Uravan Uranium Project (Union Carbide Corp.) Superfund Site

Site-wide Record of Decision

COLORADO
Department of Public Health & Environment

EPA United States Environmental Protection Agency

PART 1 – DECLARATION OF THE RECORD OF DECISION

A. Site Name and Location

The Uravan Uranium Project (Union Carbide Corp.) Site ("Uravan Site" or "Site") is located in Montrose County, Colorado. The 700-acre Site was not divided into Operable Units. This Record of Decision (ROD) addresses the entire Site.

The US Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation and Liability System (CERCLIS) Site Identification Number is COD007063274.

B. Statement of Basis and Purpose

This decision document represents the selected site-wide remedy for the Uravan Site. This ROD has been developed in accordance with the requirements of the Comprehensive, Environmental Response, Compensation and Liability Act (CERCLA) of 1980, 42 U.S. Code (USC) §9601 et. seq. as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), 40 CFR Part 300. This decision is based on the Administrative Record for the Uravan Site.

This remedy is selected by the US Environmental Protection Agency (EPA) Region 8. The Colorado Department of Public Health and Environment (CDPHE) concurs with the selected remedy.

C. Assessment of Site

The response actions selected in this ROD are necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. Such release or threat of release may present an imminent and substantial endangerment to public health or welfare.

D. Description of Selected Remedy

The majority of the work at this Site was conducted as a State-lead site under a Consent Decree/Remedial Action Plan (CD/RAP) (Civil Action No. 83-C-2384) between the State of Colorado, Union Carbide Corporation and Umetco Minerals Corporation (Umetco). EPA was not a party to the Consent Decree. This ROD serves to document the previous completed work and to select the final remedy components that EPA and CDPHE have determined are appropriate for long-term protectiveness at the Site.

Summary of Completed Remedial Action and Residual Contamination

Under the CD/RAP, as amended, Umetco was required to complete the following remedial activities:

- Determine the extent of dispersed contamination and clean up areas found to be contaminated to applicable criteria for approximately 400 acres;
- Relocate more than 3 million cubic yards of mill wastes and contaminated materials to secure repositories on Club Mesa;
- Construct waste and tailing repository covers, liquid evaporation and retention ponds, and permanent runoff control structures, utilizing more than 1.7 million cubic yards of earthen materials;
- Construct five double-lined ponds (totaling 40 acres) for the evaporation of hillside seepage, tailing pile seepage, and extracted groundwater;
- Construct and utilize a new repository in the "B-Plant" area capable of disposing in excess of 1.8 million cubic yards of evaporative pond demolition debris and radioactive waste;
- Demolish and remove about 50 major mill facility structures and buildings, including the process systems and circuits, and remove over 260 buildings in the Town of Uravan;
- Collect over 70 million gallons of hillside and tailing seepage, containing approximately 6,000 tons of contaminated inorganic compounds. (Hillside and tailing seepage that was collected was transferred to Club Ranch Ponds for management by evaporation);
- Extract approximately 245 million gallons of contaminated liquids from the groundwater, with the removal of approximately 14,500 tons of contaminated inorganic compounds. (Contaminated groundwater that was collected was transferred to Club Ranch Ponds for management by evaporation.); and
- Remove contaminated materials from the Old and New Town Dumps, with placement into the Club Mesa Tailing repository.

A summary of remedial actions completed is summarized below for the nine solids areas (including town subareas) and five liquids remedial activities described in the RAP.

<u>Solids</u>

Management of solids generally consisted of excavation of contaminated material, placement of material in onsite repositories, and Site restoration. The work completed in the nine Solids areas, including subareas, comprised the following activities:

- *Atkinson Creek Crystal Disposal Area.* Approximately 113,000 cubic yards of contaminated soil and raffinate crystals were removed. The site was graded with 1 foot of clean fill and revegetated.
- *Club Ranch Ponds Area.* Reclamation of the ponds occurred in three phases. Phases 1 and 2 included construction of new lined evaporation ponds for transfer of material from unlined ponds and for collection/evaporation of collected groundwater. Phase 3 consisted of removal of the ponds, disposal of contaminated media, and site restoration.

- *River Ponds Area.* Approximately 332,500 cubic yards of contaminated material was excavated from the floodplain to below historic low flow elevation. Restoration consisted of placing riprap to enhance siltation.
- *Tailings Piles.* Remediation activities for Tailings Piles 1 and 2, Tailings Pile 3, and the B-Plant Repository included dewatering, construction of drainage features, and capping.
- *Club Mesa Area.* Over 550,000 cubic yards of raffinate crystals, contaminated soil, and neutralized sludge were removed and placed in onsite repositories.
- *Mill Areas.* Remediation of the A-Plant and B-Plant areas was conducted in stages and included decommissioning of mill structures, removal of contaminated materials, and site restoration. On February 18, 2005, 9.84 acres of the Site that formerly contained 2 historic structures, the Boarding House and the Community Center, were deleted from the National Priorities List (NPL).
- *Town and Adjacent Areas.*
  - *Town Area.* Over 236,000 cubic yards of contaminated materials were removed from the Town Area and placed in onsite repositories. The Town Area was then reclaimed and revegetated.
  - *Town Dump.* Over 264,000 cubic yards of contaminated materials were removed from the town dump and placed in the B-Plant repository. The area was then reclaimed and revegetated.
  - *Windblown Area.* Exposure in most windblown areas was attributed to naturally occurring radioactive material (NORM). Residual impacts were noted for Area E and Area J. Tailings slimes were removed from Area J.
  - *Mill Hillside.* Approximately 23,000 cubic yards of contaminated materials were removed from the mill hillside and placed in onsite repositories. Terraces were established to reduce erosion and enhance the hillside seepage collection system.
  - *County Road Y-11*. Approximately 8,600 cubic yards of contaminated materials were removed from select portions of the roadway in 2006. Risk assessment was performed for deeper contamination along the roadway.
  - *County Road EE-22.* Approximately 6,230 cubic yards of contaminated material was removed from the right-of-way, and the roadway was restored. Paving of the roadway was recommended.
  - *Water Storage Ponds.* Approximately 17,500 cubic yards of contaminated soil were removed and placed in onsite repositories. The area was then reclaimed and revegetated.
  - *Atkinson Creek Drainage Way.* Radionuclide and metal concentrations in soil samples were found to be below background levels. No remediation was performed.
  - *Hieroglyphic Canyon Drainage Way.* Discrete deposits of contaminated material were removed from the drainage way and placed in onsite repositories. No further action was proposed.
  - *Northeast Side of County Highway 141*. Removals were conducted to the northeast of the right-of-way in 2000 and within the right-of-way during 2006. On September 4, 2007, EPA deleted from the NPL a second portion of the Site, comprising approximately 7 acres including a one-mile section of Highway 141 between mile posts 75 and 76.

- *Nature Conservancy Visitor's Center*. Approximately 4,800 cubic yards of contaminated soil were removed and placed in the B-Plant repository. The site was reclaimed and revegetated. This cleanup was not included in the RAP.
- *Other Town Areas.* Based on contaminant levels reported to be below background levels, no remedial action was performed at the Corrals, E Block, F Block, Gym Area, Ball Park, or Homer Woods.

- *Burbank Quarry.* The lower portion of the quarry was used as a repository for onsite materials. The upper portion of the quarry was used as a Title 1 Repository by the DOE for disposal of waste from the nearby Naturita processing site. The repository areas were capped, and drainage materials were installed.
- *Borrow Areas on Club Mesa*. The borrow areas were not contaminated and were used as backfill sources during remediation activities

Liquids

The RAP also described five liquid remedial activities: Hillside Seepage and Tailings Liquids, Ponded Liquids, Surface Runoff and Ground Water.

- *Hillside Seepage and Tailings Liquids.* Seepage from the Hillside area and Tailings Piles was collected and disposed of in the new lined Club Ranch Ponds.

- *Ponded Liquids and Surface Runoff.* Liquid wastes across the site were consolidated and evaporated. Surface runoff collection systems were operated until cleanup activities were completed, when the systems were decommissioned.

- *Ground Water.* Ground water was monitored and extracted. The extracted ground water was evaporated in lined ponds. The extraction and evaporation was discontinued when steady state conditions were achieved, and CDPHE approved a ground water Alternate Concentration Limit (ACL) application in 2003.

Residual impacts were primarily assessed through confirmation surveys at the various areas and subareas.

The remedy selected in this Record of Decision supplements the completed work with Institutional Controls (ICs), monitoring and maintenance for areas of the Site that have not achieved the standard of Unlimited Use and Unrestricted Exposure (UU/UE).

The selected remedy (Alternative 2) includes the following:

- Custody, and long-term care of uranium and thorium mill tailings sites closed (reclaimed) under Title II of the Uranium Mill Tailings Radiation Control Act (UMTRCA) of US Department of Energy (DOE)-administered land;
- Inspection, maintenance, and environmental monitoring within the future DOE transfer boundary to be completed by DOE as specified in the Long-Term Surveillance Plan (LTSP); and

- Implementation, monitoring and maintenance of additional institutional controls in the form of proprietary controls (e.g., environmental covenants, restrictive notices, etc.) throughout the Site where residual contamination is present, either within and/or outside the future DOE transfer boundary. The additional institutional controls under CERCLA will inform the community of risks, and will restrict access to and use of contaminated media within the DOE transfer boundary and on parcels not resulting in UU/UE land use scenarios outside of the future DOE transfer boundary, but still within the Site. The proprietary controls would generally prohibit residential use, soil disturbance, and/or groundwater use.

Once the ICs have been implemented, no additional CERCLA remedial action is necessary for the Site. Regardless of authority, it is recognized that inspection, maintenance, and environmental monitoring is necessary for the long-term protectiveness and permanence of the remedy. Monitoring, maintenance and five-year reviews will be on-going.

E. ROD Data Certification Checklist

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record for this Site.

- Contaminants of Concern (COCs) and their respective concentrations. (Section 5 and Section 7)
- Baseline risk represented by the COCs. (Section 7)
- Cleanup levels established for COCs and the basis for the levels. (Section 7)
- Whether source materials constituting principal threats are found at the Site. (Section 11)
- Current and future land and ground water use assumptions used in the baseline risk assessment and ROD. (Section 6)
- Potential land and ground water use that will be available at the Site as a result of the selected remedy. (Section 12)
- Estimated capital and operation and maintenance (O&M) costs. (Section 12)
- Key factors that led to selecting the remedy. (Section 12).

F. Statutory Determinations

The selected remedy for the Site is protective of human health and the environment, complies with federal and State requirements that are applicable or relevant and appropriate for the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment technologies to the extent practicable.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, statutory reviews will continue to be conducted every 5 years to ensure that the remedy is, or will be, protective of human health and the environment. (NCP §300.430(f)(4)(ii))

Authorizing Signatures

Federal

This Record of Decision documents the selected remedy to address the contamination at the Uravan Uranium Project (Union Carbide Corp.) Site.

The following authorized official at EPA Region 8 approves the selected remedy as described in this ROD.

Betsy Smidinger — Date: 6/1/18

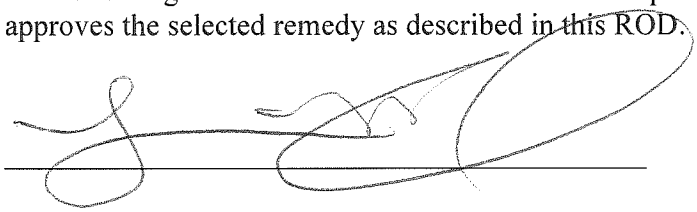
Betsy Smidinger
Assistant Regional Administrator
Office of Ecosystems Protection
and Remediation

Authorizing Signatures

State of Colorado

This Record of Decision documents the selected remedy to address the contamination at the Uravan Uranium Project (Union Carbide Corp.) Site.

The following authorized official at the Colorado Department of Public Health and Environment approves the selected remedy as described in this ROD.



5/9/18

Larry Wolk, MD, MSPH
Executive Director and Chief Medical Officer
Colorado Department of Public Health and Environment

Date

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PART 2 – THE DECISION SUMMARY

A. Site Name, Location, and Description

The Uravan Uranium (Union Carbide Corp.) Superfund Site ("Uravan Site" or "Site") is located in Montrose County, Colorado. The approximately 700-acre Site is located in the western portion of Montrose County, Colorado, on Colorado Highway 141 approximately 13 miles northwest of the Town of Nucla, Colorado; 81 miles south of the Town of Whitewater, Colorado, in Mesa County; and 50 air miles southwest of the City of Grand Junction, Colorado (Figure 1). The Site was not divided into Operable Units. This Record of Decision (ROD) addresses the entire Site.

The US Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation and Liability System (CERCLIS) Site Identification Number is COD007063274.

The majority of the work at this Site was conducted as a State-lead site under a Consent Decree/Remedial Action Plan (CD/RAP) (Civil Action No. 83-C-2384) between the State of Colorado, Union Carbide Corporation and Umetco Minerals Corporation (Umetco). EPA was not a party to the Consent Decree. This ROD serves to document the previous completed work and to select the final remedy components that EPA and CDPHE have determined are appropriate for long-term protectiveness at the Site.

The Site began operating as a radium-recovery plant in 1912. From the 1930s until 1984, the plant operated as a uranium and vanadium processing facility. Operations at the Site left a large volume of wastes, which contaminated air, soil and ground water near the facility and in the San Miguel River. The Site includes the former processing areas, the former Town of Uravan, and surrounding areas. Colorado Scenic Highway 141 is located along and partially through the eastern portion of the Site. The San Miguel River runs through the Site. The area surrounding the Site is rural with very few residences nearby. The Umetco office is the only remaining building on the Site. The Site habitat is characterized by an arid climate, sparse vegetation and rugged topography. The Site's topographic features are dominated by broad mesas and incised canyons. The Site is within the incised San Miguel River Valley and on top of a part of the adjacent Club Mesa. The Site contained over 10 million cubic yards of byproduct wastes, which included radioactive elements, metals and inorganic compounds. From 1987 until 2004, over 350 million gallons of liquid waste from seepage collection and ground water extraction systems were collected.

B. Site History and Enforcement Activities

History of Contamination

The Joe Jr. Mill, owned by the Standard Chemical Company was the first mill at the Site. It operated from 1912 until 1923. A radium slime concentrate was produced using an acid leach process. Sulfuric acid was used to leach radium from the ore, with incidental vanadium and uranium dissolution. Limestone neutralized the liquid and precipitated the radium and other metals. The mill was idle for a period of time.

In 1928, Union Carbide and Carbon Corporation (later named Union Carbide Corporation or UCC) purchased the Standard Chemical Company holdings in Colorado through its subsidiary U.S. Vanadium Corporation (USV). The Standard Chemical Company reserves were reportedly purchased for the recovery of vanadium. UCC expanded the "A-Plant" in 1934, constructing a mill and roasting plant to recover vanadium from carnotite ore, and added uranium recovery circuits shortly thereafter with operations starting in 1937 and 1938 at the Uravan site. The town of Uravan was established in 1936 to house workers at the mill and mine facilities and their families.

Between 1937 and 1938, the mill produced approximately 250,000 pounds of triuranium octoxide, U_3O_8. USV refined the material in Uravan and sold the recovered vanadium and uranium concentrates to the U.S. Army. In the fall of 1942, the Manhattan Project and USV officials discussed building new facilities for the U.S. government to process uranium. Construction began in 1943 for a new plant at Uravan (termed the WSP Plant) near the existing USV mill (termed the WAA Plant). USV's WAA Plant went under government contract by June 1944. Operations at the government's WSP Plant at Uravan began in July 1943 and discontinued in 1945; USV subsequently dismantled the plant. In 1945, USV's WAA mill reverted to private operations.

The Uravan mill's capacity continued to expand in the 1950s to meet the demand for uranium required by the U.S, government's weapons programs, pursuant to a contractual agreement between USV and the U.S. Atomic Energy Commission (AEC). The Uravan mill received uranium/vanadium ores from over 200 mines in the area. The mill operated under a series of licenses issued by AEC [subsequently regulated by the United States Nuclear Regulatory Commission (NRC)] and from the State of Colorado from 1947 to the present. The amended licenses became increasingly complex, addressing worker safety and health concerns, public safety and health and environmental issues. UCC operated the Uravan mill under an AEC Source Material License Number SUA-673 until 1968. In 1968, the State of Colorado became an Agreement State with AEC. Section 274 of the Atomic Energy Act provides the statutory basis under which the NRC relinquishes to the States portions of its regulatory authority to license and regulate byproduct materials (radioisotopes); source materials (uranium and thorium); and certain quantities of special nuclear materials. After 1968, the Uravan mill operated under a radioactive material license issued by the Colorado Department of Public Health and Environment (CDPHE).

UCC continually improved the mill circuits to meet product demand and constructed the "B-Plant" in 1955 on a bench on Club Mesa, several hundred feet above the San Miguel River. Starting in 1956, all ore receiving, sampling, crushing and grinding, and initial leach operations were conducted at B-Plant. Dissolved leach liquor was piped to A-Plant located in the River valley for uranium and vanadium recovery. UCC recovered uranium and vanadium from leach liquors initially with a column ion-exchange process, followed by precipitation and drying of the uranium containing "yellow-cake" or milled uranium oxide. Vanadium was recovered in a second-stage solvent extraction process. UCC placed slurry tailings from "B-Plant" in engineered piles on a bench of Club Mesa. A radium removal circuit was installed in 1958 to treat waste solutions. UCC constructed three unlined ponds (the "Club Ranch Ponds" or CRPs), between 1963 and 1965 to aid liquid management through a combination of evaporation and seepage. Additional improvements added later to liquid management units included adding a neutralization circuit to permit part of the mill process wastes to be discharged directly to the San Miguel River and installing a spray evaporation system in 1976 on Club Mesa. Between 1936 and 1984, when UCC operated the mill complex, the mill produced approximately 42 million pounds of uranium oxide (U_3O_8) and 222 million pounds of vanadium oxide (V_2O_5).

The uranium industry collapsed in the 1980's due to a domestic decline in demand from nuclear energy generating plants and competition from foreign supply sources. As a result, from 1981 through 1984, the Uravan Mill operated only about 6 months per year. The mill was placed on standby status in November 1984, and mill operations never resumed prior to mill closure. Umetco, a subsidiary of UCC (later, a subsidiary of Dow Chemical), has maintained the Site since its closure in 1984.

Initial Investigations

In December 1983, the State of Colorado filed a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) natural resources damages claim against Union Carbide in the U.S. District Court for the District of Colorado. The State subsequently amended its complaint to include a CERCLA cost recovery claim. EPA proposed the Uravan Site to the National Priorities List (NPL) on October 15, 1984, and finalized the NPL listing on June 10, 1986. By stipulated agreement between the parties, Umetco (a wholly owned subsidiary of Union Carbide) was added as a defendant in 1986. On April 2, 1986, EPA and the State of Colorado entered into a Memorandum of Agreement which, among other things, gave the State of Colorado the lead on overseeing the Site remediation. In order to avoid litigation and to expedite decommissioning and reclamation of the Uravan Site, the State and UCC/Umetco subsequently assigned legal and technical representatives to negotiate a technical agreement regarding remedial actions at Uravan. A joint group consisting of Umetco, CDPHE, and their consultants developed the Remedial Action Plan (RAP) on the basis of a review and reassessment of previous reclamation, the Uravan Environmental Report, dated August 31, 1978 (as amended 3/31/1982), and the ERI Logan Report, dated August 11, 1986. In addition to prescribing detailed technical requirements and schedules for Site remediation, the RAP specified that UCC/Umetco require all residents of the Town of Uravan to vacate their residences by December 31, 1986, and prevented UCC/Umetco from permitting any building or improvement at the Site to be constructed for, or occupied as, a residence.

The U.S. District Court approved the Final Consent Decree (No. 83-C-2384), with the appended and incorporated RAP, on February 23, 1987. In the Consent Decree, the District Court specifically found that the RAP required a level or standard of control for all hazardous substances or pollutants or contaminants that would attain all legally applicable or relevant and appropriate standards, requirements, criteria or limitations. The Court found that the remedial action prescribed in the RAP would attain a degree of cleanup of hazardous substances, pollutants and contaminants at or released from the Site that assured protection of human health and the environment. The Court further found that site investigation, analysis of remedial alternatives, and scoping of response actions were consistent with the National Contingency Plan (NCP) requirements, and that the remedial action prescribed in the RAP was the "appropriate extent of remedy" as required by the NCP.

After a mobilization period, remedial action under the Consent Decree/RAP commenced during 1988. Specific remedial actions at the Site are described below.

The Uravan Mill License

The Uravan Site has been subject to several licenses over the past 60 years. The mill operated under a series of licenses issued by the AEC, [Subsequently regulated by the Nuclear Regulatory

Commission (NRC)] and from the State of Colorado from 1947 through the present. The amended licenses became increasingly complex, addressing worker safety and health concerns, public safety and health, and environmental issues. The Uravan mill was operated under an AEC Source Material License Number SUA-673 until 1968. In 1968, the State of Colorado became an Agreement State with the AEC, and as such, took over all licensing functions. After 1968, the Uravan mill operated under a radioactive material license issued by CDPHE.

At the time the Site was placed on the NPL, Union Carbide and CDPHE were developing a source material license for the facility. Upon entry into the Consent Decree, the Uravan License 660-02, was made final. This license issued by the State of Colorado is enforceable by the provisions of the Consent Decree and under applicable provisions of state law.

Remedial Investigation/Feasibility Study (RI/FS)

Although a conventional CERCLA remedial investigation and feasibility study was not conducted for this Site, much of the equivalent types of information were collected and similar studies were performed and are documented in the RAP. These studies form the basis for the remedial actions documented in this Record of Decision.

The Site work falls under the 1978 Uranium Mill Tailings Radiation Control Act (UMTRCA) Title II program. Congress enacted UMTRCA to provide for the disposal, long-term stabilization, and control of uranium mill tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards to the public. This Act established two programs to protect the public and the environment from uranium mill tailings. Title I of UMTRCA authorizes the Department of Energy (DOE) to remediate specifically identified “inactive” processing sites. Inactive processing sites are those that were no longer licensed under the Atomic Energy Act as of January 1, 1978. The UMTRCA Title II program is directed toward uranium mill sites licensed by the NRC or Agreement States on or after 1978. Title II of the Act provides NRC authority to control radiological and non-radiological hazards and EPA authority to set generally applicable standards for both radiological and non-radiological hazards. In addition, UMTRCA requires eventual State or Federal ownership of the disposal sites, under general license from NRC. Colorado declined long-term custodial care of the Site on October 15, 2003. The Site is subject to Title II, although there is a small Title I disposal area located on the Site. The Title I disposal area is not considered part of the Site.

In 2017, Remedial Investigation and Focused Feasibility Study documents were finalized, documenting the work completed at the Site and developing alternatives for the remaining work needed.

Remedial Action

Under the Consent Decree, Umetco was required to complete reclamation activities specified in the RAP, as amended. (The terms reclamation, remedial action and remediation are used interchangeably in this document.) To complete these activities, Umetco prepared construction, health and safety and environmental documents. Umetco submitted the documents to the State of Colorado for review and approval. As remedial activities progressed, Umetco and CDPHE periodically modified and approved these documents to reflect changing site conditions. These

documents formed the basis for conducting, monitoring and assessing the remedial activities and determining if the selected remedy is protective of human health and the environment.

The RAP, as amended, described remedial activities for solids in nine different areas:

- Atkinson Creek Crystal Disposal Area
- Club Ranch Ponds Area
- River Ponds Area
- Tailings Piles
- Club Mesa Area
- Mill Areas
- Town and Adjacent Areas
- Burbank Quarry
- Borrow Areas on Club Mesa

These areas and others are depicted in Figure 2.

The RAP also described five liquid remedial activities: Hillside Seepage and Tailings Liquids, Ponded Liquids, Surface Runoff and Ground Water.

Under the Consent Decree/RAP, as amended, Umetco was required to complete the following remedial activities:

- Determine the extent of dispersed contamination and clean up areas found to be contaminated to applicable criteria for approximately 400 acres;
- Relocate more than 3 million cubic yards of mill wastes and contaminated materials to secure repositories on Club Mesa;
- Construct waste and tailing repository covers, liquid evaporation and retention ponds and permanent runoff control structures, utilizing more than 1.7 million cubic yards of earthen materials;
- Construct five double-lined ponds (totaling 40 acres) for the evaporation of hillside seepage, tailing pile seepage and extracted ground water;
- Construct and utilize a new repository in the “B-Plant” area capable of disposing in excess of 1.8 million cubic yards of evaporative pond demolition debris and radioactive waste;
- Demolish and remove about 50 major mill facility structures and buildings, including the process systems and circuits, and remove over 260 buildings in the town of Uravan;
- Collect over 70 million gallons of hillside and tailing seepage, containing approximately 6,000 tons of contaminated inorganic compounds. (Hillside and tailing seepage that was collected was transferred to Club Ranch Ponds for evaporation);
- Extract approximately 245 million gallons of contaminated liquids from the ground water with the removal of approximately 14,500 tons of contaminated inorganic compounds. (Contaminated ground water that was collected was transferred to Club Ranch Ponds for evaporation); and
- Remove contaminated materials from the Old and New Town Dumps with placement into the Club Mesa Tailing repository.

An area-by area summary of conditions, RAP requirements, remedial actions conducted and contamination remaining, if any, will be described in the sections below following the nine solids areas and five liquid remedial activities described in the RAP. It will be noted if contamination remains in each area over levels that allow for unlimited use and unrestricted exposure (UU/UE). Areas above levels that allow for UU/UE will be carried forward to later sections of this document describing the ICs.

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate federal and State requirements, standards, criteria, and limitations, which are collectively referred to as ARARs, unless such ARARs are waived under CERCLA 121(d)(4). A summary of the ARARs for the work completed under the CD/RAP is described in Table 1.

Note that the radiation term "Unrestricted Use" and the CERCLA term "Unlimited use/Unrestricted Exposure" (UU/UE) are not equivalent. Since the term unrestricted use is referred to in various documents, including compliance documents, and UU/UE is considered under CERCLA when determining is institutional controls are needed, the two terms are defined below.

"Unrestricted Use" is defined in the Colorado Rules and Regulations Pertaining to Radiation Control (Part 1 and Part 18, Appendix A, Criterion 6(6) of 6 CCR 1007-1, respectively, Radiological criteria for unrestricted use). A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a Total Effective Dose Equivalent (TEDE) to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA).

Unlimited Use and Unrestricted Exposure (UU/UE) means that there are no restrictions placed on the potential use of land or other natural resources. In general, if the selected remedy relies on restrictions of land, ground water, or surface water use by humans or if any physical or engineered barrier is part of the remedy, then the use has been limited. UU/UE is generally the level of cleanup at which all exposure pathways present an acceptable level of risk for all land uses.

Atkinson Creek Crystal Disposal Area

The Atkinson Creek Crystal Disposal Area was located downstream from the Club Ranch Ponds and adjacent to Atkinson Creek. UCC constructed this disposal area in the early 1970s on the site of a former mobile home park. UCC removed the mobile homes and the underlying soils were excavated and stockpiled adjacent to the area. After preparation of the site, UCC removed an estimated 200,000 cubic yards of raffinate crystals from Club Ranch Ponds #1 and #6 and stored them in the Atkinson Creek area. No liner was placed beneath the crystals to prevent contamination of the underlying soils or groundwater. UCC placed natural soils on the raffinate crystals to form a soil cover approximately 12-inches thick. The RAP specified the following remedial activities for the Atkinson Creek Crystal Disposal Area.

- Remove raffinate crystals and cover soils from the Atkinson Creek Crystal Disposal Area and place the materials in the Burbank Quarry secure crystal repository;

- Remove peripheral contaminated soils and contaminated soils beneath the crystals in accordance with Table 4.1.2-1 of the RAP, or until bedrock or the water table is encountered. (The peripheral contaminated soil was to be disposed of on the Club Mesa tailings piles);
- Put runoff controls in place during remedial activities; and,
- Following removals, grade the ground surface to a stable configuration, cover with at least 1 foot of random fill, and vegetate.

Major removal activities began at the Site in 1991 following construction of runoff and drainage controls. Approximately 110,000 cubic yards of raffinate crystals (including the crystals, cover soils, and minimum 1 foot of contaminated soil from under the crystals) were removed from January to June 1991.

Following the initial removal, Umetco performed a walking scintillometer scan of the work area. All readings were below the 20 microroentgens per hour (µR/h) standard for no further action established on Table 4.1.2-1 of the RAP. However, confirmatory laboratory soil sample results revealed RAP cleanup objective exceedances at 18 locations (all 18 locations for Thorium-230, three for Uranium-nat, one for molybdenum, and one for vanadium). Umetco removed an additional 3,000 cubic yards of soil in the exceedance areas and resampled the locations.

Based on the resampling results, residual RAP cleanup objective exceedances of thorium-230, molybdenum, vanadium, and arsenic remained at the Atkinson Creek Crystal Disposal Area. Umetco conducted a risk assessment of the residual contamination and developed proposed appropriate remediation levels (ARLs) for these constituents, with 1 foot of clean soil cover. It was concluded that although arsenic concentrations remained above ARLs, the resultant concentrations did not pose a significant incremental risk above that associated with background concentrations.

Umetco submitted revisions to the risk assessment report in November 1994, based on CDPHE comments set forth in a letter dated June 14, 1994. The revisions included an updated ARL for Molybdenum of 4,200 mg/kg for soil exposure (assuming the 1-foot cover is in place). The revised report also included an assessment of the longevity of the one-foot soil cover. The soil cover was estimated to last between 1,700 and 5,000 years in different portions of the excavation area.

Post-excavation activities, including removal of runoff controls, removal of the wheel wash system, grading with 1 foot of random fill and reseeding, were completed in December 1993 and were documented in *Compliance Report CR-400-4*.

Umetco performed radiological surveys for exposure rates and surface soil radium-226 in December 2001, as documented in *Compliance Report CR-400-5*. An average exposure rate of 13.6 µR/h with a maximum exposure reading of 58.0 µR/h was noted (average exposure in the grid with the maximum reading was 20 µR/h). Radium-226 concentrations averaged 3.4 picocuries per gram (pCi/g) with a maximum grid average of 106.4 pCi/g. The grid with the maximum reading had a reading average of 13 pCi/g. Two grids had reading averages over 7 and less than 17 pCi/g.

Club Ranch Ponds Area

The Club Ranch Evaporation Ponds (CRPs) Area consisted of six unlined liquid waste disposal ponds located down valley from the former mill site area and ancillary disposal areas. UCC constructed the CRPs in the early 1960s to serve as both evaporative and seepage discharge ponds. UCC excavated the ponds into gravel terrace deposits of the San Miguel River. The depths of the ponds ranged from approximately 8 feet to almost 30 feet. When operations ceased, Umetco estimated the ponds contained 560,000 cubic yards of raffinate crystals and 30 million gallons of liquid. Remedial investigations identified contaminants in the alluvial gravels and the underlying Kayenta Formation.

In the RAP, CDPHE selected a remedy for the CRPs Area that would excavate and dispose of (on-Site) raffinate crystals in the Burbank repository and dispose of other contaminated soils in the Tailings Piles on Club Mesa. The objectives of this remedy were to remove the source of potential future contamination of the Kayenta-Wingate aquifer and the San Miguel River.

Reclamation of the Club Ranch Ponds area occurred in three phases. Phase 1 consisted of the construction of two new lined evaporation ponds, the transfer of liquids from the unlined ponds to the lined ponds, and removal of raffinate crystals and contaminated soils from the unlined ponds into the repositories. Phase 2 covered the construction of additional lined ponds for collection and evaporation of contaminated groundwater and runoff during reclamation of the entire Site. Phase 3 included the removal and disposal (in the on-Site repository) of pond liner materials, residual raffinate sediments, contaminated soils, and final grading and revegetation of the Site.

Phase 1 Remediation

Remedial activities began with the construction of two lined evaporation ponds (CRP-7 and CRP-8) in a portion of the Town Area. The new evaporation ponds were built to contain contaminated liquids from the other remedial activities conducted at Uravan. The ponds were constructed with leak detection systems and synthetic liners to eliminate contamination of underlying soils and groundwater from the containment of contaminated fluids. Construction started in September 1987, with the demolition and removal of town buildings and appurtenances from within the pond footprints. Approximately 43,000 cubic yards of contaminated soils were removed and placed in Tailings Piles 1 and 2. Confirmation surveys were completed in September 1987 for the CRP-7 area and in May 1988 for the CRP-8 area. CRP-7 and CRP-8 were completed and placed in use in May 1988, and June 1988, respectively. The pond construction activities were addressed in *Compliance Reports CR-428-1, CR-428-2A, CR-428-2B, CR-428-3A, CR-428-3B, CR-428-4A, CR-428-4B, CR-428-5A, and CR-428-5B.*

Dewatering of the unlined Club Ranch Ponds began after discharges to these ponds were redirected to CRP-7 on May 31, 1988. By December 24, 1988, all contaminated liquids had been transferred from the unlined ponds into the new lined ponds. This work was addressed in *Compliance Report CR-401-2*.

