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WM-60

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Mr. Don Aragon, Executive Director
Wind River Environmental Quality Commission
P. O. Box 217
Fort Washakie, WY 82514

Subject: Evaluation of Risk at the Department of Energy (DOE) Riverton Site

Dear Mr. Aragon:

In response to concerns raised about the accumulation of site contaminants in fish and shellfish and subsequent transmittal of contaminants through the food chain, the DOE committed to the Wind River Environmental Quality Commission (WREQC) to further evaluate the associated ecological and human health risks. To better understand the impact that site-related contamination may pose, DOE evaluated recent WREQC and DOE data in the context of risk. The results of this evaluation are presented in (1) Evaluation of Risks Associated with the Riverton, Wyoming UMTRA Ground Water Site paper. Exposure parameters used for this paper are found in (2) *Baseline Risk Assessment of Ground Water Contamination at the Uranium Mill Tailings Site Near Riverton, Wyoming*, which was provided to you several years ago and is provided again for your convenience.

Please contact me at 970/248-6197 with any questions.

Sincerely,

Tracy Plessinger
Site Manager

Enclosures
(1). Evaluation of Risks Associated with the Riverton, Wyoming UMTRA Ground Water Site paper
(2) *Baseline Risk Assessment of Ground Water Contamination at the Uranium Mill Tailings Site Near Riverton, Wyoming*

cc w/enclosure:
J. Arum, Ziontz, Chestnut, Varnell, Berley, and Slonim (1)
V. Thomas (1)
W. Von Till, NRC (1)

cc w/o enclosures:
S. Campbell, Stoller
File: RIV 105.02 (Roberts)

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U. S. Department of Energy
Office of Land and Site Management

EVALUATION OF RISKS ASSOCIATED WITH THE RIVERTON, WYOMING, UMTRA GROUND WATER SITE

Introduction

Natural flushing with institutional controls was selected as the ground water compliance strategy for the Riverton, Wyoming, site by the Department of Energy (DOE) in it's Environmental Assessment for ground water compliance at the Riverton site (DOE 1998a), and was subsequently approved by the Nuclear Regulatory Commission. DOE has been monitoring ground water and surface water at the site in accordance with the GCAP (DOE 1998b); results generally indicate that contaminants of concern (COCs) identified for the site are decreasing as predicted by the ground water model. More recently, DOE analyzed fish tissue of fish caught in the oxbow lake. Low levels of uranium and molybdenum were detected in those samples.

The Wind River Environmental Quality Commission (WREQC) completed additional sampling at the site and published the results in a September 2003 report ("WREQC report"; WREQC 2003). Based on those sampling results, concerns have been raised about accumulation of site constituents in fish and shellfish in the area and transmittal through the food chain, including exposure to humans.

The WREQC report and recent DOE monitoring data (DOE 2003) have been evaluated to better understand the risks that site-related contamination may pose. Those results are presented in this paper. The focus here is on the surface water environment.

Surface Water

Human health risks associated with use of surface water were evaluated in the baseline risk assessment for the Riverton site (DOE 1995); no unacceptable risks were identified through any complete exposure pathway (e.g., incidental ingestion, dermal exposure) even using established conservative exposure assumptions (EPA 1989a) and worst-case concentrations (see DOE 1995 for exposure parameters). Uranium was the analyte of primary concern. While uranium concentrations in surface water, primarily the oxbow lake, have continued to be above the UMTRA ground water standard, risks associated with human exposures to surface water should remain low.

Questions have been raised regarding the potential impacts of contamination on aquatic biota. Aquatic benchmarks and water quality criteria were compiled for comparison to recent data. Those are contained in Table 1.

Table 1. Aquatic benchmarks for selected constituents

Constituent	Aquatic Benchmark[1]	Source
Aluminum	0.75 mg/L	Wyoming Surface Water Standards (WSWS)
Arsenic	0.15 mg/L	National Ambient Water Quality Criteria (NAWQC; EPA 2002)
Iron	1.0 mg/L	NAWQC, WSWS
Manganese	1.462 mg/L	NAWQC, WSWS
Nickel	0.052 mg/L	NAWQC, WSWS
Selenium	0.005 mg/L	NAWQC, WSWS
Uranium	0.0026—0.455 mg/L	Suter and Tsao 1996
Zinc	0.12	NAWQC, WSWS

[1]Where both acute and chronic benchmarks are available, chronic value is listed

Note that for nickel and zinc, the specific standard is hardness dependent. Values given assume a hardness of 100 mg/L. Site-specific hardness values were not determined for the Riverton site. However, if concentrations of calcium + magnesium are used as an estimate of hardness, site-specific standards can be higher or lower than table values.

