D-glucuronide (Na-MUG agar; DIFCO, Sparks, MD) and incubating for 4 hours at 37°C and counting the number of colonies with blue fluorescent halos. A second membrane filter for each volume of filtered water was placed on mEI agar as described by U.S. Environmental Protection Agency (2000) and incubated at 41.5°C for 24 hours, after which enterococci colonies (blue halo colonies) were counted. Sediment:PBS mixtures were filtered in 10-mL, 1 mL and 0.1-mL volumes and processed as above for water samples. USEPA recommended drinking water standards for fecal indication bacteria concentrations are given in table 23.

**Table 20.** Fecal indicator bacteria concentrations in river water samples from selected locations in the

Yukon River Basin

[Figure #, refers to sample site location shown on figure 1; CFU, colony-forming units; mL milliliters]

Date	Location/Figure #	Fecal coliforms CFU/100mL	E. coli CFU/100mL	Enterococci CFU/100mL
<u>Tanana River at Nenana, AK/4</u>				
8/7/2001	Along bank of river near downstream edge of village	19 <sup>a</sup>	19 <sup>a</sup>	80 <sup>b</sup>
8/7/2001	Along bank of river near upstream edge of village	22 <sup>a</sup>	22 <sup>a</sup>	31 <sup>a</sup>
8/7/2001	Center of main channel of flow downstream from village	29 <sup>a</sup>	29 <sup>a</sup>	70 <sup>b</sup>
8/7/2001	Center of main channel of flow upstream from village	35 <sup>a</sup>	30 <sup>a</sup>	100 <sup>b</sup>
<u>Porcupine River near Fort Yukon, AK/6</u>				
8/7/2001	Center of main channel of flow upstream from Fort Yukon	5 <sup>a</sup>	5 <sup>a</sup>	10 <sup>b</sup>
8/13/2001	Along bank of river near village	2 <sup>a</sup>	2 <sup>a</sup>	6 <sup>a</sup>
<u>Yukon River at Eagle, AK/1</u>				
8/9/2001	Center of main channel of flow upstream from village	70 <sup>b</sup>	70 <sup>b</sup>	4 <sup>a</sup>
8/9/2001	Center of main channel of flow downstream from village	16 <sup>a</sup>	16 <sup>a</sup>	3 <sup>a</sup>
8/9/2001	Along bank of river near upstream edge of village	17 <sup>a</sup>	17 <sup>a</sup>	2 <sup>a</sup>
8/9/2001	Along bank of river near downstream edge of village	30 <sup>a</sup>	28 <sup>a</sup>	4 <sup>a</sup>
<u>Yukon River near Fort Yukon, AK/6</u>				
8/13/2001	Along bank of river near downstream edge of village	15 <sup>a</sup>	16 <sup>a</sup>	21 <sup>a</sup>
8/13/2001	Along bank of slough in village near town well	13 <sup>a</sup>	14 <sup>a</sup>	13 <sup>a</sup>
8/13/2001	Along bank of river near upstream edge of village	9 <sup>a</sup>	10 <sup>a</sup>	24 <sup>a</sup>
<u>Yukon River near Stevens Village/3</u>				
8/14/2001	Along bank of river near the center of village	15 <sup>a</sup>	18 <sup>a</sup>	50 <sup>b</sup>
8/14/2001	Along bank of river near downstream edge of village	14 <sup>a</sup>	14 <sup>a</sup>	5 <sup>a</sup>
8/14/2001	Along bank of river near upstream edge from village	40 <sup>b</sup>	40 <sup>b</sup>	990

<sup>a</sup> Not an optimal plate count; filter contained a lot of silt<sup>b</sup> Results based on 10-mL sample volume; not an optimal plate count, less than 20 colonies per filter

**Table 21.** Fecal indicator bacteria concentrations in village domestic water supplies and other samples from selected locations in the Yukon River Basin

[Figure #, refers to sample site location shown on figure 1; CFU, colony-forming units; mL, milliliters; NT, not detected; DNR, Division of Natural Resources]

Date	Village/Figure #	Location	Fecal coliforms CFU*/100mL	E. coli CFU/100mL	Enterococci CFU/100mL
8/7/2001	Nenana/4	Chlorinated sewage prior to discharge	2	2	0
8/7/2001	Nenana/4	Drinking water after chlorine treatment	0	0	0
8/7/2001	Nenana/4	Drinking water before water treatment-well	0	0	0
8/9/2001	Eagle/1	Pressurized bladder storage-well water source	0	0	NT
8/9/2001	Eagle/1	Kitchen tap, homeowner well water source	0	0	0
8/9/2001	Eagle/1	Kitchen tap, homeowner well water source	0	0	0
8/9/2001	Eagle/1	Storage barrel filled from watering point	0	0	0
8/9/2001	Eagle/1	Central village watering point well	0	0	0
8/13/2001	Fort Yukon/6	Storage barrel filled from watering point	16	2	0
8/13/2001	Fort Yukon/6	Kitchen tap piped from town well	0	0	0
8/13/2001	Fort Yukon/6	Kitchen tap piped from town well	0	0	0
8/13/2001	Fort Yukon/6	Bathroom tap piped from town well	0	0	0
8/13/2001	Fort Yukon/6	Swimming hole	0	0	0
8/13/2001	Fort Yukon/6	Central well, watering point (fluoride treated)	0	0	0
8/14/2001	Stevens Village/3	Town well, chlorine treated central watering point	0	0	0
8/14/2001	Stevens Village/3	Rainwater primarily used for washing	0	0	300
8/14/2001	Stevens Village/3	Pitcher filtered rainwater	0	0	0
8/14/2001	Stevens Village/3	Rainwater collection used for drinking	0	0	4
8/14/2001	Stevens Village/3	DNR office building	0	0	0
8/14/2001	Stevens Village/3	Rainwater in barrel with cloth covering	41	10	65
8/14/2001	Stevens Village/3	Storage barrel filled from watering point	0	0	0

**Table 22.** Fecal indicator bacteria concentrations in river sediments from selected locations in the Yukon

River Basin

[Figure #, refers to sample site location shown on figure 1; CFU, colony-forming units; g, grams]

<b>Date</b>	<b>Location/Figure #</b>	<b>Fecal coliforms CFU/1 g sediment wet weight</b>	<b>E. coli CFU/1 g sediment wet weight</b>	<b>Enterococci CFU/1 g sediment wet weight</b>
8/7/2001	Nenana upstream bank/4	15.17	10.93	26.1
8/9/2001	Eagle downstream bank/1	4.35 <sup>a</sup>	4.35	0
8/9/2001	Eagle upstream bank/1	2.77 <sup>a</sup>	2.77	0
8/13/2001	Fort Yukon downstream bank/6	1.82 <sup>a</sup>	0	2.73 <sup>a</sup>
8/14/2001	Stevens Village upstream bank/3	12.71	12.71 <sup>a</sup>	4.4
8/14/2001	Stevens Village town bank/3	4.39	4.39	1.47

<sup>a</sup> Not an optimal plate count; filter contained a lot of sediment

**Table 23.** U.S. Environmental Protection Agency recommended drinking water standards

[CFU, colony-forming units; mL, milliliters]

<b>Water Use</b>	<b><i>E. coli</i> CFU per 100 mL</b>	<b>Enterococci CFU per 100 mL</b>
Recreational waters	235	33
Moderate full body contact	298	No standard
Lightly full body contact	406	No standard
Infrequent used full body contact	576	No standard
Drinking Water	0	0

Source: <http://www.epa.gov./safewater/mcl.html>