Excavation of the raffinate crystals from the unlined ponds occurred between September 1989 and December 1990. Approximately 368,000 cubic yards of raffinate crystals were removed in accordance with Section 4.2.2.2 of the RAP and placed in the Burbank Repository. In 1990, contaminated soils were removed in accordance with the prescriptive, visual and radiological

criteria cited in the RAP and transported to Tailings Pile 3. Approximately 40,100 cubic yards of contaminated soils were removed from under the upper ponds.

The removal of raffinate crystals in the lower ponds exposed cemented river terrace gravels which were initially left in place in anticipation of re-shaping these ponds for additional evaporative storage capacity. These gravels were removed during Phase 2.

Phase 2 Remediation

The plans and specifications for the construction of the additional lined ponds provided additional storage and evaporation of contaminated liquids while preventing additional seepage of these liquids into the subsoil or the groundwater. The approved design provided 36.1 acres of pond surface area, perimeter ditches to intercept offsite runoff, high-density polyethylene (HDPE) synthetic liners, 3 feet of freeboard for normal operating conditions including 1 foot of freeboard for emergency conditions and separate leak detection/collection systems for each pond. The 3 feet of freeboard specified was sufficient to contain a 100-year, 24-hour storm (and was in excess of the 25-year storm specified in the RAP) and designed to accommodate wave action/overspray.

The three upper ponds (CRP-1, CRP-4, and CRP-6) were re-shaped and lined between June 1990 and June 1992. The upper ponds were the only three out of the six original ponds that were reconstructed, and the lower ponds were held in reserve. Approximately 67,000 cubic yards of uncontaminated soil obtained from within the Club Ranch Ponds area were placed and compacted as dikes during re-shaping activities. Field Change Order FC-401-2 allowed the 12-inch clayey base material originally specified to be placed beneath the pond liner to be replaced by very low-density polyethylene (VLDPE) liner material. The VLDPE liner was substituted in the three ponds that were completed. As a design refinement and to expedite installation, the liner systems in CRP-4 and CRP-6 were upgraded to include a VLDPE secondary liner placed on the pond subgrade followed by an 8-ounce per square foot non-woven geotextile and an HDPE primary liner. In CRP-1, a 12-ounce per square foot non-woven geotextile was placed on the subgrade, followed by a VLDPE secondary liner and a HDPE primary liner.

Terrace gravels left in the bottoms of the lower ponds (CRP-2, CRP-3, and CRP-5) during Phase 1 were removed in 1998 to expose sandstone bedrock. This removal was in response to a groundwater remediation optimization program, designed to remove fluids perched beneath the lower ponds. Approximately 32,800 cubic yards of contaminated river gravels were removed during the 1998 construction season and placed in Tailings Piles 1 and 2. The pond reconstruction activities are detailed in *Compliance Reports CR-401-1, CR-401-3, CR-401-4, CR-401-5, and CR-401-6.*

Phase 3 Remediation

Cleanup activities were detailed in the Characterization Report and Remedial Action Plan for the Club Ranch Ponds Area dated June 2004, prepared in accordance with the Characterization Investigation Plan for Club Ranch Ponds Area, Revision 1 dated June 1997. The plans required dewatering the ponds, the removal of raffinate crystal residue, removal of pond liner materials, removal of leak detection systems, and removal of contaminated material as dictated by verification survey and sampling. Upon completion of remediation and confirmation activities, drainage channels were established and the entire Club Ranch Ponds area was covered with a

minimum 1-foot thickness of uncontaminated soil and seeded, in accordance with a field change order (Final Grading and Drainage Plan for the Club Ranch Ponds Area, dated June 2006).

Pond removal and remedial activities in the eight Club Ranch Ponds were conducted as follows:

Club Ranch Pond 1 (CRP-1)

Between July 2005 and August 2006, approximately 125,000 cubic yards of contaminated soils were removed from CRP-1 and the Caustic Pond area and placed in the B-Plant Repository. Approximately 14,000 cubic yards were excavated from the Caustic Pond area, the fence line below Highway 141, CRP-4 and CRP-6 and spread over the surface of the raffinate crystals in CRP-1 to stabilize the residues prior to being hauled to the repository. This activity is detailed in *Compliance Report CR-401-7A*.

Club Ranch Pond 2 (CRP-2)

The initial phase of remediation of the unlined CRP-2 and the adjacent area occurred between May and August 2001. This work consisted of the removal of trees, wood debris and contaminated soils from the area between the river and pond embankments. In addition, the work consisted of the removal of 1 foot of soil from the top and outside face of the pond embankments, the removal of 2 feet of soil from the inside face of the pond embankments and all the soil from the pond bottom. This work was detailed in the document *Uravan 2001 Project Work* submitted to CDPHE on April 10, 2001. Approximately 13,000 cubic yards of contaminated material was excavated and hauled to the B-Plant Repository for disposal during this period.

Final remediation occurred between December 2005 and June 2006. Approximately 45,000 cubic yards of contaminated material were excavated during this period. Approximately 13,000 cubic yards of the total materials were temporarily placed in CRP-3 and -5 and Runoff Control Pond 3 to blend and stabilize wet soil. The stabilizing material was subsequently removed as part of the cleanup activities in those ponds. The remaining contaminated soil was hauled directly to the B-Plant Repository for disposal. These activities are detailed in the CDPHE-approved *Compliance Report CR-401-7B*.

Club Ranch Pond 3 (CRP-3)

The initial cleanup from the unlined CRP-3 and the adjacent area occurred between April and September 2001. Approximately 6,000 cubic yards of contaminated soils from CRP-2 and the adjacent riverbank were placed in CRP-3 to help dry the material being hauled to the B-Plant Repository. Approximately 41,000 cubic yards of contaminated soil were excavated from CRP-3 of which 10,000 cubic yards was placed in CRP-7 to stabilize the crystal residues; the remaining material was transported to the B-Plant Repository for disposal. The soils in the uncontaminated portions of the embankments were sampled and tested in incremental segments to verify the absence of contamination. All the material verified as uncontaminated was stockpiled in the area for use during final grading activities.

Final remediation occurred during the 2005-2006 construction seasons. The approved remedial activities required the removal of one foot of altered soil from the road and center pond embankment, the removal of alluvial fill, the removal of a five-foot vertical wedge of altered

material from the center pond embankment, the removal of contaminated material and the relocation of uncontaminated soils from the lower embankment. Approximately 50,000 cubic yards of contaminated soils were excavated from CRP-3 and the CRP-19 well area between July 2005 and June 2006 and placed in the B-Plant Repository. The pond bottom area was excavated to bedrock. These activities are detailed in *Compliance Report CR-401-7C*.

Club Ranch Pond 4 (CRP-4)

Between July 2005 and June 2006, approximately 91,000 cubic yards of contaminated materials were removed from CRP-4 and the adjacent area. Approximately 2,000 cubic yards of contaminated materials were excavated from ancillary areas, including the caustic pond area, the fence line below Highway 141 and CRP-6, and placed in CRP-4 to stabilize the crystal residue. Approximately 23,000 cubic yards of dry contaminated soils excavated from CRP-4 were placed in CRP-1, CRP-5, CRP-8, and Runoff Control Pond 3 to stabilize wet material prior to its being hauled to the B-Plant Repository. The remaining portion of the contaminated material was hauled directly to the B-Plant Repository for disposal. Residual contaminated material located in the southeast portion of CRP-4 required excavation to bedrock. This activity is detailed in *Compliance Report CR-401-7D.*

Club Ranch Pond 5 (CRP-5)

Cleanup initially started along the riverbank area adjacent to CRP-5. This work consisted of the removal of trees, wood debris and contaminated soils from the area between the river and pond embankments. Between June and September 2001, approximately 3,400 cubic yards of contaminated soils were excavated and placed in the B-Plant Repository.

Approximately 50,000 cubic yards of contaminated materials were removed from CRP-5 between July 2005 and June 2006 and placed in the B-Plant Repository. This material included approximately 33,000 cubic yards of contaminated material from CRP-2, CRP-3, CRP-4, and CRP-6, which had been spread out over the bottom of the pond to stabilize wet soils. The pond bottom area was excavated to bedrock. These activities are detailed in *Compliance Report CR-401-7E*.

Club Ranch Pond 6 (CRP-6)

Approximately 5,300 cubic yards of contaminated soils, from ancillary areas within the general ponds area, were excavated and placed in the CRP-6 pond bottom to stabilize the raffinate crystal. Approximately 17,400 cubic yards of raffinate crystal residue, liner system and underdrain piping debris were transported to the B-plant Repository for disposal between September and November 2003.

During the 2005 and 2006 construction seasons, approximately 26,000 cubic yards of contaminated soils were excavated from CRP-6. The majority of this material was placed in CRP-1, CRP-4 and CRP-5 in order to stabilize the raffinate crystal residues and wet soils prior to their placement in the B-Plant Repository. The remaining portion, approximately 11,000 cubic yards, was taken to the B-Plant Repository. These activities are detailed in *Compliance Reports CR-401-7F and CR-401-7F (Part 2).*

Club Ranch Pond 7 (CRP-7)

Final remediation of CRP-7 included the removal of raffinate crystal residue and the liner and underdrain systems. Because CRP-7 was a new pond constructed in an uncontaminated area within the Club Ranch Ponds area with uncontaminated materials, little or no prescriptive excavation beneath the underdrain system was necessary to meet regulatory cleanup criteria. Contaminated soils were excavated from the embankments of CRP-2 and CRP-3 and the San Miguel riverbank between CRP-3 and CRP-8 and placed in CRP-7 between March and May, 2001. The contaminated materials were placed over the raffinate crystals in a 2 to 3-foot thick layer to prevent the raffinate crystals from becoming airborne and to facilitate access and removal of the pond liner. A total of 17,900 cubic yards of contaminated material was placed in CRP-7. Raffinate crystals mixed with the contaminated soils, the pond liner and the underdrain system were removed between May and July, 2001. A total of 91,600 cubic yards of contaminated materials were removed and placed in the B-Plant Repository. This activity is detailed in *Compliance Report CR-401-7G*.

Club Ranch Pond 8 (CRP-8)

The approved remedial plan for CRP-8 required the removal of raffinate crystal residue, the liner and underdrain systems, and the relocation of uncontaminated soils from the embankments. Contaminated material from County Road EE-22, Highway 141, CRP-4 and CRP-6 was stockpiled in CRP-8 between January and June 2006. The stockpiled material was spread over the bottom of the pond to stabilize the wet raffinate crystal residue prior to its being transported and placed in the B-Plant Repository. Between July and September 2006, the approximately 69,000 cubic yards of contaminated materials, including the stockpiled material, crystal residue and liner/underdrain debris, were excavated from CRP-8 and placed in the B-Plant Repository. This activity is detailed in *Compliance Report CR-401-7H*.

Confirmation and Final Reclamation

On October 17, 2006, Umetco informed CDPHE that the RAP deadline for removal of the ponds and contaminated material within the Club Ranch Ponds area had been met. The *Confirmation Investigation Report, Club Ranch Ponds, Uravan, Colorado,* was submitted to CDPHE in June 2007. The report concluded that the remedial activities were successful in decontaminating the Site for unrestricted future use. The average exposure rate was reduced to 19.3 μR/hr and met the RAP guideline. The average radium-226 concentration derived from field measurements and soil sampling for both surface subsurface soil samples met the RAP criteria. Individual grids with radium concentrations over 7.1 pCi/g are located in bedrock areas or within the 100-year floodplain of the San Miguel River. The average concentration of thorium-230 met Criterion 2.2 in the RAP. Due to the high radium concentrations in the grids adjacent to the river, this area was included in Alternate Soils Standards application.

Final grading activities were completed on October 22, 2007. Approximately 324,000 cubic yards of uncontaminated material were placed over the area to achieve the final grade and provide a minimum of 1 foot of cover soils. This uncontaminated material was obtained from the embankments of CRP-7 and CRP-8, which were originally constructed with material from the Valley Borrow area. Drainage channels were constructed and armored with riprap obtained from the Kaiser Quarry.

Revegetation activities were conducted between September and November 2007. Permanent fencing was installed between October and November 2007. The final reclamation activities are addressed in *Compliance Report CR-401-8*.

River Ponds Area

The River Ponds Area consisted of seven small ponds constructed along the San Miguel River adjacent to the mill. Five of the ponds were located on the mill side (south side) of the river and two ponds were located on the north side of the river adjacent to Colorado Highway 141. Mine operators constructed these ponds within old tailings piles by excavating into and, in some cases, through the tailings. UCC mantled/covered exposed surfaces of the excavations with natural soils. UCC used the five ponds on the mill side of the river as settling basins for liquids collected within the mill area and stored them there prior to discharge to the river. UCC used the two ponds on the north side of the river to clarify treated process liquors prior to discharge. These ponds contained neutralized sludge from clarification operations. Umetco estimated that the River Ponds Area contained about 290,000 cubic yards of mill wastes and contaminated soils. Seepage of liquids from the River Ponds Area to groundwater, and eventually to the San Miguel River, was estimated at 10 to 40 gallons per minute when they were in use.

In the RAP, CDPHE selected a remedy for the River Ponds Area that would excavate and dispose of (on-Site) all sludges and tailings in the Tailings Piles of Club Mesa. The objectives of this remedy were to remove the source of potential future contamination of the groundwater and the San Miguel River.

Tailings and contaminated materials were excavated from the River Ponds and placed on Tailings Piles 2 and 3. The initial removal occurred from October 1988 to May 1989. Excavation of contaminated material extended to below the water table, which was deeper than the excavation specification (i.e., where sandstone or siltstone bedrock or the water table is encountered, no additional material shall be removed and soil sampling shall not be necessary, established in the CD/RAP for termination of excavation). Umetco agreed to perform additional excavation in areas of elevated scintillometer measurements from August 1990 to September 1990 because the water table dropped due to low river flows. In total, 332,500 cubic yards of contaminated material was excavated from the floodplain adjacent to the San Miguel River. Accordingly, contaminated materials and river gravels were excavated to below historic low flow elevation of the San Miguel River and historic water table elevation.

Re-grading, back filling and re-vegetation were not required, since final reclamation activities were completed at a river flow rate of approximately 100 cubic feet per second (cfs). Alternatively, Umetco placed riprap jetties to enhance siltation and the natural re-vegetation of the pond bottom.

The *Alternative Soil Standards Application* notes that residual contamination from 20 to 60 µR/hr existed as local hot-spots prior to final excavation, and final verification surveys were not possible due to flooding of the area. These areas were covered by 2 to 3 feet of alluvial sediment and stabilized by riparian vegetation. Alternative standards were proposed for the area for the following reasons:

- Additional excavation would cause environmental harm by damaging the riparian vegetation and the wetland areas that have formed at the remediation site.

- The area met RAP exposure criteria of less than 20 µR/hr.
- No habitable structures would be constructed in the area because the area is within both the floodplain of the San Miguel River and the future DOE long-term surveillance area.
- Riprap groins and riparian vegetation formed a stabilizing cover over the residual contaminants.
- The cost of remediation would be high compared to the relative decrease in human exposure.
- Previous remedial actions had reduced exposures to As Low As (is) Reasonably Achievable (ALARA). This term means making every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as practical, consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

The CDPHE accepted the *Alternative Soil Standards Application* in a letter dated September 26, 2007, and the application was approved by the NRC in 2012.

Tailings Piles

In the mid-1950s, UCC started to store tailings generated by the Uravan Mill in the Club Mesa Tailings Piles. The Tailings Piles are located on Club Mesa above the Uravan Mill. UCC constructed the Club Mesa Tailings Piles using the upstream method whereby the tailings slurry was pumped from the mill to the Tailings Piles and deposited through spigots placed along the tailings delivery line. The embankment raises were constructed from tailings sands that were re-graded, placed and compacted.

Prior to 1980, the downstream slopes on the tailings embankments varied from approximately 1.5(H):1(V) to 3(H):1(V). As the height of the embankment increased, there was concern for the stability of the embankments. Consequently, in 1980, UCC constructed rockfill berms, including a drainage blanket, for seepage control to buttress the lower portions of the Tailings Piles. UCC also installed horizontal drains to promote drainage of the tailings; however, these drains were ineffective.

Observed impacts from the tailings disposal system included seepage of contaminated liquids into the Club Mesa bedrock; erosion and transport of tailings material away from the disposal area by wind and water action; and radon emanation from the Tailings Piles.

In the RAP, CDPHE selected a remedy for the Tailings Pile that would cease the discharge to the Tailings Piles, remove the liquids, and cover the slopes of the Tailings Piles material prior to final reclamation. The objectives of this remedy were to minimize surface water infiltration, seepage from the Tailings Piles, wind and water erosion, and radon emanation from the Tailings Piles.

Remedial activities set forth in the RAP for the tailings piles of Club Mesa included dewatering, pile reshaping, buttress protection, toe drain system maintenance, top and side slope cover

construction, and storm water drainage diversion. The RAP called for dewatering through natural seepage enhanced by surcharging caused by additional materials placed on the piles.

Prior to final closure, the tailings piles were used for disposal of contaminated materials generated during other Site remediation activities. Approximately 1.3 million cubic yards of contaminated materials (soils, tailings, sludge, concrete rubble, building scrap, and debris from cleanup projects) were placed on Tailings Piles 1 and 2 from December 1987 to April 2002, as documented in *Compliance Report CR-404-2*. Tailings Pile 3 accepted 306,000 cubic yards of contaminated material from July 1988 to August 1990, as documented in *Compliance Report CR-405-2*.

As required by the CD/RAP, the closure actions for the two Tailings Pile disposal structures were subdivided into six different components: dewatering; slopes and contours; rockfill buttress and toe drain systems; side slopes protective cover; top cover; drainage diversion. Final cover thicknesses, grading and drainage plans, as required to supplement the RAP requirements were designed, reviewed, and approved by CDPHE.

Dewatering

Dewatering activities included the construction of shallow trenches and channels leading to collection/transfer basins and/or sumps. All collected fluids were transferred to one or more of the lined Club Ranch Ponds for evaporation in accordance with RAP requirements. Waste materials were placed on the Tailings Piles to surcharge the structures and accelerate dewatering drainage (E2 2010). Dewatering activities are documented in *Compliance Reports CR-404-1 (Tailings Piles 1 and 2)* and *CR-405-1 (Tailings Pile 3).*

Rock Fill Buttress and Toe Drains

The existing rockfill buttresses previously placed to stabilize the tailing slopes were covered with 4 feet of 48-inch minus erosion protection rock material obtained from the Burbank Quarry. The existing toe drain system was maintained until seepage ceased in 2003. The toe drains were subsequently grouted shut as documented in *Compliance Reports CR-404-7B (Tailings Piles 1 and 2) and CR-405-7B (Tailings Pile 3)*. During operation, toe drain liquids, were collected and transferred to the Club Ranch Ponds for evaporation as required by the CD/RAP. Construction of rock-fill buttresses and toe drains are documented in *Compliance Reports CR-404-3A (Tailings Piles 1 and 2)* and *CR-405-3A (Tailings Pile 3).*

Side Slope Reclamation Cover

The covers on the existing re-graded tailings portion of the slopes consisted of a 0.3 meter (1 foot) layer of random interim cover material, 0.9 meter (3 feet) of compacted (radon barrier) clay, 0.9 meters (3 feet) of random (frost barrier) fill and 1.2 meter (4 feet) of 48-inch minus riprap rock for a total thickness of 3.3 meters (11 feet) measured perpendicular to the slope. The original RAP-specified cover on the new 5(H):1(V) portion of the slopes, where contaminated soils from the various remedial activities were placed, consisted of 0.9 meter (3 feet) of compacted (radon barrier) clay, 1.5 meters (5 feet) of random (frost barrier) fill and 0.6 meters (2 feet) of 12-inch minus riprap rock for a total thickness of 3.0 meters (10 feet). Design Change Orders reviewed and approved by CDPHE on June 14, 2000 and February 22, 2002 for Tailings Pile 3, 1, and 2 respectively, modified the thickness of the final side slope covers to include 3 feet of compacted

radon barrier clay, 6 feet of random frost barrier fill and 1 foot of 12-inch minus erosion protection riprap on the 5(H):1(V) slopes of both disposal structures. Erosion protection riprap was obtained from the Burbank Quarry and the state-approved Kaiser Quarry. Random fill and clay materials were obtained from the Surprise Borrow area and the state-approved Elk Borrow area. Side slope management activities are documented in *Compliance Reports CR-404-4 (Tailings Piles 1 and 2)* and *CR-405-4 (Tailings Pile 3).*

Top Cover

The conceptual design required in the RAP provided for a 3 percent grade on the top surfaces of each of the two disposal structures, sloping from the crest to the back or abutment of the structures with drainage channels located at the contact between the reclamation cover and the existing sandstone abutments at the back of the structures. Design change orders reviewed and approved by CDPHE on June 14, 2000 and February 22, 2002 for Tailings Pile 3, 1, and 2, respectively, provided for modification of cover drainage patterns, while still maintaining a positive 3 percent grade. The design change order also realigned diversion channels to direct runoff flows away from the contact between the reclamation covers and sandstone abutments to reduce infiltration at the interface and provided a catchment apron to prevent potential rockfalls from the sandstone rims above the structures from blocking permanent drainage channels. The design modifications also provided for blasting and recontouring (laying back) of the natural sandstone rims above both disposal structures. The thickness of the final cover material components is the same as that required for the 5(H):1(V) side slopes. Top cover activities, including change orders, are documented in *Compliance Reports CR-404-5, CR-404-5A, CR-404-5B (Tailings Piles 1 and 2), CR-405-5, CR-405-5A, and CR-405-5B (Tailings Pile 3).*

Drainage Diversion

Drainage from the areas above and adjacent to the Tailings Pile structures and precipitation runoff from the piles are controlled. The drainage diversion system was designed and constructed as follows:

- The Club Mesa Spray area runoff was directed away from the Tailings Piles by contour grading of the spray area and constructing a cut and fill diversion channel located a minimum of 100 feet away from the crest of the sandstone rim above the tailings piles. The diversion channel was designed to pass the probable maximum flood (PMF) with a minimum of 1 foot of freeboard and constructed to minimize erosion by providing minimum invert slope grades. The riprap erosion protection was sized to withstand PMF velocities and was obtained from the State-approved Burbank Quarry.
- Drainage from the top surfaces and adjacent to the Tailings Pile structures is intercepted by drainage channels at the back of the piles as described previously. The runoff from both structures is conveyed through a channel cut into the sandstone rim which separated the structures to a natural gully located to the north of Tailings Pile 1 and 2. The diversion channels were designed to pass the PMF with a minimum of 1 foot of freeboard and constructed to minimize erosion by providing minimum invert slope grades. The riprap erosion protection was sized to withstand PMF velocities and obtained from the State-approved Burbank Quarry.

- Surface runoff from the top surface of the Tailings Piles is directed away from the embankment face or crest at a maximum 3 percent grade and collected and conveyed to the channels and natural gully described above.
- Surface runoff from the faces of the covered tailings embankments is dispersed over the sandstone bedrock foundation surface and away from the structures by graded dispersion aprons and turnout structures at the toes of the slopes. Turnout structures are located to convey runoff flows to the cliff faces where long term cliff retreat will not impact the disposal sites. The dispersion aprons and turnout structures were designed per NRC Guidance documents cited previously.

Drainage diversions are documented in *Compliance Reports CR-404-6 (Tailings Piles 1 and 2)* and *CR-405-6 (Tailings Pile 3).* Final reclamation of the Tailings Pile 1 and 2, and 3 disposal structures was completed in 2007.

B-Plant Repository

Performance characterization work required by the CD/RAP resulted in a significant increase in the volume of contaminated materials than was originally anticipated. Accordingly, an additional repository, B-Plant Repository, was designed and constructed. Umetco began the B-Plant repository construction and operations and placement of contaminated materials in 1998. A toe drain system was also installed in the B Plant Repository Area. This capped repository accepted contaminated materials from the final reclamation of the Club Ranch Ponds and has a designed capacity of approximately 1.8 million cubic yards of waste material. Approximately 834,000 cubic yards of contaminated materials from various cleanup activities were placed in the repository from 1998 to 2007. Sources of contaminated materials placed in the B-Plant Repository include the Town Dump Areas; A and B-Plant areas; Mill Hillside; Water Storage Ponds; Northeast Colorado Highway 141; Frog Pond; Electrical Sub-Station; County Roads EE-22 and Y-11; former Runoff Control Ponds 1, 2, and 3; Town Area; and the Club Ranch Pond Area. Additional minor quantities of 11e (2) byproduct material were received from CDPHE Gateway Mill Clean-up Project, CDOT Highway 141 realignment project, Colorado School of Mines Research Institute, and Table Mountain Research Center. Design and construction of the plant is documented in *Compliance Report CR-404-8*. Placement of waste is detailed in *Compliance Reports CR-404-9* and *CR-404-13 through CR-404-16*.

The reclamation cover for the B-Plant Repository consists of a minimum 1.5-foot thick clay radon barrier, 4.5-foot thick frost protection layer and 1- to 8-foot thick rock riprap erosion protection layer. Reclamation activities are documented in *Compliance Reports CR-404-10 through CR-404-12*.

Club Mesa Area

Club Mesa Area is located upslope from Tailings Piles 1, 2, and 3. UCC used this area primarily for evaporation of raffinate. Mounds of raffinate crystals formed around the spray nozzles within the spray area. As part of the raffinate spray process, two clay-lined storage ponds were constructed upslope of the raffinate spray area. The purpose of these ponds was to provide hydrostatic head for the spray system. UCC excavated neutralized sludge from the River Ponds Area and placed it in the Club Mesa Area.

Umetco estimated that the Club Mesa Area (also known as the Club Mesa Spray Disposal Area or Club Mesa Raffinate Spray Disposal Area) housed approximately 484,000 cubic yards of contaminated materials. These materials included 250,000 cubic yards of raffinate crystals, 150,000 cubic yards of neutralized sludge, 40,000 cubic yards of contaminated pond material, and 44,000 cubic yards of contaminated soils in the fringe area.

Superficial and subsurface contamination occurred as a result of the raffinate spray process. Superficial contamination was due to the presence of the raffinate crystals in addition to the windblown spray, which contaminated soils in the adjacent fringe area. Subsurface contamination was caused by seepage of excess spray liquids into the underlying soils and bedrock through the unlined surface of the spray area.

In the RAP, CDPHE selected a remedy for the Club Mesa Area that would excavate and dispose of (on-Site) the raffinate crystals in the former Burbank Quarry (now known as the Burbank Repository) and dispose of other contaminated soils in the Tailings Piles on the Club Mesa. The objective of this remedy was to remove the source of future potential contamination of surrounding soils and the underlying soils and bedrock.

Remedial activities in the Club Mesa Area fell into four phases: construction of temporary surface water controls, removal and confirmation investigation of contaminated material, remediation of mine portals and subsidence areas, and final site remediation. These phases are described below.

Surface runoff and drainage controls were designed to contain and control discharges from 10-year, 24-hour storms during remediation and reclamation at this area. Originally, the plan required the construction of two unlined ditches to divert runoff away from the Tailings Piles. However, the ditches were not installed due to topographic constraints; instead, two existing sediment basins, SB-8 and SB 9, were utilized to collect liquids, which were routinely transferred to the Club Ranch Ponds for evaporation during the initial cleanup. In 1997, SB-8 was removed, SB-9 was reconstructed to include a lined spillway, and two additional lined runoff control basins, RC-5 and RC-6 were constructed. The three basins, along with two 36-inch diameter corrugated metal pipe culverts under a haul road, were then used to control runoff during reclamation. Upon completion of final reclamation activities, these temporary runoff control structures were removed and disposed of in the Tailings Piles, and these areas were vegetated. This work segment was detailed in *Compliance Report CR-406-1*.

Cleanup of contaminated materials took place in stages beginning in September 1989 with the removal of neutralized sludge. Approximately 165,000 cubic yards of raffinate crystals were excavated in 1990, 1991, and 1992, and placed in the Burbank Crystal Repository. Approximately 117,000 cubic yards of contaminated soils and 121,000 cubic yards of neutralized sludge were removed and placed on top of the Tailings Piles between 1989 and 1994. Prior to removal of contaminated soils from the storage ponds, the liquids contained in these ponds were transferred to the Club Ranch Ponds for evaporation. The two storage pond embankments were subsequently breached and graded so that no liquid would collect. Material removal was completed in May 1994.

During 1996, a preliminary confirmation investigation survey was conducted in preparation for the final reclamation design. As a result, an additional 150,000 cubic yards of soil were removed and placed on the top of Tailings Piles 1 and 2 by January 1998. Overall, the entire Club Mesa Spray

Disposal Area was excavated to expose sandstone bedrock in accordance with the cleanup criteria set forth in Section 4.5.2 of the RAP. The removal activities were detailed in *Compliance Report CR-406-2* dated February 27, 1998 and approved by CDPHE.

Upon completion of the contamination removal, confirmation investigations were conducted including gamma surveys, bedrock samples, radon emanation measurements from the spray area, and a risk assessment. The results concluded that even though naturally occurring uranium ores are present in some of the exposed bedrock, the average activity of the un-mineralized areas was less than 5 pCi/g radium-226 above background and does not pose significant future health risk to individuals. The results also indicated radon flux ranges from 0.04 to 3.6 picocuries per square meter per second (pCi/m2s) with an average of 1.2 pCi/m2s, below the regulatory standard of 20 pCi/m2s for repository covers. These activities formed the basis of the final reclamation design, and were reported in *Compliance Report CR-406-5*.

The subsided areas, shafts and mine portals shown in the original plans as well as seventeen other mine features encountered during the soil cleanup activities in the area were backfilled with uncontaminated rock rubble and soil materials from the Burbank Quarry and Upper Club Mesa Borrow Area. This work was conducted in 1994 after the majority of the soil cleanup activities were complete. Additional subsidence areas, shafts, and portals discovered during final cleanup of the area were closed during 1997. This work was detailed in *Compliance Report CR-406-3*, dated February 27, 1998 and approved by CDPHE.

The final reclamation activities were governed by *the Final Plans, Specification and Quality Plan for Club Mesa Final Reclamation*, submitted February 27, 1998, and approved by CDPHE on June 30, 1998. This document included construction of permanent drainage features designed to control probable maximum precipitation flood events, and the grading, backfilling and covering of specified areas with erosion resistant rockfill materials to minimize offsite sediment transport, create a natural appearance and promote the establishment of natural vegetation. The permanent drainage features consisted of a haul road embankment, which bisected the Club Mesa Spray Disposal Area, and a channeling swale leading to a runoff diversion berm/channel and channeling fill areas. These structures were constructed using over 137,000 cubic yards of random fill and approximately 39,000 cubic yards of Type B riprap. In addition, over 17,000 cubic yards of rock mulch material were used to fill depressions and reduce erosion in the specific areas required in the approved plans and drawings. The earthwork was completed by March 1998. Seeding was performed in April 1998. The final reclamation activities were detailed in *Compliance Report CR-406-6*, approved by CDPHE on December 18, 2001.

Mill Areas

The Mill Areas include the A-Plant in the valley northwest of the Club Mesa Tailings Piles; the B-Plant; Ore Stockpile Area; Barrel Storage Area, the Heap Leach site on a bench below and east of Club Mesa Tailings Pile 2, and the Bone Yard for miscellaneous scrap equipment located west of Tailings Pile 2. Radioactive material resulting from Uravan operations impacted all of these areas.

The mill process area consisted of the A-Plant and B-Plant and included the uranium and/or vanadium milling systems and ancillary facilities located along the San Miguel River valley floor at the base of Club Mesa and the facilities located on the canyon face and lower bench immediately next to the Club Mesa Tailings Piles. The mill system included ore receiving bins and

crushing and sampling plan, aerofall grinding circuit, crushed and ground ore storage bins, hot sulfuric acid leach circuit, counter-current decantation circuit, sulfuric acid generation plant, uranium ion exchange circuit, uranium precipitation and calcining circuits, vanadium salt roast leach circuit, vanadium fusion circuit, metallurgical control laboratory and solution transfer system. The mill system also included ancillary facilities such as reagent storage and mix systems, fuel distribution/storage systems, steam generation systems, electrical distribution systems, equipment maintenance facilities and office and warehouse facilities. Mill operations facilities consisted of maintenance to office, warehouse, electrical and liquid transfer systems.

