U.S. DEPARTMENT OF ENERGY | Legacy Management

Program Update

January–March 2016

Welcome to the January–March 2016 issue of the U.S. Department of Energy (DOE) Office of Legacy Management (LM) Program Update. *This publication is designed to provide a status of activities within LM. Please direct all comments and inquiries to lm@hq.doe.gov.*

Observing the remedial and ecological changes from atop the Fernald Preserve On-Site Disposal Facility (from left to right) Yvonne Deyo (Navarro), Jonathan Graebener (U.S. Army Interagency Fellow), Tania Smith Taylor (DOE LM), Gwen Hooten (DOE LM), Bill Hertel (Navarro), David Klaus (DOE Deputy Under Secretary), and Bud Sokolovich (DOE LM).

Goal 1

Deputy Under Secretary Klaus Visits the Fernald Preserve in Ohio

On March 30, 2016, David M. Klaus, the Deputy Under Secretary for Management and Performance at the U.S. Department of Energy (DOE), traveled to the Fernald Preserve in southwest Ohio. The Office of the Under Secretary for Management and Performance has responsibility for the Department's primary mission support functions (i.e., management, procurement, human capital, information technology, safety and health, and project management) and two program offices (the Office of Environmental Management and the Office of Legacy Management [LM]). Mr. Klaus was joined by a member of his staff, Jonathan Graebener.

To start the visit, Mr. Klaus was given a briefing about the history of the Fernald site. The briefing included the uranium processing work from the early 1950s through the present-day LM mission of managing the land, contractor retiree benefits, and records, and maintaining the site's environmental remedies.

Following the briefing, Mr. Klaus was provided a tour of the Visitors Center exhibits. The tour included a discussion about the Center's role in building

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Goal 6

Preservationists Tour Historic Log Cabin at the Grand Junction, Colorado, Office

A working committee of local historic preservation specialists held their monthly meeting at the U.S. Department of Energy Office of Legacy Management (LM) Grand Junction, Colorado, Office on February 2, 2016. The group also participated in a private tour of the site's historic log cabin. The committee consists of representatives from the City of Grand Junction, Mesa County, and the Museums of Western Colorado.

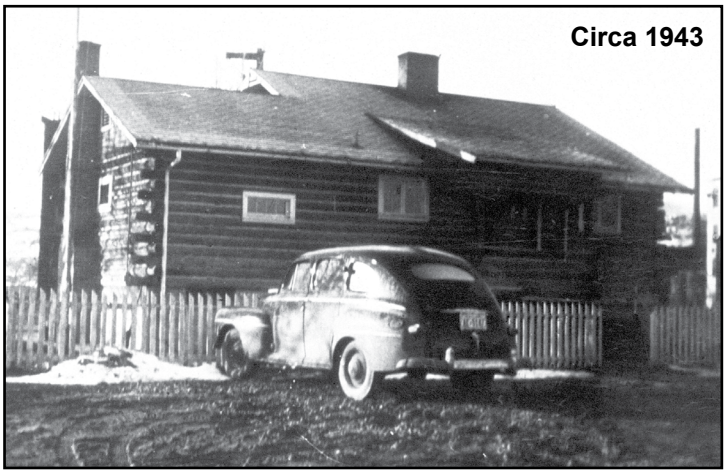
Dr. April Gil, Grand Junction Office Site Manager, provided a historical overview of the Grand Junction office, including the early use of the cabin, which has been nominated for inclusion on the National Register of Historic Places.

"We want to share the critical role this site had in the Manhattan Project as the center for uranium exploration and processing," Dr. Gil told her guests. "Uranium was key to developing nuclear technology and sparked many scientific innovations. We plan to restore the cabin and use it as a center for education and public outreach."

"Operations were shrouded in secrecy during the Cold War, but now we have the opportunity to tell the story of the Grand Junction office and the scientists and engineers who applied their talents to developing the domestic uranium industry. The mission of the Grand Junction office has changed since the Cold War; the focus is [now] on long-term stewardship for sites contaminated by uranium processing."

Due to early security measures, many area residents were unaware of the work being conducted at the site, so the cabin held great interest for the city and county preservationists attending the tour. The visitors explored

The log cabin office in 2012.



The log cabin office building surrounded by a picket fence. Photographer unknown, on file at the DOE Grand Junction, Colorado, Office.

what had been the World War II– and Cold War–era offices and the basement vaults, which, decades earlier, had secured classified records for the nation's secret "Project X."

In 1943, on what was once a 55.7-acre riverfront gravel mine, Army Second Lieutenant Philip C. Leahy established headquarters for domestic uranium procurement for the Manhattan Engineer District (MED). He didn't know it at the time, but his role was to find uranium ore and invent refining methods to process that ore for shipping to enrichment facilities for the development of nuclear weapons.

On the Colorado Plateau of western Colorado, the city of Grand Junction had been selected for its proximity to remote vanadium mines, the site's uranium-rich mill tailings, and the area's available labor pool and employee housing possibilities. A Denver & Rio Grande Railroad spur already served the site and an abundant supply of water was available from the Gunnison River, which flows around two sides of the property.

Working from the cabin and an office in downtown Grand Junction, Leahy directed construction of a refinery that processed green sludge from vanadium mills into yellowcake—concentrated uranium oxide compounds. The site grew to be the country's most important center for exploration, procurement, and experimental processing of uranium ores. The operation was located just behind a city cemetery and little more than a mile from downtown.

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Goals 1 and 5

Applied Studies and Technology: Training Course in Groundwater Geochemistry and Reaction Modeling

In September 2015, the U.S. Department of Energy Office of Legacy Management (LM) sponsored a three and a half–day, groundwater geochemistry and reaction modeling internal training course for federal and contractor staff at the Grand Junction, Colorado, Office. Course instructors were Dr. Raymond Johnson (LM contractor) and William Deutsch (private consultant). Participants had varied backgrounds and experience, but shared a goal to improve their understanding of geochemical data and its application to compliance for remediated sites. The course focused on the following basic geochemical reactions that occur in groundwater:

- Carbonate system
- Ion speciation
- Metal sorption/desorption
- Oxidation-reduction reactions
- Gas equilibrium
- Mineral precipitation

All are necessary for characterizing groundwater conditions at legacy uranium sites.

Specific uranium-transport examples demonstrated the potential for uranium migration at a legacy site. Participants learned how to use the geochemical modeling program pH-Redox-EQuilibrium in C programming language (PHREEQC), a free, publicly available code, developed and provided by the U.S. Geologic Survey (http://wwwbrr.cr.usgs.gov/projects/GWC_coupled/phreeqc/) for speciation, batch reaction, one-dimensional transport, and inverse geochemical calculations. This code allows users to input water quality data via an interactive interface to quantitatively test their possible reaction concepts. PHREEQC also allows for one-dimensional reactive-transport simulations, enabling participants to use their new-found "reaction toolbox" to simulate real-world scenarios.

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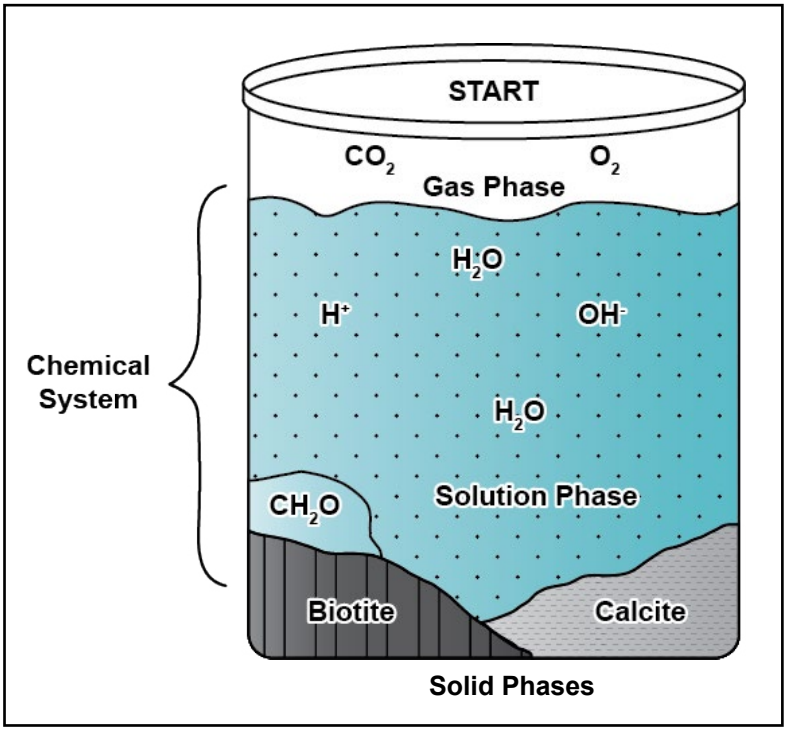
Dr. Raymond Johnson (LM contractor) shares information with students at the training course.



Groundwater geochemistry is the study and interpretation of water/rock/gas interactions as they influence the composition of groundwater.

Goal 4

Watershed Protection at the Fernald Preserve in Ohio

The U.S. Department of Energy (DOE), U.S. Fish and Wildlife Service (USFWS), and Ohio Environmental Protection Agency (Ohio EPA) are working with a local land trust organization to acquire conservation easements within the Paddys Run watershed. Funds for this effort are provided from a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) natural-resource damage settlement. DOE and Ohio EPA settled their claim in November 2008. As part of the settlement, DOE paid $13.75 million to compensate for natural resource injury. These settlement funds were appropriated for restoration, replacement, or acquisition of equivalent natural resources at or near the Fernald Preserve.

