The Historical Significance of Tailings and Slag: Industrial Waste as Cultural Resource

Fredric L. Quivik

Mine-waste dumps, milling wastes, and other processing residues are ubiquitous features of mining landscapes that are often slated for removal or containment under environmental remediation projects undertaken under Superfund or other environmental cleanup programs. All too often, such features of the cultural landscape as industrial waste products are not valued for their historical significance and the lessons they embody about our past. This article uses a case study of the Butte-Anaconda National Historic Landmark District to show that deposits of industrial waste, and the engineering features meant to manage such wastes, can have significance far beyond merely showing all of the steps of industrial process from beginning to end. Industrial wastes can have national significance, help to portray the work of nationally important individuals, and illuminate the long history of conflict over the environment. As such, industrial wastes merit preservation in their own right.

Historic mining properties have long been recognized as an important class of cultural resources on the landscape. Primary attention is often given to such features as headframes, hoist houses, mills, smelters, mine offices, and workers' housing collections. Ancillary features, like railroad grades, aerial tramways, flumes, or mine-waste dumps and tailings deposits, are usually noted as important for the ways they contribute to a fuller understanding of the primary features. This article demonstrates, by means of a case study examining the Butte-Anaconda National Historical Landmark (NHL) District in Montana, how one of these classes of ancillary features—resources associated with the waste products of the mining industry—can take on primary importance when the resources are seen in the context of broader historical events.

The wastes produced by the copper-mining industry in the Butte-Anaconda NHL have assumed great significance in another context, that of the legacy of hazardous materials being remediated by the U.S. Environmental Protection Agency (EPA) under the Superfund program. Created by the Comprehensive Environmental Response, Cleanup, and Liability Act of 1980 (CERCLA), Superfund is a nationwide program that endeavors to permanently treat, remove, or contain hazardous materials at abandoned or inactive industrial sites throughout the United States. Many of the sites also possess significant cultural resources. The Clark Fork Superfund site in Montana, which embraces the Butte-Anaconda NHL, is one such site.

The Clark Fork Superfund site extends from Butte to Anaconda and along the Clark Fork River about 100 miles downstream to near Missoula. It is the largest Superfund site in the U.S., as measured by geographical area. Operable units in the Clark Fork Superfund site include the Berkeley Pit (a giant open-pit mine adjacent to Butte; the pit is flooding with acidic mine water that is laced with heavy metals), tailings deposits on the outskirts of Butte and Anaconda, and lands contaminated by decades of arsenic dust precipitating out of the smelter smoke emanating from the giant copper smelter that once operated at Anaconda.

At the Clark Fork and other Superfund sites, however, piles of mine waste, tailings, and slag are too often seen by EPA officials and other land managers merely as eyesores and sources of environmental contamination that are best removed from the landscape. This article argues that wastes from the mining industry are more than just visual, physical, or chemical presences on the landscape; they embody powerful and important cultural meanings as well. The article challenges land and resource managers, whether they are environmental engineers, park officials, landscape architects, or others who exercise the care and maintenance of our shared landscapes, to consider more deeply the values embodied or exhibited by such wastes on the cultural landscape.

Because in the U.S. there are regulations, stemming from the National Historic Preservation Act of 1966, which delineate, when the federal government undertakes its work, a formal planning process for considering and weighing the value of cultural resources against other values or objectives, this article makes its
argument in terms of that planning process. The process begins with determining whether resources are eligible for listing in the National Register of Historic Places by using the National Register’s Criteria for Evaluation (see sidebar on p. 48). The same planning process can be useful for land managers involved in landscape planning and design projects that are not federal undertakings.

The National Register’s bulletins, “Guidelines for Identifying, Evaluating, and Registering Historical Mining Properties” and “Guidelines for Evaluating and Documenting Rural Historic Landscapes,” offer valuable guidance on identifying, documenting, and analyzing the significance of landscape features composed of or associated with mining wastes. ¹ This article documents some of the significant features associated with industrial waste that comprise the Butte-Anaconda NHL. It also shows that some of those features played much larger roles in Montana and U.S. history than merely being a necessary component of a giant copper-mining enterprise.

“Guidelines for Identifying, Evaluating, and Registering Historical Mining Properties,” mentions mine wastes in several paragraphs, emphasizing the importance of wastes in fully understanding, embodying, and representing the mining and mineral-processing methods that were historically employed on and beneath the landscape. ² Yet, the technologies of mining and mineral processing are important beyond their own histories. Citing Larry Lankton’s work on the history of copper mining on Michigan’s Keweenaw Peninsula, the bulletin’s authors stress, “It is important to link the evolution of mining technology to the impact it had on management, labor, business, politics, and communities, besides the obvious role it had in the history of science and technology.”

