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UMTRA
Ground Water Project

Site Observational Work Plan for the Durango, Colorado, UMTRA Project Site

January 2002

Prepared by the
U.S. Department of Energy
Grand Junction Office

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End of current text

Acronyms and Abbreviations

ACL	alternate concentration limit
AEC	U.S. Atomic Energy Commission
AGW	actual ground water
AWQC	ambient water quality criteria
BAF	bioaccumulation factor(s)
BCF	bioconcentration factor(s)
Bendix	Bendix Field Engineering Corporation
BLRA	Baseline Risk Assessment
BOR	U.S. Bureau of Reclamation
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
COPC	constituent/contaminant of potential concern
CRDL	contract required detection limit
DOE	U.S. Department of Energy
DQO	data quality objective
EA	environmental assessment
E-CPOC	ecological constituents of potential concern
EPA	U.S. Environmental Protection Agency
ERA	ecological risk assessment
ESL	Environmental Sciences Laboratory
ft	foot (feet)
ft/day	foot (feet) per day
ft^2/day	square feet per day
ft^3	cubic feet
GCAP	Ground Water Compliance Action Plan
GJO	Grand Junction Office
HI	hazard index
HNO_3	nitric acid
HQ	hazard quotient
IC	institutional control
ICP-AES	inductively coupled plasma-atomic emission spectrometry
ICP-MS	inductively coupled plasma-mass spectrometry
i.d.	inside diameter
IRIS	Integrated Risk Information System
K	hydraulic conductivity
K_d	distribution coefficient
LOAEL	lowest observed adverse effect level
LTMP	Long-Term Management Plan
LTSP	Long-Term Surveillance Plan
MAP	Management Action Process Document
MCL	maximum concentration limit
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
mL	milliliter(s)
mL/g	milliliter(s) per gram

mV	millivolt(s)
NEPA	National Environmental Policy Act
NIWQP	National Irrigation Water Quality Program
NOAEL	no observed adverse affect level
NRC	U.S. Nuclear Regulatory Commission
ORP	oxidation-reduction potential
pCi/L	picocuries per liter
Q	inflow
PEIS	Programmatic Environmental Impact Statement
PVC	polyvinyl chloride
RAP	Remedial Action Plan
RBC	risk-based concentration
REDC	Ranchers Exploration and Development Corporation
RfD	reference dose(s)
ROD	Record of Decision
RRM	residual radioactive material
SEE_PRO	Site Environmental Evaluation (database)
SOWP	Site Observational Work Plan
TAGR	Technical Approach to Groundwater Restoration
TDS	total dissolved solids
UCL_{95}	95 percent upper confidence limit
UF	uncertainty factor(s)
UMTRA	Uranium Mill Tailings Remedial Action (Project)
UMTRCA	Uranium Mill Tailings Radiation Control Act
USGS	U.S. Geological Survey
USV	United States Vanadium Corporation
VCA	Vanadium Corporation of America

Executive Summary

Uranium ore was processed from 1941 through 1963 at the Durango site, located 0.25 mile southwest of the city of Durango in La Plata County, Colorado. The former processing site consists of two geographically contiguous, but hydrogeologically separate, areas: the mill tailings area, which encompasses the northern portion of the site, and the raffinate ponds area, which encompasses the southern portion of the site. The site is bounded by Lightner Creek to the north, the Animas River to the east, South Creek to the south, and Smelter Mountain to the west. Contaminated materials were removed from both areas from 1986 through 1991 and stabilized in a disposal cell in Bodo Canyon, approximately 1.5 miles southwest of the processing site.

Mill Tailings Area

The mill tailings area is underlain by Mancos Shale, which has been truncated by the Smelter Mountain fault south of the mill tailings area. Along the base of Smelter Mountain, the Mancos Shale directly underlies a thick layer of colluvium; closer to Lightner Creek and the Animas River, deposits of river-laid sand and gravel occur over the shale bedrock and under the colluvium. Ground water at the mill tailings area is present in an unconfined alluvial aquifer, which is recharged by infiltration of precipitation and runoff, and by contact with the Animas River and Lightner Creek.

The primary sources of ground water contamination in the mill tailings area were the large and small tailings piles. The constituents of potential concern (COPC) identified in the 1995 Baseline Risk Assessment (BLRA) were reevaluated using data collected through August 2001. The more recent data indicate that uranium presents the greatest risk and is the COPC with concentrations that exceed the Uranium Mill Tailings Remedial Action (UMTRA) Project maximum concentration limit (MCL) in ground water in the greatest number of wells. Concentrations of selenium also exceed the MCL in several locations, and cadmium and molybdenum levels exceed their MCLs in only one location each.

To achieve compliance with Subpart B of Title 40 *Code of Federal Regulations* Part 192 (40 CFR 192), the U.S. Department of Energy's (DOE) proposed action is natural flushing in conjunction with institutional controls and continued monitoring. Ground water flow and transport modeling has predicted that site-related concentrations of uranium and molybdenum in the alluvial aquifer will decrease to levels below the MCL within 100 years. Modeling results also indicate manganese and sulfate concentrations will decrease below their risk-based and background levels, respectively. Selenium occurs naturally in background locations at the mill tailings area in concentrations above the MCL. Ground water flow and transport models indicate selenium concentrations will not decrease below the MCL within 100 years. Therefore DOE defers to the alternate concentration limit (ACL) value of 0.05 milligrams per liter (mg/L) for selenium from the U.S. Environmental Protection Agency's (EPA) Safe Drinking Water Act (the predicted concentration after 100 years is 0.0246 mg/L). Selenium concentrations are less than levels considered to be a risk to human health and the environment.