The Fernald Natural Resource Trustees (DOE, Ohio EPA, and USFWS) agreed to implement a watershed protection program that encompasses the Fernald site. Paddys Run is a stream that flows through the western portion of the preserve. Its watershed encompasses about 16-square miles, including most of the Fernald property (see aerial photo). By protecting the Paddys Run watershed (and therefore the water quality in Paddys Run and the Great Miami Aquifer), the Trustees are meeting their CERCLA obligations. The Paddys Run Conservation Project (PRCP) allows landowners within the watershed or the surrounding area to voluntarily preserve land via conservation easements or sale of property to a land trust organization on behalf of the Trustees.

The Trustees, through Ohio EPA, contracted with a local land trust—Three Valley Conservation Trust (TVCT). TVCT is a nonprofit organization and an accredited land trust through the Land Trust Alliance. TVCT contributes experience working with local landowners and state agencies to protect property through conservation and agricultural conservation easements. In addition, TVCT has an ongoing partnership with the U.S. Department of Agriculture (USDA), which is useful when expanding the reach of settlement funds. Conservation easements, or agricultural conservation easements, are the Trustees' primary tools for implementing watershed protection under the PRCP.

The Fernald settlement funds are eligible to act as matching grant funds for additional federal agency programs. TVCT's expertise working with the USDA Natural Resource Conservation Service's Farmland Protection program allows the Trustees to significantly expand the purchasing power of the available funds. TVCT had an agreement with USDA to implement grants from the former Farm and Ranch Land Protection Program. The agreement enabled TVCT to obtain funding from USDA for 50 percent of the properties' easement value, as long as they met program requirements and provided a 17-percent match for the federal funds. Thus the Trustees could purchase large-farm agricultural conservation easements for 17 percent of the easement value, with USDA providing the largest portion of the funding. The Trustees, through TVCT, are responsible for selecting properties and funding the significant property documentation required for the USDA applicants. USDA reviews and gives final approval of the applicant farms.

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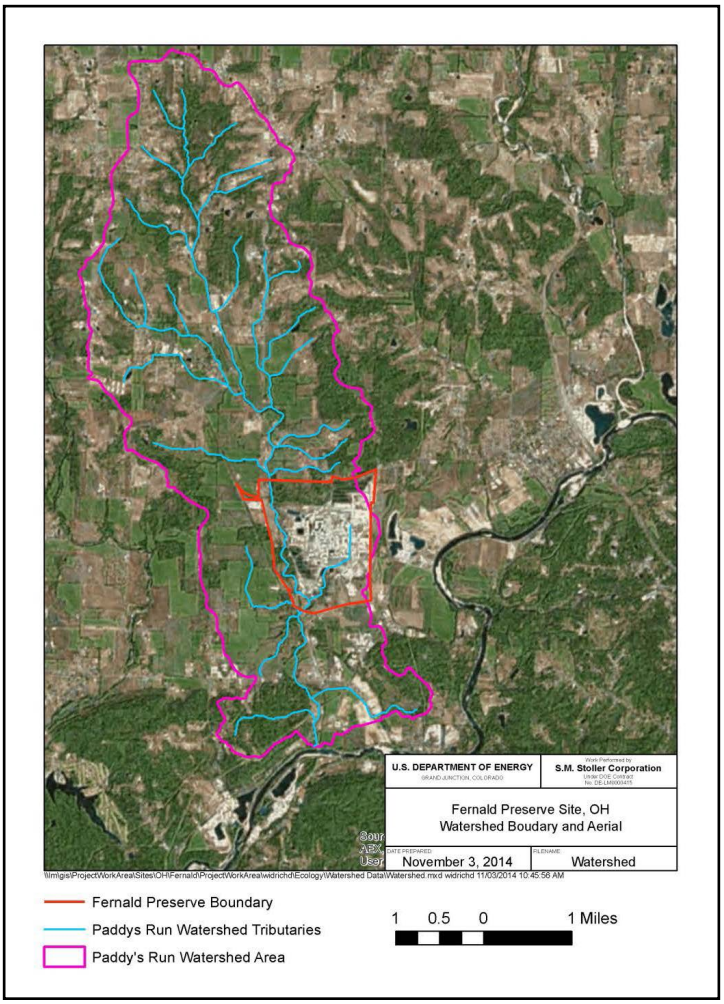

Fernald Preseve, Ohio, Watershed Boundary.

Goal 6

African Americans and the Manhattan Project

After the Manhattan Project, J. Ernest Wilkins, Jr. (1922–2001), served as president of the American Nuclear Society, received the Outstanding Civilian Service Medal from the U.S. Army, and the Lifetime Achievement Award from the National Association of Mathematicians.
(Photo courtesy of Dan Dry)

National African American History Month, February 2015, provided an opportunity to reflect on the contributions of African Americans to the Manhattan Project. The majority of African Americans on the project were employed as laborers at Oak Ridge, Tennessee; and Hanford, Washington. Performing necessary, often-overlooked work at the sites, they endured separate and unequal conditions due to segregation. Today, the U.S. Department of Energy Office of Legacy Management (LM) is responsible for several sites where African Americans once worked on the Manhattan Project as scientists, technicians, and in one instance, a factory owner. Those LM sites include the Chicago South, Illinois, Site; the Site A/Plot M, Illinois, Decommissioned Reactor Site; and the Columbus East, Ohio, Site.

Prior to the Civil Rights Movement, many colleges barred African American enrollment. However, the University of Chicago (UChicago) had welcomed black students since its founding in 1890. Carter G. Woodson graduated from UChicago with a master's degree in European history in 1908. Remembered today as the "Father of Black History," Dr. Woodson earned his PhD at Harvard University, founded the Association for the Study of Negro Life and History, and became the driving force behind what is now African American History Month. By the early 1940s, UChicago had granted more doctorate degrees to African Americans than any other institution in the United States.

During World War II, UChicago was home to the Manhattan Project's Metallurgical Laboratory—known as Met Lab. Ten of the roughly 15 African Americans who worked on the Manhattan Project were employed at Met Lab as scientists or technicians. Several of them attended UChicago before joining the lab.

George W. Reed (1920–2015), senior scientist at Argonne National Laboratory.

- Jasper Brown Jeffries – MS in physics, 1940
- Jesse Ernest Wilkins, Jr. – PhD in mathematics, 1942 (at age 19!)
- Moddie Daniel Taylor – PhD in chemistry, 1943
- Edwin Roberts Russell – Pursuing a PhD when he was recruited by Met Lab

Others employed at the lab remained at the university after the war, to further their education.

- George Warren Reed, Jr. – Arrived at Met Lab with an MS from Howard University and stayed on at UChicago to earn a PhD
- Benjamin Franklin Scott – Joined the project with a BS degree from Morehouse College and went on to earn an MS at UChicago

Several African Americans working at Met Lab attended various other colleges and universities.

- Harold Delaney reported to Met Lab with an MS from Howard University and eventually returned to Howard for his PhD

Harold Delaney (1919–1994) served as a faculty member at Morgan State for more than 2 decades.

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Goals 1 and 6

LM Updates Stakeholders on the Recent Closure of Central Nevada Test Area

On January 20, 2016, the U.S. Department of Energy (DOE) Office of Legacy Management (LM) met with the Nevada Site Specific Advisory Board (NSSAB) in Beatty, Nevada, to present information on the recently finalized closure report for the Central Nevada Test Area (CNTA) subsurface Corrective Action Unit (CAU) 443. The meeting presentation included background information on CNTA and summarized the site's closure process and long-term monitoring strategy.

The NSSAB comprises volunteer members who represent Nevada stakeholders by reviewing and commenting on environmental restoration (e.g., groundwater contamination, cleanup of the historic nuclear test area, etc.) and waste management (e.g., radioactive waste transportation and disposal) activities at the Nevada National Security Site (NNSS)—formerly known as the Nevada Test Site. Members offer a public perspective of the environmental restoration, while also including rural interests, environmental concerns, and local-government viewpoints. NSSAB functions as an educational and informational link to the community by providing residents the opportunity to review and comment about environmental activities associated with NNSS.

Attending the meeting were community members and representatives from the Nevada Division of Environmental Protection (NDEP) and the National Nuclear Security Administration. The presentation was well received by all attendees. "It was a great opportunity to share site-specific information with the community, as well as the corrective action strategy innovations that were implemented by LM during the closure process," said Mark Kautsky, LM Site Manager.

During the briefing, Kautsky described the history of CNTA, including the underground nuclear test, which was code-named the Faultless Test, and the site's corrective action strategy and closure process. Since acquiring CNTA's long-term stewardship responsibilities in 2006, the site-closure strategy included drilling programs in 2009 and 2013, to enhance the monitoring-well network; demonstrating the monitoring network's adequacy for long-term surveillance; and validating the compliance boundary through monitoring efforts. The closure strategy was developed by LM and approved by NDEP.

Mark Kautsky, LM Site Manager, presents information on CNTA to NSSAB members.

Surface casing for UC-1 (emplacement borehole).