In the RAP, CDPHE selected excavation and on-Site disposal of contaminated equipment, structure, waste materials, contaminated soils and ancillary contaminated materials into the Club Mesa Tailings Piles, the Burbank Quarry or a disposal site in the Elk Claim Area as the remedy for the Mill Area. The objectives of this remedy were to remove the source of future potential contamination of surrounding soils and the underlying soils and bedrock.

A-Plant Area

Remedial activities in the A-Plant area were initiated in June 1990 and continued intermittently through 2002, and consisted of the decommissioning of mill structures, the removal and confirmation of contaminated material, and the final site remediation.

Decommissioning at the A-Plant began with the removal of small amounts of asbestos containing material from two tanks in June 1990. During 1993, friable asbestos and asbestos insulation were removed from the Power House, the Community Building and all outside piping. The asbestos was disposed of in Tailings Piles 1 and 2.

The *Uravan Mill Decommissioning Plan*, approved by CDPHE on October 14, 1993, required the demolition and removal of 91 structures, including buildings and mill processing equipment, from the A-Plant area. The plan provided procedures for the development of Dismantling and Demolition Plans for each of the mill structures to be removed. The subsequent individual Dismantling and Demolition Plans were submitted to CDPHE for approval prior to commencement of the work. Decommissioning began in February 1994 with additional asbestos abatement of mostly transite siding. The structures were demolished after final asbestos monitoring was conducted and clearance given on March 15, 1995. The majority of the structures were demolished by 1997. Approximately 23,500 cubic yards of sized concrete, metal and other building debris were placed in Tailings Piles 1 and 2, with the exception of the metal Office Building, which was dismantled, decontaminated and donated to the Montrose County Transportation Department in 1997.

Between March 1995 and June 2002, approximately 481,000 cubic yards of contaminated soils were removed from the A-Plant area, including the mouth of Hieroglyphic Canyon, the Treasure Island storage area and around the Historic Buildings (the Community Center and the Boarding House). In general, the contaminated soils were removed to expose the sandstone bedrock. Decommissioning of the A-Plant was detailed in *Compliance Report CR-413-6*, approved by CDPHE on January 14, 2003, and *Confirmation Investigation Report, A-Plant*, approved by CDPHE on January 30, 2003.

Removal of contaminated material in the A-Plant North Area was initiated in October 2006 and continued through June 2007. The reclamation included the removal of approximately 17,500 cubic yards of material and debris associated with a runoff control pond, work trailers and wheel wash facility located next to the San Miguel River. This material was placed on the B-Plant Repository.

Confirmation investigations of the A-Plant area were conducted between 1998 and 2002 using the procedures set forth in *Soil Cleanup Methodology for Uravan, Colorado, approved by CDPHE,* as well as Site-specific documents regarding data collection and evaluation. The investigation included exposure rate surveys and surface and subsurface soil samples of radionuclides and metals. The results of this investigation were detailed in *Confirmation Investigation Report, A-Plant*, Uravan, Colorado, dated December 2002. Average exposure rates and contaminant concentrations in soil were reduced to levels below the Category 2 soil cleanup objectives given in the *Soil Cleanup Methodology*.

Confirmation investigation was also conducted in the A-Plant North area, and detailed in the Appendix to the *Confirmation Investigation Report, A-Plant*, Uravan, Colorado, for A-Plant North (*Compliance Report CR-413-8*) dated October 25, 2007 and approved by CDPHE on November 12, 2007. The results indicated the average exposure rate met the RAP cleanup criteria and the average heavy metal concentrations were less that the Category 2 criteria given in the *Soil Cleanup Methodology*.

Alternative soils standards were applied to the steep slopes on the north side of the A-plant area in the *Alternative Soil Standards Application*. Residual gamma exposure was documented to average 21.47 µR/hr with a maximum exposure of 45.1 µR/hr for a single 10-by-10-meter grid in the area. Ra-226 levels were noted to average 5.37 pCi/g with a maximum reading of 28.38 pCi/g for a single 10-by-10-meter grid. Alternative standards were proposed for the following reasons:

- Additional remediation in the floodplain of the San Miguel River would cause excessive environmental harm to the wetland areas.
- Residual Ra-226 contamination was relatively low and did not pose a risk to recreational users or the environment. No habitable structures would be constructed in the area.
- The cost of future remedial actions would exceed benefits because potential human exposures were negligible.
- Previous remedial actions had reduced exposure to ALARA.
- Future land use would be habitat for wildlife and not for residential or related structures. DOE will assume long-term stewardship of the property and manage land use.

Final reclamation was performed between April and September 2003, including removal of the runoff control ponds, rock mulch and rock rubble placement, sediment dam construction, grading, and revegetation. The rock mulch and rock rubble were spread over the exposed sandstone bedrock to provide a stable erosion resistant seed bed and to create gentle slopes to the river. In 2007 and 2008, the area previously occupied by the Historic Structures was graded to gently slope towards Hieroglyphic Canyon and then covered with rock mulch. The rock mulch seed beds were disked, fertilized and seeded. The reclamation work was detailed in *Compliance Report CR-413-7and CR-418A-1*.

Boarding House and Community Center

The Boarding House and the Community Center buildings (Historic Structures) in the A-Plant area were demolished in February 2007. Approximately 5,000 cubic yards of building debris and contaminated soils from beneath and immediately surrounding the demolished buildings were excavated and placed in the B-Plant Repository in March 2007. The area previously occupied by the Historic Structures was graded to gently slope towards Hieroglyphic Canyon and then covered with rock mulch. The rock mulch seed beds were disced, fertilized and seeded. The demolition, cleanup, confirmation surveys, and reclamation of these two buildings were detailed in *Compliance Report CR-418A.*

Confirmation surveys were performed in the Historic Structures area in March and April 2007, and the results showed that the RAP cleanup criteria were met. This work was detailed in *Compliance Report CR-418A-1* dated January 30, 2008, and approved by CDPHE. On April 17, 2007, a CDPHE inspector surveyed the area and verified that the cleanup was completed. On February 18, 2005, EPA deleted a portion of the Site from the NPL. This partial deletion pertains to 9.84 acres previously containing the Historic Structures.

B-Plant Area

Remedial activities in the B-Plant area were initiated in August 1986 and continued intermittently through September 2002 and consisted of the decommissioning of mill structures, the removal and confirmation of contaminated material and the final site remediation.

Removal of ore grade and partially processed ore materials from the Ore Stockpile and Heap Leach areas began in late August 1986. A total of 18,000 tons of ore grade materials was transported to the White Mesa Mill in Blanding, Utah, by mid-October 1986. This work was detailed in *Compliance Report CR-413-2,* approved by CDPHE on December 19, 2001.

The inventory of the barrels was completed on December 10, 1987. Barrels containing radioactive materials and non-Resource Conservation and Recovery Act (RCRA) waste products were disposed of in Tailings Piles 1 and 2. Barrels containing feed grade materials were transferred to the White Mesa mill in Blanding, Utah for processing along with barrels containing new commercial products, oils, resins, etc. Drums of waste oil were transferred to an approved off-Site disposal facility. Empty barrels were reduced in volume and placed into Tailings Piles 1 and 2. All barrels were removed by January 22, 1988. This work was detailed in *Compliance Report CR-413-3* dated January 26, 1988, and approved by CDPHE.

The removal of debris, clay base, and contaminated soils from the Bone Yard, Barrel Storage Area, Ore Stockpile Area and Heap Leach Site occurred intermittently from 1987 through the end of 1989. Approximately 96,000 cubic yards of material were excavated to expose the sandstone bedrock and placed on the top of Tailings Pile No. 3. These work segments were detailed in *Compliance Reports CR-413-1, CR-413-2, CR-413-4 and CR-413-5*, which were approved by CDPHE.

On October 17, 1989, Umetco requested permission to remove the wooden thickener (Counter-Current Decantation) tanks. The request was granted by CDPHE on January 5, 1990 as a

modification to the RAP. The tanks were dismantled and placed in Tailings Piles 1 and 2 between March 1990 and January 1991.

The *Uravan Mill Decommissioning Plan*, which included procedures to develop Dismantling and Demolition Plans for each of the B-Plant mill structures, was approved by CDPHE on October 14, 1993. Subsequent individual Dismantling and Demolition Plans were submitted to CDPHE for approval prior to commencement of the work. Decommissioning took place in 1995 and involved the removal of asbestos containing material, the demolition of all forty-eight structures and the removal of approximately 65,000 cubic yards of contaminated soils.

The final cleanup of the B-Plant area took place intermittently between August 1997 and November 1999 and involved the removal of all loose material from the bedrock surface. An additional 290,000 cubic yards of contaminated soil was removed during this period. Slimes resulting from the Heap Leach process area were removed between 2000 and 2002. Contaminated soils in this area were generally removed until bedrock was encountered. This bedrock contains naturally occurring subgrade uranium ore. This work was detailed in *Compliance Report CR-413-6* and *Confirmation Investigation Report, B-Plant*.

Confirmation surveys of the B-Plant area were conducted between 1999 and 2002 using the procedures set forth in *Soil Cleanup Methodology for Uravan, Colorado* as well as Site-specific documents regarding data collection and evaluation. The investigation included exposure rate surveys and surface and subsurface soil samples of radionuclides and metals. The results of this investigation were detailed in *Confirmation Investigation Report, B-Plant, Uravan, Colorado,* which was submitted to CDPHE on December 21, 2002, and approved on February 6, 2003. As noted in the report, in general, the contaminated soils were removed to bedrock, which exposed naturally occurring subgrade uranium ore. The average contaminant concentrations in soil were reduced to levels below the appropriate soil cleanup objectives given in the *Soil Cleanup Methodology*.

Final reclamation was performed between April and September 2003, including removal of the runoff control ponds, rock mulch and rock rubble placement, sediment dam construction, grading, and revegetation. The rock mulch material was spread over the level surfaces and minor depressions in the B-Plant area to provide a stable erosion resistant seed bed. The rock mulch was then disked, fertilized and seeded. Type C riprap (48-inch minus) was placed in the three drainages leading from the B-Plant area to establish permeable sediment trap dams. This work is detailed in *Compliance Report CR-413-7*.

Town and Adjacent Areas

The Town of Uravan occupied the San Miguel River valley area just northeast of Tailings Piles 1 and 2. Adjacent areas were the town dumps (Old Town Dump and New Town Dump), which were located on the south side of the San Miguel River, south of Colorado Highway 141 and west of CRP-4; and areas adjacent to the town affected by deposition by windblown materials, including the Hieroglyphic Canyon, San Miguel River and Atkinson Creek drainage.

UCC used tailings in localized construction activities that were spilled from delivery pipelines running through the Town Area. Wind and surface water transported tailings were found in the

town and adjacent drainages. CDOT routed Colorado Highway 141 over an old World War II mill and associated tailings.

In the RAP, CDPHE selected a remedy for the Town and Adjacent Areas that would excavate and dispose of (on-Site) Town Area contaminated materials, waste from the Town Dumps, remnant tailings, streams and storm water drainage deposits, and windblown material into the Club Mesa Tailings Piles repositories, the Burbank Quarry or disposal site in the Elk Creek Claim Area. The objectives of this remedy were to remove the source of future potential contamination of surrounding soils, underlying soils, groundwater and surface water.

All Uravan residents were relocated by 1986. From 1987 to 1994, Umetco removed all housing structures (approximately 260) from the Town of Uravan and removed and transported contaminated soils to the Club Mesa Tailings Piles. Umetco graded and re-vegetated the Town Area in 2000 after soil verification studies were completed and accepted. Details regarding remediation of the town and adjacent areas are included in the subsections below.

Town Area

The Town Area encompassed the areas known as A-Block, B-Block, G-Block, H-Block and J-Block Housing Areas, the Trailer Court, the Old Trailer Court, the Flat Tops, the Sewage Treatment Plant, and the Atomic Energy Commission Pile. Remedial activities were initiated in early 1987 with the removal of structures, vegetation and contaminated soils from the footprint of new evaporation ponds CRP-7 and CRP-8. The remaining structures and contaminated materials were removed between September 1989 and December 1994. Over 200,000 cubic yards of contaminated material were removed and placed in Tailings Piles. This work was detailed in *Compliance Report CR-418G-2*.

Initial confirmation surveys were performed in 1995 and resulted in approximately 24,000 cubic yards of contaminated material to be removed and placed in the B-Plant Repository in 1998 and 2000. Additional confirmation surveys were conducted between 1999 and 2003. Overall, post-remedial conditions were evaluated using exposure rates surveys and soil assay, and the results were detailed in the *Confirmation Investigation Report, Town Area, Uravan, Colorado* (CR-418G-3) dated June 2003. The report indicated that the average exposure rate and the average radium-226 concentration met the requirements of the RAP, and the average contaminant concentrations in soils had been reduced to levels below appropriate soil cleanup objectives given in the *Soil Cleanup Methodology*.

Final reclamation and vegetation activities took place between October and December 2000 in accordance with the Final Grading Plan, Town Area, dated October 16, 2000. In general, the area was graded to a natural appearance by removing sharp contours and steep slopes and backfilling major depressions. Long or steep drainage paths were reduced by pocking the ground surface and providing cross drainage contouring and water bar contouring. The plan also required the construction of runoff control structures including a grouted riprap discharge chute from an existing culvert under Highway 141 and a shallow discharge channel with a small rockfill sediment trap to drain runoff from the other existing culvert under the highway. Vegetation activities were performed in November 2000, in accordance with the Revised Revegetation Specification approved by CDPHE on November 20, 2000. Final reclamation activities were detailed in *Compliance Report CR-418G-4*.

Approximately 12,000 cubic yards of remnant tailings were removed from the entrance road to the B-Block area and placed in Tailings Pile 3 in 1989. Discrete deposits of tailings and contaminated materials were also removed from the gas station area, Atomic Energy Commission pile, B-Block septic tank and leach field area, G-Block septic tank and leach field, and the new trailer court septic tank and leach field. Final cleanup, confirmation surveys, and final reclamation were included in the Town Area (refer to Section 4.1.7.1 of this report). The details of this work segment were given in *Compliance Report CR-418-3A*.

Town Dump

The Town Dump area is split into the New Town Dump and the Old Town Dump, located on the south side and the north side of County Road Y-11, respectively.

In August 1988, a total of 16 trenches were excavated through the trash zone into several feet of clean material. Visual examinations of the material in the trenches are described in the Town Dump Investigation dated August 24, 1988, attached to *Compliance Report CR-418-2*. On December 4, 1990, CDPHE required the submittal of plans and specifications for the removal and reclamation as the results of the report indicated heavy metals and radionuclide contamination were present. The plans and specifications were approved by CDPHE on April 6, 1998.

Preparatory work at the Town Dump Area began on May 11, 1998, with the construction of runoff control and decontamination facilities. Surface water ditches and lined ponds were constructed during May and June 1998. Minor modifications to the ponds and ditches in the Old Town Dump were made to ease construction. The Design Engineer approved all the modifications to the ponds. This work segment is detailed in *Compliance Report CR-419-1*.

The removal of contaminated materials from the Old Town Dump occurred in June 1998. Contaminated materials at the New Town Dump were excavated and removed between July and November 1998. Approximately 257,600 cubic yards of contaminated materials were placed in the B-Plant Repository. Post-excavation verification surveys in December 1998 and May 1999 indicated contaminated material remained at the New Town Dump. Approximately 6,570 cubic yards were excavated in April 1999 and 42 cubic yards were excavated in September and October 1999 and placed in the B-Plant Repository. The remediation work was detailed in *Compliance Report CR-419-2*.

A final verification was performed in October 1999. The *Confirmation Investigation Report, The Town Dump, Uravan, Colorado* was submitted to the CDPHE for review and approval on December 21, 1999. The report concluded the cleanup activities were successful. The average exposure rate (14 µR/hr) met the RAP criterion as did the average concentration of Ra-226 (2.5 pCi/g). All laboratory analytical results for radium-226, arsenic, cadmium, lead, nickel, selenium, and zinc in both surface and subsurface soils met RAP Category 1 objectives. Some confirmation soil samples exceeded Category 1 objectives but were below Category 2 objectives for uranium, molybdenum, and vanadium. One surface soil sample for thorium-230 exceeded Category 2 surface soil objectives. This sample was less than the Category 1 subsurface soil objective; therefore, Umetco proposed the placement of a minimum of 15 centimeters of uncontaminated fill as shown in the final grading plan included in the confirmation report. Implementation of the grading plan provided the necessary stable backfill for the appropriate application of subsurface RAP objectives and to restore the site to conditions similar to the surrounding environment.

Implementation of the grading plan minimized the potential future risks to individuals from the current steep slopes and minor residual soil contamination. CDPHE approved the report on December 29, 1999. Confirmation activities are detailed in *Compliance Report CR-419-3*.

Final reclamation activities were performed in May and June 2000, in accordance with the plan detailed in the approved Confirmation Investigation Report. Both former dump areas were graded to blend with the surrounding topography. The vegetation activities were conducted in November 2000 in accordance with the Revegetation Specifications, approved by CDPHE on November 20, 2000. The final reclamation was completed before the modified RAP deadline dates, approved by CDPHE on March 22, 2000, and detailed in *Compliance Report CR-419-4*.

Windblown Area

The windblown materials are defined in the RAP as mill-derived contaminants dispersed by the wind into the surrounding areas. This material was most likely mill tailings blown from the Tailings Piles. The windblown area also contains naturally occurring radioactive materials (uranium ore and sub-grade ore) and mine-related materials such as waste rock piles. These materials are not milling related, they are not regulated by the RAP or CDPHE Radioactive Materials License 660-02, but rather are associated with mine regulations, permits, and associated reclamation activities. Section 4.7.2.4 of the RAP states windblown deposits do not require removal due to the thin soils and environmentally sensitive nature of the Club Mesa area. However, the RAP requires the removal of concentrated, contaminated mill-related deposits with exposure rates greater than 30 µR/hr. The *Characterization Investigation Plan for Windblown Material, Revision 1*, was submitted October 20, 1998 to address these areas.

The report, *Characterization of Areas of Elevated Radioactivity Levels, The Windblown Area*, submitted on June 24, 2003, details the results of exposure surveys conducted in 1998 and 2000. Several areas were identified with exposure rates greater than 30 µR/hr. These areas were further inspected to determine whether they were impacted by mill-related deposits or mine-related/ore outcrops. In most cases these areas were determined to be mine-related/ore outcrops. The report identified very thin windblown deposits north of Tailings Piles 1 and 2, but because these deposits were thin and within the area described by Section 4.7.2.4 of the RAP, no additional cleanup was required or performed. The report identified two elevated areas containing mill-related material: Area E due to windblown material, and Area J due to mill tailings slimes.

CDPHE requested further evaluation of Area E and on September 1, 2006, Umetco submitted a report titled *An Evaluation of Area E in the Windblown Area*. The report concluded that average radionuclides and heavy metals present in Area E, although elevated, did not exceed RAP cleanup standards. Average exposure rates (average 34 µR/hr) for Area E were found to have similar exposure rates to bordering areas (D and G) with naturally occurring radioactive material (NORM) attributed exposure rates of 36 to 46 µR/hr (Umetco 2006a). Therefore, no further additional remedial action was proposed. CDPHE concurred with the finding by letter dated October 12, 2006. The letter indicated that EPA staff also reviewed the report.

During 2000, mill tailings slimes were removed from Area J. These materials (approximately 2,700 cubic yards) were removed by vacuum truck and hand excavated to the extent practicable, given the extremely steep and dangerous slopes. During 2002, approximately 3,700 cubic yards of contaminated soils were removed above Sedimentation Basin 9 and from an area between Tailings

Piles 1 and 2 and the Bone Yard, sometimes known as the North Forty. Although no discrete deposits of windblown material were identified by the characterization survey, a few contaminated areas along the haul road in the North Forty were remediated. In 2003, an additional 9,000 cubic yards of contaminated soils were removed from these areas. These cleanup activities are documented in *Compliance Report CR-418B-2*. An additional radiological survey of this area was performed and submitted in *Compliance Report CR-418B-3*. During 2014, approximately 300 cubic yards of mill tailings slimes were removed from a small area within Area J. These materials were removed by hand excavation to the extent practicable, given the extremely steep and dangerous slopes and sent to the Energy Solutions site in Clive, Utah.

Final reclamation activities were performed between May and July 2003 in accordance with the Final Grading and Drainage Plan dated February 22, 2002. The mine adits were backfilled with random fill. Areas in front of the adits were graded to blend with the existing slope using rock mulch and two-foot minus rock rubble. Permanent drainage diversion channels were constructed in the locations of the former ponds (CRP-5, CRP-6, and SB-9). The reclamation work is described in *Compliance Report CR-418B-4*.

Mill Hillside

The Mill Hillside is located within the Uravan restricted area and includes steep terrain extending from near the base of the colluvial slope in the former A-Plant area to the top of the Club Mesa rim and from the mouth of Hieroglyphic Canyon to the northwest for about 4,000 feet. A characterization investigation was conducted in 1998 to determine the depth and areal extent of contaminants in accordance with the *Characterization Investigation Plan for Surface and Subsurface Soils at the Mill Hillside, Water Storage Ponds, and County Road EE-22*, dated August 19, 1998 and approved by CDPHE on September 10, 1998. The objective of this investigation was to characterize radionuclide contamination on the surface of remnant mill area foundation structures. The results were detailed in the *Characterization Report and Remedial Action Plan for the Mill Hillside*, revised on April 14, 1999. The characterization activities were also reported in *Compliance Report CR-418C-1*. Approximately 40 percent of the hillside could not be characterized due to the presence of steep slopes and dense vegetation, precluding safe access. However, it was determined that sufficient data were gathered to assess project area conditions using historic information and to develop appropriate remedial actions.

Remedial activities were initiated in 1999 with the focus on the demolition and removal of concrete foundations and structures associated with the former uranium/vanadium mill. Over 7,000 cubic yards of sized concrete debris and contaminated soils were taken to the B-Plant Repository. CDPHE's Uravan On-Scene Coordinator inspected the cleanup activities and recommended that discrete deposits of contaminated material be removed. This resulted in approximately 23,000 cubic yards of contaminated materials removed in 2001 and 2002 and placed in the B-Plant Repository and Tailings Piles 1 and 2. This additional remediation was also conducted to establish terraces to reduce erosion and enhance the hillside seepage collection system. These activities were described in *Compliance Report CR-418C-2*.

A confirmation investigation was conducted between 1999 and 2002 after removal of contaminated material, including exposure rate measurements, assays for surface and subsurface soils, and a risk assessment. The results were detailed in the *Confirmation Investigation Report, Mill Hillside, Uravan, Colorado*, submitted in December 2002 as *Compliance Report CR-418C-3*.

These reports were approved by CDPHE in February 2003. The confirmation investigation concluded that, in general, all contaminated materials physically and safely accessible were removed from the hillside; however, final verification measurements indicated elevated concentrations of residual contaminated material on some of the steeper inaccessible sloped areas.

Alternate Soils Standards were requested for this area in the *Alternative Soils Standards Application*. An average exposure rate of 45.4 µR/hr was measured for the area with a maximum exposure of 202 µR/hr for a single 10-by-10-meter grid. Average Ra-226 concentrations were measured to be 22 pCi/g with a maximum exposure of 173 pCi/g for a single 10-by-10-meter grid. Confirmation soil sampling measured average Ra-226 concentrations to be 17.1 pCi/g for surface samples and 10.5 pCi/g for subsurface (15-30 cm) samples. NORMs were noted on the mill hillside. Based on a risk assessment performed for the area, maximum human exposure would occur for a hunter-hiker using the area and ingesting meat from an animal harvested in the area. The annual radiation dose to such a hiker would be 4.6 millirem per year (mrem), below a 25 mrem per year public radiation dose standard. Alternative standards were proposed for the following reasons:

- The steep hillsides posed a risk of injury to construction workers during potential additional remediation.
- Remedial actions could result in destabilization of the slope and release of sediment to drainages (and ultimately the San Miguel river), causing excessive harm to the environment.
- No habitable structures would be constructed in the area because of future institutional control and stewardship of the land by the DOE.
- Cost of remediation would be excessive in relation to small decrease in human exposure.
- Previous remediation actions reduced exposures to ALARA.
- Future land use would be habitat for wildlife and not for residential or related structures. The DOE would assume long-term stewardship of the property and manage land use.

The general (accessible) hillside area was stabilized with a nominal 3-foot thickness of 2-foot diameter minus rock rubble to prevent sediment migration in 2003. The final reclamation, including grading and drainage activities, was conducted in 2003 in accordance with the *Design Change Order, Final Reclamation Grading for the B-Plant Mill/Bone Yard areas, Mill Hillside Area and the A-Plant Mill Area*, dated September 20, 2002, and approved by CDPHE. These activities also included the removal of the concrete seepage collection system. The reclamation work was described in *Compliance Report CR-418C-4*.

County Road Y-11

The County Road Y-11 area is located along the southwest side of San Miguel River. The road in the vicinity of the Town Dump was remediated during the cleanup activities at the Town Dump between March 1998 and December 2000.

Umetco conducted a characterization investigation on the portion of County Road Y-11 from the new bridge over the San Miguel River to the Town Dump between June 1996 and April 1997 in accordance with the *Remedial Investigation Plan for County Road Y-11,* dated May 1996. Gamma exposure rates and radionuclide and metal concentrations were measured above average regional

background levels in and beside an approximately 5800-ft portion of the road between the County Road Y-11 Bridge and the old Iron Bridge adjacent to the Town Dump. The roadbed is composed of natural earthen materials, NORM in the form of overburden, waste rocks, and tailings. Contaminated soils were found to exist at depths greater than 3 feet beneath the roadway. Remediation of the road was not considered practical because of lack of access. As a result of this and the elevated readings, a risk assessment was prepared for this portion of the road.

The Risk Assessment determined that the excess radiation doses received by an individual along the surveyed portion of County Road Y-11 would be less than 10 percent of the decommissioning dose limit of 25 mrem per year. The final Risk Assessment, including response to CDPHE comments and an ALARA analysis, was submitted in May 2004. CDPHE approved the Risk Assessment on December 8, 2005. The characterization investigation and ensuing risk assessment activities were addressed in *Compliance Report CR-418D-1*.

In September 2006, Montrose County Engineering approved plans to perform prescriptive remediation work on the road between the new County Bridge and Old Iron Bridge (Black Bridge) (road segment Y11-400) and between the Hieroglyphic Canyon Bridge and the Historic Community Center Building (road segment Y11-800). In September 2006, approximately 8,200 cubic yards of visible tailings were removed from several locations along these road sections and placed in the B-Plant Repository. The discrete excavations were in the roadway and extended into the shoulders either through the drainage ditches on the hill side of the road or out towards the riverbank as necessary to remove all visible tailings. Excavation depths, up to 11 feet deep in places, were determined by real time scintillometer surveys. After excavation, the roads were backfilled and reestablished. The reclamation activities were addressed in *Compliance Report CR-418D-2*.

Radiological surveys of the roadway were performed in February and April 2007, and reported in CR-418D-2. The results indicated that the removal of the discrete visible tailings had reduced the average radium-226 concentration to 4.5 pCi/g, below the RAP guideline of 7.1 pCi/g. However, some areas with radium-226 concentrations over 7.1 pCi/g remained (up to a maximum value of 20.2 pCi/g reported in the alternative standards application based on field measurements), and are located approximately 1,000 feet west of the intersection of County Road Y-11 with County Road V-18. The County Road Y-11 roadway and right-of-way were included in the *Alternative Soil Standards Application* for the following reasons:

- Potential health risks were considered negligible as contaminated material were only present at depths greater than 3 feet, and future exposures will be minimized by institutional controls.
- Cost of remediation would be excessive in relation to small decrease in human exposure.
- Previous remediation actions reduced exposures to ALARA.
- Future land use would be as a road and not for residential or related structures. The DOE would assume long-term stewardship of the property and manage land use.

County Road EE-22

The County Road EE-22 project area includes the roadway from the San Miguel River to the top of the Club Mesa. It was mainly used to provide access to the numerous uranium, radium, and

vanadium mines located on the mesa. Radiological anomalies were highly probable due to the presence of ores along the side of the road. Soil contamination also included uranium tailings from past mill operations at Uravan.

A characterization investigation was conducted in 1998 in accordance with the *Characterization Investigation Plan for Surface and Subsurface Soils at the Mill Hillside, Water Storage Ponds, and County Road EE-22,* dated August 1998. The objective of the characterization investigation was to provide radiological, radiochemical, and inorganic data for surface and subsurface soils. Gamma surveys were also conducted. Results of the investigation were submitted in the *Characterization Report and Remedial Action Plan for Montrose County Road EE-22* in December 1998. The characterization investigation was documented in *Compliance Report CR-418E-1*.

Based on the results of the characterization investigation, remedial action plans for this area were developed. In 2000, approximately 1,730 cubic yards of visible slimes were removed from the hillside above the road and placed in the B-Plant Repository. In April 2001, approximately 4,500 cubic yards of visible tailings and contaminated soils were removed from beneath a 500-foot section of the roadway and right-of-way. These materials were placed in the B-Plant Repository. Upon completion of the cleanup activities, the area was inspected and approved by the CDPHE On-Site Coordinator. An additional 88 cubic yards of contaminated material was removed in April 2002 after it was identified during the field inspection by CDPHE. The remedial activities were documented in *Compliance Reports CR-418E-2 and CR-418E-3*.

Backfilling and regrading activities took place in April and May 2001. Approximately 5,744 cubic yards of clean random fill from the Club Mesa borrow area was used to backfill the road. After the roadway was reestablished, it was surfaced with a 6-inch layer of Class 6 roadbase. The final reclamation activities were documented in *Compliance Report CR-418E-4*.

Confirmation Investigation Report, Montrose County Road EE-22, Uravan, Colorado was submitted in December 2002 as *Compliance Report CR-418E*-3. The report indicates remedial action was successful in removing uranium mill tailings from the roadway. The average exposure rate is below the 30 µR/hr standard specified in Section 4.7.2.4.1 of the RAP. The average concentration of radium-226 in surface soil from scintillometer survey data met the RAP criteria; however, the average radium-226 and thorium-230 results from laboratory analyses for surface soil samples were above Category 1 and Category 2 soil cleanup values but less than risk-based Category 3 values.

Because of elevated radium and thorium readings along the roadway, Umetco recommended the county road be paved so potential future exposures are maintained ALARA. Paving the roadway would ensure mitigation of possible dust generation and further reduce potential exposures to humans.

Water Storage Ponds

The Water Storage Ponds project area is located outside the Uravan restricted area, west of the San Miguel River and County Road EE-22, and bounded on the east by Hieroglyphic Canyon. This area consisted of the pond embankments and two former ponds with dimensions approximately 500 feet long by 200 feet wide. The ponds were dry for 10 to 15 years before remediation. This area was one of the areas of dispersed deposits at Uravan.

A characterization investigation was conducted in 1998 to determine the depth and areal extent of contamination. The investigation was performed in accordance with the *Characterization Investigation Plan for Surface and Subsurface Soils at the Mill Hillside, Water Storage Ponds, and County Road EE-22* and approved by CDPHE on September 10, 1998. The investigation provided data for radiological, radiochemical, and inorganic constituents of concern in surface and subsurface soils. Based on the characterization investigation, remedial actions were developed, and the resultant *Characterization Report and Remedial Action Plan for the Water Storage Ponds* was submitted on December 3, 1998 and approved by CDPHE on June 15, 1999. This activity was reported in *Compliance Report CR-418F-1* approved by CDPHE on May 9, 2002.

Cleanup activities occurred in March and April 1999, with the removal of approximately 17,500 cubic yards of contaminated soils. The depth and extent of excavation was controlled and monitored by real-time gamma scintillation measurements. The excavated soils were placed in Tailings Piles 1 and 2 and the B-Plant Repository. This work was detailed in *Compliance Report CR-418F-2 and CR-418F-3*.

Confirmation surveys and soil sampling were performed during 1999 and 2000. *The Confirmation Investigation Report, Water Storage Ponds* was submitted in January 2000. The report indicated that the contaminant concentrations were reduced to levels below the corresponding remedial action plan objectives given in the *1999 Site-Specific Soil Cleanup Objectives Rational Document*, below the NRC license termination criteria, and to levels below typical EPA CERCLA requirements. Therefore, the area was proposed to be released for unrestricted use. The confirmation activities were documented in *Compliance Report CR-418F-3*.