This article shows that kind of relationship between broader historical themes and the evolution of technologies for discharging and managing industrial waste. This case study of the history of mining and metallurgical wastes at Butte and Anaconda shows that not only did those wastes have local impacts on labor, politics, and communities but that mining and metallurgical wastes in Butte and Anaconda were also important historical factors outside the immediate realm of managing and engineering a mining operation. The production of industrial wastes at Butte and Anaconda touched the lives of the workers who discharged the smoke, tailings, and slag as well as the farmers whose livelihoods were threatened by the wastes. Butte’s and Anaconda’s discharges drew prominent national figures to grapple with the problems created by the wastes. Smoke and tailings were the subjects of major court cases in the early-20th century. The need for sinks to receive industry’s wastes led to large-scale land transfers that reshaped regional land use. ³ This case study of wastes at Butte and Anaconda highlights the often-troublesome entanglement of industry with local and national economies, and it exhibits the often-uneasy relationships between big business and government at the local as well as the national levels. Preserved vestiges of these industrial wastes offer potential for thoughtful interpretation, which can help the public understand very palpably the contested history of industrial waste.

Several scholarly publications on industrial archaeology have noted the importance of mining and metallurgical wastes. Stephen Lavender’s New Land for Old describes work done in Swansea, Wales, to rehabilitate an environment ravaged by mining and smelter. Those ravages led to conflict between farmers and the mining industry, similar to the episodes in Butte and Anaconda described below. Reclamation in Swansea paid little heed to cultural values represented by deposits of industrial waste. The book is a fine example of landscape restoration that focuses almost solely on environmental factors. Richard Francaviglia’s Hard Places analyzes cultural features that help give mining landscapes a distinctive appearance, and evidence of mining and metallurgical wastes is one of them. Robert Gordon and Patrick Malone offer generous attention to local environmental effects of industrial waste in The Texture of Industry, and they also stress how important the discharge of waste is to any industrial process. An example of a book analyzing a historic cultural landscape for its cultural values, which notes the prevalence of industrial wastes but which accords them little cultural value or significance, is The Landscape of Industry by Judith Alfrey and Catherine Clark. ⁴ This article argues that industrial wastes can be much more.

The Historical Role of Waste in the Histories of Butte and Anaconda

Butte and Anaconda are at the head of the Clark Fork River watershed in the mountains of southwest Montana. Butte is the mining city that developed a world-renowned copper-mining industry in the wake of the
discovery of gold there in 1864. Anaconda, located 26 miles west of Butte, is the smelter city where ores and concentrates from the Butte mines were processed to yield pure copper. A wide array of cultural resources survives from the copper industry’s heyday in Butte and Anaconda, including residential, commercial, institutional, and industrial structures. Recognizing the significance of that fact, the U.S. Secretary of the Interior declared Butte a National Historic Landmark in 1961. The landmark district was expanded to encompass Anaconda and the historic railroad corridor between the two cities in 2006 (see figure 1).8

The landscapes of both cities have been intensely altered from a state of nature by the mining industry across more than a century of mining. Visitors to Butte now see a landscape dominated by the Berkeley pit, the giant open-pit mine that was established in 1955. When Butte reigned as the world’s largest supplier of copper decades earlier, selective underground lode mining was the method of choice (see figure 2). The Butte hill is punctuated by 13 steel headframes that survive from the earlier period. Anaconda has the ruins and remains of three giant smelter complexes that once operated there. Both cities have major landscape features associated with the disposal of industrial waste.9

Butte began as a gold boomtown in 1864. In the early 1870s, silver became the principal metal being mined, and by the late 1870s, small amounts of copper ore were also being extracted. The ore was copper glance (calcocite, Cu$_2$S) and other more-complex copper sulfide minerals bearing such elements as iron and arsenic. Practical miners and metallurgists in that remote setting devised means to increase the extraction of ore from the underground, separate copper in the ore from the other elements, and transport Butte copper to markets at reasonable cost once the railroads arrived. Butte surpassed Michigan as the world’s leading supplier of copper in 1887 and retained that distinction through WW I, after which Arizona assumed the title. All of Butte’s mines were located on a hill rising west and north of the head of Silver Bow Creek, which flows into the Clark Fork River, a tributary of the Columbia River. In the very early years, each Butte mine featured wood- or coal-fired boilers, hoisting engines, and a wood or steel headframe that stood atop the vertical shaft, giving access to the underground world of drifts, crosscuts, and stopes, where miners toiled to wrest millions of tons of ore from the earth.10

For the first few years, all of the mills and smelters that treated Butte ores were located at Butte. Almost imme-

Figure 1. Map (1985) showing the spatial relationship of Butte and Anaconda and their locations in southwest Montana. Renewable Technologies, Inc., "Butte-Anaconda Historic System Master Plan," Butte Historical Society.
Immediately, the waste products discharged by the Butte smelters began to pollute the environment with smoke and tailings. Although the main focus at the mines and smelters was the copper and other metals being produced, smelter managers had to devote considerable attention to the waste products, if for no other reason than to get the waste out of the way so that they could run more ore through treatment and produce more copper. Features on today's landscape help visitors understand this aspect of the technological system installed at Butte to produce copper. A summary of that system and its landscape features follows.