Now that the closure report is complete, the task to expand the land withdrawal to encompass the entire compliance boundary remains. Kautsky stated that the land withdrawal will add approximately 360 acres to the existing withdrawal area and LM will be working with its support contractor and the U.S. Bureau of Land Management during the next year to complete the closure process. ❖

Goal 1

LM Organizes Conference Session on Uranium Studies

Wednesday, December 16, 2015, the U.S. Department of Energy Office of Legacy Management (LM) convened a special session at the American Geophysical Union (AGU) meeting in San Francisco, California. The session "Uranium Mobility in the Environment," was organized by Bill Dam, LM; John Bargar, SLAC National Accelerator Laboratory; Mark Brusseau, University of Arizona; and Paul Reimus, Los Alamos National Laboratory.

The conference session goal was to bring together researchers working on various aspects of uranium studies to discuss legacy waste site stewardship and groundwater remediation options. LM is conducting numerous studies and collaborating with several organizations that presented at AGU to better understand persistence of contaminant plumes, determining why site performance may vary from model predictions, and finding technological solutions to improve site performance. Thirty-one abstracts were received and divided into seven oral talks and twenty-four poster presentations. Fifteen universities and eight federal organizations participated in authorship of the presentations.

Twelve LM uranium mill tailings sites were discussed during the session including sites in Arizona, Colorado, Idaho, New Mexico, Oregon, Washington, and Wyoming. Additional sites not managed by LM were also discussed including: the White Mesa Mill at Blanding, Utah; uranium mine sites at the Grand Canyon in Arizona; and Jackpile mine on Laguna Pueblo, New Mexico; active in situ uranium mines in Texas and Wyoming; and a site at Lawrence Livermore National Laboratory in California.

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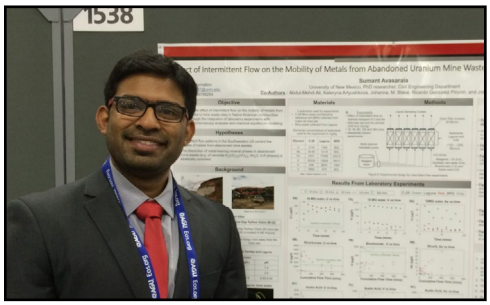
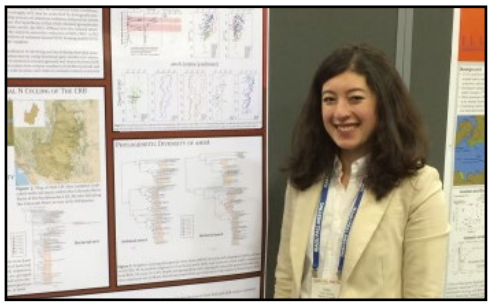
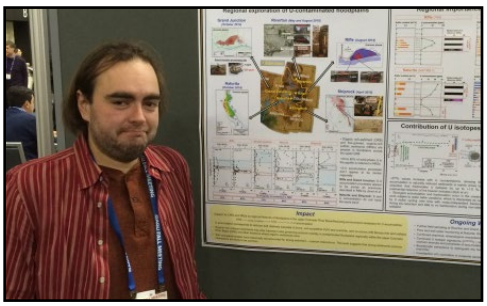


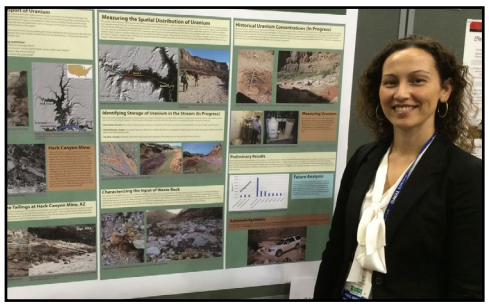
Sumant Avasarala, University of New Mexico, "Effect of intermittent flow on the mobility of metals from abandoned uranium mine waste sites on Native American land."



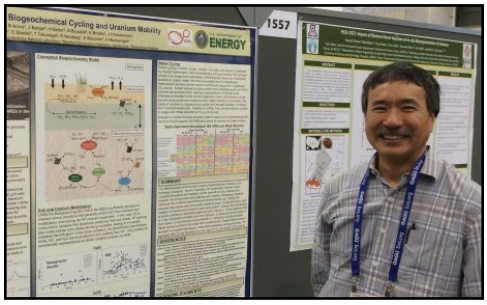
Emily Cardarelli, Stanford University, "Subsurface microbial nitrogen cycling communities of uranium contaminated sites."



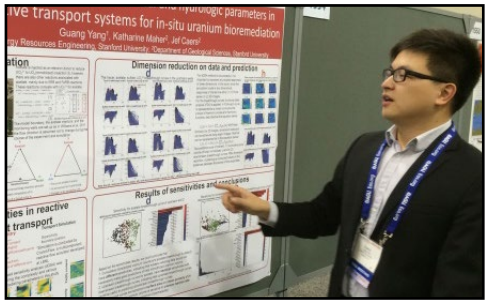
Vincent Noel, SLAC, "Combining uranium speciation and uranium isotopes to evaluate the importance of naturally reduced organic-rich sediments in controlling the mobility of uranium in the upper Colorado River basin."



Katherine Skalak, U.S. Geological Survey, "Quantifying uranium transport rates and storage of fluvial eroded mine tailings in the Grand Canyon region."



Steve Yabusaki, Pacific Northwest National Laboratory, "Floodplain water table dynamics: Biogeochemical cycling and uranium mobility."



Guang Yang, Stanford University, "Sensitivity of geological, geochemical and hydrologic parameters in complex reactive transport systems for in situ uranium bioremediation."

Goal 6

Updated Radiation Exhibit Unveiled at Math and Science Center in Grand Junction, Colorado

A newly updated radiation exhibit, created by the U.S. Department of Energy (DOE) Office of Legacy Management (LM) office in Grand Junction, Colorado, was recently unveiled at the John McConnell Math and Science Center. The January 7, 2016, Family Night event also introduced other new collections, including a bird-watching exhibit and a 3D virtual erosion table. The newest exhibits reinforce the Center's aim to demonstrate its increased focus on STEAM—science, technology, engineering, art, and math—education.

LM's new "Radiation and You" exhibit combines information and demonstrations from its previous display with updated information and feedback from stakeholders wanting to know more about naturally occurring and human-made sources of radiation, and ways to reduce exposure to our surroundings and ourselves. Also, incorporated are eye-catching graphics, a radioactive-material detector (Geiger–Müller probe), testing materials, a questionnaire for pre- and post-testing responses, and a feedback survey.

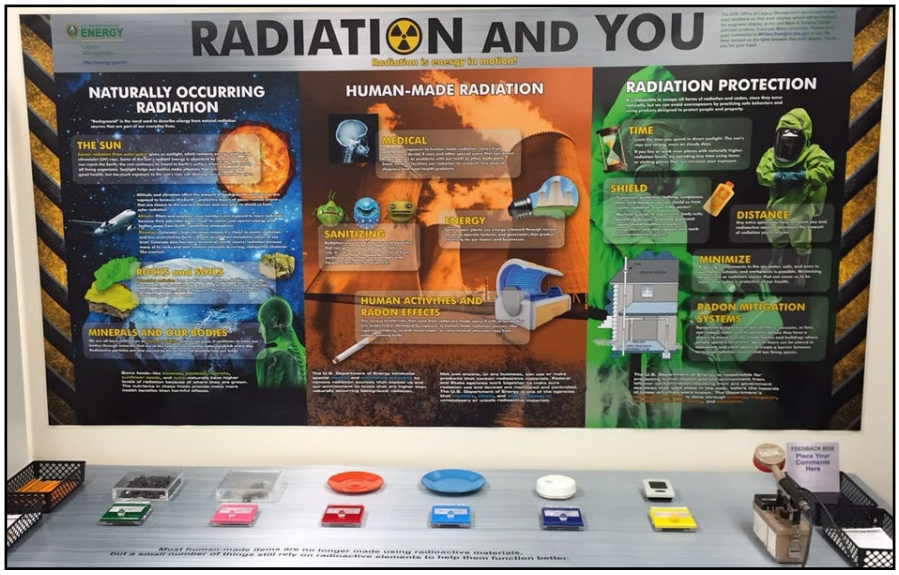
Physicist John McConnell spent 16 years of his 30-year scientific career at Los Alamos National Laboratory in New Mexico. When he decided to retire, John filled the trunk of his car with a variety of scientific materials, and created a mobile laboratory to deliver experiments and presentations to school-age children throughout western Colorado.

As his traveling science center grew in popularity, so did the number of exhibits and equipment. In January 2000, with assistance from enthusiastic contributors, John created a more grounded, interactive learning establishment in a Grand Junction elementary school. It was originally named the Western Colorado Math and Science Center.

LM's original exhibit in the Center was geared toward high school–level students, but in recent years, attendance by elementary-aged children increased. For its updated display, LM obtained reviews from experts with the Colorado Department of Public Health and Environment.

A unique collaboration between the John McConnell Math and Science Center and the local Colorado Mesa University's growing engineering program will allow the Center to relocate to a larger facility within the University's campus. The new, central location will provide the perfect venue by allowing greater accessibility to a larger, more age-diverse audience.

LM continues to meet its outreach and education goals by staying involved and contributing this—and hopefully more—informational exhibits to centers and events designed to keep students and the community excited about STEAM concepts. Informing the community about LM's history with uranium, and continuing activities will ensure its actions protect human health and the environment for decades to come. ❖



Visitors can use the Geiger–Müller probe (at right) to detect radiation levels in an assortment of provided materials..