Cadmium concentration is elevated in only one well (0612) at the mill tailings area; all other on-site wells concentrations are at or near the detection limit. Cadmium accounts for only 6 percent of the risk at the mill tailings area using the worst-case residential drinking water scenario. Ground water flow and transport models indicate cadmium levels will not decrease below the MCL or risk-based concentrations within 100 years. Cadmium concentrations from well 0612

vary considerably, and since the completion of surface remediation, data indicate a downward trend greater than indicated by the model (because of the high estimated distribution coefficient used in modeling); the trend indicates that cadmium will decrease below the MCL. Cadmium will be monitored in well 0612 for the next 10 years to verify the downward trend in concentration.

The volume of water with cadmium concentrations above the MCL is considered to be small enough that it poses no unacceptable ecological risks. In addition, ground water at the mill tailings area is not a current or potential source of drinking water. Because of existing institutional controls and the availability of municipal water as a drinking water source, the most likely scenario for the mill tailings area is that no ground water exposures will occur.

Raffinate Ponds Area

Two bedrock units, both members of the Mesaverde Group, underlie the raffinate ponds area. The Point Lookout Sandstone underlies the northwestern two-thirds of the raffinate ponds area between Smelter Mountain and the Bodo Fault. The Bodo Fault is a northeast-southwest trending normal fault and dips to the southeast across the site. The Menefee Formation underlies the southeastern one-third of the raffinate ponds area, southeast of the fault. The Point Lookout Sandstone consists of siltstone with interbedded sandstone and shale. The Menefee Formation consists of massive sandstone with beds of carbonaceous shale and coal. Ground water at the raffinate ponds site is unconfined and is recharged by infiltration of precipitation and runoff, and by horizontal inflow from Smelter Mountain. Ground water flow at the raffinate ponds area is predominantly through joints, open bedding planes, and fractures.

Before surface remediation was completed, ground water in the raffinate ponds area occurred in both the surficial deposits and bedrock. At present, ground water in the raffinate ponds area occurs primarily in the bedrock. The primary sources of ground water contamination at the raffinate ponds area were spent raffinate liquids from the milling process that were pumped into a ditch and carried to the settling ponds. There the raffinate was disposed of through evaporation and seepage.

Since completion of surface remediation, uranium and selenium are the only constituents that have consistently exceeded the MCLs at the raffinate ponds area. The highest concentrations of selenium and uranium are detected in the central portion of the site east of the Bodo Fault, in the shallow wells of the Menefee Formation. With the exception of selenium, concentrations of all contaminants related to the uranium-ore processing (arsenic, molybdenum, sulfate, uranium, and vanadium) have decreased since the completion of surface remediation and continue to show downward trends in concentrations.

To achieve compliance with Subpart B of 40 CFR 192 at the raffinate ponds area, DOE's proposed compliance strategy is no remediation with the application of supplemental standards based on the criterion of limited use ground water due to widespread selenium contamination. The following facts indicate that selenium concentrations exceeding the MCL at the raffinate ponds area are a result of natural sources of selenium and not uranium-ore processing:

- The U.S. Department of Health, Education, and Welfare analyzed seepage from the tailings piles and the raffinate liquor while the mill was in operation. Selenium concentrations were below the detection limit in both sources. In addition, present-day pore water in the tailings at

the Bodo Canyon disposal cell shows that selenium is not the dominant contaminant in the mill tailings. The fact that selenium is the sole element of this group to increase in concentration, while concentrations of other constituents are decreasing, and historical selenium concentrations in the raffinate liquids are below the detection limit, indicate that the presence of selenium is not related to the uranium-ore processing.

- Concentrations of selenium vary; in most wells where selenium values are elevated, the wells are screened across coal deposits. The carbonaceous shales, coal deposits, and pyrite that are widespread across the raffinate ponds area are well documented to be enriched in selenium. The mobilization of selenium into ground water from these sources is related to the oxidation-reduction potential (ORP) in the ground water; selenium is mobilized with increasing oxidation. In most cases, increasing and decreasing selenium values at the raffinate ponds area show a definite correlation with ORP.

- Selenium concentration exceeds the MCL at background well 0599; most recently by nearly a factor of nine. The ORP is oxidizing in well 0599; in other background wells the ORP is negative (reducing conditions), preventing selenium from being mobilized into the ground water. Selenium concentrations in background surface water locations sampled by the U.S. Bureau of Reclamation exceed the MCL.

Ground water from the bedrock formations beneath the raffinate ponds area is not a current or potential source of drinking water. Potable water is readily available from the municipal water system in the vicinity of the site. Future use of ground water from the bedrock aquifer is unlikely based on the planned future development of a pumping plant on the raffinate ponds site. Therefore, the current and reasonably projected uses of site-affected ground water would be preserved with the application of supplemental standards.

In addition, ground water could not be reasonably treated for use as drinking water at the raffinate ponds area because the bedrock aquifer does not produce water in usable quantities except in the fault, joints, and fractured coal beds. Also, the poor quality of water in wells screened in theses features would prevent anyone from wanting to drink the water. Ground water in some of the background wells (and many of the on-site wells) has a black discoloration and a strong odor of hydrogen sulfide gas; sulfide is detected in several background wells in concentrations above risk-based levels.

End of current text