A comparison of the benchmarks in Table 1 with data from the WREQC surface water sampling, as well as recent DOE surface water sampling, indicates that while surface water associated with the Riverton site may exceed background levels, benchmarks are exceeded more rarely. Uranium in the oxbow pond is consistently higher than the low end of the benchmark range, though has stayed below the high end of the range. A WREQC sample from the Peak Sulfur discharge drainage ditch exceeded benchmarks for aluminum and iron; however, these constituents are not site-related and discharges to this ditch are being regulated through a different environmental program.

Though site-specific zinc standards may be lower than the value in Table 1, zinc has rarely been detected in site-related samples and at concentrations much lower than the table value. Nickel has been detected at the site, but is also not likely to be a problem. If hardness were as low as 50 mg/L (which is much lower than common estimates for the site), a standard of 0.028 mg/L would apply. This value is still higher than the highest concentration observed in recent sampling. In most cases, site-specific standards for nickel and zinc would be higher than those presented in Table 1.

Based on this analysis, it can be concluded that surface water in the area is suitable for aquatic life, particularly in those areas where aquatic organisms would be most anticipated (rivers and oxbow lake).

Sediment

The WREQC collected and analyzed a number of sediment samples for the same analytes as surface water. Sediment quality criteria benchmarks for aquatic organisms are compiled in Table 2.

Table 2. Sediment Quality Benchmarks[1]

Constituent	Benchmark (mg/Kg)	Type
Aluminum	25,500	Lower threshold value (TEL)
Arsenic	10.8	TEL
Iron	188,400	TEL
Manganese	630	TEL
Nickel	19.5 35.9	TEL Probable Effects Level
Selenium	1-4	Level of concern[2]
Strontium	49	Typical background
Vanadium	50	Typical background
Zinc	98	TEL

[1]From Buchman 1999
[2]Dept. of Interior 1998

As with surface water, site-related sediment samples may frequently exceed site-specific background concentrations, but benchmarks are exceeded more rarely. Highest concentrations of many constituents are associated with samples from the constructed wetland. Wetlands such as this are often designed to accumulate metals in sediments and vegetation and serve as cleansing agents for surface water and ground water. It appears that these wetlands may be doing just that.

A macroinvertebrate study was conducted in conjunction with the WREQC characterization project to evaluate actual effects on sediment dwelling organisms. Macroinvertebrate organisms (chironomid larvae) were collected from the oxbow lake and from a control area to compare rates of deformities between the two areas. Deformity rates were identical in the two sample populations. While this does not provide conclusive evidence that the contamination associated with the oxbow lake is harmless, obvious signs of adverse impacts were not observed.

Biota

Vegetation, fish (carp), and crayfish were sampled and analyzed as part of the WREQC characterization effort. DOE also conducted fish sampling during its 2003 monitoring event.

Fish and Crayfish

As mentioned above, potential risks to humans from eating contaminated fish were estimated using assumptions regarding bioaccumulation and potential fish concentrations. Since that time, fish sampling was undertaken by both WREQC and DOE. Uranium is the constituent of greatest concern because of elevated concentrations identified in the oxbow lake. Fish sampling results (combined WREQC and DOE) indicated that carp had concentrations of uranium ranging from 0.009 to 0.22 mg/kg. Water concentrations in the oxbow lake are typically around 0.3 mg/L. A comparison of water and fish tissue concentrations indicate that fish do not appear to be concentrating uranium in their tissues and that the bioconcentration factor of 1 used in previous risk calculations was conservative and overestimated actual site risks.