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Watershed Protection at the Fernald Preserve in Ohio

Ohio EPA worked with TVCT to develop property selection criteria for funding conservation easements, based upon the Trustees' goals to protect the Paddys Run watershed and underlying Great Miami Aquifer. TVCT is responsible for monitoring the easement properties in perpetuity. As part of the Trustee funding, an endowment is established for long-term monitoring and legal support to TVCT to enforce easement terms. TVCT conducts annual easement property inspections to ensure easement terms are followed.

As of January 2016, almost 3,000 acres have been established as conservation easements. An additional 169 acres have been purchased by TVCT. Settlement funds are being used to ecologically restore the purchased properties, with plans to donate the properties to the Metro Parks of Butler County. The project has been a success. The collaboration of the various organizations and open communication with the public are key factors in that success. As a result, the PRCP has surpassed its goals to protect the Paddys Run Watershed and Great Miami Aquifer. ❖

Fernald Preseve, Ohio.

Goal 2

LM—First DOE Office to Make Geospatial Data Available on Geoplatform.gov

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) manages Cold War legacy site environmental records spanning nearly 40 years. These records are key assets and must be managed and maintained efficiently and effectively. LM staff partnered with EarthSoft, Inc., to implement the cradle-to-grave environmental management system, which is tentatively planned to go live in spring of this year.

LM also upgraded its Geospatial Environmental Mapping System (GEMS) (http://gems.lm.doe.gov). Stakeholders, regulators, and project personnel can use GEMS to display data and information in several forms, such as interactive tabular reports, graphs, geospatial displays, or map views with labeled or highlighted data.

In addition to this modernization effort, LM has chosen to submit its data to Data.gov and GeoPlatform.gov. Data.gov is a government website, launched in late May 2009, developed to improve public access to high value, machine-readable datasets generated by the Executive Branch of the federal government. Data.gov has grown from launching 47 datasets to over 180,000.

GeoPlatform.gov is an offshoot of Data.gov focused on enhancing geospatial resource sharing for our government and worldwide. This resource allows users to participate in an online, geospatial services experience. In addition to supporting the ideals of an open, transparent government, both websites provide access to authoritative, trusted, consistent, and documented data. Access to quality data is invaluable and LM is proud to be the first DOE office to have geospatial data available on the GeoPlatform.gov. ❖

Goal 1

Paddys Run Streambank Stabilization at the Fernald Preserve in Ohio

Streambank stabilization was performed along a 475-foot stretch of a stream on the Fernald Preserve property in Hamilton County, Ohio. Paddys Run travels south, along the western side of the Fernald Preserve (see map at right). The Paddys Run watershed encompasses nearly 16 square miles, which includes most of the Fernald site.

Field personnel conducting routine site inspections in March 2014 observed that Paddys Run was migrating east, via bank erosion into the Pit 3 Swale (see figure on page 15). Elevated concentrations of uranium have been found in surface water within this area. The specific locations are actually puddles that are dry for portions of the year. Soil in this area was certified pursuant to site regulatory agreements and meets the final remediation level for uranium. The U.S. Department of Energy (DOE) Office of Legacy Management (LM) investigated the issue in 2007 and concluded that the elevated concentrations were likely due to variability in the soil's residual uranium leachability. This issue is detailed in the 2011 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) *Third Five-Year Review Report for the Fernald Preserve*.

During normal flow conditions, the puddles do not drain into Paddys Run. Groundwater underlying the swale area is also contained within the capture zone for an onsite extraction well. Furthermore, the swale is not located near a publicly accessible area. For these reasons, regulators agreed to allow LM to continue weekly monitoring with the expectation that surface-water concentrations would reduce over time. Declines in one of the two locations have been observed so far. Weekly sampling results are presented annually in the *Fernald Preserve Site Environmental Report*.

Recent Paddys Run migration into the Pit 3 Swale area was rapid (see photo on page 15). The stream meandered east—approximately

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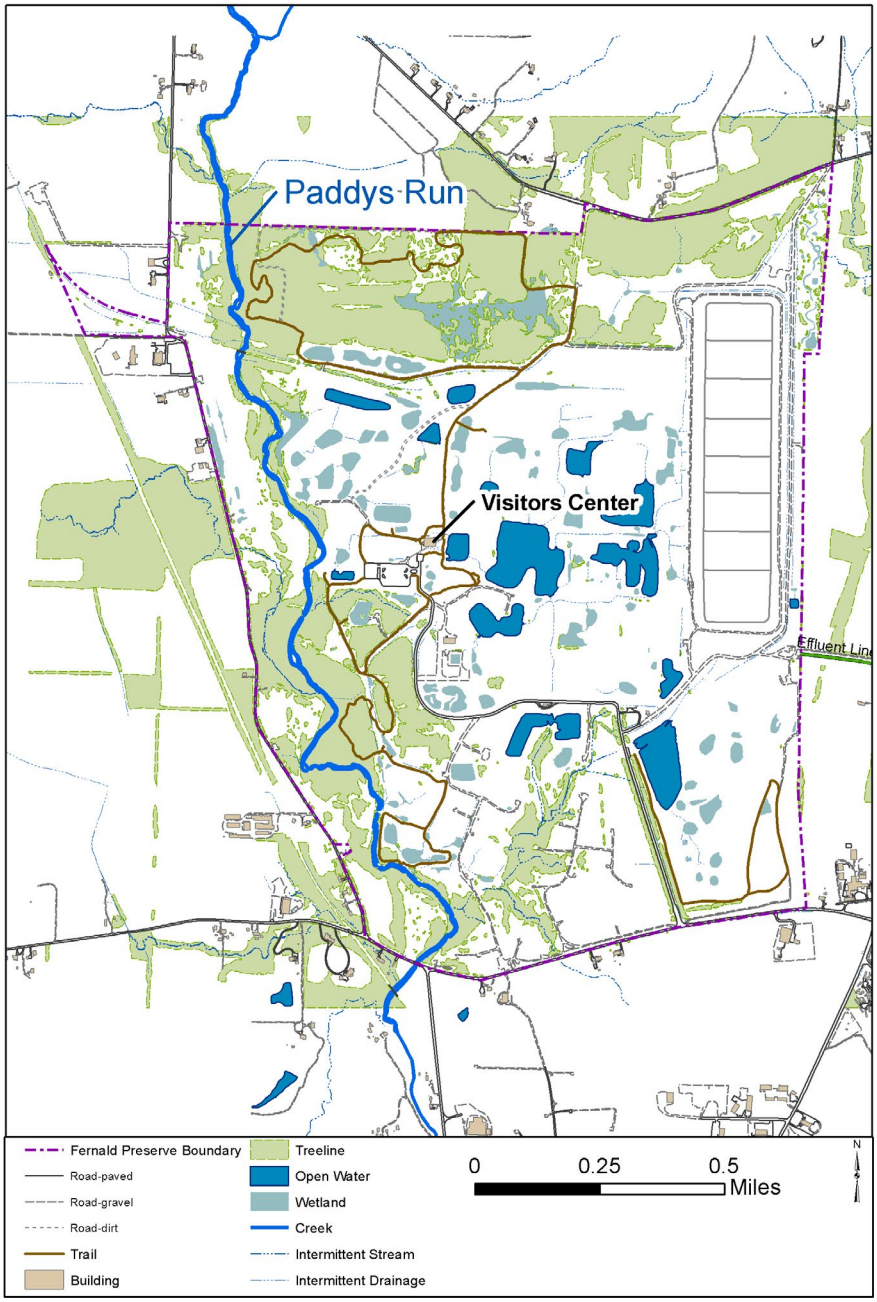

Fernald Preserve site map.

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LM Organizes Conference Session on Uranium Studies

Several presentations evaluated natural flushing regulatory compliance strategies as well as enhanced-bioremediation technology alternative remediation strategies. Uranium mobility in water is controlled by the oxidation-reduction (redox) state where uranium is immobile as U(IV) under reducing conditions, but is mobile and generally soluble as U(VI), under oxidizing conditions. Many solutes in addition to oxygen (including species of calcium, organic carbon, iron, nitrogen, and sulfur) help control uranium mobility through chemical bonding or redox reactions.

Advanced techniques discussed included:

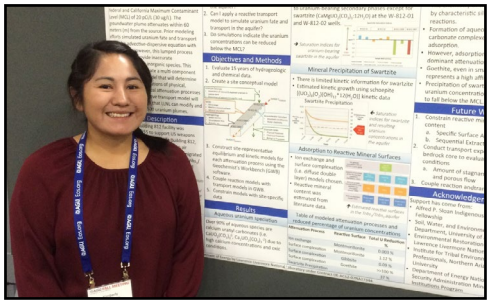
- Field sampling methods using trenching and sonic drilling
- Tracer testing and monitoring of pore water via subsurface samplers
- Laboratory column testing
- Numerical modeling of hydrology
- Biogeochemistry with reactive contaminant transport

Areas and processes contributing uranium to groundwater was the overarching theme of the conference. Many former mill tailings processing sites were situated adjacent to rivers, which provided abundant water supply for milling the ore during the mid-20th century. Rivers are subject to seasonal flooding and fluctuating groundwater levels which can introduce oxygen and transfer remnant sources of uranium from soil and rocks to groundwater.