In the 19th century, several large mining companies operated in Butte, each of which had a few mines as well as a concentrator and a smelter. At underground mines, the headframes and hoists were used to haul ore to the surface, where it was loaded into ore cars for shipment to the concentrator or smelter. The ore was crushed and ground at the concentrator and then subjected to various jigs and tables, where the denser metal-bearing particles were separated from the lighter nonmetal-bearing particles that were discharged as tailings. The concentrator at each smelter discharged hundreds of tons of tailings onto the flood plain of Silver Bow Creek each day. Because the process of concentration was not 100% effective, the tailings still contained copper and other heavy metals.12

Figure 3 shows the launder or flume that carried water and tailings from the concentrator of the Montana Ore Purchasing Company (MOP) to the nearby tailings dump along Silver Bow Creek. Because the creek did not have enough volume of flow during most months of the year to carry the tailings away, most of the tailings stayed on the dumps (see figure 4). Spring snowmelt runoff, however, increased the flow during May and June, which eroded the margins of the tailings dumps and carried some of the tailings downstream. A 1947 aerial photograph of Silver Bow Creek (about 10 miles downstream of Butte) shows tailings from the Butte concentrator that had settled along the stream's banks (see figure 5).13 Water flowing in the stream carried tailings more than 100 miles downstream.

Many farmers downstream of Butte took water from Silver Bow Creek to irrigate their croplands. The water carried tailings onto the fields and crops, causing damage. In 1905, one of the farmers, Hugh Magone, filed suit in federal court against the mining companies on behalf of downstream property owners, claiming that tailings had damaged his property. Technically, he won his case. The court awarded him damages of a few hundred dollars, which was divided among the several mining companies. The penalty barely amounted to a slap on the wrist.14

Another principal waste product of ore treatment was smoke. Figure 6 shows the smoke emanating from the Colorado smelter at Butte as well as from other Butte smelters, visible in the background on the right. Smoke came from the use of heat in the roasting and smelting processes to alter the chemistry of the copper
sulfide ore and thus drive off sulfur and arsenic. In this series of chemical processes, the first step (roasting) heated the ore to a very high temperature but not to the melting point. The oxygen in the air could chemically react with the ore, oxidizing it and releasing sulfur dioxide, arsenic trioxide, and other waste products into the atmosphere. In the early years, Butte ores were roasted in heaps on the ground, which smoldered for weeks. Sulfurous smoke hovered near the ground, killing vegetation and causing severe health problems for people, especially during winter inversions. Butte's local government passed an ordinance in 1891 prohibiting the open roasting of ore in heaps. When some mining companies ignored the ordinance, citizens demonstrated outside city hall in an effort to compel city officials to enforce the ordinance.15
The alternative to roasting in heaps was to roast the ore in stalls, which could be connected by flues to a chimney, carrying the smoke aloft. During the 1890s, companies tried a number of mechanical devices, such as the Brückner furnace (see figure 7). It facilitated materials handling, (thereby reducing costs) and improved the chemical reactions brought about by roasting. Nevertheless, by the late 1890s it had become apparent that the use of chimneys or stacks did not carry the smoke high enough to abate deadly inversions during winter months, and many Butte citizens again pressed for either a technological or a legal solution to the problem. Others resisted any threat to the smelting industry. One Butte smelterman told a public meeting that “his wife and children had been buttering their bread with smelter smoke and he did not want to take this bread out of their mouths.” The smoke problem in Butte was not resolved until the last Butte smelter closed in the early-20th century, and all smelting was consolidated at the Anaconda smelter, described below.16

The product of roasting, called calcine, was fed into reverberatory furnaces, long brick vessels with a firebox at one end and a flue at the other. As combustion gases passed over the bed of calcine, heat from the combustion gases was said to “reverberate” from the vaulted ceiling down onto the calcine, raising it above the melting temperature. At this point, the denser copper matte (approximately 50% copper) would settle to the bottom, and the less dense slag (containing silica and iron oxide but virtually no copper) would float on top of the matte. Smoke from the reverberatories also contained sulfur and arsenic. Smelter workers would tap openings in the reverberatories to draw off slag, sending it to the dump, and tap other openings to draw off copper matte, sending it to the converters (see figure 8).17

Copper converters worked to bessemerize the copper matte, much like converters in steel mills worked to bessemerize iron (see figure 9). In 1884, Butte’s Parrot smelter was the first copper smelter in the U.S. to install converters to treat copper matte. Because blowing air through the molten matte in the converters is a rather violent process, the slag produced by converters contained relatively high amounts of copper. Converter slag was therefore not considered a waste product and was sent back to the reverberatories to be resmelted. Converter copper was more than 99% pure, but it was still not ready for market. The last step in the process was electrolytic refining, in which anodes of converter copper were placed in electrolytic cells. Electrical current passed from the anodes through the electrolytic fluid to the cathodes, carrying copper with it to be deposited on the cathodes. This left small amounts of impurities, mostly silver and gold, to settle to the bottoms of the cells as sludge. Electrolytic copper was more than 99.98% pure and ready for market.18