A final grading plan, included in the confirmation investigation report, was established and required the placement of a minimum of 6 inches of stable fill in the area of the highest residual contaminant concentrations to provide for the appropriate application of subsurface RAP objectives and minimize potential future exposures to individuals. Final grading activities were conducted in May 2000. The steep slopes within the excavated area were graded and contoured to blend with the existing slopes and drain towards Hieroglyphic Canyon. Depressions were backfilled and a minimum of 6 inches of soil was placed in the required areas. Revegetation activities were performed during November 2000. This work was documented in *Compliance Report CR-418F-4*.

Atkinson Creek Drainage Way

Atkinson Creek enters the San Miguel River from the north, approximately 3 miles west-northwest of Uravan. The creek is an intermittent stream and provides drainage from much of Atkinson and Spring Creek Mesas.

A characterization scintillometer survey was conducted in May 1990. No readings greater than 20 µR/hr were observed along the streambed and therefore no remedial activities were required. A confirmation scintillometer and soil sampling survey were conducted on December 17, 1992, which also indicated no readings over 20 µR/hr. Radionuclide and metal concentrations in the soil samples were all below background levels. The results of both surveys were submitted to CDPHE on December 28, 1992, and were also detailed in the *Characterization Investigation Report and Remedial Action Plan for Atkinson Creek Streambed, Uravan, Colorado*, dated May 5, 1994.

These activities were documented in *Compliance Report CR-418H-1*, approved by CDPHE on February 19, 2002.

Hieroglyphic Canyon Drainage Way

Exposure measurements were collected within the stream channel of Hieroglyphic Canyon in May 1990, to characterize the extent of contamination. Two additional surveys were conducted in June 1994. The first survey was completed in the upper portion of the canyon, upstream of the area covered by the 1990 survey, and was conducted to establish mining-related effects. The second survey covered a portion of the 1990 survey area and was conducted as a veracity check. The results of the characterization surveys are detailed in *Technical Assessment of the Hieroglyphic Canyon Streambed, Uravan, Colorado,* which was submitted in December 1994. The report concluded that mechanized soil removal would be costly and result in significant disturbance to the environment, and that the impacts of contaminant release to the river would not cause exceedance of radionuclide concentration limits in the San Miguel River. Therefore, a no-action alternative was proposed. However, the report stated that discrete deposits of contaminated materials would be remediated where accessible. In the approval letter dated April 6, 1995, CDPHE agreed to limit the remediation activities to the removal of accessible mill-related contamination within the stream channel and the radioactive hot spots on the canyon slopes. In this letter, CDPHE also requested a Materials Identification and Removal Plan. The plan was submitted on August 17, 1995, and stated that contaminated material would be removed from the canyon mouth to an area upstream where movement of materials and equipment would be restricted. In addition, to assure that stream sediments continued to meet appropriate standards, contaminated soils would also be removed from the area known as Treasure Island and from the rim of Club Mesa.

Cleanup activities took place in 1991 and 1994 at the replacement location of the County Bridge and along the rim of the canyon, respectively. Additional cleanup work was performed between June 1998 and February 1999 with the removal of contaminated soils from the mouth of Hieroglyphic Canyon and the Treasure Island area. Iterative cleanup was conducted in August and September 2000. These activities are documented in *Compliance Report CR-418I-1*.

Northeast Side of Colorado Highway 141

Northeast side of Colorado Highway 141 encompasses approximately 7 acres of land along the northeast side of the 0.5-mile highway in San Miguel River valley. The characterization survey of the area was conducted in 1996 under a CDOT survey permit and in accordance with the *Remedial Investigation Plan for Surface and Subsurface Soils and Structures, Northeast of Highway 141, Uravan, Colorado,* Revision 1, dated March 1996. The investigation provided data for radiological, radiochemical, and inorganic constituents in the surface and subsurface soils and structures. The results were detailed in *the Characterization Report and Remedial Action Plan for the Surface and Subsurface Soils and Structures, Northeast of Highway 141*, revised April 2000. The characterization activities were detailed in *Compliance Report CR-418J-1*.

The characterization investigation identified contaminated materials in the specific areas along the northeast side of the highway. These areas included the liquid impoundment (Frog Pond), the transformer substation area, the explosive magazine, the mouth of Red Canyon, the G-Block Well House, the F-Block Electrical Storage Building and the F-Block Pump House, but not the highway

itself. Approval to remove contaminated material located on BLM property was given on February 23, 1999 by BLM. Based on the characterization investigation, approximately 25,400 cubic yards of contaminated soils, debris and structures were removed and placed in the B-Plant Repository in 2000. These activities were detailed in *Compliance Report CR-418J-2*.

The RAP stipulated that Umetco was responsible for the removal of contaminated soils from beneath the highway whenever they were exposed but only while the Tailings Piles were open. The CDOT was informed of this, but declined to have any contaminated materials removed from beneath the highway as noted in the CDOT construction permit issued on March 13, 2000, for the work within the right-of-way.

Confirmation surveys were performed in 2000 and detailed in the *Confirmation Report, Northeast of Highway 141*, dated December 21, 2002, and approved by CDPHE on January 14, 2003. The report indicated that the average exposure rate is below the RAP guideline of 20 µR/hr. Surface and subsurface soil concentrations of radionuclides and heavy metals were below the Category 2 cleanup objectives. Radium concentrations in four surface soil samples exceeded the Category 2 surface soil cleanup objectives. All radium concentrations in the subsurface soil samples met the Category 1 soil cleanup objectives. The report concluded no additional remedial actions were warranted in the Highway 141 project area outside of the highway right-of-way. This work segment was addressed in *Compliance Report CR-418J-3*.

Final reclamation was conducted in 2000, including backfilling, regrading, erosion protection, and revegetating the disturbed areas. Approximately 7,900 cubic yards of random fill were used as backfill. All disturbed areas were graded to blend with the surrounding topography and provide, as far as practicable, the original drainage features. Riprap was placed in the channel at the mouth of Red Canyon as erosion/scour control. Revegetation activities were performed during November 2000 in accordance with the Revegetation Specifications. The reclamation activities were detailed in *Compliance Report CR-418J-4*.

The CDOT Highway 141 remedial action area encompasses about 1 mile of land in the right-of-way corridor in the San Miguel River Valley. This remedial action occurred in 2006 and resulted in excavation of 51,000 cubic yards of material being disposed of in the B-Plant Repository. Following the remedial action, on September 4, 2007, a one-mile section of Highway 141 between mile posts 75 and 76 comprising approximately 7 acres was deleted from the NPL.

The Nature Conservancy Visitor’s Site

Elevated radiation levels in soil were observed in an open parcel of land located southeast of the Uravan Ball Park, approximately one mile from the town center. A portion of the approximately 7.5-acre site belongs to Umetco and the remainder belongs to the Nature Conservancy. The site is collectively referred to as the Nature Conservancy Visitor’s Site (NCVS). Umetco conducted investigations of the NCVS in 1997 and performed remedial activities in 1998. The site was not included in the RAP; a separate remedial action plan was developed for the NCVS.

Approximately 4,800 cubic yards of contaminated soil were removed from September to November of 1998 and disposed of in the Uravan B-Plant repository. Groundwater was encountered in two areas adjacent to the San Miguel river during excavation. Excavation did not

continue below the groundwater table. A soil cover was installed in accordance to the final grading plan at the NCVS.

Other Town Areas

Several other areas of the former town were reported by Umetco to be below contaminant background levels and were therefore not a part of the RAP cleanup efforts. These town areas include the E Block, F Block, Corrals, Gym Area, Ball Park, and Homer Woods.

Burbank Quarry

The Burbank Quarry was originally intended to be the source of riprap for remedial activities. Random fill and clays were mined from the quarry pit for use in remedial construction. The quarry area was divided into two repositories. The lower Burbank Quarry was used for disposal of raffinate crystals originating from the Site. The upper Burbank Quarry was used as a Title I Repository by the DOE for disposal of waste material from the nearby Naturita processing site.

In the RAP, as amended, CDPHE selected a remedy that placed the raffinate crystals removed from the Atkinson Creek Crystal Disposal Area, the CRPs and the Club Mesa Spray Area in below-grade Burbank Quarry locations. The RAP specified that the raffinate crystals were to be dispersed in clay-lined cells that would be capped by earthen materials and riprapped for erosion control and protection. Umetco designed the Burbank Quarry cap systems in consideration of the probable maximum precipitation events and maximum credible earthquakes.

Umetco began placement of the raffinate crystals into the lower Burbank Quarry in 1989 and completed the work in 1992. Umetco capped the raffinate crystals with an earthen cover in accordance with the RAP; the side slope was completed in 1993; the toe drain was installed in 1998; and the top cover was completed in 1999 with the placement of cover of riprap rock. The Burbank Quarry – Uravan UMTRCA Title II activity was completed by 2000.

DOE used the upper portion of the Burbank Quarry Repository for disposing Title I radioactive materials from the Naturita processing site. Approximately 600,000 cubic yards of radioactive materials were placed in the Burbank Quarry repository. A multilayered cover, identical to the Uravan Tailings Piles covers, was constructed on top of the placed contaminated materials. Permanent drainage diversion structures and control features were constructed for storm water management to and from the repository. The Burbank Quarry Repository – DOE UMTRCA Title I activity was completed in 1998.

Borrow Areas on Club Mesa

The Borrow Areas on Club Mesa were not contaminated and were used as sources of the clayey soils and random backfill to be used during remedial activities. The Club Mesa Borrow Area is operated pursuant to the requirement of a Mine Land Reclamation permit issued by the Colorado Department of Natural Resources, Division of Minerals and Geology.

Remediation activities at these areas were not required. This area was the intended resource for clayey soils and random backfill to be used in remedial activities. Final mine land reclamation will

be accomplished pursuant to the requirements established by the issuance of the Borrow Area Mine Land Reclamation Permit.

Three borrow areas exist for the Site. Two (Elk and Surprise Borrow areas) are located on Club Mesa, with one above the Burbank Repository. The third is located in the San Miguel River Valley on the east side of Colorado Highway 141, across from the Club Ranch Ponds. The borrow areas on Club Mesa, which includes the Kaiser Quarry, were expanded in 1992, 1997, 2002, and 2003.

The Kaiser Quarry produces sandstone suitable for erosion protection materials. The Kaiser Quarry is located west of the Club Mesa Area within Umetco's patented Kaiser Claim Boundary. All the borrow areas are operated in compliance with the Mine Land Reclamation Permits issued by the Colorado Department of Natural Resources, Division of Minerals and Geology. The Borrow Areas on Club Mesa were not contaminated and were used as sources of the clayey soils and random backfill to be used during remedial activities.

Liquids

The RAP also described five liquid remedial activities: hillside seepage and tailings liquids, ponded liquids, surface runoff and groundwater.

Hillside Seepage and Tailings Liquids

Seepage had been occurring intermittently along approximately 4,600 linear feet of the Club Mesa rim. Seepage occurred near the contact between the Summerville and Salt Wash Formations and exited the valley walls of Hieroglyphic Canyon and the San Miguel River above the A-Plant Area. The seepage was composed of geochemically modified tailings solutions from the Club Mesa Tailings Piles and the Club Mesa Spray Area.

The dewatering and consolidation process forced liquids from the Club Mesa Tailings Piles for some time prior to and after final reclamation activities. Seepage was collected by a toe drain system at the base of the slopes of the Club Mesa Tailings Piles and conveyed to the CRPs with the Hillside Seepage Collections System liquids.

Sections 5.1.1.2 and 5.1.2.2 of the RAP required the following construction activities to ensure adequate remediation of the Hillside Seepage and Tailings Liquids.

- Improve and line the existing collection system.
- Construct a lined collection system at the base of the Entrada Formation to collect surface flow and seepage.
- Construct trenches and sumps to enhance dewatering and consolidation of tailings in the repositories.
- Collect and dispose of contaminated liquids until there are no flows for 3 consecutive years in any collection system segment or contaminant concentrations meet water quality objectives.
- Dispose of collected liquids in the new lined Club Ranch Ponds.

Improvements to the existing hillside seepage collection system started in August 1988 and continued until completion in December 1988. Work included the following: cleaning; regrading and lining the main ditch; cleaning, enlarging and lining the three diversion ponds; installation of two culverts; and patching and widening other ditches. This work is detailed *in Compliance Report CR-426-1*, dated April 1989.

Construction of the new Subgrade Collection System drains at the base of the Entrada Formation was started after preliminary grading of the hillside seepage collection system in August 1988. The system consisted of several lined drains that were completed in accordance with the plans. Drains were not constructed if the excavations were dry and were extended if the excavations indicated a greater seep area. Energy dissipater was not required because of extremely low fluid velocity. A pump back system was constructed to return collected fluids to the new Club Ranch Ponds. The system was operational in December 1988 as required by the RAP. The construction work and changes to the Subgrade Collection System were noted in *Compliance Report CR-426-2*.

The construction of trenches and sumps for the toe berm seepage collection system to enhance surface dewatering and maintenance on the Tailings Piles began in January 1988 with the upgrading of the existing toe drains with concrete sumps and double pipelines. Between June and November 1988, the collection system was extended to intercept seepage detected along the southeast end of the Bone Yard below the toe of Tailings Piles 1 and 2. The toe drain extension routed the seepage towards the sumps. This work segment is detailed in *Compliance Report CR-426-5*, dated March 2003.

During 2000, Umetco drilled 17 borings into the mine workings on Club Mesa for the purpose of evaluating and managing contained contaminated liquids, of which five were selected for pumping and conveyance of mine workings liquid. Umetco extracted and transferred the raffinate solution in the mine workings to the Club Ranch Ponds for evaporation. Approximately 500,000 gallons of raffinate contaminated liquid was pumped from the mine workings during 2000 and 2001. Umetco has not reported any additional liquids extracted from the Club Mesa Area mine workings since the fourth quarter of 2001.

Umetco submitted *Technical Evaluation of Mill Hillside Seepage: Uravan, Colorado* on September 4, 2002. The analysis concluded that seepage flow volumes would continue to decline and that the water quality of the seepage would not impact the San Miguel River water quality even during low river flow conditions. CDPHE approved the report on September 24, 2002, and stated that the collection of hillside seepage was no longer required and allowed for the Hillside Seepage Collection System decommissioning in April 2003. All liners, hardware and contaminated soils were removed and placed in the B-Plant Repository. Details of this work are given in *Compliance Report CR-426-3*, dated April 30, 2003, and were approved by CDPHE.

A Design Change Order for final grading activities in the Mill Area, including the areas used for the Hillside Seepage Collection System, was submitted to CDPHE on September 27, 2002. The approved plan included the removal of concrete from the ditches and diversion ponds and the placement of rock rubble to provide erosion protection. Placement of rock rubble began on May 2003 after the concrete within the ditches and ponds had been removed. Reclamation activities were completed in June 2003 and are documented in *Compliance Report CR-426-4*, dated June 2005.

Ponded Liquids and Surface Runoff

Contaminated liquids were contained in various ponds around the mill and within the mill circuit. The liquid in the Club Ranch Ponds consisted of toe drain and hillside seepage, collected since mid-1985, and raffinate solution from discharges to the ponds prior to 1984. These liquids along with those in the River Ponds and Club Mesa Storage Ponds seeped into the subsurface below these unlined ponds. The RAP required these liquids to be placed into lined ponds.

Sections 5.2.1.2, 5.2.2.2, and 5.3.2 of the RAP required the following construction activities to ensure adequate remediation of the Ponded Liquids and Surface Runoff:

- Evaporate all liquid waste in the existing unlined Club Ranch Ponds.
- Transfer all liquids in the River Ponds, Storage Ponds on Club Mesa, and within the Mill Circuit to the Club Ranch Ponds.
- Construct and operate the surface runoff collection and sedimentation pond system until all remedial activities are complete.

By May 31, 1988, all collected fluids from mill circuit, hillside seepage and toe berm collection systems, and the surface runoff collection systems were being pumped into the new lined evaporation pond, CRP-7. Verification of this work was detailed in *Compliance Report CR-429-1*, approved by CDPHE on June 14, 1988.

Dewatering of the existing Club Ranch Ponds began as soon as all the site wide liquids were transferred to CRP-7 on May 31, 1988. Only internal flows between the existing Club Ranch Ponds were authorized to enhance the surface area for evaporation. By December 24, 1988, the remaining liquids were pumped to new lined evaporation ponds. The existing ponds were drained and approximately 11.4 million gallons were transferred by the deadline date given in the RAP. The dewatering activities are detailed in *Compliance Report CR-401-2*, approved by CDPHE on April 20, 1989.

By letter dated December 11, 1987 and reconfirmed on April 11, 1989, Umetco notified CDPHE that the River Ponds and the Storage Ponds on Club Mesa were empty. On May 2, 1989, CDPHE indicated that since the ponds were empty and no longer existed, Umetco would no longer be required to submit reports on the status of the ponds.

On April 13, 1998, Umetco informed CDPHE that they had been contacted by MK-Ferguson Company, the construction contractor for the DOE's Title I Naturita Project, to request permission to dispose of contaminated water stored in the Title I lined retention basins at the Title I Upper Burbank Disposal Cell. Umetco requested these liquids be transferred to the lined Club Ranch Ponds. CDPHE authorized acceptance on April 14, 1998.

A Field Change Order was submitted on August 17, 1998, for approval to relocate four Runoff Control Ponds in the A-Plant area to facilitate contaminated soils removal and to construct a new return water pond in the B-Plant area. The ponds were constructed by March 1999.

On Apri1 30, 2003, Umetco notified CDPHE that the remediation of all waste material was complete and the placement of the reclamation covers on the Tailings Piles was complete. Since

there were no longer exposed contaminated soils, Umetco requested all the runoff control ponds be decommissioned. CDPHE approved the pond decommissioning on May 20, 2003. All the runoff control ponds were removed during the second quarter of 2003. This activity is detailed in *Compliance Report CR-429-2*, dated October 2005.

Ground Water

Seepage from the Uravan Mill operations and waste disposal infiltrated into the Salt Wash and created a body of perched fluids on Club Mesa. This infiltration primarily consisted of raffinate from the Club Mesa Spray Area and seepage from the Club Mesa Tailings Piles. Hydrologic monitoring wells constructed in the Salt Wash indicate the areal extent of the fluids is in the area beneath and down gradient from the three Club Mesa Tailings Piles and spray evaporation area. Groundwater flows to the northeast toward the west and south San Miguel River Valley walls and to the walls of Hieroglyphic Canyon. Perched liquids on top of the Summerville Formation have dispersed and no significant seepage has been noted along the canyon valley walls.

Umetco's past operations on Club Mesa and past waste disposal activities had the potential to impact the groundwater quality in the Kayenta-Wingate aquifer beneath Club Mesa. Past activities that could potentially impact the aquifer were the use of the Club Mesa Spray Area and Club Mesa Tailings Piles. These activities have ceased. The low permeability of the Summerville shale formation above the Kayenta-Wingate aquifer prevents significant contaminant transport down to the Kayenta-Wingate aquifer. In 1986, Umetco drilled groundwater monitoring wells V-768 and V-769 into the Kayenta-Wingate Formation beneath the Club Mesa. Samples taken from the Club Mesa wells drilled down to the Kayenta and Wingate Formations showed no significant contamination from the milling operations.

In 1993, three additional groundwater monitoring wells (CM93-1, CM93-2, and CM93-3) were installed on Club Mesa, at CDPHE's request, for further testing and monitoring of the Kayenta-Wingate aquifer and to provide additional permeability data for the Summerville Formation. CM93-1 and CM93-2 are hydraulically up-gradient of the Tailings Piles and Spray Area; while the CM93-3 is hydraulically down-gradient of these areas. The results of the testing concluded that the Summerville and Kayenta had very low permeabilities while the Salt Wash had much higher permeabilities.

A summary of the results of groundwater monitoring and permeability testing through 1993 were detailed in Hydrogeology of Club Mesa, Uravan, Colorado, submitted on March 4, 1994. The water quality data in this report showed that the aquifer had not been affected by raffinate or tailings solutions and that the Summerville aquitard stopped these solutions from reaching the aquifer.

In March 1998, DOE presented a groundwater hydrology report, attached as Appendix B of the report entitled *Remedial Action Plan and Site Design for Stabilization of the Naturita Title I Residual Radioactive Materials at the Upper Burbank Repository, Uravan, Colorado*. The Upper Burbank Repository is now DOE's UMTRCA Title I Naturita Disposal Site, and is located adjacent to and up-gradient of the Club Mesa Spray Area and the Tailings Piles; therefore, the groundwater hydrology presented in this report is also representing the Club Mesa area. This report indicated that the travel time needed for the contaminated fluids from the bottom of the repository to infiltrate through the Salt Wash Member and the Summerville Formation are 130 and

900 years, respectively. This means that it would take over 1,000 years for any contamination fluid in the repositories on the Club Mesa to reach the Kayenta-Wingate aquifer and discharge to the San Miguel River.

On December 6, 1999, CDPHE approved the use of monitoring well CM93-3 as the Point of Compliance well for Club Mesa repositories because it was hydraulically down-gradient of the repositories and would allow for early detection of any contamination from the repositories. CDPHE also reviewed the historic differences in water chemistry between the groundwater from the Paradox Valley and the groundwater adjacent to the San Miguel River. On March 29, 2001, CDPHE approved Umetco's proposal on the background concentrations and concentration limits for CM93-3. The concentration limits were chosen to be the larger values of the background concentrations and the EPA's drinking water standards. The concentration limits were then used to evaluate the groundwater quality in this well for raffinate-derived constituents. In addition, a time-sequence trilinear plot was also used to evaluate the change in the calcium-magnesium ratio of these constituents.

In December 2006, Umetco informed CDPHE that groundwater monitoring at CM93-3 between 1993 and 2006 had not shown any mill-related contaminants in the Kayenta-Wingate aquifer and this aquifer had not been contaminated over the 50 years since the use of the Spray Area and the Tailings Piles. This is consistent with previous studies showing that the 90-foot thick Summerville aquitard effectively isolates the water resources in the Kayenta-Wingate aquifer. This is also consistent with the 1998 DOE groundwater hydrology report concluding that the travel time to the aquifer from the repositories on Club Mesa would be greater than 1,000 years. In addition, Umetco stated that the presence of CM93-3 may pose a problem in the future since it may allow a pathway for contaminants to reach the Kayenta-Wingate aquifer, in the case of any deterioration or failure of this well. Therefore, Umetco requested the abandonment of this well.

Both CDPHE and DOE reviewed Umetco's request for CM93-3 abandonment and agreed with Umetco's assessment. DOE further considered that accessing this well for future rehabilitation or abandonment may become a concern as the Site roads were remediated and removed. In addition, CDPHE considered that the Tailings Piles were consolidated with covers constructed with drainages and would not contain enough water to produce any significant amount of seepage to the subsurface. Even if seepage were to occur from the Tailings Piles, it is likely to flow toward the hillside and surface on the cliff face as historically shown rather than infiltrating into the Kayenta-Wingate aquifer due to the Summerville aquitard. Even if the seepage were to infiltrate into the aquifer, any wells on the Club Mesa to monitor the groundwater in the Kayenta-Wingate aquifer would not be able to identify the contamination as the travel time from the repositories to the aquifer is greater than 1,000 years. CDPHE also considered that the Kayenta-Wingate aquifer discharges to the San Miguel River, and the approved long-term groundwater monitoring program, including the alternate concentration limits of groundwater and monitoring wells, in the San Miguel River Valley, is effective to protect the water quality in the San Miguel River. Therefore, both CDPHE and DOE did not find a need for this well to be included in the long-term monitoring program. CDPHE approved the abandonment of CM93-3 on March 19, 2008 with concurrence from DOE on May 5, 2008, and determined that no further remedial activities would be needed for Kayenta-Wingate aquifer on Club Mesa.

CM93-1 and CM93-2 were transferred to DOE as the monitoring wells for the DOE Title I Naturita Disposal Site. On April 15, 2014, NRC approved the termination of the groundwater

monitoring program at the Naturita Disposal Site. The monitoring program includes wells CM93-1, CM93-2, BP95-1, BP95-2, and BP95-3. NRC determined that leakage from the disposal cell was not impacting the uppermost aquifer, and it is unlikely for any future leakage to impact the Salt Wash Member due to lack of significant amount of water in the disposal cell as driving force of infiltration, and stable water levels and water quality have been observed. Therefore, NRC concurred with DOE that continuous monitoring of these wells was no longer needed and approved the termination of the monitoring program (DOE letter dated October 31, 2013; NRC letter dated April 15, 2014). All other wells on Club Mesa were abandoned in 2005 and 2007 with CDPHE approval.

Umetco's liquid waste handling and disposal operations in the San Miguel River valley released contaminants into the Kayenta-Wingate aquifer. The most significant contribution to groundwater contamination was the disposal of liquid raffinate in the unlined Club Ranch Ponds. Groundwater monitoring well data have identified seepage from the Club Ranch Ponds.

The groundwater system in the San Miguel River valley is a complex, fractured aquifer that maintains a recharge-discharge relationship with the San Miguel River. The groundwater monitoring well system in the river valley detected contamination in the fractured aquifer system. This contaminated groundwater acted as a source of non-point contamination to the San Miguel River. The sandstone matrix likely produces very little liquid relative to the fractures, and may have contributed contaminants to the fracture system at a relatively slow rate.

Sections 5.4.1.2, 5.4.2.2, and 5.4.3.2 of the RAP required the following activities to ensure adequate remediation of the groundwater.

- Collect and dispose of contaminated hillside and toe berm seepage.
- Monitor the Salt Wash wells on Club Mesa.
- Attempt to pump the underground mine workings in Club Mesa Spray area.
- Sample the Club Mesa wells to monitor the Kayenta-Wingate aquifer.

The RAP also required extraction and evaporation of Kayenta-Wingate groundwater in the Club Ranch Ponds Area. Groundwater pumping was to be conducted at a rate of 60 gallons per minute and operational adjustments were to be made as necessary to maintain optimal system performance. The extracted groundwater was to be conveyed to and evaporated in the lined Club Ranch Ponds. Performance of the groundwater extraction system was to be evaluated annually.

Umetco installed the initial groundwater extraction system in 1991 and upgraded it in 1996 and again in 1998. Groundwater pumping began in 1991 in accordance with the RAP. In 1997, the groundwater cleanup effort was evaluated in detail and an optimized system was developed so that contaminated liquids from low-permeability zones in the Kayenta-Wingate aquifer could be extracted. Umetco installed this optimized system in 1998 by drilling and completing 12 new extraction wells. The change in groundwater withdrawal successfully reduced contaminant concentrations.

In general, the groundwater extraction and Club Ranch Ponds (CRP) System has removed approximately 15,000 tons of contaminants from the groundwater flow regime. Throughout the life of the groundwater remedial action, Umetco modified the groundwater monitoring procedures

with CDPHE approval to ensure optimum performance of the extraction program and to monitor compliance with groundwater protection standards.

The Kayenta-Wingate aquifer reached steady state conditions by 2002. The groundwater performance evaluations showed that future groundwater extraction would not significantly enhance aquifer restoration. In 2003, CDPHE approved a groundwater Alternate Concentration Limit (ACL) application. ACLs were proposed for 11 groundwater constituents at the Site. The ACLs were developed using a point of exposure in the San Miguel River and in accordance with State procedures. ACLs were calculated using a mass balance approach for aquifer concentrations that did not exceed the surface water quality standards for the San Miguel River. Action levels well below the ACL values were established so that corrective actions could be identified and implemented prior to degradation of the river. The ACL application implemented a monitoring program that consisted of quarterly monitoring with annual performance evaluations for a period of three years. After three years of monitoring and annual evaluations the program showed that there were no contaminants in the Kayenta-Wingate Aquifer above the ACLs and the ACL monitoring program was terminated. Currently, as required by the ACL application, groundwater is monitored in accordance with the anticipated long-term monitoring for the Site. The application of the CDPHE ACLs at the Site will remain unchanged since they were established prior to EPA's 2005 policy guidance document.

A summary of cleanup goals, amended RAP cleanup goals, and State ACLs for Groundwater COCs is included in Table 6.

Alternative Soil Standards

On October 10, 2007, CDPHE submitted a proposal to the NRC to use alternate soil standards for four discrete areas at the Site, based on an application submitted by Umetco in September 2007 (The alternative soil standards concept is known as supplemental standards under CERCLA). CDPHE submitted additional documentation to the NRC on March 20, 2009. These four discrete areas are: The Mill Hillside Area, A-Plant North, the River Ponds Area, and County Road Y-11. On November 10, 2011, the NRC published a notice in the federal register seeking comments on a proposal for Alternative Soil Standards for 4 areas of the Site. The NRC approved the application on May 18, 2012.

Current Status

CDPHE anticipates applying to the NRC in mid-2018 for approval of alternative soil standards for 242 grids (10 meters by 10 meters) that have radium between 7.1 and 58 pCi/g but met the Category 3 standard of the 1999 soil methodology document (Umetco 1999a). According to the RAP, as amended, PRGs for soil COCs (radionuclides) were based on 40 CFR 192. Subpart D of 40 CFR 192 established radioactivity limits for uranium byproduct materials pursuant to Section 84 of the Atomic Energy Act of 1954, as amended. These standards were developed specifically for the cleanup of uranium mill tailings sites under Section 102(2)(1) of UMTRCA (Title 1 sites) and were developed to limit the risk from inhalation of radon decay products in houses built on land contaminated with tailings, and to limit gamma radiation exposure of people using contaminated land. The State of Colorado uses UMTRCA standards for uranium mill sites (6 CCR 1007-1 Part 18). The concentration criterion for surface soil (0-15 cm below ground surface [bgs]) averaged over an area of 100 square meters (m2) is a health-based standard for exposure to gamma

radiation. As indicated in the memorandum, the concentration criterion for subsurface soil (greater than 15 cm bgs) is not a health-based standard but was developed to allow the use of field measurements to locate and remediate discrete deposits of high activity tailings (typically 300-1,000 picocuries per gram [pCi/g]) in subsurface locations. These PRGs were designed to achieve toxic constituent concentrations approximating levels that existed prior to operations at the Site. Nevertheless, the RAP notes that the ALARA principle applies to soil radium cleanup at the Site.

C. Community Participation

This section summarizes the community relations activities performed by CDPHE and EPA historically and during the proposed plan process.

CDPHE and EPA have involved the public in decision-making at the Site for most of its regulated history. License renewals in 1979, 1984, 1990, and 2000 involved public notice, opportunity for written comments and in some cases, public meetings. Reading rooms were established and publicized for these decisions. In 1995, the EPA conducted the first 5-year review at the Site, which included public notice and comment. Subsequent 5-year reviews occurred in 2000, 2005, 2010, and 2015. In addition, two partial deletions from the National Priorities List in 2005 and 2007 have included public processes.

As part of the Consent Decree signed in 1987, the owners of the Site committed funds for natural resource damages, which were subsequently awarded through public notice and selection.

In 2011, during its consideration of an alternative soil standards proposal, the NRC announced the proposed approach for the alternative soil standards proposal and accepted public comment.

CDPHE and EPA conducted community interviews, as well as newspaper announcements related to the five-year reviews, in 2009 and in 2014. The interview summaries are included in the five-year review reports.

Recent community interest and public involvement have been limited. EPA and CDPHE announced the availability of the proposed plan for the Site in a public notice in the following five newspapers: *Ouray County Plaindealer*, Grand Junction *Daily Sentinel*, *Telluride Daily Planet*, *The Norwood Post*, *Montrose Daily Press*. The proposed plan identified the Preferred Institutional Controls (ICs) Alternative for addressing the remaining work needed at the Uravan Uranium Project (Union Carbide Corp.) Superfund Site.

The 30-day public comment period started on October 16, 2017 and concluded on November 14**,** 2017**.** A public meeting was held on October 30, 2017 at the First Park Community Center, 1045 Main Street in Nucla, CO, beginning at 6:30pm. A transcript of the public meeting is included in the Administrative Record.

The public notice indicated that comments would be accepted verbally at the public meeting, or by mail or email.

No comments were received on the proposed plan or alternatives during the public comment period. No public comment period extension requests were received during the public comment period.

D. Scope and Role of Operable Unit or Response Action

The Site has been managed under the 1987 CD/RAP and was not divided into operable units. Two partial deletions have occurred. On February 18, 2005, EPA deleted 9.84 acres from the NPL. This area previously contained two historic structures, the Boarding House and the Community Center, which were removed. On September 4, 2007, EPA deleted a one-mile section of Colorado Highway 141 between mile posts 75 & 76 comprising approximately 7 acres. This ROD summarizes and discusses ICs for all of the work at the Site, including the 2 portions of the Site that have been partially deleted since the deleted areas were not included in a prior decision document.

The remedy selected in this ROD is necessary to protect future users of these properties and for the long-term protectiveness of the remedy. This ROD describes the remediation activities completed to date and addresses whether ICs are necessary for contaminated source areas because wastes were left in place at levels such that unrestricted use and unrestricted exposure is not possible.