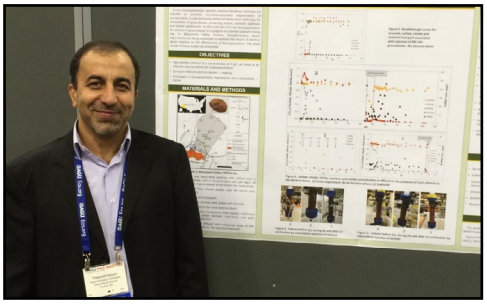
Even at sites where mill tailings were removed, supplemental standards areas are shown to supply residual sources of uranium to groundwater that result in exceeding regulatory standards. For example, at the Rifle, Colorado, site, episodic contact between shallow groundwater and residual contamination resulted in a 20-fold increase in uranium concentrations to seasonally replenish the plume. Additionally, uranium in groundwater plumes that contact shallow sediments and naturally reduced zones may be retained and re-released at future times, contributing to long-term persistent plumes. Uranium oxidation and leaching during a high-river stage may occur via abiotic chemical reactions. In comparison, the onset and maintenance of reducing conditions in naturally reduced sediments or, conversely, the generation of oxidants such as denitrification products (e.g., NO_2-), requires microbial activity.

Microbiological activity consumes oxygen, leading to the onset of reducing conditions, under which uranium reduction and immobilization occurs. Uranium reduction can be stimulated by injecting soluble electron donors such as vinegar (acetate) or ethanol into an aquifer, a remediation strategy known as biosequestration. LM, in partnership with the University of Arizona at the Monument Valley, Arizona, site on the Navajo Reservation, is finding that adding ethanol to groundwater can promote biological activity which can reduce uranium and other elements. Results indicate this may be more effective than acetate, which was tested previously at the Rifle site.

Organizing and participating in the AGU conference session support LM's Goal 1 activities, protect human health and the environment. Direct, positive contributions are being made toward continued studies at key LM sites by refining conceptual models, generalizing key processes, and evaluating remediation strategies at many similar LM sites. This produces substantial cost savings by limiting detailed site information requirements. ❖



Kimberly Danny, University of Arizona, "Attenuation and transport mechanisms of uranium at LLNL Site 300 Building 812."



Sayyed-Hassan Tabatabaei, University of Arizona, "Impact of electron donor injection on in situ biosequestration of uranium."

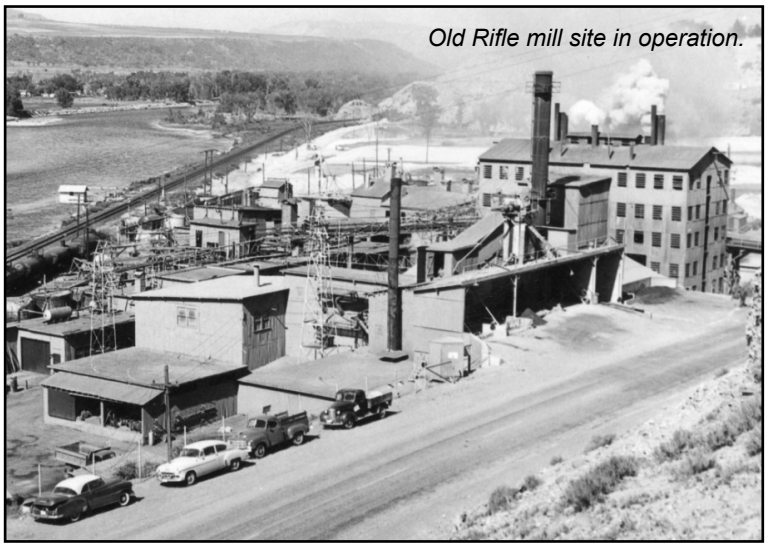
Goal 1

Uranium Mining and Milling near Rifle, Colorado

The small town of Rifle, Colorado, has an interesting history related to uranium and vanadium production. A mineral found near Rifle, called roscolite, contains both vanadium and uranium but was originally mined and milled for its vanadium content. Union Carbide Corporation began milling the ore in 1924 at what is now referred to as the Old Rifle mill site.

The plant was shut down in 1932 due to a poor market, but reopened in 1942 to produce vanadium for the war effort. The mill was left abandoned along with several million tons of unprocessed ore. In 1946, the plant was torn down and a new one built on the site to recover uranium. Vanadium is still used in the process of hardening steel. Additional ores were mined and milled for the uranium content from other sites in Colorado. Concentrated ores from Slick Rock, Colorado, and Green River, Utah, were processed at the Rifle mill in the 1960s at what is referred to as the New Rifle mill site (Merritt, 1971).

Much of the uranium present in economic concentrations occurs in the desert southwest, so most of the products' mines and mills were located on the Colorado Plateau, which extends from the U.S. Four Corners states north into Wyoming. Many of the mines and mills in this area supported the effort to produce uranium during World War II and the Cold War era. In 1978, Congress recognized the public health hazards associated with access and exposure to uranium mill tailings and the Uranium Mill Tailings Radiation Control Act (UMTRCA) was enacted.



Old Rifle mill site in operation.

The principle health threat associated with uranium mines, ore, and tailings is the accompanying colorless, odorless radon gas, which is radioactive and heavier than air, so it settles and accumulates in low places, such as crawl spaces and basements.

Through a number of chemical processes vanadium, and then uranium, were precipitated from solution at the Old Rifle mill. This eventually resulted in yellowcake—a uranium oxide product. The yellowcake was sent to Hanford, Washington, for further processing into plutonium, or to Oak Ridge, Tennessee, to produce uranium metal.

Ammonia was used for neutralization at the Rifle mill sites to create precipitation. Open, unlined ponds were used for slimes settlement and waste solutions storage at many mill sites. Process chemicals leached into the ground and resulted in the groundwater contamination we observe today.

Continued on page 23

Old Rifle mill site following cleanup and reclamation by DOE.

New Rifle mill (left), pond (middle), and tailing pile (right) during operation.

Continued from page 2

Preservationists Tour Historic Log Cabin at the Grand Junction, Colorado, Office

Project X was hidden in plain sight. When the MED mission ended upon Japan's surrender, the Grand Junction facility stopped refining operations and transitioned to being the principal U.S. Atomic Energy Commission (AEC) office for acquiring and exploring domestic uranium sources for nuclear weapons production during the Cold War.

The facility later housed program operations for National Uranium Resources Exploration (NURE), the Uranium Mill Tailings Radiation Control Act (UMTRCA), vicinity properties cleanup, decontamination and decommissioning, and, since 1985, for long-term surveillance and maintenance of legacy sites.

Kaye Simonson, senior planner who oversees historic preservation for Mesa County, was among the group of local preservationists who met first for a presentation by Dr. Gil and then toured the log cabin.

Dr. Gil, LM GJO Site Manager (second from right), and Jalena Dayvault, LM Hydrologist/Site Manager, (second from left), show local preservationists the log cabin's 1943 refinery office.

"Mesa County is happy to support efforts to list the DOE's Grand Junction site on the National Register of Historic Places, which will help increase public awareness and appreciation of its very significant role in the modern history of the area, as well as the nation," Simonson said. "The idea of creating an interpretive center in the cabin is particularly interesting, providing a venue to tell the important story of the Grand Junction site and all the contributions that have been made as a result of the work done here. It has the potential to provide educational opportunities for our local students, and will also be an attraction to visitors. We look forward to seeing the project going forward, and believe it will be a great asset to the community."

Eight acres of site property were transferred from DOE to the U.S. Army Reserve in 2001. The remaining property was transferred to Riverview Technology Corporation (RTC), a nonprofit business-development entity sponsored by the City of Grand Junction and Mesa County. DOE now rents its LM office space from RTC.

A little more than 25 acres of the original Grand Junction office footprint, including the cabin; 15 main buildings; and 16 ancillary buildings, structures, and sites; have been nominated for inclusion on the National Register of Historic Places.

Many artifacts have been donated by DOE, and the local museum will assist in curating those artifacts for display at the learning center, which is expected to host tour groups from schools and the public, showcase informative displays, and provide a meeting room for presentations.

The learning center is scheduled for completion in fall 2017, before the Grand Junction site's 75-year anniversary in March 2018. ❖

LM is continually seeking opportunities to protect natural resources and the future. One simple step we can take toward improving environmental consciousness is to distribute the *Program Update* newsletter by email instead of sending a printed copy.

Please send your email address and your first and last names to lm@hq.doe.gov so that we can update our database. Thank you for your assistance.

Continued from page 5

African Americans and the Manhattan Project

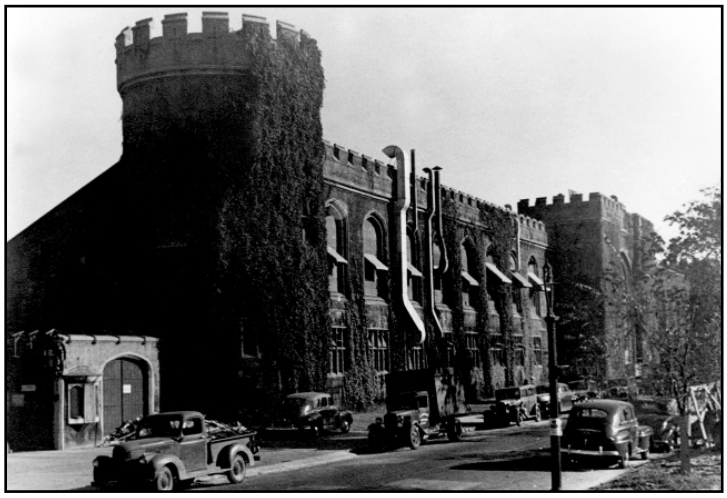
After his time at Met Lab, Ralph Gardner-Chavis (1922–) became a professor at Cleveland State University.

Lloyd Albert Quarterman (1918–1982) worked at Argonne National Laboratory for 3 decades.