Figure 7. Brückner roasting furnace, showing the firebox (right) and the cylindrical furnace in which the concentrates were calcined. World Museum of Mining Photo Archives, Butte.
The Butte smelters produced tremendous amounts of smoke in the 19th and early-20th centuries, making Butte a miserable place to live and work during some weather conditions. That condition was alleviated because most of the smelting eventually moved to Anaconda. Marcus Daly, who with his San Francisco-based investors developed the famous Anaconda mine in Butte and launched the giant Anaconda mining enterprise, had the foresight to see that Butte would be an unwise location for the smelter he envisioned. Besides water and timber shortages around Butte, the city's location in a high mountain valley could inhibit the dissipation of smoke. He therefore chose a site to the west along Warm Springs Creek, which had ample water and timber and prevailing winds that would carry smoke out over the broad Deer Lodge Valley. His first Anaconda smelter went into operation in 1884 with a capacity five times greater than any of the Butte smelters and with construction already underway to double its capacity—treating 1,000 tons per day (see figure 10). That smelter came to be called the Upper Works when, a few years later, Daly built a second smelter of even greater capacity a couple miles downstream to help treat the tremendous output of his Butte mines.19

Those two smelters had a combined capacity of almost 3,000 tons per day. By the turn of the 20th century, their equipment was obsolete, and the Anaconda Company needed even more capacity. Instead of
remodeling the Upper and Lower Works, Anaconda kept them operating while it built the Washoe Reduction Works, an entirely new replacement smelter, across Warm Springs Creek from the other two smelters. The Washoe works went into operation in 1902 with a capacity to treat 4,800 tons per day. It was designed so that each department could be, and was, expanded without impinging on the operations of neighboring departments. Each of the four departments that produced metallurgical smoke—the roasting, reverberatory, blast furnace, and converter departments—had its own 200-foot-tall stack. One can distinguish the metallurgical smoke emanating from the several stacks visible in figure 11 because it is white, while the coal smoke from the two powerhouse stacks is black.

Almost immediately after the Washoe Reduction Works went into service, farmers downwind of the smelter in the Deer Lodge Valley started reporting sick and dying livestock. One of the symptoms farmers reported was that horses had developed sores in their nostrils about the size of a silver dollar. Chickens were not laying eggs. There were reports that cows had developed sores in their mouths and that bad milk was killing calves. In August 1902, the state veterinarian condemned the milk being produced on dairy farms in Mill Creek, just east of the smelter, concluding that smelter smoke was making the milk unfit for human consumption. Veterinarians performed autopsies on dead livestock and found that arsenical poisoning was the cause of death.

Believing that smelter smoke was the source of the arsenic, the farmers filed damage claims against the Anaconda Company, which readily admitted it was at fault. The company paid the farmers more than $300,000 dollars in damages and closed the smelter to remodel the smoke-discharge system. The company eliminated the individual stacks and, instead, connected each department to a giant flue running up the hillside south of the smelter to a new 300-foot stack atop the hill. The flue had a very large cross-section, which would slow the velocity of the smelter gases and allow the arsenic and other flue dust to settle. The tall stack was to carry remaining contaminants in the smoke aloft to the upper atmosphere.

The Anaconda Company claimed it had implemented a state-of-the-art technical solution to the problem, but the farmers still complained of sickly and dying livestock. When the company refused to make further improvements, Fred Bliss, on behalf of the Deer Lodge Valley Farmers Association, filed suit in federal court in 1905, seeking an injunction to prevent the company from continuing to damage their properties. The ensuing trial was said to have been the largest trial ever heard in equity court. It featured more than 200 witnesses, and their testimony filled more that 25,000 typed pages. The farmers spent about $500,000 dollars prosecuting Bliss’s case, and the Anaconda Company was said to have spent more than $3,000,000 defending itself. Each side offered expert witnesses to testify on its behalf. Testifying as an expert veterinarian for the farmers was D. E. Salmon, the man for whom

Figure 11. Washoe Reduction Works, Anaconda, 1902, showing the four 200-foot stacks for the smelting departments (with white smoke) and the two powerhouse stacks (with black smoke). Author’s personal collection.
the bacterium *salmonella* is named. One of the most renowned veterinarians in the U.S. at the time, he had been the founding chief of the U.S. Department of Agriculture’s Bureau of Animal Industry (BAI). He had served in that capacity for more than 20 years when, in 1905, he was forced to resign by President Theodore Roosevelt over an action that seemed related to the meat inspection scandal that was rocking the U.S. Department of Agriculture at the time.25