For human health, uranium has a reference dose of 0.003 mg/kg/day (EPA's IRIS database). This is the amount of uranium a person can safely ingest per day, per kilogram of body weight. Therefore, a 70 kg adult (EPA risk assessment body weight default; EPA 1989b) can safely ingest 0.21 mg/day of uranium. Even with the highest observed uranium concentration in carp of 0.22 mg/Kg, this means that humans could safely ingest nearly 1 kilogram (2.2 lbs) of fish per day from the oxbow lake. This amount of fish is well above any quantity likely to be ingested on a regular basis, regardless of source. Sampling results provide empirical data supporting previous conclusions that ingestion of fish from the pond would not pose any unacceptable risk for humans.

Crayfish collected from the oxbow lake do appear to be concentrating uranium to some degree. WREQC analysis of crayfish resulted in a concentration of 0.55 mg/Kg of uranium. With the range of uranium concentrations in surface water from the oxbow lake, it is possible that crayfish could be concentrating uranium by as much as a factor of about 2. Though humans could ingest crayfish, it is unlikely that they would be the most likely receptors for ingestion of crayfish. (Based on calculations similar to above, an adult human receptor could safely ingest 0.38 Kg [0.84 lb] of crayfish per day.)

Terrestrial receptors, such as raccoons, are more likely receptors as crayfish do make up a large part of their diet (EPA 1993). Because raccoons are pervasive in nearly every aquatic habitat (EPA 1993), they were selected in this evaluation as appropriate receptors for evaluating ecological risk. Based on the published literature (EPA 1993), a conservative average body weight for raccoons is approximately 6 kg. A "no observed adverse effect level" (NOAEL) toxicity reference value (TRV; similar to a reference dose for humans) for mammals is 3.07 mg/Kg/day (Sample and others 1996). This is a value at which no adverse effects were observed in laboratory tests using mice. The lowest TRV at which some adverse effect was noted (LOAEL; also from mouse data) is 6.13

mg/Kg/day (Sample 1996). Based on EPA methodology (EPA 1993), a 6 Kg raccoon ingests food at an estimated rate of 0.3 kg/day. Using the NOAEL TRV, a 6 kg raccoon could therefore safely ingest 18.42 mg of uranium per day (TRV x body weight). If a raccoon ingests only 0.3 kg of food per day, this means that concentrations of over 50 mg/Kg in food would result in no adverse effects on the raccoon. Because crayfish concentrations associated with the oxbow lake are two orders of magnitude lower than this, it can be concluded that regular ingestion of crayfish should pose no unacceptable risks to probable ecological receptors, even considering the uncertainties and assumptions associated with these calculations (e.g., extrapolation of mouse data to raccoons).

Vegetation

WREQC sampled vegetation from cottonwood and willow trees at the site and in background locations. For the majority of vegetation sampled, background samples contained the highest constituent concentrations. Concentrations of some site-related constituents, such as molybdenum and uranium, were highest in site-related samples. However, it is unlikely that contaminated vegetation associated with the site would have an adverse impact on ecological receptors in the area. Concentrations in the vegetation are quite variable and it is likely that any given receptor would ingest a range of concentrations from low to high. Also, unless a terrestrial receptor spent most of its time in the site vicinity, it would undoubtedly eat vegetation from uncontaminated areas as well as contaminated areas. Because site-related vegetation is not significantly higher in contaminant concentrations than background vegetation, it is unlikely that vegetation at the site presents a significant risk. As noted in the WREQC report, it is possible that the types of vegetations sampled are not the most appropriate for evaluating risks and that grasses or other vegetation types provide more likely exposure pathways. Data are insufficient to evaluate those potential risks.

Conclusions

Based on the above evaluation, it can be concluded that residual contamination does exist at the Riverton UMTRA site. However, though concentrations of site-related constituents, particularly uranium, are elevated above background levels, expected exposures to these media (surface water, sediment, and biota) are not expected to produce any unacceptable risks in either human or ecological receptors. Fish with concentrations observed in from both WREQC and DOE sampling can be safely consumed by humans, even in large quantities. Consumption of contaminated crayfish by likely terrestrial receptors are unlikely to produce any observable detrimental effects. This conclusion is supported by a WREQC macroinvertebrate study, which showed no difference between samples from the oxbow pond and the control location. Sampling and anlysis of vegetation is inconclusive, but suggests little effect from site-related contamination.

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