- Harold Bethuel Evans, Jr., arrived with an MS from Michigan State College and, years later, retired from Met Lab's descendant, Argonne National Laboratory
- Ralph Gardner-Chavis held a BS from the University of Illinois—he later attended Case Western Reserve University for his PhD
- Lloyd Albert Quarterman had already earned his BS from St. Augustine's College in North Carolina and after the war, earned his MS from Northwestern University in Illinois

Met Lab led the research that produced plutonium through nuclear reaction and chemical separation. Among its other accomplishments, the lab constructed the world's first reactor, Chicago Pile-1 (CP-1), which was built on a squash court under a stadium at UChicago. Early in 1943, CP-1 was dismantled and moved to a remote location named Site A in the Argonne Forest outside of Chicago.

After proving that reactors could create plutonium, Met Lab's next step was to devise a way to mass produce the element. Battelle Memorial Institute, a research and development organization in Columbus, Ohio, was enlisted to determine how to form uranium rods that could be made into fuel for plutonium production reactors. With Battelle on board, a search ensued to find a nearby fabrication shop that could



Met Lab built the world's first nuclear reactor under the west stands at University of Chicago Stagg Field.

Met Lab's Site A outside of Chicago as it looked in the 1940s.

extrude uranium rods. Luckily, B&T Metals Company was only about 3 miles from the institute. B&T, purchased in 1932 by entrepreneur Lyman Kilgore, was one of the first African American-owned factories in the United States.

B&T specialized in manufacturing aluminum pieces for decorative trim on countertops and carpet edges. But most important, it had an in-house extrusion press. A purchase order was quickly put into place, and from March through August 1943, B&T extruded more than 35,300 pounds of uranium for Met Lab and more than 300,800 pounds for Oak Ridge. The work conducted at B&T also helped the Manhattan Project by determining what temperatures, pressures, and dimensions were best suited for extruding uranium rods.

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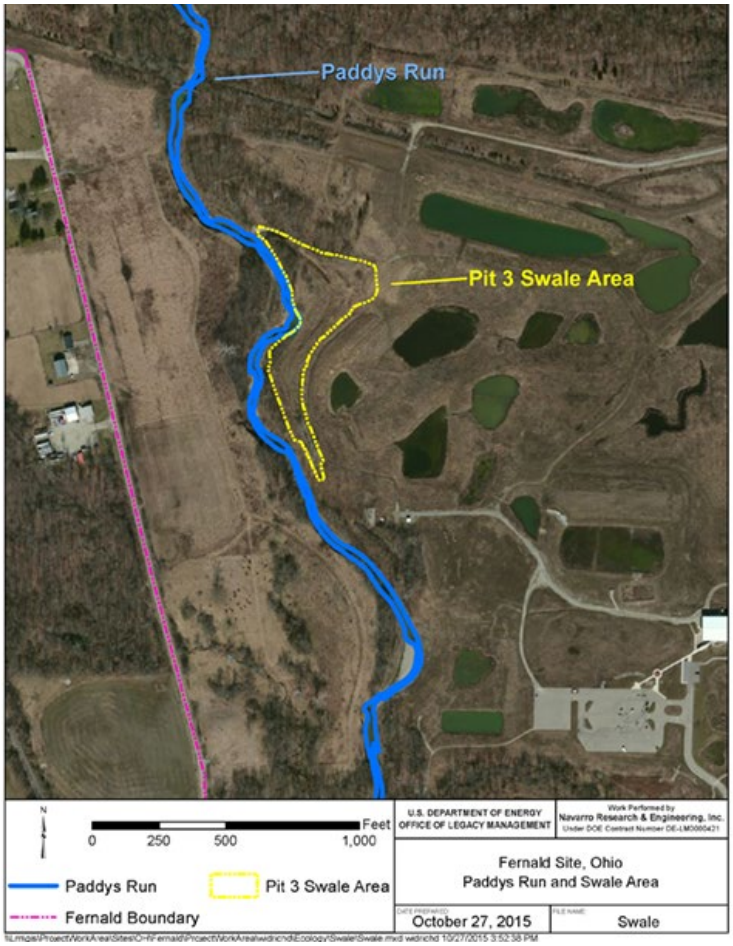
Paddys Run Streambank Stabilization at the Fernald Preserve in Ohio



Pit 3 Swale area located between Paddys Run and the former waste storage area.

The severely eroded Paddys Run streambank.

13 feet in 2 years—and was approaching the closest sample location. At this pace, the stream was expected to alter the stable conditions that allowed swale-area monitoring to continue. Therefore, LM and its regulators determined in May 2014 that the east bank of Paddys Run required stabilization.

Project design included the following components:

- Relocating over 475 feet of streambed approximately 30 feet to the west
- Installing a rock toe along the east bank (see photo on page 19)
- Installing two cross-vane, in-stream, grade-control structures (see photo on page 19)
- Stabilizing a portion of the east bank using soil-encapsulated lifts, and regrading, seeding, and planting within the remaining disturbed areas

Compliance issues included meeting substantive Clean Water Act Section 404 permit (i.e., Nationwide Permit No. 38) requirements, and several measures to avoid impacting threatened and endangered species. A bat emergence survey was conducted to determine whether federally endangered Indiana bat (*Myotis sodalis*) or northern long-eared bat (*Myotis septentrionalis*) species were present. The project area encompasses summer breeding habitat for these species. While no bats were observed, DOE committed to minimize tree loss and to avoid any vegetation removal until after October 1, 2014.

Sloan's crayfish (*Orconectes sloanii*) is a state-threatened species that inhabits Paddys Run. Areas that would be disturbed by construction activities were seined on several occasions, in an effort to relocate Sloan's crayfish and native fish species upstream of the project area. Relocation was identified as the proper action in the *Integrated Environmental Monitoring Plan*, which is an attachment to the *Fernald Preserve Legacy Management and Institutional Controls Plan*.

Paddys Run is a "losing" stream, which means that flowing water infiltrates through sand and gravel into the groundwater table. This results in a dry stream at certain times during the year. In order to take advantage of these conditions, construction was initiated in September 2014.

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Goal 2

LM and NETL Records Staff Collaborate on Disaster Preparedness

U.S. Department of Energy Office of Legacy Management (LM) Business Center personnel were recently challenged to rethink how they would approach a disaster affecting LM records. The challenge was a key component of an emergency response exercise held at the LM Business Center in Morgantown, West Virginia, in mid-February.

"The LM Business Center holds records that are critical to the LM mission," explained Doc Parks, LM Archives and Information Management Team Lead. "We have an obligation to ensure we are ready for any situation that puts these records at risk."

The annual exercise is conducted to challenge staff with out-of-the-ordinary situations and improve cross-functional communications in the event of an emergency. LM invited DOE's National Energy Technology Laboratory (NETL) records management staff to join the records disaster preparedness discussion. Records management personnel from the LM Grand Junction, Colorado, Office also participated in the exercise, to share their expertise and consider how the exercise findings could be applied to the Grand Junction records storage area.

Specifically, exercise participants reviewed the events surrounding a 2015 water leak that affected a NETL records storage area. That real-life experience was contrasted with the results of a recent LM disaster exercise that simulated a sprinkler leak in the LM Business Center's records storage facility.

The discussion regarding NETL's experience with a flooded records storage area allowed LM records personnel to take a critical look at their processes and procedures relating to a flood. NETL's lessons learned are also applicable to LM's disaster prevention and recovery plans.

Through the exercise, LM personnel were able to take a closer look at their recovery equipment, disaster recovery contracts, and training. The collaboration showed that LM may want to explore training for in-house recovery efforts to mitigate damage that could result while waiting for disaster vendors to respond.

Overall, the exercise was deemed beneficial for both organizations, with the teams comparing NETL's real-life experience to the guidance in LM's Records Disaster Prevention, Mitigation, and Recovery Procedure.

The LM Business Center records team is already looking ahead and making recommendations for preparedness for next year's annual disaster exercise. ❖

Records emergency exercise participants from the LM Business Center and NETL discuss records disaster preparedness.

Goal 6

Environmental Justice Activities

2016 National Environmental Justice Conference and Training Program – Washington, DC

The annual *2016 National Environmental Justice Conference and Training Program*, was co-hosted this year with the Ninth Annual National Conference on Health Disparities. The Conference was held March 9 to 12 at the Marriott Marquis in Washington, DC. More than 450 participants, including 100 students, attended.

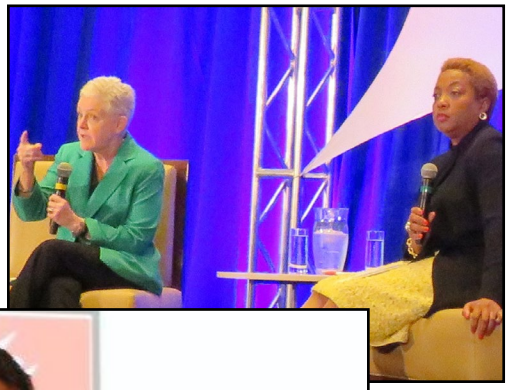
The theme for this year's conference, "A National Dialogue for Building Healthy Communities" provided opportunities for environmental justice (EJ) communities to have access to federal, state, and local government and private sector leaders. Attendees enjoyed the opportunity to obtain information, resources, and strategies to address ongoing EJ issues, and health disparities solutions for building healthy, sustainable communities.