Salmon was one of the first two graduates of Cornell University’s school of veterinary medicine, which was one of the first university veterinary programs in the U.S. His graduation in 1872 was at the very time Louis Pasteur, Robert Koch, and other European scientists were advancing the germ theory of disease. Trained at Cornell in this science-based approach to medicine, he began using his new skills to study how microorganisms caused diseases in livestock and how to protect flocks and herds from those diseases. After a decade of conducting such studies for state and federal governments, the U.S. Secretary of Agriculture appointed Salmon to head the new BAI. The U.S. Department of Agriculture (USDA) had been established under President Abraham Lincoln in 1862, in part to apply scientific understandings to improve the lot of the nation’s agricultural sector. Finding ways to apply science to solve practical problems was still a new endeavor for the federal government, and the USDA stumbled for a couple decades trying to find an effective model for organizing its scientific agencies. Historian Hunter Dupree calls the BAI the first USDA agency to be organized on a successful model for applying science.26

Salmon headed the BAI for more than 20 years, assembling a team of brilliant young scientists who made significant contributions to the emerging field of bacteriology and who devised effective methods for treating, controlling, and vaccinating against such devastating livestock diseases as hog cholera. One member of his staff at the bureau, Theobald Smith, discovered the strain of bacteria that was named for Salmon.27 Salmon’s agency also had responsibility for the federal government’s meat-inspection program. In this context, Salmon was implicated in a scandal, which involved the awarding of a contract for printing meat-inspection labels to a printer with whom he had had a personal business relationship. The accusation arose in 1905, the year in which Upton Sinclair’s sensational novel about the meatpacking industry, *The Jungle*, appeared. The U.S. Secretary of Agriculture ordered an investigation, finding Salmon to have been free of wrongdoing. Nevertheless, because of suspicions of the government aroused by *The Jungle* and the contemporaneous controversies involving corporate consolidation of the meatpacking industry, President Roosevelt asked for his resignation.28 Shortly thereafter, Salmon began working for the Deer Lodge Valley farmers.

Meanwhile, the Anaconda Company contracted with some of the top veterinary educators and bacteriologists in North America, including V. A. Moore of Cornell University and Theobald Smith of Harvard University, both of whom had worked for Salmon at the BAI. Expert veterinarians for both sides conducted extensive work in the fields and pastures around Anaconda prior to testifying. Salmon and other experts testifying for Bliss and the farmers concluded that livestock in the Deer Lodge Valley were succumbing to arsenical poisoning. Anaconda’s experts (including Moore, Smith, and the Anaconda Company’s own veterinarian, H. C. Gardiner) believed that they had identified a microorganism living in the valley that was the cause of ill health and death among the livestock populations downwind of the smelter.29

The judge ruled in favor of the Anaconda Company, even though he believed that arsenical poisoning had caused the livestock to die. Anaconda’s expert witnesses had created enough doubt in the judge’s mind, however, that a different argument prevailed. Anaconda argued that it could do no more to abate the smoke problem. Thus, in response to being enjoined from discharging smelter smoke into the atmosphere over the Deer Lodge Valley, the company would have to close the smelter. That in turn would force the closure of the mines in Butte. Residents of Butte and Anaconda provided the principal markets for the farmers’ agricultural output. The Anaconda Company argued, therefore, that closing the smelter would do the farmers more harm than the smoke might be causing. In weighing the relative impacts of various available court rulings, the judge was employing the balancing doctrine that was frequently implemented in the period.30 In the wake of the Bliss trial, many farmers in the valley who lived east and northeast of the smelter and were faced with an untenable situation sold their land to the company, so the company was thereafter free to pollute that ground.31

However, the smoke didn’t always blow to the northeast. Under certain conditions, smelter smoke would
blow to the south and southwest, blowing across the mountains and thousands of acres of the newly created Deerlodge National Forest. While U.S. Department of Agriculture scientists had been in the vicinity of the smelter conducting field work in support of the farmers’ case, those scientists had observed that vast tracts of federally owned timberland had been damaged by smelter smoke. Under the administration of President Roosevelt, the U.S. Department of Justice prepared to file suit against the Anaconda Company and hired attorney Ligon Johnson to handle its case. Johnson had earlier represented the State of Georgia before the U.S. Supreme Court in a case involving damage by smoke from copper smelters just over the border at Ducktown, Tennessee. While he worked to prepare the case against the Anaconda Company, Johnson also worked on cases for the federal government against copper smelters in northern California. The government finally filed suit against Anaconda in 1910 under the administration of President Howard Taft, claiming that sulfur in the smoke had damaged government property in the form of trees growing in the national forest.

Before the case went to trial, however, the government and the Anaconda Company entered an agreement to create a three-man board of experts, called the Anaconda Smelter Smoke Commission, which would conduct research to try to find technical solutions to the problem. Anaconda agreed to pay the expenses of the smoke commission, and Anaconda agreed to implement any technical solutions the smoke commission recommended. After a delay because of World War I, the smoke commission recommended the following: the Anaconda Company should (1) install electrostatic precipitators, designed by Frederick Cottrell, to recover additional arsenic and other dust from the smoke, and (2) replace the 300-foot stack with a 585-foot stack, creating the draft necessary to draw the smoke through the treaters. Anaconda veterinarian Gardiner urged his superiors in the company to comply with the commission’s recommendations (see figure 12). By the late 1910s, as he continued studying the impact of smelter smoke on the surrounding countryside, he had come to recognize the extent of damage the smoke was actually causing and the ways it was causing its damage. Built in 1918, the new stack was the tallest in the world at the time.