The remedy selected by EPA and documented in this ROD includes remedial actions necessary to protect human health and the environment. EPA identified the need for this remedy in the Fourth Five-Year Review Report, dated September 28, 2010, as well as the Fifth Five-Year Review Report, dated September 30, 2015.

E. Site Characteristics

This section summarizes information obtained through the investigations and remediation. The major characteristics of the Site and the nature and extent of contamination are summarized below. More detailed information is available in the Administrative Record for the Site.

The Site is located in the Club Mesa area to the west of the San Miguel River Canyon and along the river canyon floor as shown on the vicinity map. Uravan is in the eastern part of the Canyonland section of the Colorado Plateau Physiographic Province. The topography of this region is primarily canyons and mesas. This landscape is the result of downcutting of the principal streams that drain the region and accompanying lateral cliff retreat along the canyon rims. Resistant sandstone units that cap the mesas in the Uravan area are the Dakota and Burro Canyon formations and the Salt Wash member of the Morrison Formation.

Principal streams in the immediate area of Uravan have formed the mesa and canyon topography and include the San Miguel River, Spring Creek, Atkinson Creek, and Tabeguache Creek. Geomorphic processes that have led to the present day landscape started as the result of regional uplift during the Miocene or Pliocene ages, about 10 to 25 million years ago. River downcutting has resulted in local relief between the San Miguel River and the bordering mesas of about 900 feet. Downcutting has been more or less continuous. However, several episodes of river aggradation, associated with Quaternary glacial periods, have also occurred, but have been relatively minor and short-lived in comparison with continued river downcutting.

Climate

The annual mean temperature during the period of record (1960 through 2014) was 53.2°F (11.8°C). The annual mean maximum temperature at Uravan was 69.1°F (20.6°C) and the annual mean minimum was 37.3°F (2.90°C). Extreme temperatures recorded at Uravan during the period of record show a minimum of -14.6°F (-23.3°C) which occurred in January 1971 and a record maximum of 110.7°F (41.1°C) which occurred in July 1989.

The annual average total precipitation received at Uravan from 1960 through 2014 was 12.5 inches (31.8 centimeters [cm]). An annual maximum of 21.4 inches (54.4 cm) of precipitation was recorded in 1965, and an annual minimum of 7.1 inches (18.0 cm) was recorded in 1989. The maximum monthly precipitation recorded at Uravan was observed in October 1972 when 5.9 inches (14.9 cm) of precipitation was recorded, and the minimum monthly precipitation has been 0.0 inches for several months during various years. During the period of record, the greatest single daily precipitation amount was 1.9 inches (4.8 cm), occurring on July 24, 1971.

Winds at Uravan are strongly influenced by the San Miguel River Valley. The highest frequency wind directions generally parallel the river valley and are from the southeast. Winds from this general quadrant were observed 59 percent of the time during the period of record. These winds represent the drainage flow of air that occurs generally during the night and early morning hours. Winds flowing up the river valley from the northwest were observed 24.9 percent of the time. These winds generally occur during the late morning and afternoon or after a frontal passage. The annual mean wind speed is approximately 4.4 miles per hour (1.95 meters/second).

Studies in the Uravan area have shown the net potential evaporation rate for the entire year to be approximately two gallons per minute per acre or approximately 36 inches per year (91 cm/year).

Severe weather in the area is usually in the form of intense rainfall or hail, both resulting from thunderstorms. The 10-year storm is estimated to be 1.3 to 1.5 inches of rainfall within 6 hours and the 100-year storm consists of 2.9 to 3.3 inches of rainfall within 24 hours. The thunderstorm season occurs during late spring and summer. Strong winds and hailstorms may accompany thunderstorm activity. The annual mean temperature during the period of record (1960 through 2014) was 53.2°F (11.8°C). The annual mean maximum temperature at the Site was 69.1°F (20.6°C), and the annual mean minimum was 37.3°F (2.90°C).

Regional Geology

Near-surface formations in the Uravan area are primarily Mesozoic-era sandstones, shales, and conglomerates. The general stratigraphy, structure, seismicity, fault activity, and geomorphology, as described below.

Stratigraphy

About 18,400 feet of relatively flat-lying Paleozoic and Mesozoic-age sedimentary rocks underlie the Uravan area. This sedimentary section consists of about 1,700 feet of Mesozoic rock, which is primarily comprised of sandstone, mudstone and shale of continental origins. The Mesozoic rocks are underlain by about 16,700 feet of Paleozoic rocks consisting of non-marine sandstones and

marine carbonates, evaporites, and shales. This thick sedimentary section rests on Precambrian-age crystalline rocks.

Surficial deposits are usually thin and primarily colluvial, residual, and eolian deposits interspersed with bedrock outcrops along the canyon sides and on the mesa tops. Stream alluvium and small alluvial fans are present along the San Miguel River and its principal tributaries. Modern floodplain deposits are limited. In the Uravan area, these deposits are present upstream of the former town. Downstream of the former town for several miles, the San Miguel has incised a narrow canyon into the Kayenta Formation and underlying Wingate Sandstone and Chinle Formation. At Uravan, there is evidence of three former floodplain levels as indicated by thin terrace gravels. The three former floodplains lie about 10, 25, and 60 feet above the present incised river channel. These floodplain surfaces have been modified considerably by subsequent colluvial deposition from the adjacent canyon side.

Structure

Uravan is located on the southwest limb of the northwest trending Nucla Syncline. This syncline is a relatively simple structure downwarp, which lies between the structurally more complex Uncompahgre Uplift and the Paradox Valley Anticline. The Mesozoic strata at Uravan are gently inclined at about 2° toward the northeast. Folding of these major structural elements may have occurred during the late Cretaceous or Eocene Laramide orogeny, about 40 to 70 million years ago.

Faults with large displacements in the Mesozoic sedimentary rock are not present in the Nucla Syncline and major faults have not been recognized at the existing tailings or mill effluent disposal sites. Northwest-trending faults that may have been active in the Quaternary are present along the western flank of the Uncompahgre Uplift. Several northwest-trending normal faults that displace Quaternary deposits are present along the collapsed crest of the Paradox Valley Anticline.

Seismicity

The Uravan region is in an area that has experienced a relatively low level of seismic activity for about the last 125 years. The more frequent and larger earthquakes in the region have occurred in the intermountain seismic zone which generally coincides with the Wasatch Mountain range in Utah. This zone of major seismic activity is located about 170 miles to the west of Uravan. Because of its distance from the Site, the intermountain seismic zone will not have a major impact at Uravan. The historic seismicity from this zone probably has not caused site intensities at Uravan greater than IV and peak bedrock accelerations likely have not exceeded 0.02g.

Active Faults

Studies indicate there are several faults in the region that are suspected to be active faults. Historic earthquake activity has not been associated with any of these faults, but geologic conditions indicate fault movement may have occurred as recently as the Quaternary, within the last 1.8 million years. The suspected active faults are located either along the flanks of the Uncompahgre Uplift or along the flanks of the collapsed Paradox Valley Anticline and other salt anticlines to the southwest. The Paradox Valley Faults and other salt anticline faults are suspected to be actively

moving at the present. However, because their movement is caused by salt flowage, they are not considered by researchers to be capable of generating moderate to large earthquakes.

The other potentially active faults northeast of Uravan are along the southwestern or northeastern flank of the Uncompahgre Uplift. Detailed studies of the Uncompahgre faults would be required to establish if they have moved recently enough to be classified as capable faults in accordance with NRC criteria. Since such studies have not been made, these faults were assumed to be capable faults and therefore considered in assessing the seismic risk at Uravan.

Geomorphic Processes

Geomorphic features along the Colorado River and its principal tributaries in the Colorado Plateau, such as the San Miguel and Dolores Rivers, indicate the Colorado River system has been downcutting during at least the last 10 million years. Long-term average rates of river incision, from a variety of localities within the Colorado Plateau, range from 0.005 feet per thousand years to 1.4 feet per thousand years and average about 0.5 feet per thousand years. Canyon widening has also accompanied river downcutting during this period. Canyon widening primarily results from mesa rim retreat and mass wasting along the mesa flanks. Mesa tops are formed by resistant sandstone units and remain relatively unchanged during erosional processes. Slow erosion, primarily by mass wasting of the underlying weaker rock units, results in slow retreat of the rims. Although the regional geomorphology indicates river downcutting and mesa rim retreat have been the predominant geomorphic processes, several episodes of river aggradation associated with Quaternary glacial periods have also occurred.

The past geomorphic processes of river downcutting and aggradation, along with canyon widening, have shaped the present landscape and these processes are expected to continue. Future long-term geomorphic rates are expected to be similar to those in the past. Since parts of the long-term repositories are on Club Mesa, which is about 400 to 700 feet above the San Miguel River, long-term impacts were assessed. The resistant sandstone cliffs that make up the mesa rims are actively retreating. Maximum rate for rim retreat adjacent to the San Miguel River is estimated to be about 1.0 to 4.0 feet per thousand years. Retreat rates for the mesa rims adjacent to tributary drainages range from 0.4 to 4.0 feet per thousand years.

Hydrogeology

Aquifers in the Uravan area are generally limited to the hydrostratigraphic units that have sufficient permeability to transmit groundwater. These sandstone units generally have variable permeabilities due to grain size, fracturing, sorting and secondary cementing. Groundwater in the region is transmitted via secondary (joint) permeability and primary (intergranular) permeability. Secondary permeability in the region tends to be directional and highly variable. Mesozoic Formations capable of transmitting water in economic amounts include the Dakota and Burro Canyon Formations, the Salt Wash member of the Morrison Formation, and the Entrada, Kayenta, and Wingate Sandstones. Mesozoic strata that are not capable of transmitting water in economic amounts and are therefore considered aquitards, include the Brushy Basin member of the Morrison Formation and the Summerville, Chinle, and Moenkopi formations.

The Chinle Formation, which underlies the Kayenta-Wingate aquifer, is the first hydrogeologic unit of concern in the Uravan area. All geologic units below this aquitard, which underlies the

deepest water-bearing zone of concern, should not be impacted by the migration of contaminated liquids. A description of the Chinle Formation and the hydrogeologic units above this formation follows.

Chinle Formation

The Chinle Formation is about 400 feet thick and consists predominantly of soft red siltstone. The Chinle does not produce water in the Grand Junction area and most likely will not produce water in the Uravan area. Because of its lithology, the permeability is probably very low, and it likely acts as an aquitard. The upper part of the Chinle in the Uravan area contains sandstones of low permeability and probably is in hydraulic connection with the overlying Wingate sandstones.

Wingate Sandstone

The Wingate Sandstone is about 200 feet thick in the Uravan area and is composed of very fine to fine grained sand with minor interstitial clay and calcite cement. Portions of the Wingate are water-bearing in the region, despite its relatively low permeability. The aquifer can produce up to 500 gallons per minute and well yields of over 100 gallons per minute are common. These high yields are probably due to high fracture permeability, rather than primary permeability of the formation. However, studies indicate the Wingate at Uravan is predominantly unfractured and of low permeability.

Regionally, Wingate groundwater is sodium bicarbonate water of relatively good quality, similar to that of the Entrada Sandstone. In the past, this groundwater has been used as the Uravan water supply. In the Uravan vicinity, recharge to the Wingate Sandstone probably occurs in two primary areas: (1) west of Uravan along the Dolores River and the flanks of the Paradox Valley, and (2) northeast of Uravan along its exposed margin, bordering the Uncompahgre Uplift. Recharge occurs from both direct infiltration to Wingate outcrops and from vertical infiltration from overlying units. The Wingate is not exposed in the immediate area around Uravan, so discharge is either northwest along the trend of the synclinal axis (near the confluence of the San Miguel and Dolores Rivers) or upward into the Kayenta through connecting fractures.

Kayenta Formation

The Kayenta Formation is approximately 180 to 200 feet thick in the Uravan area. The formation consists of lenticular to irregularity-bedded layers of fine to medium-grained sandstone, irregular lenses of siltstone and shale, and a few lenses of conglomerate or conglomeratic sandstone. The sandstones are generally harder and coarser grained then the underlying Wingate, particularly the lower beds of the Kayenta.

Regionally, the Kayenta is not considered to be an aquifer. Locally, the Kayenta contains water and is hydrologically connected with the underlying Wingate and overlying Navajo and Entrada formations. Permeabilities are generally very low, but in the Uravan area laboratory values of horizontal and vertical permeabilities are 740 and 690 feet per year, respectively, for an upper sandstone.

Also, a porosity of 26.9 percent has been reported. Recharge probably occurs along the flanks of the Dolores River and Paradox Valley, west of Uravan, where the Kayenta is exposed. Northeast of

Uravan, recharge also may occur along the exposed edge of the Kayenta on the margins of the Uncompahgre Uplift. Flow is probably towards the San Miguel River Canyon where the Kayenta is at its lowest exposed elevation. Therefore, flow is generally toward the San Miguel from both the northeast and southwest.

Navajo Formation

The Navajo formation in the Uravan area is an outlier of the main formation body that lies further to the west. The Navajo is 30 feet thick or less in this area and is composed of massive, fine-grained, very well-sorted, clean, nearly white sandstone. Because the areal extent of the Navajo in the vicinity of Uravan is small, groundwater information is not available; however, it is thought to allow vertical hydraulic connection between water-bearing zones above and below it.

Entrada Formation

The Entrada Formation is 80 to 110 feet thick in the Uravan area and is predominantly a fine to very-fine grained sandstone with small amounts of medium-grained sand and from less than 10 percent to as high as 30 percent silt. Some beds, particularly those near the base, contain a small proportion of well-rounded, frosted and iron-stained, coarse-grained sand.

Regionally, the Entrada is considered the most productive of the various bedrock water-bearing zones. Locally, however, the Entrada may be relatively dry due to dissection by various canyons. Flow tests made on the Entrada wells have yielded transmissivity values of 150 gallons per day per foot (gpd/ft) and storativity of 5 x 10-5.

Water quality tends to be good and the water is a sodium bicarbonate type that becomes increasingly soft at greater distances from the recharge area due to natural base exchange. Recharge probably occurs west and southwest of Uravan where the Entrada is exposed and northeast along the flanks of the Uncompahgre Uplift. Discharge probably occurs along the San Miguel River and in Hieroglyphic Canyon.

Summerville Formation

The thinly bedded Summerville Formation consists mainly of alternating beds of siltstone and sandstone with shale and mudstone near the top. In the Uravan vicinity, the Summerville is 40- to 60 feet thick and considered an aquitard in this region. This formation generally does not yield water to wells, due to its low permeability. The Summerville Formation effectively confines water in the Entrada and lower units; however, the Summerville Formation is not an aquiclude.

Morrison Formation

The Morrison Formation in the Uravan Area consists of the Salt Wash Member and the Brushy Basin Member. The lithology and hydrogeological properties of each member are described below.

Salt Wash Member

The Salt Wash Member of the Morrison Formation ranges in thickness from 0 to 300 feet in this area and is comprised of alternating beds or lenses of siltstone or mudstone and highly lenticular

sandstone, and near the base, a few thin limestone beds. The sandstone beds, which are the dominant lithology, consist mostly of fine, medium, and coarse grained quartz sand.

Because of the lithology and lenticular nature of the Salt Wash Member, permeabilities tend to be relatively low and water availability highly variable. Flow tests on wells in the region completed in the Salt Wash yield a transmissivity and storativity of 47 gpd/ft and 3 x 10-5, respectively.

Salt Wash groundwater tends to be sodium bicarbonate-sodium sulfate water of relatively good quality. Pyrite is suspected as the source of the sulfate. High sodium levels suggest water in the Salt Wash has undergone more natural base exchange than water in any of the other water-bearing units.

The Salt Wash Member is exposed over a wide area southwest of Uravan and is probably one area of recharge. As are the other formations, this member is also exposed along the flanks of the Uncompahgre Uplift and receives water at that location. The San Miguel River Canyon and Atkinson Creek are areas of natural discharge.

Brushy Basin Member

The Brushy Basin Member of the Morrison Formation is about 400 feet thick and composed dominantly of variegated mudstone with lesser amounts of sandstone, conglomeratic sandstone, and limestone. This unit is considered to be an aquitard for the underlying water-bearing zone in the Salt Wash Member. Packer tests in the upper part of the Brushy Basin on Spring Creek Mesa showed permeabilities ranging from 0.62 to less than 0.01 foot/year. Very small yields have been reported from wells completed in sandstone layers in this unit, but water availability is highly variable and for the most part poor to nonexistent.

Burro Canyon Formation

The Burro Canyon Formation is up to 200 feet thick in this area and is composed of as much as 85 percent sandstone with individual sandstone beds up to 100 feet thick. Green shale or siltstone, red or purple shale, and locally, thin gray nodular limestone is also present in the formation.

Because the sandstones of the Burro Canyon are generally lenticular and tightly cemented, intergranular permeability is very low. However, locally, fracture permeability may provide fresh water to wells. Aquifer tests on well SCM-1 on Spring Creek Mesa showed a permeability of 827 feet/year.

South of the San Miguel River on Club Mesa, the Burro Canyon exists as isolated erosional remnants, whereas north of the river it caps much of the area. The erosional remnants are most likely unsaturated. North of the river on Spring Creek Mesa, the lowest portion of the formation is saturated. Recharge occurs along the flank of the Uncompahgre Uplift, exposed areas on the mesa tops, and possibly through the overlying Dakota Sandstone. Discharge is through the walls of the various canyons which dissect the mesas and possibly by vertical leakage.

Water quality in the Burro Canyon Formation on Spring Creek Mesa is somewhat variable. For example, total dissolved solids (TDS) measured in various monitoring wells on Spring Creek Mesa show a TDS range from 640 to 3,500 milligrams per liter (mg/L).

Dakota Sandstone

The Dakota Sandstone is up to 150 feet thick in the Uravan area and is composed of fine to medium-grained sandstone that ranges from non-cemented to well-cemented.

Interbedded with the sandstone are carbonaceous shales and low-grade coals, and mudstone. In the Uravan area, the Dakota may be water-bearing only locally. Generally, the erosional remnants of the Dakota in the Uravan area are unsaturated, but may allow recharge to the Burro Canyon.

Hydrology

The following subsections provide a general overview of the Site hydrology.

General

The San Miguel River provides the primary drainage of the project area. Headwaters of the San Miguel originate in the San Juan Mountains from which the river flows northwest to its confluence with the Dolores River, about 4 miles downstream from Uravan. The San Miguel is perennial with pronounced seasonal fluctuations exhibited by its hydrograph. This streamflow pattern is characteristic of rivers whose flow is derived primarily from snowmelt runoff. Peak discharges on the San Miguel generally occur in late spring or early summer. The San Miguel exhibits a seasonal flow pattern typical of streams in the region. Major flows occur from May to late June with moderate peaks, large volumes, and long flow durations. Average flow is 345 cfs with a range of 12 to 6,690 cfs. The San Miguel flows are influenced by upstream diversions, storage and irrigation.

Principal tributaries to the San Miguel River in the vicinity of Uravan include Spring, Atkinson, Tabeguache, and Hieroglyphic Creeks. All are intermittent streams that peak following rainfall events. Peak flows occur most frequently in spring and summer. Flows are generally low in fall and winter and may reach zero flow.

Flood Forecast

A flood study for the Site was conducted in 1982. This study did not include an analysis of flood erosion mechanisms such as bank erosion rates during floods. The study encompassed the stretch of river upstream of Hieroglyphic Canyon to downstream of Atkinson Creek. The 10-, 50-, 100-, and 500-year frequency floods were calculated using the Army Corps of Engineers HEC-2 model.

The 500-year frequency flood would reach the former level of the River Ponds. This flood would not overtop the former Club Ranch Ponds area, or Atkinson Creek Disposal area, or impact the former A-Plant mill area. The River Ponds area would not be overtopped by the 100-year frequency flood.

Surface Water Chemistry

The San Miguel River water quality changes significantly as it flows from the Telluride valley to the mouth below Uravan. The seasonal water quality varies in response to snowmelt and storms, as well as to natural and mining loadings at various locations within the watershed. Best water

quality for major ions is observed during spring runoff while fall and winter baseflow periods show increased concentrations of contaminants.

Historical data (1969-1981) on the concentrations of major cations (calcium [Ca], magnesium [Mg], sodium [Na], potassium [K]) and anions (sulfate [SO4] and chloride [Cl]) above and below Uravan illustrate the seasonal variability as well as the changes caused by the Uravan mill when it was in operation.

During January 1986, a network of river and stream stations was designed to identify the various natural and anthropogenic inputs to the San Miguel and Dolores Rivers. At each river station, water quality samples were taken in conjunction with samples of sediments and aquatic biota. Data collected during 1986 showed average concentrations relative to the 1969-1981 data set.

Significant chemical changes were noted in the study sections of the San Miguel River from Naturita to its confluence with the Dolores River. Data shows that there is a nearly continuous rise in conductivity. The dominant parameters for downstream station ASM01 and upstream station ASM06 were compared showing increases in Ca, Mg, K, Na, Cl, SO4, ammonia (NH3) and nitrate (NO3).

Ecological Setting

The following sections provide a general overview of the Site ecological setting.

Soils

Soils on the steep and extremely steep side slopes of the canyons are classified as the Rock outcrop-Torriorthents complex. Rock outcrop and Torriorthent components are intricately intermingled. Rock outcrop components consist of barren escarpments, ridge caps, and sandstone points. Torriorthent components may be shallow or deep and formed in residuum and colluvium derived from sandstone and shale. The surface layer is commonly light, bouldery clay loam. Permeability is moderately slow, available water capacity is moderate, runoff is very rapid, and hazard of water erosion is very high.

Bench areas are covered primarily by the very bouldery clay loams of the Bodot-Torriorthents complex. The Bodot soil composes 45 percent of the map unit, with 40 percent Torriorthents, 10 percent Rock outcrop, and 5 percent Pinon and Bowdish soils. The Bodot soil is moderately deep and formed in residuum derived dominantly from shale. The surface layer is very bouldery clay loam. Permeability is slow, water capacity is moderate, runoff is rapid to very rapid, and hazard of water erosion is slight to very high.

Soils on the mesa tops are composed primarily of a combination of Pinon-Bowdish-Rock outcrop complex and Barx-Progresso complex. Pinon soils are shallow and formed in residuum derived from sandstone and shale. The surface layer can be gravelly loam, gravelly sandy loam, sandy loam, or cobbly loam.

Permeability is moderate, available water capacity is very low, runoff is medium to very rapid, and hazard of water erosion is slight to very high.

Bowdish soils are moderately deep and derived from interbedded sandstone and shale. The surface layer may be sandy loam, sandy clay loam, gravelly sandy loam, or cobbly sandy loam. Permeability is moderate, available water capacity is low, runoff is medium to very rapid, and the hazard of water erosion is slight to very high.

The Barx soil is deep and formed in alluvium derived dominantly from sandstone. The surface layer is typically fine sandy loam. Permeability is moderate, available water capacity is high, runoff is medium to rapid and the hazard of water erosion is slight to very high. Barx soil composes 45 percent of the Barx-Progresso complex.

Forty percent of the Barx-Progresso complex consists of Progresso loam. The Progresso soil is moderately deep and formed in sandstone-derived alluvium. Permeability is moderate, available water capacity is moderate, runoff is medium to rapid, and the hazard of water erosion is slight to very high.

In the riparian zone, fluvaquents are the predominant soil type. These are deep, poorly drained soils that formed in stratified alluvium from mixed sources. The surface layer is commonly silt loam. Permeability is moderately rapid to very slow to medium, and the hazard of water erosion is slight to high.

Regional Vegetation

Vegetation in the area surrounding the Site is divided into three major community types: pinon-juniper woodland; sagebrush-grass community; and riparian zone. Small areas of mountain brush vegetation also occur where slopes are very steep and rocky. These vegetation types are described below.

Pinon-Juniper Woodland

This vegetation is a very widespread plant community type in the area around Uravan. It occurs on the canyon slopes, the mesa tops, and at higher elevations on the ridges than the sagebrush community. About 40 percent of the pinon-juniper woodland in this area occurs on moderate to steep slopes with sandstone outcrops. These steep slopes are areas of shallow soils and low productivity, producing 10 to 30 trees per acre. The other 60 percent of the pinon-juniper woodland occurs on gentler slopes with deeper soils. These stands are more productive with an average of 140 to 190 trees per acre. Additional species information may be found in the RI Report.

Sage-Grass Community

This vegetation is found in canyon bottoms, on mesa tops, and on gentle, lower slopes of ridges. This vegetation generally occupies finer, deeper soils than the pinon-juniper woodland. It often occurs as open parks within pinon-juniper vegetation where the two vegetation types intergrade. Sagebrush forms about 10 percent of the plant cover. Perennial grasses and forbs form 50 percent and 5 percent of the plant cover, respectively. Additional species information may be found in the RI Report.

Riparian Community

Riparian vegetation dominates in canyon bottoms near the San Miguel River Major. Species include tamarisk (Tamarix pentandra), narrowleaf cottonwood (Populus angustifolia), willows (Salix spp.), alder (Alnus tenuifolia), and birches (Betula spp.). The understory vegetation includes sedges (Carex spp.) and rushes (Juncus spp.).

Disturbed Area Revegetation

Disturbed areas of the Site were reseeded following reclamation activities utilizing the revegetation specification found in the Uravan Remedial Action Plan.

The revegetation specification called for a specific seed mixture, application rate, and application methodology (equipment and amendments) to be used for seeding of final grades in all disturbed areas. This mixture represents species that are quick growing and capable of providing organic material to the soils as well as native species for long term vegetative success.

All disturbed and graded areas except where bedrock was exposed were reseeded. Prior to applying seed, the area was inspected. Any areas that appeared unsuitable for seeding (either too compact or too loose) were prepared to provide a firm but friable seedbed. Seedbed preparation consisted of deep ripping parallel to the contours at a minimum of 12-inches deep at a maximum of 2-foot spacing. Following the deep ripping operation, all disturbed areas were then deep scarified as required to provide a suitable surface for the drill, pock, or broadcast seed application method.

Fertilizer, fungi, mulch and seed were applied to the prepared seedbed surfaces by drill, pock, or broadcast seeding methods.

Fertilizer used was a standard commercial grade and provided the minimum percentage of available nutrients. Fertilizer was a mixture of ammonium phosphate (16-20-0) and was applied at a rate of 200 pounds per acre.

Soil in areas designated to receive seed were also inoculated with four species of pelletized fungi at a rate of ten (10) liters per acre. Vesicular-arbuscular mycorrhizal (VAM) fungi establish beneficial symbiotic relationships with the fine roots of many trees, shrubs, flowers and grasses. This symbiotic relationship with VAM makes water absorption by the plant more efficient and improves absorption of essential mineral elements.

The mulch employed consisted of native or locally grown grass hay, free of mold and other objectionable material. Mulch placement was done with a mulch blower or other suitable equipment. The mulch and/or organic material were applied to seeded areas at a rate of about 1.5 tons per acre. The purpose of the mulch was to promote growth and provide temporary stabilization.

All final grades were seeded between September 1 and the date of consistent ground freeze using the seed mixes specified above. “Consistent ground freeze” was defined as that time during the fall months in which the surface soil, due to freezing conditions, prevents burying the seed ½-inch by normal drill seeding operations. At no time was seed sown, drilled or otherwise planted when the

surface soil was in a frozen or crusted state. Seeding was consistently completed within a few days of preparation of the seedbed before weeds became established or erosion modified the tilt and contour of the seedbed.

Threatened, Endangered, and Sensitive Species

Several threatened, endangered, and sensitive plant and animal species are found or have potential habitat in the area around Uravan. Endangered and sensitive plant species known to occur in the area are the Spineless Hedgehog Cactus (endangered), Paradox Lupine (sensitive), and Clove Phlox (sensitive). Endangered or threatened wildlife potentially in the vicinity of Uravan are the Peregrine Falcon, Bald Eagle, and the Black-footed Ferret.

Peregrine Falcons (Peregrinus anatum) may hunt waterfowl along the San Miguel River but more probably occur as migrants along the Dolores River where such prey as waterfowl, shore birds and passerine birds are more numerous. Sightings indicate an eyrie occurs in the area but its location is unknown. The Southern Bald Eagle (Haliaeetus leucocephalus leucocephalus) hunts fish and feeds upon carrion along the rivers of the Dolores River Basin. The Northern Bald Eagle (Haliaeetus leucocephalus alascanus) winters in the basin. The only difference between the subspecies seems to be that the Northern Bald Eagle is larger and heavier than the Southern Bald Eagle, but ranges in wing measurements and weights overlap. The Black-footed Ferret has not been definitely sighted in the Uravan vicinity, but its habitat is present.

F. Current and Potential Future Site and Resource Uses

Mining operations in this area of Colorado began in the early 1900s. Standard Chemical Company first acquired mining claims in the area and began mining radium-bearing carnotite ore in approximately 1910. In 1912, the Standard Chemical Company built a radium mill, located on the valley floor along the San Miguel River at the site of what later became known as “A-Plant.” The mill produced radium until 1919, and from the 1930s to 1984 the plant operated as a uranium and vanadium processing facility. The RAP required all residents of the town of Uravan to vacate their residences by December 31, 1986. The RAP stated that UCC/Umetco were not to permit any building or improvement at the Site to be constructed or occupied as a residence.

The Annual Summary Reports provided by Umetco to CDPHE indicate that the Radioactive Materials License, CO 660-02 requires a survey of land and water use within an 8-kilometer radius of any portion of the restricted area or site boundary. Recreational activities in the area include, but are not limited to, hunting, fishing, camping and rafting in the survey area. Limited activities, including mine reclamation and exploration drilling activities, were observed during 2009 within the 8-kilometer radius of the Site. Cattle were observed to be grazing within the 8-kilometer radius survey area during the spring and fall months. There are no gardens or fruit trees in any restricted areas of the Site. Land use is predominately fall and winter grazing of beef cattle. There were no dairy cattle grazing in the area during the report period. Mine dumps and sub-ore stockpiles that have the potential to impact reclamation activities were identified. The San Miguel River flows northwest year round with pronounced seasonal fluctuations exhibited by its hydrograph. This stream flow pattern is characteristic of rivers whose flow is derived primarily from snowmelt runoff. Peak discharges on the San Miguel River generally occur in late spring or early summer.

Umetco expects to transfer portions of the Site to the DOE Legacy Management program as required by UMTRCA Title II, and other portions to the BLM and Montrose County. A portion of State Highway 141 passes through the Site as well.

Based on online cadastral mapping provided by Montrose County, most parcels within the Site are currently owned by Umetco with a few exceptions [i.e., portions of Windblown Areas E and J (BLM ownership), the Upper and Lower Burbank Quarry (DOE ownership), and ancillary BLM withdrawal areas]. A portion of the approximately 7.5-acre site Nature Conservancy Visitor's Site belongs to Umetco and the remainder belongs to the Nature Conservancy. Montrose County owns the Town Area, the Ball Park, and a portion of Homer Woods. There are also CDOT Highway 141 as well as County Roads EE-22 and Y-11 within the Site. Two areas of the Site have been previously deleted from the NPL, and CDOT Highway 141 is one of the deleted areas.

Limited mine reclamation and exploration drilling activities were observed from 2010 to 2014. No mining or drilling activities were observed within the 5-mile radius of the Site during 2016. However, survey markers were re-staked at a mine claim on the Dolores Bench. Only the Spring Creek Mesa Mine spoil piles have the potential to impact reclamation activities within the 5-mile radius of the Site. Cattle, although not dairy cattle, graze during the spring and fall. There are no gardens or fruit trees in restricted areas of the Site.

The ground water in the area of the Site has not been formally classified. However, using *Guidelines for Ground-Water Classification Under the EPA Ground-Water Protection Strategy*, dated November 1986, the ground water would be considered Class II. Class II ground waters are currently and potentially a source for drinking water. Within approximately a 10-mile radius of the Site, there are nine completed wells for domestic, municipal, or stock use:

- Five domestic wells owned by UCC with one on-Site well and four off-Site wells; the closest off-Site well is approximately 6 miles away from the Site.
- One municipal well owned by UCC is approximately 3.80 miles away from the Site.
- Three privately-owned stock wells, with the closest well approximately 2.75 miles from the Site.

Umetco has and will continue to maintain existing water rights in the San Miguel River (in trust) and the F-Block Well (for construction water). No new water rights were filed during 2016.

Reasonably Likely Future Ownership and Land Use

Future ownership has not yet been finalized; however, Umetco proposes to transfer ownership of land to various entities, including DOE, Montrose County, and BLM. Figure 3, revised May 12, 2015, is the land status map that indicates the proposed land transfer boundaries. Within these transfer boundaries, various county and state roads have easements to enable long-term operations and maintenance (O&M) – these are likely to remain in place in the future.