Preceding the conference was an Undergraduate and Graduate Student Research Forum, featuring oral and poster presentations by students, roundtable discussions, and a networking reception. Students engaged in discussions throughout the conference.

The Grand Opening Plenary Session was held at the Howard University School of Law. This session, "The Laws of Attraction: Creating the Community Conditions that Draw Desired Development," focused on identifying and discussing community approaches to attract societal and economic investments that positively impact EJ communities as they move toward building a sustainable future. This session identified challenges, opportunities, partnerships, resources, successes, and lessons learned for communities.

Days two and three of the conference included concurrent training workshops and presentations covering various topics such as:

- Clean Power;
- Rural Development Investments, Environmental Justice and Climate Change;
- A Global Perspective;
- Faith and Stewardship;
- Alternative Transportation;
- Nitrogen Oxide Concentrations;
- Food Hubs;



Gina McCarthy, EPA Administrator (left), responds to a question during a Q&A session moderated by Carolyn Sawyer (right).

Environmental Justice Proclamation Award presented to Milton Bluehouse, Jr., by DOE EJ program manager Melinda Downing at the Grand Opening Plenary Session at Howard University School of Law.

- Title VI;
- Grant Writing and Technical Assistance;
- Educate, Motivate, and Innovate: Student Climate Change Justice for Healthy, Sustainable Communities;
- A Congressional Roundtable Discussion with Congressional Tri-Caucus members on addressing EJ and health disparities; and
- The Impact of Human Trafficking (for labor and sexual purposes) at the national, state, and local level.

Like previous conferences, this year's joint conference offered participants the chance to interact in a variety of settings to discuss solutions, review "programs that work," and recommend policies to strengthen and enhance the current "medical and environmental justice model" of health through diverse, multi-disciplinary partnerships and perspectives.

One additional component to this year's conference was the opportunity to engage a film maker, Lee H. Jordan, of A Look Over Jordan and Company, LLC, to assist with production of a documentary on this year's conference.

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Environmental Justice Activities

2016 National Environmental Justice Conference and Training Program

We want to thank Kim Lambert, of the U.S. Fish and Wildlife Service, for contributing to this opportunity. The film trailer can be found on the conference website (www.thenejc.org) and will be linked on the various agencies' EJ websites. The final documentary is expected to be released within the next 6 months. ❖

Conference attendees learn to use EPA's new EJSCREEN mapping tool during the Educate, Motivate, and Innovate Initiatives' inaugural Student Climate Change Justice Workshop.

A student attendee asks a question during the main session of the 2016 National Environmental Justice Conference and Training Program.

Goal 6

Interagency Working Group on Environmental Justice – Cabinet-Level Meeting

Building on the momentum generated by last year's successful Interagency Working Group on Environmental Justice (IWG EJ) Cabinet-level meeting, the senior staff of the IWG EJ met on February 4 to discuss the advancement of EJ in the federal community.

This year's meeting featured a presentation from Na'Taki Osborne Jelks, Chair of the Board for the West Atlanta Watershed Alliance, on community collaboration with federal agencies on EJ. The presentation moved into a roundtable discussion sharing long-term EJ strategies and the key elements of a sustainable EJ program including a presentation by U.S. Department of Energy (DOE) Deputy Under Secretary for Management and Performance, David Klaus, on DOE's progress in implementing EJ and its plans for the future.

Also, discussed this year were two work products from the IWG EJ. The first was *Framework for Collaboration: Fiscal Years 2016–2018*, which outlines goals for the next 3 years that advance greater federal agency collaboration to improve quality-of-life and support economic opportunities in overburdened and under-resourced communities. The second was *Promising Practices for Environmental Justice Methodologies in the National Environmental Policy Act (NEPA) Reviews*, a compilation of promising EJ practices from across the federal government that can be utilized in NEPA-related work.

U.S. Environmental Protection Agency administrator, Gina McCarthy, will host a follow-up Cabinet-level meeting to discuss the IWG EJ action agenda progress. The meeting is scheduled for June 2016. ❖

Goal 6

Educate, Motivate, Innovate: Student Climate Change Justice for Healthy Sustainable Communities– Washington, DC

The *Educate, Motivate, and Innovate Initiative (EMI)* launched in 2015 by the Interagency Working Group on Environmental Justice, held its first workshop on Friday, March 11, during the *2016 National Environmental Justice Conference and Training Program*. This workshop was designed to showcase climate justice projects from students attending minority-serving institutions.

This workshop included presentations on:

- Health benefits of carbon sequestration in underserved communities
- Engagement of communities in air-quality sampling

Also featured was an introductory training presentation on the climate justice applications of the U.S. Environmental Protection Agency's new EJSCREEN tool. EJSCREEN is a screening tool with powerful data and mapping capabilities used to identify potential vulnerabilities in environmental justice communities. ❖

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Paddys Run Streambank Stabilization at the Fernald Preserve in Ohio

Construction of the rock toe.

Construction of a cross-vane is completed while Paddys Run is dry.

Weather delays and subsurface flow within the Paddys Run streambed resulted in an interim shutdown of the project area in December 2014. Construction activities resumed in April 2015 and were completed the following November.

Performance to this point has been good (see photo at right). The regraded bank and stabilized streambed have remained effective following several high-flow events since the project was undertaken. Paddys Run stream levels rose 8 feet on one occasion, approximately 2 feet above the rock toe, with no compromise to the cross-vanes, the rock toe, or the soil-encapsulated lifts. Planted trees and shrubs displayed excessive mortality, most likely due to delays in planting. However, a large number of self-volunteering trees have been observed in the project area, making extensive replanting unnecessary.

The Paddys Run Streambank Stabilization Project is an excellent example of LM's quick action to address an unacceptable condition at one of its legacy sites. Ongoing communication with regulators and stakeholders led to successful project completion. ❖

The completed project following several days of rain.

Continued from page 1

Deputy Under Secretary Klaus Visits the Fernald Preserve in Ohio

community connections and the facility's Leadership in Energy and Environmental Design, or LEED-Certified Platinum design features. Next, the group hiked to the top of the On-Site Disposal Facility (OSDF) for a discussion of the structure's protective features and its' performance. The top of the OSDF provided a panoramic view of the 170-acre, restored former production and waste storage areas, and a discussion of the site's ecological restoration and maintenance activities.

The driving portion of Mr. Klaus' site tour included viewing the results of a recent 25-acre prescribed burn on one-third of the OSDF cap, the wetlands areas created during cleanup, and the restored prairie grass communities.

The tour's final stop was the site's water treatment plant where Mr. Klaus was given an overview of the Preserve's aquifer restoration efforts and a briefing on the operations and maintenance challenges associated with a large-scale groundwater remediation project. Tania Smith Taylor said, "It was great to have Mr. Klaus visit the Fernald Preserve to see what we are doing at one of LM's major sites." ❖

Goal 5

LM Announces New Employee/Team Leaders

Tania Smith Taylor

Tania Smith Taylor is the new U.S. Department of Energy (DOE) Office of Legacy Management (LM) Director of Site Operations. Tania joined LM in January 2016. Prior to LM, Tania worked for the DOE Office of Environmental Management (EM) where she led several initiatives pertinent to managing facilities and infrastructure, eliminating excess contaminated facilities, reusing assets for economic development, using project management lessons learned, creating contractor out-placement programs, and training in Science, Technology, Engineering, and Math.

Tania has extensive experience managing environmental programs for the U.S. Army Corps of Engineers in Germany, Belgium, Italy, the Netherlands, the Balkans, Iraq, Afghanistan, and Africa, and for DOE at the Savannah River Site Operations Office and EM-Headquarters.

Tania holds a civil engineering technology degree from South Carolina State University, a master's degree in mechanical engineering from Manhattan College, and a master's degree in business administration from Nova Southeastern University. ❖

Dr. Edwin "Doc" Parks

Dr. Edwin "Doc" Parks is the new Archives and Information Management (AIM) Team Leader for LM. Prior to this position, he served as the AIM Acting Team Leader and was also a records program analyst for the AIM Team. He joined LM in September 2010.

Dr. Parks was an officer in the U.S. Air Force—reaching the rank of colonel. While in the Air Force, Doc had a number of assignments including, Deputy Director for Nuclear Operations, Air Force Planner, and Strategic Policy Planner at the Pentagon; Commander, 341st Operations Group at Malmstrom Air Force Base (AFB), Montana; Commander, 742nd Missile Squadron at Minot AFB, North Dakota; Operability/Survivability Assessments Program Manager at the Defense Threat Reduction Agency; Instructor, Squadron Officer School at Maxwell AFB, Alabama; intercontinental ballistic missile (ICBM) Test Manager, 576th Flight Test Squadron at Vandenberg AFB, California; and Instructor Missile Crew Commander for the 321st Strategic Missile Wing at Grand Forks AFB, North Dakota.

Doc has an extensive educational background that includes a master's degree from the National War College, National Defense University; a doctorate in public administration from the University of La Verne; a master's degree in administration and human resource management from Central Michigan University; and, a bachelor's degree in elementary education from Trenton State College. ❖

Gwen Hooten

Gwen Hooten is the new Resource Conservation and Recovery Act (RCRA)/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/ Formerly Utilized Sites Remedial Action Program (FUSRAP) Team Leader for LM. Prior to this new position, she served as a Site Manager, responsible for a number of LM sites, including Fernald, Mound, and Piqua, Ohio, sites; the Site A/Plot M, Illinois, Decommissioned Reactor Site; and a number of FUSRAP sites. She joined LM in May 2011.