Although the taller stack addressed the arsenic problem, the Washoe Reduction Works continued to discharge vast volumes of sulfur-laden smoke into the atmosphere. Frustrated that the technical solution recommended by the smoke commission had not reduced the damage that smelter smoke was causing to trees on national forest lands, a local forester devised a novel solution to his agency’s dilemma that would use the 1922 Act to Consolidate National Forest Lands. He proposed a land exchange, in which the Forest Service would swap tracts of damaged timberland to the Anaconda Company for tracts that the company owned elsewhere in Montana and that were comparable in acreage and volumes of standing timber. The trees on the timberland the Forest Service would receive from Anaconda, of course, would be healthy trees. Company executives agreed to the proposal and, through the 1920s and into the 1930s, more than 100,000 acres of damaged national forest lands were transferred to the Anaconda Company in a series of six land exchanges for a like acreage of Anaconda timberland that the Forest Service received.

Figure 12. The 585-foot stack being built in 1918 next to the old 300-foot stack at the Anaconda Reduction Works. Note the Cottrell electrostatic precipitators being built at the base of the stack. Author’s personal collection.
Because of this set of land transfers (both from farmers to the Anaconda Company in the Deer Lodge Valley and between the Forest Service and the Anaconda Company), the Anaconda Company owned thousands of acres in the Deer Lodge Valley on which it could dispose of tailings. It also owned thousands of acres of forest on the mountain slopes south and southwest of the smelter for which it no longer need be concerned if smelter smoke continued to harm trees. Over the decades following those land exchanges, the company continued to discharge smoke and tailings into the environment at the head of the Clark Fork River until the smelter closed in 1980. After more than a century of mining and smelting at Butte and Anaconda and the accompanying impacts to the environment, the U.S. Environmental Protection Agency declared the area around Butte and Anaconda to be a Superfund site in the early 1980s.  

Cultural Resources Associated with Industrial Waste in the Clark Fork Superfund Site

The Clark Fork Superfund Site encompasses some significant cultural resources, many of which have already been officially recognized as contributing to the Butte/Anaconda NHL. They are recognized, however, for reasons that have little to do with the long history of pollution and of people working to prevent or redress that pollution. For example, shortly after the Anaconda Company closed the Washoe smelter, it began demolishing the entire smelter site. Some citizens of Anaconda formed a group, Anacondans to Preserve the Stack, to try to convince the company to leave it standing, arguing, in part, that the stack was a fitting monument to the work of generations of smeltermen and others who had worked there. Although to many latter-day Anacondans, the stack may stand for the hard and dangerous work of their forebears, today's residents have lost the collective memories that would allow them to see the stack as a monument to one of the nation's largest environmental controversies of a century ago.

Similarly, the ruins of the old Upper and Lower Works are in the midst of some of the most polluted ground near the town of Anaconda, and even those ruins show evidence of environmental problems the company was having in the 19th century. The Upper Works initially had a short chimney for each furnace, but that arrangement created a smoky workplace, which reduced worker productivity. The company therefore installed flues up the adjacent hillside to stacks, which were toppled when the Washoe works was built in 1902. Those piles of rubble remain (see figure 13).

Figure 13. Furnace ruins at the Anaconda Upper Works, showing a stone flue going up the hillside in the background. Photo by author.
Much of the rest of the area contaminated by the Upper and Lower Works has been remediated by the construction of a golf course, designed by Jack Nicklaus, atop the contaminated ground, a remedy the Environmental Protection Agency authorized. Despite the use of granulated slag instead of sand in the traps, the greens and fairways of the Old Works Golf Course give little hint of the conflicts that once smoldered along Warm Springs Creek over how the mining industry would dispose of its smelter wastes.

In Butte, historic preservationists have especially focused their attention, perhaps rightfully, on the 13 steel headframes surviving on the Butte landscape, most of them in plain view. One of the headframes, at the Granite Mountain mine, is surrounded by overburden from the Berkeley Pit. The Granite Mountain mine was the site of the worst hardrock mining disaster in U.S. history. In 1917, at least 165 miners working in the Granite Mountain mine were killed by a fire that erupted in the shaft. Historically minded citizens of Butte have erected a fine memorial to the miners killed in the Granite Mountain disaster. The memorial also serves as a scenic overlook for the Granite Mountain headframe and the headwaters of Silver Bow Creek, now filled with vast volumes of material excavated by open-pit mining and treated by the giant concentrator next to the Berkeley Pit at Butte.