For proposed transfer from Umetco to DOE, the primary areas are:

- Atkinson Creek Disposal Area
- Club Ranch Ponds Area

- River Ponds Area
- Tailings Piles Area
- Club Mesa Area
- Town Dump
- Mill Areas, including A-Plant and B-Plant (and Repository)
- Portions of the former Town of Uravan and Adjacent Areas

For proposed transfer from Umetco to Montrose County, the primary areas are:

- Portions of the former Town of Uravan and Adjacent Areas and part of Homer Woods

For proposed transfer from Umetco to BLM, the primary areas are:

- Upper Club Mesa Borrow Areas
- Portions of the A-Plant, the Gym Area, and the Water Storage Ponds
- Miscellaneous Mining Claim Areas West of the Site

The future land use allowed and proposed ownership within each of the transferred Site lands is still under consideration between Umetco, CDPHE, DOE, EPA, Montrose County, and BLM.

G. Site Risks

A review of residual risks associated with the various remediation areas following the Uravan Remedial Action conducted by Umetco Minerals Corporation under the CD/RAP with CDPHE oversight between 1986 and 2010 was undertaken in conjunction with the 2017 RI Report. The intent of this review was threefold: first, to determine the contemporary validity of the radiation and chemical risk assessments conducted as part of the Uravan Remedial Action; second, to determine whether the actions taken by Umetco were sufficiently protective of human health and the environment using current CERCLA risk assessment methodologies; and third, to make recommendations on which remediation areas with residual contamination may require ICs to be sufficiently protective of human health and the environment.

Review of Uravan Project Risk Assessment Methodology and Soil Cleanup Objectives

As part of the RAP developed pursuant to the CD with CDPHE, Umetco Minerals Corporation developed a detailed risk assessment methodology in 1999 which was used to establish soil cleanup objectives for the Site. This methodology established four different soil cleanup categories based upon the risk and dose assessments for area-specific land use scenarios and set concentration limits for each constituent of concern for each category. These four categories serve as the basis for evaluating the protectiveness of the remedy and determining the need for institutional controls. (See Table 5)

Category 1 – RAP Soil Criteria were intended to achieve cleanup of radioactive and metal constituent concentrations to the levels existing prior to any operations at Uravan. They incorporate surface gamma exposure rates, and background radionuclide and metals concentrations proximal to the site.

Category 2 – Risk-Based Objectives for Residential Land Use Scenarios were intended to be the conservative criteria to assure protection of human health for unrestricted residential land use scenarios. Meeting these objectives assures the protection of human health potentially associated with any residual soil contamination. These objectives were based on meeting relevant and appropriate CDPHE regulatory standards for radium-226 radionuclide concentrations, including thorium-230 ingrowth over 1000 years, achieving background concentrations for arsenic, and meeting EPA risk-based values for residential land use for all other metals, including uranium. Category 1 and Category 2 soil cleanup objectives are more conservative than or generally consistent with, respectively, the prevailing regulations and EPA CERCLA risk-assessment methodology used for uranium mill tailings sites with radiological and heavy metals contamination available at the time the RAP was developed.

Category 3 – Site-Specific Risk/Dose Based Objectives were developed to ensure compliance with NRC regulations governing UMTRCA Title II areas that will become the long-term responsibility of the DOE LM program and use institutional controls to restrict future land use. These objectives were intended to limit the total effective dose equivalent (excluding radon and radon progeny) to less than 100 mrem for individual members of the public. To achieve this goal, dose-based soil concentrations were developed assuming that the dose from each radionuclide summed from all pathways is less than 25 mrem per year. The Category 3 objectives were then calculated using Site-specific and exposure scenario-specific assumptions combined with the reference doses. Exposure scenarios include recreational visitors, monitoring workers, and ranchers.

Category 4 – Alternative Concentration Objectives were a contingency for performing a more detailed area-specific risk assessment in the event that the Category 3 risk/dose-based soil cleanup objectives couldn’t be attained during the remedial action. Since there were no remediation areas at the Site where residual contamination exceeded any Category 3 criteria, the Category 4 risk assessments were unnecessary. As such, the Category 3 and 4 criteria were not considered as part of the CERCLA Radiological Risk Assessment procedures and discussions that follow.

Shortly after the risk assessment methodology was developed for the Site in 1999, the EPA promulgated guidance for environmental exposures to low-level radioactivity and published conservative radiological risk coefficients for many of the radionuclides of concern at the Site. While Federal Guidance Report 13 is the basis for the EPA’s Preliminary Remediation Goals (PRG) for Radionuclides now used in CERCLA Radiological Risk Assessment, the relevant and appropriate state and federal regulations for the cleanup of UMTCRA sites (40 CFR 192.12) still apply here for radium 226. The Category 2 risk-based soil cleanup objectives identified by Umetco and approved by CDPHE under the RAP for radium 226 activity concentrations (7.1 pCi/g from 0-15 cm soil depth and 17.1 pCi/g at soil depths greater than 15 cm) are in line with the requirements of 40 CFR 192.12. The Category 2 risk-based soil cleanup objectives developed for thorium 230 activity concentrations (14 pCi/g from 0-15 cm soil depth and 17.1 pCi/g at soil depths greater than 15 cm) account for radioactive ingrowth of radium 226 over a 1,000-year time horizon and are consistent with other radiological remedial actions performed by in Region 8, that were also considered protective of human health and the environment.

With respect to arsenic concentrations at the Site, the natural background concentration in soil prevalent throughout the Site (21.4 mg/kg) is much higher than the screening level found in the current EPA Region III Risk-Based Concentration (RBC) Table (0.68 mg/kg). (The RBC Table is now incorporated into the Regional Screening Levels for Chemical Contaminants at Superfund

Sites.) As such, the background Category 1 concentration for arsenic is set as the default Category 2 concentration. For the Site-specific residual uranium contamination, the principal health effect associated with uranium ingestion in a residential exposure scenario is chemical toxicity, not radioactive carcinogenic toxicity. Therefore, the Category 2 concentration is set at 220 mg/kg, which is below the EPA Region III RBC Table value of 230 mg/kg for residential soils. These risk-based objectives for uranium and all metals in Category 2 are lower (more conservative) than those shown in the EPA Region III RBC Table due to the inclusion of the dermal exposure pathway.

Reasonably Anticipated Future Land Use and Potential Contaminant Exposure Pathways

There are currently no residential exposure pathways associated with the Site. The former Town of Uravan has been removed as part of the remedial action and the nearest resident is several miles from any of the remediation areas. That said, it may be possible for remediation areas achieving the soil cleanup objectives and being deemed “unlimited use/unrestricted exposure” (UU/UE) to have no institutional controls that would prohibit future residential developments. In these instances, a simple zoning or land usage change might allow for residential structures to be built in these areas. Given the size of some of these remediation areas and the variability in the residual contamination present therein, estimating residential risk using simple averaging is not appropriate and better spatial resolution of contamination down to typical residential parcel size of 0.5 acres is needed.

Table 3.1.3-4 of the Draft *Uravan Completion Review Report* documents the reasonably anticipated future land ownership and the soil cleanup criteria status by remediation area. Per the table, there are 12 remediation areas classified as UMTRCA Title II areas that will become the long-term responsibility of the DOE LM program, in whole or in part. In these remediation areas, DOE will be implementing land use controls and restricting access/usage to radiation workers, whose exposures will be governed by OSHA and the NRC under a general license. For this reason, only occupational exposure scenarios were evaluated in these remediation areas.

The BLM, Montrose County, and CDOT are expected to take possession of the remaining areas, including the Windblown Areas, the Water Storage Ponds, the Town Area, Northeast Highway 141, the CDOT Highway 141 Right of Way, Hieroglyphic Canyon and Atkinson Creek Crystal Disposal Area. In all these areas, recreational and rancher exposure scenarios were evaluated using average residual contamination concentrations to determine exposure risks. For Hieroglyphic Canyon and Atkinson Creek Streambeds, residential exposure scenarios were also evaluated for reference. While development for residential use is highly unlikely in any of these areas, the land ownership and land use controls are not yet in place. Also, in many areas, only partial data exist, so a complete risk assessment is not possible, but an estimate was made and IC conclusions were drawn accordingly.

Review of Remedial Action and Residual Contamination Category 1 & 2 Exceedances

During the remedial action, most of the contaminants of concern were removed from nearly all the remediation areas to below the Category 1 soil cleanup objectives, which would permit UU/UE

designation for those parcels. However, there were also several remediation areas with at least one contaminant of concern above the Category 1 soil cleanup objectives, meaning that background equivalent concentrations had not been achieved for that contaminant. Some remediation areas, including B-Plant, Mill Hillside, and County Road E-22 had exceedances of Category 2 soil cleanup objectives for Arsenic, Ra-226, and/or Th-230, meaning that residential land use exposures would exceed acceptable risks. Since all of the remediation areas with Category 2 exceedances will be transferred to DOE LM, residential exposures would not be anticipated. Residual contamination soil concentrations and activity concentrations by remediation area can be found in Table 7. Exceedances and future ownership by remediation area are summarized in Table 9.

The only remediation areas that clearly met the 1999 Soil Cleanup Objectives for Category 1 were the Town Dump, which will remain under DOE LM control due the potential for groundwater contamination, and the Water Storage Ponds, which will be transferred either to BLM or Montrose County. Of the other remediation areas that will be transferred outside of DOE LM control going to BLM, Montrose County, and/or the State of Colorado, there were typically minor exceedances of Uranium or Vanadium. The radiological risk and dose calculations and the chemical risk assessment associated with these exceedances are discussed below, as are the recommended institutional control necessary for the remedy to be protective under CERCLA.

Significant Radionuclide and Gamma Exposure Rate - Risk Calculations for CSM

For this review, two different methods were used for calculating the radionuclide carcinogenicity risk for residual radioactive contamination present in the various remediation areas at the site. The first was to apply the conceptual site model (CSM) and risk assessment approach outlined in the *1999 Site-Specific Soil Cleanup Objectives: Rationale Document for Uravan Project, Colorado* using the current slope factors for Radium 226, Thorium 230, and Uranium 238 (a mild simplification for the isotopic diversity of natural Uranium) from Federal Guidance Report 13 and the Radionuclide Table from the Health Effects Assessment Summary Tables (HEAST).

The second method utilized the EPA PRG Calculator for Radionuclides and select exposure time and duration values from the CSM, along with more conservative default values in the calculator to determine risk from residual contamination.

The radionuclide carcinogenicity risks were calculated for worker, rancher, recreational user, and, where potential exists for land usage or zoning changes, resident exposure scenarios. The protective risk range that is acceptable for any CERCLA exposure scenario is 1x10-4 to 1x10-6 excess cancers, with the point of departure at the lower end of the risk range.

Table 2 illustrates the results of these calculations, broken down by isotope and exposure pathway, and summed together to get the total radionuclide carcinogenicity risk in the right hand column. A color-coded status indicator is included in the right hand column with the results to highlight the risk range, with green indicating a lower than 1x10-6 excess cancer risk (default protective), yellow indicating an excess cancer risk between 1x10-6 and 1x10-5, red indicating an excess cancer risk between 1x10-5 and 1x10-4, and black indicating greater than 1x10-4 excess cancer risk.

The results of these calculations indicate that the rancher exposure scenarios (table rows highlighted in blue) are all well below 1x10-6 excess cancer risk for remediation areas anticipated to be outside the DOE LM control, indicating that these residual levels are protective. Similarly, the excess cancer risk for recreational exposure scenarios (table rows highlighted in green) are within the 1x10-5 to 1x10-6 risk range for remediation areas where these exposures are anticipated. Occupational exposures (table rows highlighted in orange) are expected to fall in within the 1x10-5 to 1x10-6 excess cancer risk range for remediation areas where these exposures are anticipated. The highest occupational exposure excess cancer risk calculated was for the Mill Hillside remediation area, which had the highest residual activity concentrations in soil. These calculations illustrate that Radium-226 and daughter products are the primary driver for risk in nearly all instances, owing to their shorter half-lives and radon mobility.

Residential exposures were evaluated only for the Atkinson Creek Crystal Disposal Area and the Hieroglyphic Canyon Streambed. In these instances, the risk ranged from 3.39x10-5 at Atkinson Creek to 1.30x10-4 at Hieroglyphic Canyon. The latter exposure scenario represents an unacceptable residual excess cancer risk, especially considering the data gaps for Uranium and Thorium residuals associated with this remediation area. Since the data available for the Hieroglyphic Canyon Streambed only includes Radium-226 activity concentrations, this calculation highlights the risk concerns associated with the variability of radiation levels and lack of comprehensive areal activity concentration data at the site. It also underpins the need to evaluate residual risk using smaller parcels of land, especially when considering residential or other chronic exposures.

For the EPA PRG Calculations, only the exposure time and exposure duration values from the *1999 Site-Specific Soil Cleanup Objectives: Rationale Document for Uravan Project, Colorado* were used for the various exposure scenarios. Default values from the PRG Calculator were used for all other parameters in the calculations and the particulate emission factor associated with the soils at the Site were approximated to default values for Las Vegas, NV. At Superfund remedial sites, risks from radionuclide exposures are estimated in a manner analogous to that used for chemical contaminants. The estimates of intake by inhalation and ingestion and the external exposure over the period of exposure estimated for the land use (e.g., 30 years residential, 25 years commercial/industrial) from the exposure assessment were coupled with the appropriate slope factors for each radionuclide and exposure pathway. The total incremental lifetime excess cancer risk attributed to radiation exposure is estimated as the sum of the risks from all radionuclides in all exposure pathways. Therefore, the calculated soil activity concentration was used and the conservative assumption was made that the daughter products from the Uranium 238 decay chain, which includes Thorium 230 and Radium 226, are in secular equilibrium for all remediation area.

Table 3 highlights the radionuclide risks calculated for each remediation area and applicable exposure scenario. The residual risk values associated with the EPA PRG Calculator are generally lower than those calculated manually based upon the risk assessment approach used in the 1999 Site-Specific Soil Cleanup Objectives: Rationale Document for Uravan Project, Colorado, which indicates that the Category 2 approach used is more conservative than the default values in the EPA PRG Calculator.

The results of these calculations indicate that the excess cancer risk for occupational exposures (highlighted in orange) anticipated on all of the remediation areas expected to transfer to DOE LM will be less than 1x10-6, with the highest value of 1.52x10-6 in the Mill Hillside remediation area.

Furthermore, the calculations of excess cancer risk for recreational exposures (table rows highlighted in green) and rancher exposures (table rows highlighted in blue), which include a fractional contaminated beef consumption risk factor, are all less than 8.63x10-6, which is the recreational exposure value associated with the County Road EE-22 remediation area.

Residential exposures (table rows highlighted in yellow) were evaluated only for the Atkinson Creek Crystal Disposal Area and the Hieroglyphic Canyon Streambed. In these instances, the excess cancer risk ranged from 2.03x10-5 at Atkinson Creek to 9.06x10-5 at Hieroglyphic Canyon. The latter exposure scenario in this case would represent an acceptable residual risk if Radium-226 activity were the only contaminant of concern. However, since the data available for the Hieroglyphic Canyon Streambed only includes Radium-226 activity concentrations and there is no data on Uranium or Thorium, this calculation highlights the risk concerns associated with the variability of radiation levels and lack of comprehensive areal activity concentration data at the site. It also underpins the need to evaluate residual risk using smaller parcels of land, especially when considering residential or other chronic exposures.

Significant Radionuclide and Gamma Exposure Rate - Dose Calculations for CSM

In 2014, EPA updated the recommendation for what is considered a protective dose-based ARAR from 15 to 12 millirem per year (mrem/yr). The new recommendation of 12 mrem/yr for the dose-based ARARs was based on using an updated risk assessment model to achieve the same 3 x 10-4 cancer risk as the previous recommendation, which used 15 mrem/yr. That said, dose calculations from site data are not typically used to determine long-term risk at CERCLA sites. Nevertheless, potential radiation dose calculations were performed using maximum, maximum grid, and average residual contamination values for Radium-226 in each remediation area, with dose conversion factors and the CSM values from the 1999 Site-Specific Soil Cleanup Objectives: Rationale Document for Uravan Project, Colorado to calculate doses for the various exposure scenarios.

These calculations demonstrate the extreme variability of the potential effective dose equivalents depending upon whether spatial averaging or maximum values are used in the calculation. When discussing this data with CDPHE, supplementary information about natural background variability on the Site from NORM was provided. The NORM Report thoroughly identifies and explains the sources of elevated gamma exposure rates within survey grids and helps to explain both historical mining activities nearby and the background radiation variability, especially in the Windblown Areas. Provided the institutional controls restrict any potential residential development of the remediation areas, especially Hieroglyphic Canyon and Atkinson Creek Crystal Disposal Area, the calculations of potential doses indicate that recreational, rancher, and occupational exposure scenarios are sufficiently protective.

The results of these calculations indicate that the effective dose equivalents for occupational exposures to residual Radium-226 contamination on all of the remediation areas expected to transfer to DOE LM is expected to fall within the range of 7 mrem/year to 1,816 mrem/year. The highest value of 1,816 mrem/year was found in the B-Plant remediation area and is based upon maximum activity concentrations in the remediation area. Furthermore, the calculations of dose for recreational and rancher exposures, ranged from 0 to 87 mrem/year, depending upon whether

average or maximum activity concentrations were used. Of note, the highest recreational effective dose equivalent came from the Windblown Area.

Doses associated with residential exposures were evaluated only for the Atkinson Creek Crystal Disposal Area and the Hieroglyphic Canyon Streambed. In these instances, the effective dose equivalent ranged from 129 to 2,245 mrem/year at Atkinson Creek and 377 to 404 mrem/year at Hieroglyphic Canyon. Again, the activity concentration data upon which these calculations are based are limited and the data have considerable gaps. Additional data collection, especially in Hieroglyphic Canyon, is recommended to fully characterize risks for all exposure pathways if residential development is possible based upon future land ownership and land use restrictions.

Chemical Exposure Risks

To determine the non-carcinogenic Hazard Index (HI) for the various routes of exposure in the CSM for each remediation area, the residual soil concentrations for the metal contaminants of concern (Arsenic, Cadmium, Lead, Molybdenum, Nickel, Selenium, Uranium, Vanadium, and Zinc) were input into the EPA RSL Calculator. There were exceedances of the Category 1 and 2 soil cleanup standards for Arsenic, Molybdenum, Vanadium, and Uranium in many of the remediation areas. Unlike the EPA PRG Calculator for Radionuclides, the EPA RSL Calculator does not have a default exposure pathway scenario for Farmer (Rancher), so the default Residential exposure pathway was substituted for the Rancher exposure to provide an upper bound on chemical exposure risks.

In 2016, EPA promulgated guidance related to the reference dose (RfD) for Uranium that recommends using the ATSDR Minimal Risk Level (MRL) of 0.0002 mg U/kg/day in place of the outdated IRIS RfD of 0.003 mg U/kg/day. The ATSDR MRL has been applied in the application of the RSL Calculator used in these hazard index calculations.

Table 4 outlines the results of these HI calculations for the residual metals concentrations present in each remediation area. A color-coded status is included in the right-hand column with the results to highlight the HI range, with green indicating a HI of less than 0.5 (half the default protective recommendation), yellow indicating a HI of between 0.5 and 0.75 (protective), red indicating a HI of between 0.75 and 1.0 (protective), and black indicating a HI of greater than 1.0 (not protective). In most cases ingestion of soils containing elevated Uranium concentrations by children is the driving factor associated with chemical exposure risks at the Site.

The results of these calculations indicate that the hazard indices for occupational exposures (table rows highlighted in orange) to residual metals contamination on all of the remediation areas expected to transfer to DOE LM are below 0.00606 for expected adult exposure scenarios. This indicates that residual metals concentrations are not a significant hazard for these occupational exposures. Similarly, the calculations of hazard indices for child and adult recreational exposures (table rows highlighted in green), ranged from 0.00197 to 0.185, with all values well below a HI of 1.

Hazard indices associated with adult and child residential exposures (table rows highlighted in yellow) were evaluated for the Atkinson Creek Crystal Disposal Area and the Hieroglyphic Canyon Streambed, as well as all the areas where ranching is anticipated to occur due to the limitations of the RSL Calculator. In all these instances, the adult non-carcinogenic HI for metals

exposure was well below 1, ranging from 0.0247 to 0.435. However, for the child non-carcinogenic HI for metals exposure, the HI ranged from 0.0262 to 4.63. The HI for child residential metals exposure exceeded 1 on the Windblown Area (1.92) and County Road EE-22 (4.63), where residential exposures are unlikely due to DOE LM or BLM institutional controls. Again, this lends support to land use restrictions to prevent future residential development in these areas.

H. Remedial Action Objectives

Remedial action objectives (RAOs) consist of medium-specific or location-specific goals for protecting human health and the environment. This section presents the RAOs for the Site, both for the completed work documented in this ROD and for the remedy selected in this ROD.

Need for Remedial Action

Because waste in left in place in portions of the Site over levels that allow for unlimited use and unrestricted exposure, it is necessary to implement ICs for long-term protectiveness and integrity of the remedy.

Remedial Action Objectives

In 1985, discussions between Umetco and the State of Colorado led to a CD/RAP. The RAP, as amended, was considered at the time to be the functional equivalent of an EPA RI/FS and ROD. The United States District Court for the District of Colorado lodged the Consent Decree and RAP on February 12, 1987. Objectives of the RAP were to:

- Protect surface and groundwater resources.
- Stabilize and control the tailings and other waste materials.
- Minimize radon emissions from the tailings and waste repositories.
- Conduct soil cleanup in a safe and environmentally sound manner.

Based on the identified human health and ecological risks and ARARs, additional RAOs are needed for residual contamination remaining in soil and groundwater.

The following additional RAOs were identified in the RI/FS for residual contamination in soil at the Site for this 2018 Record of Decision:

- Prevent the offsite relocation of soil by humans with concentrations of COCs greater than Category 1 criteria.
- Prevent unacceptable exposures to humans from soil with concentrations of COCs greater than Category 2 criteria under a residential use scenario.
- Prevent unacceptable exposures to humans from soil with concentrations of COCs greater than Category 3 criteria under recreational, worker, and ranching exposure scenarios.

The following RAO was identified for residual contamination in groundwater at the Site:

- Prevent human exposure through ingestion of groundwater with concentrations of COCs that result in cancer risks exceeding 1E-06 or non-cancer risks greater than a hazard quotient of 1.

I. Description of Alternatives

Alternative 1: No Further Action

Alternative 1 is required by the NCP to provide an environmental baseline against which impacts of the remedial alternatives can be compared. Although institutional controls, monitoring, and maintenance will be performed by the responsible party, Federal and/or State agencies under other regulatory programs, no further action under CERCLA would be initiated at the Site to address remaining contaminated media or otherwise mitigate the associated unacceptable risks to human health or the environment.

Property Inside the Future DOE Transfer Boundary

Alternative 1 assumes that long term custody of property inside the future DOE transfer boundary at the Site would be transferred to DOE in accordance with UMTRCA Title II after NRC has accepted the Completion Review Report (CRR). The State, under UMTCRA, would be required to terminate Umetco's Radioactive Materials License. Umetco would transfer property title within the land transfer boundary to DOE, along with a long-term care fee. The general license would take effect upon NRC acceptance of DOE's Long-Term Surveillance Plan (LTSP). The general license would require DOE to take custody and provide long-term care as specified in the LTSP, including inspections, maintenance, environmental monitoring, and emergency measures necessary to ensure that the area in the future transfer boundary will be cared for in a manner that protects public health, safety, and the environment after closure. Engineered controls, such as new fencing, may be used by DOE to control access at the Site within the DOE transfer boundary, if supplemental access control is needed.

Inspection and maintenance would be performed as specified in the LTSP to confirm the integrity of visible features at the Site within the DOE transfer boundary and to confirm that other remedy components (e.g., repository cover, institutional controls, access controls) have not been compromised. Routine maintenance of the cover systems would include controlling growth of trees and shrubs on the repository covers and access roads. Additional maintenance would be required if erosion, sloughing, slumping, or surface deformation is observed on the repository surface or if settlement or seeps are observed along the perimeter. Fencing and signage within the future DOE transfer boundary would be repaired or replaced as necessary to maintain those access controls.

Environmental monitoring may also be specified in the LTSP to ensure compliance with groundwater and surface water standards, as well as to verify the continued health of the on-site vegetation and to assure that undesirable plant species do not proliferate at the Site.

Property Outside the Future DOE Transfer Boundary

Alternative 1 assumes that the Umetco Divestiture Policy would be applied to all property outside the future DOE transfer boundary. This corporate policy includes restrictions to prevent groundwater use and residential property, which Umetco has operated on, whether there is contamination present or not (i.e., Unlimited Use/Unrestricted Exposure or UU/UE) and is typically documented through an Omnibus Agreement. These current corporate policy restrictions would be imposed upon former Umetco properties in perpetuity and would be enforceable through common law by Umetco and UCC, jointly and severally. No mechanisms would be in place to require any monitoring or maintenance in these areas.

This alternative is required by the NCP so that a baseline set of conditions can be established against which other remedial actions may be compared. This alternative allows the Site to remain in its current state with no additional remedial action being implemented. Five-year reviews are included in this alternative.

Alternative 2: Institutional Controls

Compared to Alternative 1, Alternative 2 provides protection of human health and the environment through the implementation of additional institutional controls, monitoring, and maintenance at the Site under CERCLA. Similar to Alternative 1, Alternative 2 includes custody, and long-term care of uranium and thorium mill tailings sites closed (reclaimed) under Title II of UMTRCA of DOE-administered land and application of Umetco's Corporate Divesture Policy, as described in Alternative 1. Inspection, maintenance, and environmental monitoring within the future DOE transfer boundary would also be completed by DOE as specified in the LTSP, as described for Alternative 1. Regardless of authority, it is recognized that inspection, maintenance, and environmental monitoring is necessary for the long-term protectiveness and permanence of the remedy.

Alternative 2 includes implementation, monitoring and maintenance of additional institutional controls in the form of proprietary controls (e.g., environmental covenants, restrictive notices, etc.) throughout the Site where residual contamination is present, either within and/or outside the future DOE transfer boundary. The additional institutional controls under CERCLA would be used to inform the community of risks, and restrict access and use of contaminated media within the DOE transfer boundary and on parcels not resulting in UU/UE land use scenarios outside of the future DOE transfer boundary, but still within the Site. The proprietary controls would generally prohibit residential use, soil disturbance, and/or groundwater use.

It is anticipated that proprietary controls, such as Environmental Covenants (EC)/Restrictive Notices (RN) (EC/RNs), will be implemented at the Site. EC/RNs may include enforceable restrictions on land use and excavation, and may include notification and self-certification requirements. An EC/RN can also be supplemented by a Material Management Plan (MMP), which would provide detailed procedures for radiological monitoring that must be performed when excavation takes place in areas that contain residual radioactive material in excess of 5 pCi/g radium (plus background). Areas where proprietary controls are anticipated include the three rights of way, as well as any land currently anticipated to be managed by BLM, Montrose County or CDOT.

J. Comparative Analysis of Alternatives

The NCP requires that each remedial alternative be evaluated according to specific criteria. The purpose of this evaluation is to promote consistent identification of the relative advantages and disadvantages of each alternative, thereby guiding selection of remedies offering the most effective and efficient means of achieving site cleanup goals. There are nine criteria by which feasible remedial alternatives are evaluated. While all nine criteria are important, they are weighed differently in the decision-making process depending on whether they describe or involve protection of human health and the environment or compliance with federal or state statutes and regulations (threshold criteria), a consideration of technical or socioeconomic merits (primary balancing criteria), or the evaluation of non-EPA reviewers that may influence an EPA decision (modifying criteria).

Due to the limited number of alternatives in this ROD, the comparative analysis discussion below is brief.

Overall Protection of Human Health and the Environment

Sections XXIX and XXX of the CD provide the determination that the remedial action would be protective of human health and the environment, if implemented in accordance with the RAP. The remedial activities were implemented as described, with the exception of ICs, monitoring, and maintenance. The remedial activities resulted in significant risk reduction to humans from exposure to contaminated solid and liquid media; however, as implemented (without ICs, monitoring, and maintenance), the previous remedial activities did not fully address all residual contamination in soils and groundwater that could result in unacceptable exposures based on potential future uses of the Site.

Both Alternatives 1 and 2 provide protection for human receptors from radionuclides and inorganic contaminants for areas inside the future DOE boundary. Continued monitoring and maintenance will be performed under the NRC General License and the LTSP to minimize current and potential future exposure risks within the DOE transfer boundary.

The absence of the layered ICs, monitoring, and maintenance for properties with contamination posing potential exposure risks outside of the DOE transfer boundary, but still inside the Site where residual contamination remains under Alternative 1, introduces some uncertainty that the remedy would provide long-term protection. RAOs would be fully addressed in the future. While Omnibus Agreements initiated under Umetco’s Divestiture Policy would result in proprietary controls being established on these properties, regular inspections to confirm compliance would not necessarily be conducted in a timely manner, and enforcement is dependent on Umetco initiating civil proceedings in court. Thus, the ability of this type of IC to provide adequate protection to mitigate the potential exposure risks is uncertain, and could result in unacceptable non-carcinogenic risk to children from metals exposure in a potential future residential land use scenario outside the DOE transfer boundary. Thus, Alternative 1 does not adequately provide long-term protection of human health and the environment, and it is rated *Inadequate* in this category.

Alternative 2 would provide protection of human health and the environment from exposure to contaminants compared to Alternative 1. This would be accomplished through implementation of

ICs and long-term monitoring and maintenance for residual contamination within and outside the DOE transfer boundary, in the form of enforceable proprietary controls, such as ECs and RNs, which may include MMPs and periodic monitoring to confirm compliance with the conditions set forth in the proprietary controls. Violations of these proprietary controls would be directly enforceable under existing laws and regulations. Periodic monitoring would be performed to determine whether remedy components (ICs) have been compromised in the future, or changes in land use have occurred that would require re-evaluation of IC instruments used. Thus, Alternative 2 provides adequate overall protection of human health and the environment by meeting RAOs. This alternative is rated *Adequate* in this category.

Compliance with ARARS

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate federal and State requirements, standards, criteria, and limitations, which are collectively referred to as ARARs, unless such ARARs are waived under CERCLA 121(d)(4).

Both alternatives are rated as being *Compliant* with ARARs. Two of the action-specific ARARs identified (the Uranium Mill Tailings Radiation Control Title II and Domestic Licensing of Source Material) are being addressed under separate ongoing legal and regulatory frameworks. The other action-specific ARAR which is not addressed under the other ongoing legal or regulatory processes is the Colorado Environmental Real Covenants Act.

Under Alternative 1, action-specific ARARs would not be triggered since no new remedial measures would be undertaken. Alternative 2 is expected to achieve compliance with ARARs, including the Colorado Environmental Real Covenants Act, since ICs in the form of ECs and RNs would be established, monitored, and maintained in accordance with this ARAR.

Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain on site following remediation and the adequacy and reliability of controls.

For both alternatives, contaminated media (i.e., soil and groundwater) remain present at the Site. Contaminated soil at several properties exhibit concentrations that pose unacceptable non-carcinogenic risk to children from metals exposure in a potential future residential land use scenario. Alternatives 1 and 2 have the same untreated waste remaining after the conclusion of the remedial activities onsite in soil and groundwater; however, the two alternatives differ in types of controls that are being used to manage untreated waste remaining at the Site.

Activities performed under separate legal and regulatory frameworks are ongoing and provide some degree of long-term effectiveness and permanence of the previous remedial activities for both alternatives. Long-term monitoring and maintenance will be conducted under the NRC General License and the LTSP to minimize current and potential future exposure risks within the DOE transfer boundary. However, long-term effectiveness and permanence of covered areas is

dependent on periodic inspection of the integrity of the covers and post-construction monitoring and maintenance performed in perpetuity under other regulatory programs. While Omnibus Agreements initiated under Umetco's Divestiture Policy would result in proprietary controls being established on properties outside the DOE transfer boundary, regular monitoring to confirm compliance would not necessarily be conducted in a timely manner, and enforcement is dependent on Umetco initiating civil proceedings in court.

No further remedial actions would be undertaken under Alternative 1. Given that the reliability of the controls implemented under separate private, legal and regulatory frameworks is somewhat uncertain (particularly with respect to the Umetco Divestiture Policy), the alternative was rated as *Moderate* for long-term effectiveness and permanence.