Gwen was a remedial action project manager for the U.S. Environmental Protection Agency (EPA) and directed environmental programs under CERCLA and RCRA, from site investigations to deletion from the National Priorities List. While with EPA, her site responsibilities included the Lowry Landfill and the Rocky Mountain Arsenal in Colorado; Smeltertown, Texas; Arsenic Trioxide site in North Dakota; Whitewood Creek, South Dakota; Davenport and Flagstaff Smelters, Midvale, Ogden Rail Yard, Pallas Rail Yard, Park City, Summitville, and Petrochem/Ekotek sites in Utah.

Gwen served in the U.S. Air Force as a civil engineering officer with responsibilities pertaining to records, environmental aspects, and design for the 240th Civil Engineering Squadron, and security and training for 140th Civil Engineering Squadron. She also served with the Buckley Air National Guard Base and was responsible for the support, planning, and execution of the Colorado Air National Guard mission to maintain an aircraft combat readiness posture.

Gwen holds a bachelor's degree in agricultural engineering from Texas A&M University, and has completed course work at the University of Minnesota and Abilene Christian University. ❖

Goals 5 and 6

LM Participates in 2016 Waste Management Conference

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) participated in the 2016 Waste Management Conference, in Phoenix, Arizona, March 6 through 10. LM's participation included submission of papers and oral presentations as part of a panel session on "Environmental Restoration Post-Closure Challenges and Long-Term Stewardship." The presentations provided a discussion of various topics including: Efforts to Improve Efficiency of Extraction Well Operation at the Fernald Preserve, Harrison, Ohio; Lessons Learned Concerning the On-Site Disposal Facility at the Fernald Preserve; and Transfer and Transition: Interagency Coordination for Managing Public Lands at UMTRCA Title II Sites in Wyoming. The session also provided discussions on other topics including: Lessons Learned from the Formerly Utilized Sites Remedial Action Program; Groundwater Remediation in a Floodplain Aquifer at Shiprock, New Mexico. LM managed sites were referenced in various other presentations. In addition, LM unveiled a new exhibit display featuring a large site map showing its current and anticipated sites through fiscal year 2021. ❖

An engraved monument marks the location of Site A today.

Owned by Lyman Kilgore, B&T Metals in Columbus, Ohio, extruded uranium rods for the Manhattan Project.

Continued from page 14

African Americans and the Manhattan Project

Today, the contributions of African Americans to the Manhattan Project can be remembered at LM sites. Ryerson Physical Laboratory, Kent Chemical Laboratory, Eckhart Hall, and the George Herbert Jones Chemical Laboratory were all involved with Met Lab and still stand at UChicago. Although the structures at Site A are gone, an engraved monument marks its location within parkland that is overseen by the Forest Preserve District of Cook County. The building where B&T Metals Company extruded uranium is also gone, but the site is now within the historic Franklinton Arts District (Columbus). LM honors and remembers the important work that African American nuclear weapons and uranium workers performed at legacy sites. ❖

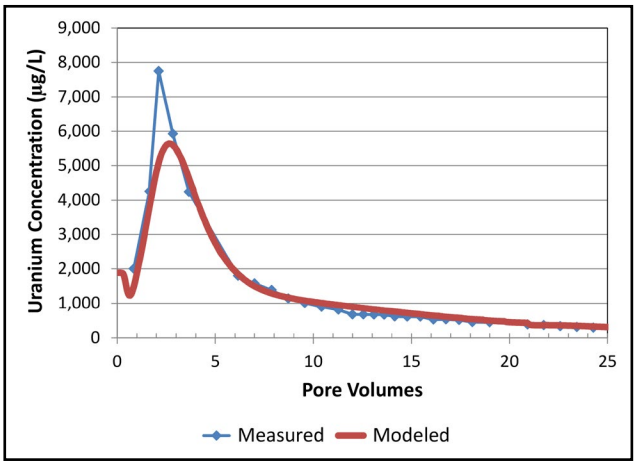
Anticipated Legacy Management Sites Through Fiscal Year (FY) 2021

Continued from page 3

Applied Studies and Technology: Training Course in Groundwater Geochemistry and Reaction Modeling

The training course helps LM site managers use geochemistry to understand remediation of legacy contaminants in groundwater and to communicate complex science to a variety of stakeholders.

LM recognizes the importance for up-to-date training to continually improve scientific understanding and use site geochemistry data to make informed, risk-based and compliance decisions that protect human health and the environment.



Example of using geochemical modeling with PHREEQC to simulate uranium data from a laboratory column test.

Continued from page 12

Uranium Mining and Milling near Rifle, Colorado

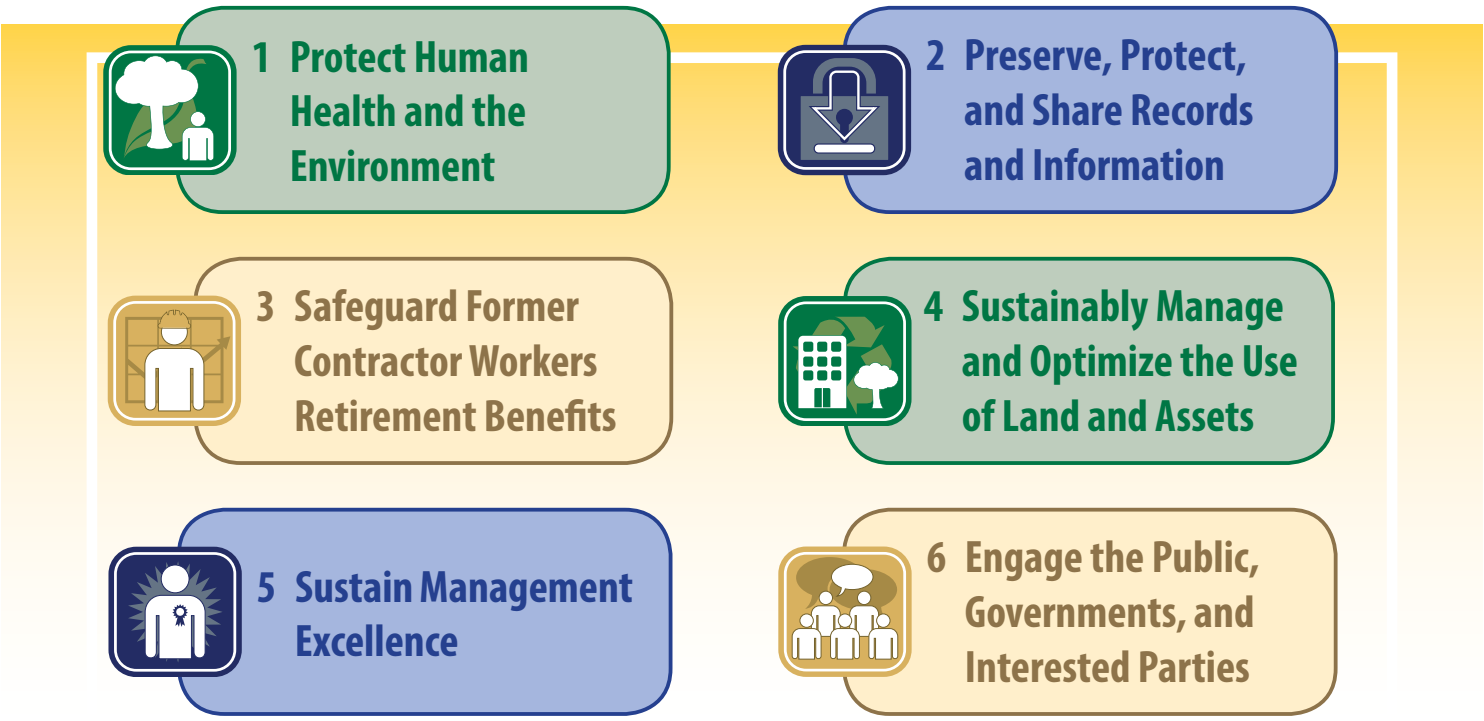
Upon passage of UMTRCA, little thought was given to the groundwater contamination. Instead, radon was seen as the principle threat requiring mitigation. Radon is relatively easy to prevent from escaping into the atmosphere by covering it with a soil layer. So, the main goal at the time became creation of a disposal cell that would be durable for 1,000 years. The protective approach generally taken is to construct an engineered cell to cover the tailings with a low-permeability material such as clay, and then to protect that layer from erosion.

The design and construction has evolved considerably since UMTRCA's inception until the end of the surface program in 1998. The surface program addressed isolation of the tailings in engineered disposal cells. The Colorado sites were addressed late in the program, and at the request of the State, mill sites near the rivers were typically relocated outside of the flood plain to a more remote location. The Rifle disposal cell is approximately 8 miles north of town in the Estes Gulch.

While UMTRCA was enacted in 1978, it was not until 1983 that a regulation addressing groundwater contamination was drafted. The regulation was not finalized until 1996. The U.S. Environmental Protection Agency sets the standards for soil and groundwater cleanup, while the U.S. Nuclear Regulatory Commission (NRC) acts as the regulator to DOE. Under an Agreement State Program, the Colorado Department of Public Health and Environment has delegated authority from NRC to regulate private licensees on permitting, operation, and cleanup of uranium mills. While UMTRCA covers uranium milling, mines were specifically and purposely excluded from the Act. ❖

References:
Merritt, Robert C. "The Extractive Metallurgy of Uranium." Colorado School of Mines Research Institute (1971): 537-39. Print.

Legacy Management Goals



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