In addition to the well-known mines of Butte and the smelters of Anaconda, however, other resources have significance for their roles in the disposal and management of the waste products of industry. Because of the scale and scope of Butte’s mining industry, these cultural resources extend well beyond Butte and Anaconda. The 1947 aerial photo of tailings shows Silver Bow Creek only 10 miles downstream of Butte (figure 5). Silver Bow Creek and the Clark Fork River carried other tailings much farther, as much as 100 miles downstream to the Milltown dam near Missoula. Many of the tailings are still where they were deposited by fluvial action, but they are fast being removed under the Superfund cleanup. While the large concentrated deposits of tailings along the stream should clearly be removed, perhaps the National Park Service (NPS) could preserve and interpret the small tailings deposits on the Grant-Kohrs Ranch. Located at Deer Lodge, about 15 miles north of the Anaconda smelter, the Grant-Kohrs Ranch is the unit at which the NPS interprets the history of the western livestock industry in the U.S. Tailings from the smelters washed down-stream onto the Grant-Kohrs Ranch in the early-20th century. Three of the owners of the ranch, Conrad Kohrs, John Bielenberg, and Nick Bielenberg, testified at the Bliss and Magone trials.

The tailings embody the conflict that often occurs (and did occur in the Deer Lodge Valley) between competing visions of how the environment should be used for human purposes: should the valley be used for agriculture to produce food and fiber or as a sink for industrial waste? The NPS has a marvelous opportunity to interpret the story of those conflicting visions at the Grant-Kohrs Ranch (see figure 14). Doing so would help make the point that ranching in the American West was not just a story of stockmen struggling against the natural elements and against cattle thieves. It also involved struggle against industrial corporations that had different uses in mind for the environment the cattlemen hoped to manipulate for raising livestock.

Another prominently visible site associated with waste from the copper industry lies in Butte at the former site of one of the big 19th-century smelters, the Butte Reduction Works, located like the others along Silver Bow Creek. Managers of the Butte Reduction Works began investigating complaints from downstream property owners about tailings as early as 1898. In response to those complaints, the Butte Reduction Works built an impoundment along Silver Bow

Figure 14. Streamside tailings at Grant-Kohrs National Historic Site. Tailings create an inhospitable matrix for plant growth, hence the bare spots in the streamside vegetation. Photo by author
Creek to contain its tailings, and it used a novel building material to do so—poured-in-place slag from the smelter. Smelter workers conveyed molten slag in ladles along a trestle and poured it into forms, much like pouring concrete (see figure 15). Those workers also built formwork with which to use molten slag to make a culvert, by means of which the creek could pass beneath the tailings deposit without eroding the tailings and carrying them downstream.

In another element of complexity, the slag perimeter wall along the northwest side of the impoundment was actually a double wall (see figure 16). It was built that way in order to channel Missoula Gulch, when it flowed seasonally, around the tailings dump. Many of Butte’s old silver mills had been located in Walkerville, at the head of Missoula Gulch, and the gulch was lined with tailings discharged from those mills in the 1880s and 1890s. Spring runoff and thunderstorms would wash some of those tailings down the gulch toward Silver Bow Creek. The Butte Reduction Works did not want those tailings filling its impoundment, so it created the double slag wall to channel them around the west perimeter to a confluence with the creek that was downstream of the impoundment.” The utilitarian slag walls are still a prominent part of the Butte landscape and tell an important story about the copper industry in Butte (see figure 17).

By building the tailings impoundment of poured-in-place slag, the Butte Reduction Works was able to accomplish three things important to managing its smelter operations: (1) it kept its tailings out of Silver Bow Creek, thus hopefully avoiding damage claims from downstream landowners; (2) it created an impoundment in which it could allow the tailings to settle out of the water that carried the tailings from the concentrator, thus making it possible to reuse...
some of the water in the concentrator (an important consideration in a semi-arid area, like Butte, where smelters and concentrators often were short of water for industrial purposes); and (3) it prevented tailings from other operations, like the silver mills up Missoula Gulch, from taking up valuable space in its tailings impoundment.

**Criteria for Evaluation**

The historical significance of industrial wastes at Butte and Anaconda may be described using the Criteria for Evaluation for eligibility for listing in the National Register of Historic Places.