Under Alternative 2, ICs in the form of proprietary controls, such as ECs and RNs, (under state law) would be applied and may be supplemented with MMPs, where appropriate. These proprietary controls provide layering with the land use restrictions established by the Umetco Divestiture Policy and could also provide an additional enforcement mechanism. Compared to Alternative 1, Alternative 2 provides additional long-term effectiveness and permanence through layering of ICs, monitoring, and maintenance. Thus, Alternative 2 is rated *Moderate to High* for long-term effectiveness and permanence.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

The previous remedial activities resulted in significant risk reduction to humans from exposure to contaminated solid and liquid media. Treatment is not a component of Alternative 1 nor Alternative 2 since physical remediation measures have been previously completed. Thus, both alternatives do not provide a reduction of toxicity, mobility, or volume through treatment, and were given a rating of *None* for this category.

Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved.

Containment measures already in-place at the Site and the exclusion of additional physical remedy components result in short-term protection of human health and environment for both alternatives. Although Long-Term Surveillance (LTS) activities are ongoing, unacceptable exposure risk to humans could occur as part of potential future land uses given that enforcement of Omnibus Agreements by Umetco is uncertain, and the LTS activities such as monitoring and maintenance conducted within the DOE land transfer boundary are being performed under separate legal and regulatory frameworks.

No further remedial action other than five-year reviews would be undertaken to address contaminated media for Alternative 1, thus, minimal impacts to the community, workers, or

environment are expected during implementation of the alternative. However, Alternative 1 was rated *Moderate to High* for short-term effectiveness due to the uncertainty of the time until protection is achieved, especially for properties outside the DOE land transfer boundary.

The proposed ICs for Alternative 2 could be implemented in less than 1 year but are potentially dependent on completion of the land transfer process. Although Alternative 2 involves additional work outside the DOE transfer boundary compared to Alternative 1, the additional properties would result in minimal additional impact to workers since the remedial activities associated with ICs are primarily administrative and inspections associated with the ICs and five-year reviews are expected to be periodic and non-intrusive within contaminated media. Therefore, both Alternatives 1 and 2 were given a rating of *Moderate to High* for short-term effectiveness.

Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability for services and materials, administrative feasibility, and coordination with other government entities are also considered.

Except for five-year reviews, no further remedial measures would be undertaken under Alternative 1. Five-year reviews should be relatively straightforward and easily implementable, thus, Alternative 1 was given a rating of *High* for this category

Implementation of ICs, monitoring, and maintenance as part of Alternative 2 adds complexity compared to Alternative 1. Regulatory approvals for implementation of ICs, monitoring, and maintenance should be obtainable. However, some difficulties may be encountered with implementing ICs on various types of properties with differing ownership. Thus, Alternative 2 was given a rating of *Moderate to High* for this category.

Cost

Cost includes estimated capital and annual operation and maintenance costs. Cost is calculated as the present worth cost, which which represents the amount of money that, if invested in the initial year of a remedial action at a given rate, would provide the funds required to make future payments to cover all costs associated with the remedial action over its planned life.

Capital, annual, periodic and present value costs for all alternatives were evaluated over a 50-year period after the base year (Years 0 through 50).

The present value cost for Alternative 1 was given a rating of *Low to Moderate*. The present value cost for this alternative is approximately $290,000. Excluding present value discounting, the capital, annual and periodic costs for Alternative 1 are $31,000; $450,000; and $450,000, respectively.

The present value cost for Alternative 2 was given a rating of *Moderate*. The present value cost for this alternative is approximately $520,000. Excluding present value discounting, the capital, annual and periodic costs for Alternative 2 are $227,000; $450,000; and $570,000 respectively.

State Acceptance

This criterion evaluates whether the State of Colorado agrees with EPA's analyses and preferred alternative.

The State of Colorado concurs with the selection of the preferred alternative.

Community Acceptance

This criterion evaluates whether the local community agrees with EPA's analyses and selected preferred alternative.

EPA and CDPHE announced the availability of the proposed plan for the Site in a public notice in the following five newspapers: Ouray County Plaindealer, Grand Junction Daily Sentinel, Telluride Daily Planet, The Norwood Post, Montrose Daily Press. The proposed plan identified the Preferred Institutional Controls (ICs) Alternative for addressing the remaining work needed at the Site.

The 30-day public comment period started on October 16, 2017 and concluded on November 14, 2017. A public meeting was held on October 30, 2017 at the First Park Community Center, 1045 Main Street in Nucla, CO, beginning at 6:30pm.

The public notice indicated that comments would be accepted verbally at the public meeting, or by mail or email.

No comments were received on the proposed plan or alternatives during the public comment period. No public comment period extension requests were received during the public comment period either.

K. Principal Threat Waste

The NCP establishes an expectation that EPA will use treatment to address principal threats posed by a site wherever practical. A principal threat concept is applied to the characterization of "source material" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to ground water, surface water, or air, or acts as a source for direct exposure. EPA has defined principal threat wastes as those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.

The principal threat wastes are Uranium and daughter isotopes, including radium, radon, radon daughters and thorium 230. Treatment was not a primary method used in addressing these wastes which are being effectively contained by the remedy in place. Principal Threat Waste is not an aspect of the IC selected remedy.

L. Selected Remedy

Summary of the Rationale for the Selected Remedy

The key factors upon which the remedy decision is based are presented below.

The majority of the work at this Site was conducted as a State-lead site under a Consent Decree/Remedial Action Plan (CD/RAP) (Civil Action No. 83-C-2384) between the State of Colorado, Union Carbide Corporation and Umetco Minerals Corporation (Umetco). EPA was not a party to the Consent Decree. This previous work is documented in this ROD. Additionally, this ROD documents the additional final remedy components selected by EPA and CDPHE that they have determined are appropriate for long-term protectiveness at the Site.

As with other aspects of this Site, this selected remedy includes requirements from UMTRCA Title II, as well as Umetco Corporate Divestiture Policy.

Description of the Selected Remedy

Long term custody of property inside the future DOE transfer boundary at the Site will be transferred to DOE in accordance with UMTRCA Title II after NRC has accepted the CRR. The State, under UMTRCA, will be required to terminate Umetco's Radioactive Materials License, as well as the CD/RAP. Umetco will transfer property title within the land transfer boundary to DOE, along with a long-term care fee. The general license will take effect upon NRC acceptance of DOE's LTSP. The general license will require DOE to provide custody and long-term care as specified in the LTSP, including inspections, maintenance, environmental monitoring, and emergency measures necessary to ensure that the area in the future transfer boundary will be cared for in a manner that protects public health, safety, and the environment after closure. Engineered controls, such as new fencing, may be used by DOE to control access at the Site within the DOE transfer boundary, if supplemental access control is needed. Table 8 contains a summary of the ARARs for this selected remedy. Table 9 includes a summary and rationale of whether ICs are needed by remediation area.

Inspection and maintenance will be performed as specified in the LTSP to confirm the integrity of visible features at the Site within the DOE transfer boundary and to confirm that other remedy components (e.g., repository cover, institutional controls, access controls) have not been compromised. Routine maintenance of the cover systems will include controlling growth of trees and shrubs on the repository covers and access roads. Additional maintenance would be required if erosion, sloughing, slumping, or surface deformation is observed on the repository surface or if settlement or seeps are observed along the perimeter. Fencing and signage within the future DOE transfer boundary would be repaired or replaced as necessary to maintain those access controls.

Environmental monitoring may also be specified in the LTSP to ensure compliance with groundwater and surface water standards, as well as to verify the continued health of the on-Site vegetation and to assure that undesirable plant species do not proliferate at the Site.

Regardless of authority, it is recognized that inspection, maintenance, and environmental monitoring is necessary for the long-term protectiveness and permanence of the remedy.

Additionally, the selected remedy includes implementation, monitoring and maintenance of additional institutional controls in the form of proprietary controls (e.g., environmental covenants, restrictive notices, etc.) throughout the Site where residual contamination is present, either within and/or outside the future DOE transfer boundary. The additional institutional controls under CERCLA will be used to inform the community of risks, and restrict access and use of contaminated media within the DOE transfer boundary and on parcels not resulting in UU/UE land use scenarios outside of the future DOE transfer boundary but still within the Site. The proprietary controls will generally prohibit residential use, soil disturbance, and/or groundwater use.

It is anticipated that proprietary controls, such as EC/RNs, will be implemented at the Site. EC/RNs may include enforceable restrictions on land use and excavation, and may include notification and self-certification requirements. An EC/RN can also be supplemented by a MMP, which would provide detailed procedures for radiological monitoring that must be performed when excavation takes place in areas that contain residual radioactive material in excess of 5 pCi/g radium (plus background). Areas where proprietary controls are anticipated include the three rights of way, as well as any land currently anticipated to be managed by BLM, Montrose County or CDOT.

Umetco Divestiture Policy

Although not under governmental control, it is recognized that the Umetco Divestiture Policy provides an additional layer of control. The Umetco Divestiture Policy will be applied to all property outside the future DOE transfer boundary. This corporate policy includes restrictions to prevent groundwater use and residential property, which Umetco has operated on, whether there is contamination present or not (i.e., Unlimited Use/Unrestricted Exposure or UU/UE) and is typically documented through an Omnibus Agreement. These current corporate policy restrictions would be imposed upon former Umetco properties in perpetuity and would be enforceable through common law by Umetco and UCC, jointly and severally.

Permits

CERCLA Section 121(e)(1) states, “No Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely onsite, where such remedial action is selected and carried out in compliance with this section.” The onsite activities must, however, comply with substantive permit requirements. The term “onsite” is defined in the NCP as “the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action.” EPA has determined that no permits are required for remediation that is conducted entirely on site.

At this Site, there are licensing requirements for the possession and use of radioactive materials that are independent of the CERCLA process. There has been a Colorado Radioactive Materials License issued to the Site for the past milling operation, decommissioning, remediation, and reclamation at Uravan. In addition, the Site will be placed under the NRC General License for long-term care after the Site is transferred to the DOE.

Summary of the Expected Remedy Costs

The present value cost for Alternative 1 was given a rating of Low to Moderate. The present value cost for this alternative is approximately $290,000. Excluding present value discounting, the capital, annual and periodic costs for Alternative 1 are $31,000; $450,000; and $450,000, respectively.

Expected Outcomes of the Selected Remedy

EPA expects that, upon implementation, this remedy will protect human health and the environment and comply with ARARs, while providing the greatest flexibility for future Site reuse options.

M. Statutory Determinations

Under CERCLA § 121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions to the extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the selected remedy meets these statutory requirements.

Protection of Human Health and the Environment

The selected remedy will protect human health and the environment by limiting future use of the industrial properties to their anticipated industrial land use.

Compliance with Applicable or Relevant and Appropriate Requirements

The selected remedy will comply with identified federal and State ARARs. No waiver of any ARAR is being sought for the selected remedy.

Cost-Effectiveness

The selected remedy is determined to be cost-effective. In making this determination, the following definition set forth in the NCP was used: “A remedy shall be cost-effective if its costs are proportional to its overall effectiveness.” (40 CFR §300.430(f)(1)(ii)(D)). This was accomplished by evaluating the “overall effectiveness” of those alternatives that satisfy the threshold criteria. Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs, and, hence, this alternative represents a reasonable value for the money to be spent.

The costs of implementing the ICs, monitoring and maintenance are relatively minimal, essentially involving drafting and negotiating the instruments for each property, as well as the filing fees.

Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable (MEP)

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the Site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the selected remedy provides the best balance of trade-offs in terms of the five balancing criteria while also considering the statutory preference for treatment as a principal element and bias against off-site treatment and disposal and considering State and community acceptance.

Preference for Treatment as a Principal Element

The selected remedy does not utilize treatment technologies, since only ICs, monitoring and maintenance remain to be implemented. Treatment was a component in previous work at the Site. Additional treatment is not required in order to be protective of human health and the environment once the ICs selected in this ROD have been implemented.

Five-year Review Requirements

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on ite above levels that allow for unlimited use and unrestricted exposure, statutory reviews have been conducted since 1994 and will continue to be conducted at least every 5 years to ensure that the remedy is, or will be, protective of human health and the environment.

N. Documentation of Significant Changes

There are no additional significant changes as a result of the public comment period.

PART 3 – RESPONSIVENESS SUMMARY

The United States Environmental Protection Agency and Colorado Department of Public Health and Environment announced the availability of the proposed plan for the Uravan Uranium Project (Union Carbide Corp.) Superfund Site in a public notice in the following five newspapers: *Ouray County Plaindealer*, Grand Junction *Daily Sentinel*, *Telluride Daily Planet*, *The Norwood Post*, *Montrose Daily Press*. The proposed plan identified the preferred Institutional Controls (ICs) Alternative for addressing the remaining work needed at the Uravan Uranium Project (Union Carbide Corp.) Superfund Site.

The 30-day public comment period started on October 16, 2017 and concluded on November 14**,** 2017**.** A public meeting was held on October 30, 2017 at the First Park Community Center, 1045 Main Street in Nucla, Colo., beginning at 6:30 p.m.

The public notice indicated that comments would be accepted verbally at the public meeting, or by mail or email.

No comments were received on the proposed plan or alternatives during the public comment period. No public comment period extension requests were received during the public comment period either.

APPENDIX

Figures

Figure 1 – Area Location Map

Figure 2 – Site Area Boundaries and Nomenclature

Figure 3 – Proposed Land Transfer Boundaries

Tables

Table 1 – Summary of Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBCs) for Completed Work

Table 2 – Calculated Radionuclide Risk via Uravan CSM found in 1999 Soil Cleanup Methodolgy

Table 3 – Residual Soil Radionuclide Carcinogenicity Risks via EPA PRG Calculator

Table 4 – Chemical Risk Assessment Hazard Index Calculations via EPA RSL Calculator

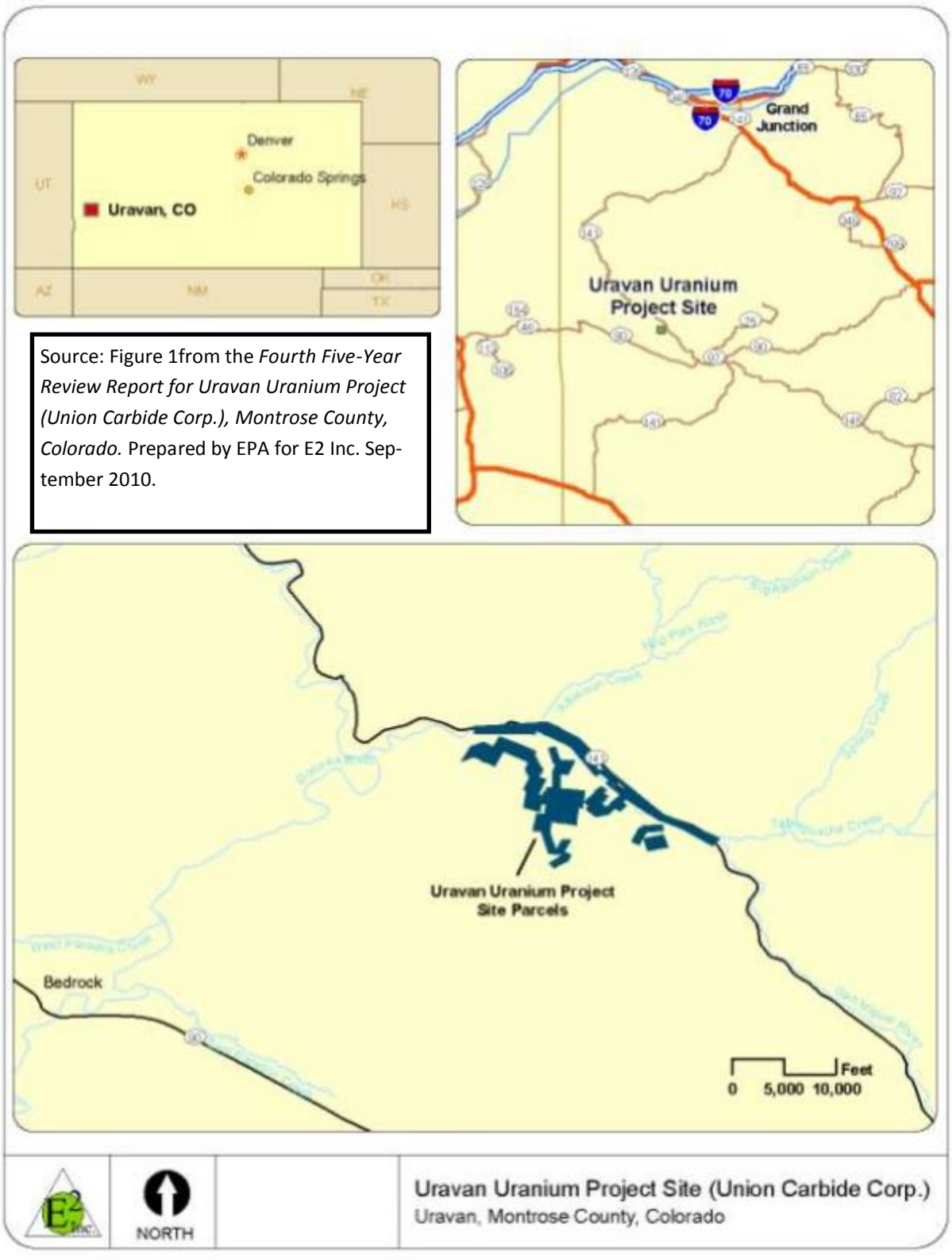
Table 5 – Summary of Soil Cleanup Objectives

Table 6 – Summary of Cleanup Goals, Amended RAP Cleanup Goals, and State ACLs for Groundwater COCs

Table 7 – Summary of Soil Cleanup Objectives, Average Residual Contaminant Values, and Exceedances in Soil

Table 8 – Summary of Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) for Selected Remedy

Table 9 – Summary of Institutional Control (IC) Needs



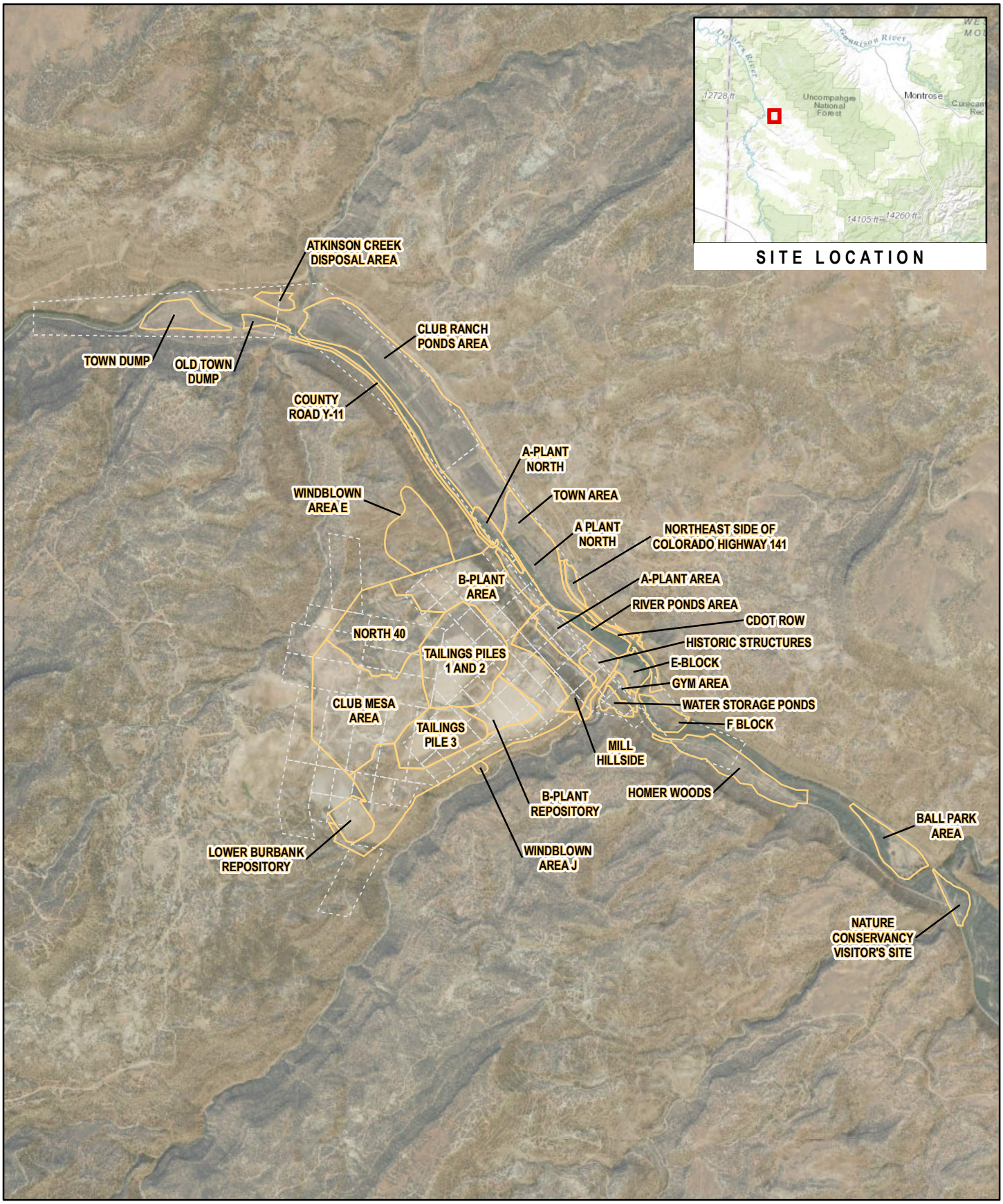
Source: Figure 1from the *Fourth Five-Year Review Report for Uravan Uranium Project (Union Carbide Corp.), Montrose County, Colorado.* Prepared by EPA for E2 Inc. September 2010.

Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map i p is for informational purposes only regarding EPA's response actions at the Site, and is not intended for any other purp

Figure 1

Location Map

Uravan Uranium Project, Uravan, Colorado



N

0 0.25 0.5 1

1 inch = 0.5 miles Miles

Site Area Boundary

Claim Boundary

Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community; Sources: Esri, USGS, NOAA; Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 2 **| Site Area Boundaries and Nomenclature**
Uravan Uranium Project, Uravan, Colorado

CDM Smith
555 17th Street
Suite 500
Denver, CO 80202
Tel: (303) 383-2300

Document Path: T:\79171_Uravan\MXD\SiteOverview_v2.mxd Date Saved: 8/30/2017 Author: WAGNERA CDMSmith

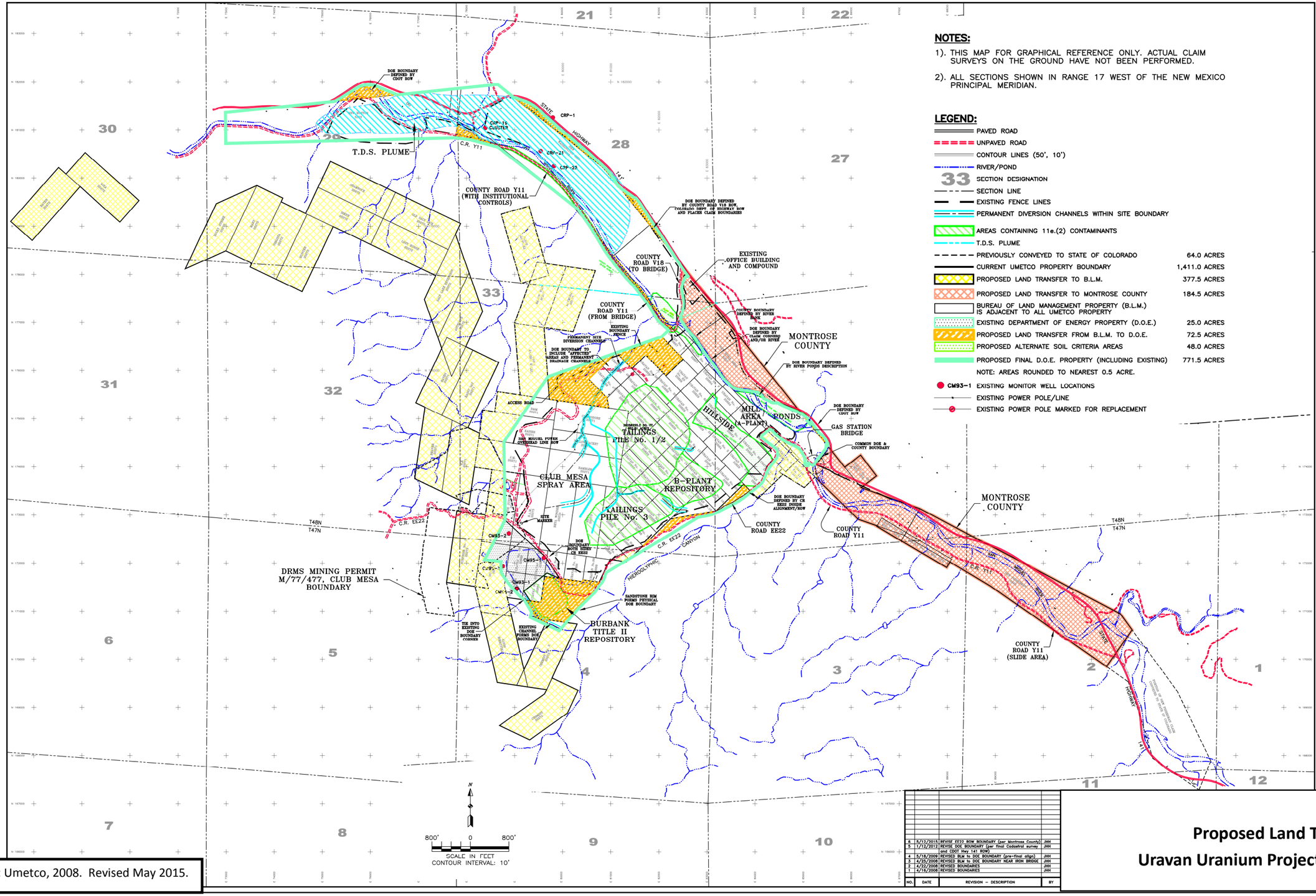


Figure 3
Proposed Land Transfer Boundaries
Uravan Uranium Project, Uravan, Colorado

Source: Umetco, 2008. Revised May 2015.

Table 1 - Summary of Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBCs)
Uravan Uranium Project (Union Carbide Corp.) Site, Montrose County, Colorado

Statues, Regulations, Standards, or Requirements	Citations or References	Description	Comment	Chemical (Tables 1 and 2)	Location	Action
Federal ARARs						
Clean Air Act (42 U.S.C. §7401, et. seq., as amended.) and Implementing Regulations						
National Emission Standards for Radon Emissions from the Disposal of Uranium Mill Tailings National Emission Standards for Radon Emissions from Operating Mill Tailings	40 CFR Part 61, Subpart T 40 CFR Part 61, Subpart W	Standards for emissions of radon-containing materials from storage disposal facilities. Standards for emissions of radon-containing materials from storage disposal facilities	Emissions of radionuclides and other hazardous air pollutants, including a release of asbestos during demolition and renovation activities, are regulated under the NESHAPs program (40 CFR Part 61) and National Emission Standards for Hazardous Air Pollutants for Source Categories (a.k.a. Maximum Achievable Control Technology [MACT]) (40 CFR Part 63).	✓		
Federal Water Pollution Control Act (33 U.S.C. §1251, et seq., as amended by the Clean Water Act) and Implementing Regulations						
Water Quality Criteria	40 CFR Part 131	Federal WQC are non-enforceable guidelines that set concentrations of pollutants which, when published, were considered adequate to protect surface waters. The WQC may be relevant and appropriate to CERCLA cleanups based upon an evaluation of four criteria set forth in CERCLA section 121(d): (1) uses of the receiving water body; (2) media affected; (3) purposes of the criteria; and (4) current information.	Alternative cleanup level (ACLs) were established in a manner that protects the surface water from nonpoint sources.	✓		✓
Safe Drinking Water Act (42. U.S.C. §300) and Implementing Regulations						
National Primary Drinking Water Standards Maximum Contaminant Level, and Maximum Contaminant Level Goals	40 CFR Part 141 40 CFR 141.50 40 CFR 141.51 40 CFR 141.52 40 CFR 141.55	Establishes health-based standards for public water systems (maximum contaminant levels [MCLs]). Includes permissible MCLs for radionuclides in drinking water systems. Establishes drinking water quality goals set at levels of no known or anticipated adverse health effects, with an adequate margin of safety for organic contaminants (141.50), inorganic contaminants (141.51), microbiological contaminants (141.52), and radionuclides (141.55) MCLs typically apply at the tap and there are no drinking water sources at the Site. CERCLA section 121(d)(2)(A)(i) requires on-site CERCLA remedies to attain standards or levels of control established under the SDWA (i.e., MCLS, where they are applicable or relevant and appropriate). CERCLA section 121(d)(2)(A) also requires on-site remedies to attain MCLGS where relevant and appropriate under the circumstances of the release.	Substantive requirements were considered during remedial action and development of ACLs.	✓		
National Secondary Drinking Water Standards	40 CFR Part 143	Establishes welfare-based standards for public water systems (secondary MCLs). This part establishes national secondary drinking water regulations pursuant to Section 1412 of the Safe Drinking Water Act, as amended (42 U.S.C. 300g-1). These regulations control contaminants in drinking water that primarily affect the aesthetic qualities relating to the public acceptance of drinking water.	Secondary MCLs for aluminum, iron, manganese, sulfate, and zinc were considered during remedial action	✓		

Statues, Regulations, Standards, or Requirements	Citations or References	Description	Comment	Chemical (Tables 1 and 2)	Location	Action
Federal ARARs						
Uranium Mill Tailings Radiation Control Act (42 U.S.C. §2022) and Implementing Regulations						
Standards for the Stabilization, Disposal, and Control of Uranium and Thorium Mill Tailings	40 CFR Part 192, Subpart D and E	Establishes health-based standards for control of from processing sites and standards for cleanup of lands and buildings having radioactive materials from inactive uranium processing sites. Includes guidance regarding the circumstances under which the subsurface soil cleanup criteria in 40 CFR Part 192, Subpart D and E, promulgated under the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) should be considered an ARAR for radium or thorium in developing a response action under CERCLA.	Used to establish site-specific soil cleanup objectives (Umetco 1999).	✓		
Atomic Energy Act (42 U.S.C. §2011, et. seq.) and Implementing Regulations						
Atomic Energy Act of 1954	42 U.S.C. §2011, et. seq.	The AEA covers the laws for the development, regulation, and disposal of nuclear materials and facilities in the United States. It was an amendment to the AEA of 1946 and substantially refined certain aspects of the law, including increased support for the possibility of a civilian nuclear industry.	Subpart D of 40 CFR 192 established radioactivity limits for uranium byproduct materials pursuant to Section 84 of the Atomic Energy Act of 1954, as amended.	✓		
	10 CFR Part 40, Appendix A	Appendix A to Part 40—Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material From Ores Processed Primarily for Their Source Material Content	Contains Criterion 6(6) used in setting soil cleanup objectives (Umetco 1999).	✓		

Statues, Regulations, Standards, or Requirements	Citations or References	Description	Comment	Chemical	Location	Action
State of Colorado ARARs						
Colorado Air Pollution Prevention and Control Act	CRS §25-7-101, et seq.	Colorado comprehensive air quality regulations.	Used to establish site-specific soil cleanup objectives (Umetco 1999). A specific RAO for Radon was established to minimize emissions from the tailings and waste repositories	✓		✓
Colorado Water Quality Control Act	CRS §25-8-101, et seq.	Colorado comprehensive water quality protection regulations.	Alternative cleanup level (ACLs) were established to ensure groundwater is protective at nonpoint sources. Substantive requirements were considered during remedial action and development of ACLs.	✓		✓
Colorado Water Quality Classifications and Standards	CCR 1002 31, 35, 41, and 65	These regulations establishing basic standards and an antidegradation rule and implementation process and establishing a system for classifying state surface waters, for assigning standards, and for granting temporary modifications is the foundation for the classification of the state surface waters of Colorado, as prescribed by the Colorado Water Quality Control Act.	5 CCR 1002-31 (Basic Standards); 5 CCR 1002-35 (Gunnison/Lower Dolores classifications and standards. Specifically: San Miguel River Segment 5 "Mainstem of the San Miguel River from a point immediately below the confluence of Naturita Creek to it' confluence with the Dolores River"); 5 CCR 1002-41 (Basic Standards for Ground Water); 5 CCR 1002-65 (Stormwater)	✓		✓
Colorado Radiation Control Act	CRS §25-11-101, et seq.	Part 1 provides regulations for all types of radioactive material.	Used to establish site-specific soil cleanup objectives (Umetco 1999).	✓	✓	✓
Colorado Rules and Regulations Pertaining to Radiation Control	6 CCR 1007-1, Parts 1, 3, 4, 10 and 18.	Establishes standards for the licensing, construction, operating and closure of uranium recovery facilities	Substantive requirements were used during design, operation and closure of the facility.	✓	✓	✓
Colorado Noxious Weed Act	8 CCR 1206-2 pursuant to CRS 35-5.5-101	Defines and sets forth noxious weed management regulations.	Defines and sets forth noxious weed management regulations during the maintenance of covers or construction of fence.			✓

Table 2 – Calculated Radionuclide Risk via Uravan CSM found in 1999 Soil Cleanup Methodology

	Th-230 Inhalation Cancer Risk	Th-230 Soil Ingestion Cancer Risk	Th-230 External Exposure Cancer Risk	Th-230 Summation of Cancer Risk	Ra-226 Inhalation Cancer Risk	Ra-226 Soil Ingestion Cancer Risk	Ra-226 External Exposure Cancer Risk	Ra-226 Summation of Cancer Risk	U-238 Inhalation Cancer Risk	U-238 Soil Ingestion Cancer Risk	U-238 External Exposure Cancer Risk	U-238 Summation of Cancer Risk	Total Radionuclide Carcinogenicity Risk
Atkinson Creek Crystal Disposal Area	6.14E-10	4.61E-08	2.05E-10	4.69E-08	2.24E-10	1.49E-07	1.90E-06	2.05E-06	5.73E-11	1.36E-08	8.10E-09	2.18E-08	2.12E-06
	1.62E-08	1.34E-06	2.98E-09	1.36E-06	5.90E-09	4.34E-06	2.77E-05	3.20E-05	1.51E-09	3.97E-07	1.18E-07	5.17E-07	3.39E-05
Club Ranch Ponds	1.59E-09	1.19E-07	5.29E-10	1.21E-07	2.90E-10	1.93E-07	2.46E-06	2.65E-06	1.16E-10	2.74E-08	1.63E-08	4.39E-08	2.81E-06
River Ponds [4]	-	-	-	-	-	-	-	-	-	-	-	-	-
Club Mesa Spray Area[5]	-	-	-	-	4.67E-10	3.11E-07	3.96E-06	4.27E-06	-	-	-	-	*4.27E-06*
A-Plant	4.37E-10	3.27E-08	1.45E-10	3.33E-08	2.76E-10	1.84E-07	2.34E-06	2.53E-06	1.24E-10	2.94E-08	1.75E-08	4.70E-08	2.61E-06
A-Plant North	8.67E-10	6.50E-08	2.89E-10	6.61E-08	2.43E-10	1.62E-07	2.07E-06	2.23E-06	2.21E-10	5.26E-08	3.13E-08	8.40E-08	2.38E-06
Historic Structures Area	-	-	-	-	2.11E-10	1.40E-07	1.79E-06	1.93E-06	3.96E-10	9.40E-08	5.59E-08	1.50E-07	*2.08E-06*
B-Plant [6]	2.18E-09	1.64E-07	7.27E-10	1.67E-07	8.82E-10	5.87E-07	7.48E-06	8.07E-06	1.16E-10	2.74E-08	1.63E-08	4.39E-08	8.23E-06
Windblown [7,8]	1.26E-09	1.95E-07	4.34E-10	1.97E-07	-	-	-	-	2.57E-10	1.26E-07	3.75E-08	1.64E-07	*3.61E-07*
	3.72E-10	2.79E-11	1.24E-10	5.24E-10	-	-	-	-	7.58E-11	1.80E-11	1.07E-08	1.08E-08	*1.13E-08*
Mill Hillside [9]	6.44E-07	2.74E-07	1.22E-09	9.19E-07	1.45E-09	9.64E-07	1.23E-05	1.32E-05	1.16E-10	2.74E-08	1.63E-08	4.39E-08	1.42E-05
County Road Y-11	-	-	-	-	2.96E-10	1.97E-07	2.51E-06	2.71E-06	1.16E-10	2.74E-08	1.63E-08	4.39E-08	*2.71E-06*
County Road EE-22	3.59E-09	4.76E-07	1.23E-09	4.81E-07	1.82E-10	2.15E-07	1.60E-06	1.81E-06	5.91E-10	2.90E-07	8.62E-08	3.77E-07	2.67E-06
	1.06E-09	7.94E-11	3.53E-10	1.49E-09	5.37E-11	3.58E-11	4.56E-07	4.56E-07	1.74E-10	4.14E-11	2.46E-08	2.49E-08	4.82E-07
Water Storage Ponds	2.56E-10	3.39E-08	8.80E-11	3.43E-08	1.12E-10	1.31E-07	9.77E-07	1.11E-06	6.79E-11	3.33E-08	9.89E-09	4.32E-08	1.19E-06
	7.54E-11	5.66E-12	2.51E-11	1.06E-10	3.29E-11	2.19E-11	2.79E-07	2.79E-07	2.00E-11	4.75E-12	2.83E-09	2.85E-09	2.82E-07
Town Area	4.48E-10	5.94E-08	1.54E-10	6.00E-08	1.60E-10	1.88E-07	1.40E-06	1.59E-06	1.03E-10	5.06E-08	1.51E-08	6.58E-08	1.71E-06
	1.32E-10	9.90E-12	4.40E-11	1.86E-10	4.72E-11	3.14E-11	4.00E-07	4.00E-07	3.05E-11	7.23E-12	4.30E-09	4.34E-09	4.05E-07
Hieroglyphic Canyon Streambed [7]	-	-	-	-	5.13E-10	6.04E-07	4.49E-06	5.10E-06	-	-	-	-	*5.10E-06*
	-	-	-	-	1.51E-10	1.01E-10	1.28E-06	1.28E-06	-	-	-	-	*1.28E-06*
	-	-	-	-	2.40E-08	1.76E-05	1.12E-04	1.30E-04	-	-	-	-	*1.30E-04*
Northeast Highway 141	5.48E-10	7.27E-08	1.88E-10	7.35E-08	2.98E-10	3.50E-07	2.61E-06	2.96E-06	8.20E-11	4.02E-08	1.20E-08	5.23E-08	3.08E-06
	1.62E-10	1.21E-11	5.39E-11	2.28E-10	8.77E-11	5.84E-11	7.44E-07	7.44E-07	2.42E-11	5.74E-12	3.42E-09	3.45E-09	7.48E-07
CDOT Highway 141	3.75E-10	4.97E-08	1.29E-10	5.02E-08	1.53E-10	1.80E-07	1.34E-06	1.51E-06	8.61E-11	1.26E-07	3.75E-08	1.64E-07	1.73E-06
	1.10E-10	8.28E-12	3.68E-11	1.56E-10	4.50E-11	2.99E-11	3.81E-07	3.82E-07	7.58E-11	6.03E-12	3.59E-09	3.67E-09	3.85E-07
Town Dump	5.17E-10	3.88E-08	1.72E-10	3.95E-08	1.65E-10	1.10E-07	1.40E-06	1.51E-06	1.09E-10	2.60E-08	1.54E-08	4.15E-08	1.59E-06

Notes:

4. See Table 2-3 in *Site-Specific Soil Cleanup Objectives Rationale Document for Uravan Project, Colorado* , dated June 1999.

5. The have been calculated from information given in *Potential Health Significance of Residual Levels of Metals in Soils at the Atkinson Creek Crystal Disposal Area, Uravan, Colorado, Revision 1* , dated April 12, 1994 to be consistent with the results provided in other reclamation area confirmation reports.

6. Alternate Soils Standards have been approved for the River Ponds, A-Plant North, the Mill Hillside, and County Road Y-11.

7. The B-Plant area will be transferred to the Department of Energy for long-term stewardship and will effectively restrict future use of the land and minimize future exposure.

8. Soils samples were only collected in Area E. Since sampling for windblown, only surface soil samples were collected. Laboratory analyses indicate that soils are NORM rather than windblown licensed materials.

9. Soil samples collected on September 15 – 17, 1998, as part of characterization investigation. Additional sampling not conducted after remedial activities as roadway was immediately backfilled with clean materials so that road traffic could be maintained in accordance with Montrose County requirements. CDPHE inspected excavated area and confirmed that all tailings material were removed.

Worker	Rancher	Recreator	Resident
< 1.00E-6 Excess Risk	< 1.00E-5 Excess Risk	< 1.00E-4 Excess Risk	> 1.00E-4 Excess Risk

Table 3 – Residual Soil Radionuclide Carcinogenicity Risks via EPA PRG Calculator

	Ingestion Risk	Inhalation Risk	External Exposure Risk	Beef Consumption Risk	Total Radionuclide Carcinogenicity Risk
Atkinson Creek Crystal Disposal Area	1.75E-07	6.61E-10	4.42E-08	-	2.20E-07
	1.88E-05	1.66E-08	1.57E-06	-	2.03E-05
Club Ranch Ponds	2.54E-07	1.28E-09	6.52E-08	-	3.21E-07
River Ponds	-	-	-	-	-
Club Mesa Spray Area	3.90E-07	1.83E-09	1.03E-07	-	*4.94E-07*
A-Plant	2.13E-07	7.76E-10	5.41E-08	-	2.68E-07
A-Plant North	2.14E-07	1.13E-09	4.99E-08	-	2.65E-07
Historic Structures Area	1.76E-07	8.26E-10	4.23E-08	-	*2.19E-07*
B-Plant	7.02E-07	2.84E-09	1.91E-07	-	8.96E-07
Windblown	1.88E-06	2.51E-09	4.40E-07	-	*2.32E-06*
	4.68E-07	2.00E-10	7.10E-08	1.29E-09	*5.40E-07*
Mill Hillside	1.20E-06	5.56E-09	3.12E-07	-	1.52E-06
County Road Y-11	2.47E-07	1.16E-09	6.38E-08	-	*3.12E-07*
County Road EE-22	7.02E-06	7.36E-09	1.60E-06	-	8.63E-06
	1.76E-06	5.89E-10	2.58E-07	2.64E-09	2.02E-06
Water Storage Ponds	6.98E-07	6.93E-10	1.54E-07	-	8.52E-07
	1.75E-07	5.55E-11	2.48E-08	3.20E-10	2.00E-07
Town Area	1.02E-06	1.07E-09	2.49E-07	-	1.27E-06
	2.56E-07	8.56E-11	4.02E-08	3.85E-10	2.97E-07
Hieroglyphic Canyon Streambed	3.34E-06	3.61E-09	7.98E-07	-	*4.15E-06*
	8.38E-07	2.89E-10	1.29E-07	1.24E-09	*9.68E-07*
	8.36E-05	9.03E-08	6.92E-06	-	*9.06E-05*
Northeast Highway 141	1.71E-06	1.35E-09	4.56E-07	-	2.17E-06
	4.31E-07	1.09E-10	7.36E-08	6.95E-10	5.05E-07
CDOT Highway 141	9.51E-07	9.40E-10	2.19E-07	-	1.17E-06
	2.39E-07	7.52E-11	3.54E-08	3.64E-10	2.75E-07
Town Dump	1.38E-07	6.52E-10	3.56E-08	-	1.75E-07

Worker | Rancher | Recreator | Resident

< 1.00E-6 Excess Risk | < 1.00E-5 Excess Risk | < 1.00E-4 Excess Risk | > 1.00E-4 Excess Risk

Table 4 – Chemical Risk Assessment Hazard Index Calculations via EPA RSL Calculator

	Ingestion Child HQ	Dermal Child HQ	Inhalation Child HQ	Noncarc. Child HI	Ingestion Adult HQ	Dermal Adult HQ	Inhalation Adult HQ	Noncarc. Adult HI
Atkinson Creek Crystal Disposal Area	-	-	-	-	1.68E-03	6.96E-06	1.25E-06	1.69E-03
	2.62E-01	6.07E-04	5.48E-05	2.62E-01	2.45E-02	1.01E-04	5.48E-05	2.47E-02
Club Ranch Ponds	-	-	-	-	3.79E-03	1.53E-05	3.51E-06	3.80E-03
River Ponds	-	-	-	-	-	-	-	-
Club Mesa Spray Area	-	-	-	-	-	-	-	-
A-Plant	-	-	-	-	3.94E-03	4.17E-06	3.38E-06	3.95E-03
A-Plant North	-	-	-	-	6.05E-03	6.96E-06	3.20E-06	6.06E-03
Historic Structures Area	-	-	-	-	-	-	-	-
B-Plant	-	-	-	-	1.07E-02	8.35E-06	5.57E-06	1.07E-02
Windblown	7.73E-02	2.43E-05	1.26E-05	7.74E-02	7.25E-03	4.05E-06	1.26E-05	7.27E-03
	1.92E+00	6.07E-04	3.07E-04	1.92E+00	1.80E-01	1.01E-04	3.07E-04	1.80E-01
Mill Hillside	-	-	-	-	2.83E-02	6.96E-06	1.41E-05	2.83E-02
County Road Y-11	-	-	-	-	-	-	-	-
County Road EE-22	1.85E-01	2.43E-05	3.16E-05	1.85E-01	1.73E-02	4.05E-06	3.16E-05	1.74E-02
	4.63E+00	8.50E-04	8.22E-04	4.63E+00	4.34E-01	1.42E-04	8.22E-04	4.35E-01
Water Storage Ponds	2.10E-02	-	3.78E-06	2.10E-02	1.97E-03	-	3.78E-06	1.97E-03
	5.24E-01	-	4.03E-04	5.25E-01	4.91E-02	-	4.03E-04	4.95E-02
Town Area	3.17E-02	2.91E-05	5.64E-06	3.17E-02	2.97E-03	4.86E-06	5.64E-06	2.98E-03
	7.92E-01	7.28E-04	1.41E-04	7.93E-01	7.42E-02	1.21E-04	1.41E-04	7.45E-02
Hieroglyphic Canyon Streambed	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
Northeast Highway 141	2.41E-02	1.75E-05	3.77E-06	2.41E-02	2.26E-03	2.92E-06	3.77E-06	2.26E-03
	5.71E-01	4.37E-04	7.13E-04	5.72E-01	5.35E-02	7.29E-05	7.13E-04	5.43E-02
CDOT Highway 141	2.65E-02	3.40E-05	4.91E-06	2.66E-02	2.49E-03	5.67E-06	4.91E-06	2.50E-03
	6.64E-01	8.50E-04	1.23E-04	6.64E-01	6.22E-02	1.42E-04	1.23E-04	6.25E-02
Town Dump	-	-	-	-	3.13E-03	-	2.07E-06	3.13E-03

Worker	Rancher	Recreator	Resident
<0.5 Hazard Index	<0.75 Hazard Index	<1.0 Hazard Index	>1.0 Hazard Index

Table 5 - Summary of Soil Cleanup Objectives

Parameter	Category 1 – RAP Objective	Category 2 – Risk-Based Objective (Residential)	Category 3 (Dose/Risk) – Recreational Visitor	Category 3 (Dose/Risk) – Monitoring Worker	Category 3 (Dose/Risk) – Rancher
Radium-226 (0-15 cm)	7.1 pCi/g	7.1 pCi/g	58 pCi/g	100 pCi/g	170 pCi/g
Radium-226 (15-30 cm)	17.1 pCi/g	17.1 pCi/g	58 pCi/g	100 pCi/g	170 pCi/g
Thorium-230 (0-15 cm)	7.1 pCi/g	14 pCi/g	58 pCi/g	100 pCi/g	170 pCi/g
Thorium-230 (15-30 cm)	17.1 pCi/g	43 pCi/g	58 pCi/g	100 pCi/g	170 pCi/g
Natural Uranium	8.4 mg/kg	220 mg/kg	5,600 mg/kg	31,000 mg/kg	3,800 mg/kg
Arsenic	21.4 mg/kg	21.4 mg/kg	Site-specific[1]	Site-specific[1]	Site-specific[1]
Cadmium	2.0 mg/kg	75 mg/kg	1,900 mg/kg	10,000 mg/kg	61,000 mg/kg
Lead	164 mg/kg	400 mg/kg	Site-specific[2]	1,500 mg/kg	1,500 mg/kg
Molybdenum	2.3 mg/kg	370 mg/kg	9,400 mg/kg	51,000 mg/kg	310,000 mg/kg
Nickel	25.1 mg/kg	1,400 mg/kg	34,000 mg/kg	180,000 mg/kg	EU[3]
Selenium	11.2 mg/kg	370 mg/kg	9,400 mg/kg	51,000 mg/kg	310,000 mg/kg
Vanadium	60.1 mg/kg	520 mg/kg	13,000 mg/kg	71,000 mg/kg	430,000 mg/kg
Zinc	422 mg/kg	22,000 mg/kg	560,000 mg/kg	EU[3]	EU[3]

Notes:

1 = To be determined on a site-specific basis evaluating lack of feasibility to implement a 10^{-6} risk-based criterion.

2 = Calculated using Integrated-Exposure Uptake Biokinetic Model (IEUBK) Method).

3 = Value exceeds unity (Risk-Based Concentration is greater than 106 parts per million).

mg/kg = milligrams per kilogram, pCi/g = picocuries per gram, EU = Exceeds Unity

Table 6 - Summary of Cleanup Goals, Amended RAP Cleanup Goals, and State ACLs for Groundwater COCs

Contaminant of Concern	1987 RAP Cleanup Goal (mg/L)	2005 Amended RAP Cleanup Goal (mg/L)	2003 State Alternate Concentration Limit (mg/L)
Aluminum	None	None	7.9
Ammonium	None	None	6,900
Antimony	Background	None	None
Arsenic	0.05	None	None
Barium	1.0	None	None
Beryllium	Background	None	None
Cadmium	0.01	0.05	0.26
Chromium	0.05	None	None
Cyanide	Background	None	None
Fluoride	Background	4.0	None
Iron	None	None	130
Lead	0.05	None	None
Manganese	None	None	130
Mercury	0.002	None	None
Molybdenum	0.05 (during period of RAP activities), 0.01, SDWA MCL, or Background, whichever is higher (after conclusion of RAP activities)	See Notes	None
Natural Uranium	0.03 (During Period of RAP activities), 0.015, SDWA MCL, or Background, whichever is higher (after conclusion of RAP activities)	0.044	5.5
Nickel	Background	Background	21
Nitrate + Nitrite (as N)	None	None	1,360
Selenium	0.01	0.05	0.5
Silver	0.05	None	None
Sulfate	None	None	32,600
Thallium	Background	None	None
Thorium-230	None	None	8,200 pCi/L
Vanadium	Background	Background	None
Zinc	Background	5.0	None
Radium-226 + Radium-228	Background	5 pCi/L	None
Gross Alpha	Background	15 pCi/L	None

Note:

Background methodology for dissolved constituents pursuant to Addendum A of the RAP, and as amended. Exhibit referenced and modified from the five-year review report (EPA 2015). Values for molybdenum and natural uranium were revised to reflect the most recent version of 5 CCR 1002-41. The molybdenum standard in 2012 was changed to 0.21 mg/L.

pCi/L = picocuries per liter, mg/L = milligrams per liter, SDWA = Safe Drinking Water Act,

MCL = Maximum Contaminant Limits, RAP = Remedial Action Plan

Table 7 - Summary of Soil Cleanup Objectives, Average Residual Contaminant Values, and Exceedances in Soil

Description	One-Meter Gamma Exposure Rate, Average µR/hr	Surface Soil Radium-226 Concentration, Average pCi/g	Radium-226 pCi/g	Thorium-230 pCi/g	Natural Uranium mg/kg	Arsenic mg/kg	Cadmium mg/kg	Lead mg/kg	Molybdenum mg/kg	Nickel mg/kg	Selenium mg/kg	Vanadium mg/kg	Zinc mg/kg
Soil Cleanup Objectives													
Category 1 Maximum Concentration	20	7.1	7.1 [2] 17.1 [3]	7.1 [2] 17.1 [3]	8.4	21.4	2	164	2.3	25.1	11.2	60.1	422
Category 2 Maximum Concentration	N/A N/A	N/A N/A	7.1 [2] 17.1 [3]	14 [2] 43 [3]	220	21.4	75	400	370	1400	370	520	22000
Check of Category 2 Screening Levels Metals - EPA Regional Screening Levels (May 2016) for Residential Soil [11], Radionuclides - EPA residential PRGs based on 1E-06 cancer risk [12].	N/A	N/A	0.012	0.054	230	0.68 [13]	71	400	390	1500	390	390 (Vanadium and compounds), 460 (vanadium pentoxide)	23000
Category 3 Recreational Visitor Maximum Concentration	N/A N/A	N/A N/A	58	58	5.60E+03	*site specific*	1.90E+03	--- [4]	9.40E+03	3.40E+04	9.40E+03	1.30E+04	5.60E+05
Average Residual Concentration by Remediation Area[10]													
Atkinson Creek Crystal Disposal Area [5], surface	13.6	3.4	1.4	3.8	3.2	3.5	0.5	6.8	2.9	4.2	0.2	15.5	21.3
Club Ranch Ponds, surface	19.3	4.4	2.94	9.83	6.45	7.79	1.1	41.85	2	6.88	0.51	58.29	88.63
subsurface	N/A	N/A	1.25	8.3	4.14	7.51	1.09	37.45	2.04	10.79	0.53	39.75	89.08
River Ponds [6]	N/A	N/A	As allowed by RAP Section 4.3.2.(3), no soil sampling required as area excavated below water table										
Club Mesa Spray Area	N/A	7.1	As allowed by RAP Section 4.5.2.(3), no soil sampling required as area excavated to bedrock										
A-Plant, surface	15.8	4.2	2.5	2.7	6.9	2.4	0.3	7	0.7	5	0.2	63.8	21
subsurface	N/A	N/A	3.1	4.7	12.2	2.9	0.3	9	1	5	0.2	72.3	26
A-Plant North, [6] surface	19.5	3.7	2.54	5.36	12.35	6.54	0.50	11.15	1.00	6.71	0.76	48.77	30.00
subsurface	N/A	N/A	2.88	5.27	11.68	6.19	0.50	10.18	1.00	6.86	0.84	40.87	25.43
B-Plant, [7] surface	28.8	13.4	8.6	13.5	22.1	7.7	0.6	8.6	1.4	3.6	0.7	86.3	17.4
subsurface	N/A	N/A	8.3	9.6	9.5	33.3	0.2	12.3	5.7	18	1.2	79.8	29
Historic Structures Area	16.0	3.2	No soil samples were collected in this area, however direct measurements have shown that it meets RAP criteria.										
Windblown Area, Area E, [8] surface	16.1	N/A	6.9	13.8	25.4	4.5	0.5	14	ND	5.3	0.5	111.7	46.3
Mill Hillside, [8] surface	35.1	22.0	17.1	22.6	60.6	7.2	0.5	12.8	1.4	20.3	1.8	194.3	39.5
subsurface	N/A	N/A	10.5	12.7	33.3	6.3	0.3	8.8	1.1	10	1.3	124	31
County Road Y-11	N/A	4.5	No soil samples were collected in this area										
County Road EE-22 [9], surface	18.2	4.9	29.6	39.3	58.4	8.2	0.5	22.1	1.5	5	3	259	43
subsurface	N/A	N/A	29.2	39.6	59.2	9.2	0.7	49	1.3	6	2	320	39.8
Water Storage Ponds, surface	15.7	3.0	2.3	2.8	6.7	6.5	ND	8.8	1.1	4.9	ND	35	26
subsurface	N/A	N/A	1.8	1.7	5	6.3	ND	7.7	1.1	5	ND	29	27
Town Area, surface	16.9	4.3	2.9	4.9	10.2	7.4	0.6	38	1.6	8	1.2	45	129
subsurface	N/A	N/A	2.9	4.7	8.7	7.6	0.6	41	1.6	6	1	40	118

Table 7 - Summary of Soil Cleanup Objectives, Average Residual Contaminant Values, and Exceedances in Soil (continued)

Description	One-Meter Gamma Exposure Rate, Average µR/hr	Surface Soil Radium-226 Concentration, Average pCi/g	Radium-226 pCi/g	Thorium-230 pCi/g	Natural Uranium mg/kg	Arsenic mg/kg	Cadmium mg/kg	Lead mg/kg	Molybdenum mg/kg	Nickel mg/kg	Selenium mg/kg	Vanadium mg/kg	Zinc mg/kg
Average Residual Concentration by Remediation Area[10]													
Atkinson Creek Streambed	N/A	N/A	1.9	2.5	2.8	7	1	6.1	2	3.9	0.8	18.3	33.4
Hieroglyphic Canyon Streambed	25.5^	13.8	No confirmation investigation necessary as remedial activities performed as prescribed in *Materials Identification and Removal Plan*										
Northeast Highway 141 including Right of Way, surface	16.9	8.0	4.4	6	8.1	5.8	0.36	19.8	0.89	4.5	0.41	28.2	45.5
subsurface	N/A	N/A	2.8	4	5.3	6	0.3	15.3	0.92	5.2	0.24	23.1	44.7
CDOT Highway 141, subsurface	17.9	4.1	3.1	4.1	8.5	8.8	0.7	16.7	1.3	5.5	0.2	40	55.7
Town Dump, surface	13.8	2.5	1.4	3.2	6.1	5.1	ND	9.7	1.6	6.5	ND	32	29
subsurface	N/A	N/A	1.8	2.6	5.8	5.5	ND	11	1.8	6.7	ND	32	31

Key:

Category 1 Exceedance Category 2 Exceedance

Notes:

1. The information summarized in this table is from the Compliance Reports provided by CDPHE.
2. Surface cleanup criteria i.e. 0 to 15 centimeters
3. Subsurface cleanup criteria i.e. > 15 centimeters
4. See Table 2-3 in Site-Specific Soil Cleanup Objectives Rationale Document for Uravan Project, Colorado, dated June 1999.
5. The have been calculated from information given in Potential Health Significance of Residual Levels of Metals in Soils at the Atkinson Creek Crystal Disposal Area, Uravan, Colorado, Revision 1, dated April 12, 1994 to be consistent with the results provided in other reclamation area confirmation reports.
6. Alternate Soils Standards have been approved for the River Ponds, A-Plant North, the Mill Hillside, and County Road Y-11.
7. The B-Plant area will be transferred to the Department of Energy for long-term stewardship and will effectively restrict future use of the land and minimize future exposure.
8. Soils samples were only collected in Area E. Since sampling for windblown, only surface soil samples were collected. Laboratory analyses indicate that soils are NORM rather than windblown licensed materials.
9. Soil samples collected on September 15 – 17, 1998, as part of characterization investigation. Additional sampling not conducted after remedial activities as roadway was immediately backfilled with clean materials so that road traffic could be maintained in accordance with Montrose County requirements. CDPHE inspected excavated area and confirmed that all tailings material were removed.
10. Confirmatory Soil samples were collected on a 10 x 10-meter grid basis. Surface Soil= 0-15 cm, Subsurface Soil= 15-30 cm
11. Regional Screening Levels (RSLs) are based on EPA 2014 exposure assumption recommendations which vary from those used in the 1999 RSL table; in addition, toxicity values and/or relative bioavailability default values have been updated since 1999. Exposure pathways include: ingestion, dermal contact, and inhalation of particulates.
12. The PRG table values were released in 2014 and do not reflect December 2016 changes to PRG equations. Residential exposure pathways include: external exposure, ingestion, inhalation, and ingestion of fruits and vegetables. EPA 40 CFR 192: The concentration of radium-226 in land averaged over 100 m2 shall not exceed the background level by more the 5 pCI/g averaged over the first 15 cm of soil below the surface, and 15 pCI/g averaged over 15 cm thick layers of soil more than 15 cm below the surface.
13. Because the RSL for arsenic is below background; the background value is considered the appropriate value for IC determination.

* = Distance along streambed centerline.

^= The RAP Sections 4.7.2.4.1, 4.7.2.5.2 and 4.7.2.5.3 requires cleanup of Windblown Area, Atkinson Creek, and Hieroglyphic Canyon that are “concentrated, contaminated deposits” with exposure rates greater than 30 µR/hr. These results are from the characterization surveys as either no remediation or only limited prescriptive remediation was performed and as such no confirmation investigation was completed as noted in the Compliance Reports.

Table 8 - Summary of Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC)
Uravan Uranium Project (Union Carbide Corp.) Site, Montrose County, Colorado

	Statute and Regulatory Citation	ARAR Determination	Description	Comment	Chemical	Location	Action
Potential Federal ARARs							
1	Uranium Mill Tailings Radiation Control Title II 42 U.S.C. §§ 2113	Potentially Applicable	The Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978 (Public Law 95-604) is a federal law that provides for the safe and environmentally sound disposal, long-term stabilization, and control of uranium mill tailings in a manner that minimizes or eliminates radiation health hazards to the public. Uranium ore–processing sites addressed by Title II of UMTRCA were active when the act was passed in 1978. These sites were commercially owned and regulated under an NRC or Agreement State license. For license termination, the owner conducts an NRC-approved reclamation of any onsite radioactive waste remaining from uranium ore–processing operations. The site owner also ensures full funding for inspections and, if necessary, ongoing maintenance. DOE then accepts title to a site for long-term custody and care. DOE administers Title II sites under the provisions of a general NRC license granted under 10 CFR 40.28.	It is anticipated that portion of the Site will be managed for long-term custody and care by DOE under a general NRC license.			✓
2	Domestic Licensing of Source Material 10 CFR 40.28 (*General License for Custody and Long-Term Care of Uranium or Thorium Byproduct Materials Disposal Sites*)	Potentially Applicable	For DOE to accept title to a site for long-term custody and care, DOE administers Title II sites under the provisions of a general NRC license granted under 10 CFR 40.28.	It is anticipated that portion of the Site will be managed for long-term custody and care by DOE under a general NRC license.			✓

Table 8

Summary of Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBCs)

	Statute and Regulatory Citation	ARAR Determination	Description	Comment	Chemical	Location	Action
Potential Colorado ARARs							
1	Colorado Environmental Real Covenants Act CRS § 25-15-317 to 327	Potentially Applicable	Requires environmental covenant whenever environmental remediation project results in less than unrestricted land use or uses an engineered structure or feature that requires monitoring, maintenance or operation to function or that will not function as intended if disturbed.	Substantive requirements will be considered during the development of ICs.			✓
2	Institutional Controls Implementation Guidance CDPHE HMWMD, January 2012	To Be Considered	A policy outlining the process of evaluating, creating, modifying, terminating, and implementing environmental covenants and restrictive notices ("ECs/RNs"), as well as the ordinance/intergovernmental agreement mechanism.	Substantive requirements will be considered during the development of ICs.			✓

Table 9
Summary of Institutional Control (IC) Needs

Remediation Area	IC Needed?	Rationale
Atkinson Creek Crystal Disposal Area	YES	DOE LM - Average Category 1 Exceedance (Mo)
Club Ranch Ponds	YES	DOE LM - Average Category 1 Exceedance (Th), Discrete Category 2 Exceedance (Th)
River Ponds	YES	DOE LM - Alternative Soil Standards Area
Club Mesa Spray Area	YES	DOE LM
A-Plant	YES	DOE LM - Average Category 1 Exceedance (U, Th), Discrete Category 2 Exceedance (U, Th)
A-Plant North	YES	DOE LM - Alternative Soils Standards Area
B-Plant	YES	DOE LM - Exposure and Ra-226 Survey Exceedances, Average Category 1 Exceedance (U, Th, Mo, V), Discrete Category 2 Exceedance (U, Th, V), and Average Category 2 Exceedance (As)
Historic Structures Area	NO	Deleted from Superfund Site. UU/UE - Residential Hazard Index < 1 and Excess Cancer Risk < $1x10^{-6}$
Windblown	YES	Partial DOE LM - Average Category 1 Exceedance (U, Th, V)
Mill Hillside	YES	DOE LM - Category 2 Exceedances, Alternative Soil Standards Area
County Road Y-11	YES	DOE LM - Alternative Soil Standards Area
County Road EE-22	YES	DOE LM - Average Category 1 Exceedance (U, Th, Mo, V), Average Category 2 Exceedance (Ra, Th)
Water Storage Ponds	NO	UU/UE - Residential Hazard Index < 1 and Excess Cancer Risk < $1x10^{-6}$
Town Area	YES	Category 2 Exceedances (U)
Atkinson Creek Streambed	NO	UU/UE - Residential Hazard Index < 1 and Excess Cancer Risk < $1x10^{-6}$
Hieroglyphic Canyon Streambed	YES	No confirmatory sampling following hot-spot removal, Category 2 Exceedances (U, Th, V)
Northeast CDOT Highway 141	NO	Land use restrictions due to right-of-way
CDOT Highway 141	NO	Deleted from Superfund Site.
Town Dump	NO	DOE LM - UU/UE - Residential Hazard Index < 1 and Excess Cancer Risk < 1x10-6