**Criterion A**

Many of the historical features in Butte and Anaconda related to mining and metallurgical waste described in this article are of resources that were associated with the smoke and tailings controversies of the early-20th century, long before federal and state governments established environmental regulations by which industries must abide. Such regulations are an important part of the legal environment in which industries operate today. A long history led to state legislatures and Congress passing laws in the 1960s and 1970s that enabled the creation of environmental regulations. Near the beginning of that history, the federal govern-

The Anaconda stack is a particularly important feature of the history of early efforts by the federal government to encourage giant corporations to moderate their output of polluting materials. Presidents Theodore Roosevelt and Howard Taft had to weigh the extent to which they should pressure the Anaconda Company to cease discarding pollutants into the environment in such a way that those pollutants damaged federal property. Presidents and the government officials who worked for them recognized that the industries employed many people, made significant contributions to local and national economies, and produced raw materials that were critical to the rapid industrial growth of the American economy. On the other hand, government officials did not believe that giant corporations should be allowed to run roughshod over their neighbors or use their economic power to avoid taking costly steps to rectify the problems they were causing. Creation of the Anaconda Smelter

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**National Register Criteria for Evaluation**

The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and

a. that are associated with events that have made a significant contribution to the broad patterns of our history; or  
b. that are associated with the lives of persons significant in our past; or  
c. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or  
d. that have yield, or may be likely to yield, information important in prehistory or history.
Smoke Commission, which recommended that the Anaconda Company build the stack and its associated Cottrell treaters, was an approach the government attempted in the Anaconda and other cases through which the government could work cooperatively with an industry to find a solution, rather than confronting that industrial corporation directly in the courts.

*Criterion B*

The episodes described in this article were significant in the lives of several historically important individuals, such as D. E. Salmon, the nationally prominent former director of the U.S. Bureau of Animal Industry; Frederick Cottrell, the U.S. Bureau of Mines official who had invented the electrostatic precipitators (now demolished) that were an essential component of the technological solution represented by the Anaconda stack; and Ligon Johnson, the justice department attorney who prepared the government’s case against the Anaconda Company. Although these individuals were arguably nationally significant figures, none of the resources described in this article have the kinds of connections to these individuals which merit eligibility based on *Criterion B.* H. C. Gardiner, the veterinarian who worked for the Anaconda Company, was an individual of local, if not regional, importance. His house, or a comparable building associated with his life and work, would be eligible for listing in the National Register.

*Criterion C*

Many of the physical resources from Butte and Anaconda described in this article embody the distinctive characteristics of industrial construction intended to manage waste products. Some, like the Anaconda stack, possess individual distinction. Others may lack individual distinction, but the structures associated with waste convey an important facet of the copper industry. Built to manage industrial wastes and surviving in the context of the Butte-Anaconda National Historic Landmark District and its many other structures, they represent the mining and smelting industry of the period. For example, the slag walls at the Butte Reduction Works show the method one smelter company employed to use a readily available waste product, slag, to create a solution to a problem facing the company concerning another waste product, tailings. Downstream property owners were complaining to the Butte Reduction Works that tailings from its operation were being washed downstream and damaging their farmlands. The slag walls allowed the Butte Reduction Works to impound its own tailings, to keep tailings from upstream operations out of its impoundment, and to manage the flow of Silver Bow Creek through its property.

*Criterion D*

The Upper and Lower Works in Anaconda are ruins but could be analyzed as archaeological resources to yield additional information about the smelting methods used by the American copper industry in the late-19th century. As with historic industrial resources in general, people who built and used the Upper and Lower Works in Anaconda did not write down everything historians like to know about them. Although the Upper Works have been disturbed to a considerable extent by the construction of the Old Works Golf Course, the Lower Works lie largely undisturbed from the time they were demolished during the first few years of the 20th century.

**Conclusion**

The preservation and interpretation of cultural resources embodying the history of industrial waste can complement, rather than interfere with, the large and important work that is being done to clean up the environment. Cultural resources such as waste deposits can help visitors or viewers understand the uneasy relationships that have long existed and continue to exist between industry and local economies, industry and government, and industry and the environment. Historic industrial wastes and the infrastructure erected to manage wastes palpably show that these uneasy relationships are much older than the environmental movement that emerged in the U.S. after World War II or the 1970s. By working together to preserve and interpret industrial wastes, historic preservationists and advocates of environmental remediation alike can help to educate a populace that knows and appreciates its history and therefore supports regulations that protect the environment, communities’ livelihoods, and the health and safety of people who live in proximity to industrial operations. The contested terrain of industrial waste has characterized human life ever since people learned to manipulate environments in large-scale ways. Keeping that contested terrain before the public’s eyes in appropriate locations and with appropriate interpretation can help citizens appreciate the importance of properly regulating, managing, and remediating industrial wastes.

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Notes

1. Operable units are distinct areas within a Superfund site that, because of differences in their physical and topographic characters and differences in the composition of contaminants, require different remediation planning and implementation. In the 1990s, the Clark Fork Superfund Site was divided into four distinct Superfund sites (Silver Bow Creek/Butte Area Site, Anaconda Company Smelter Site, Milltown Reservoir/Clark Fork River, and Montana Pole), each with its own set of operable units. For descriptions of the current Superfund sites that once comprised the single Clark Fork Superfund Site, see the web pages maintained for each by the U.S. Environmental Protection Agency (<www.epa.gov/region8/superfund/siteinfosf.html>). See also the website maintained by the Clark Fork River Technical Assistance Committee (<www.cftrac.org>.


5. Noble and Spude, "Guidelines," 7, 12, 14, 20 (see n. 4).


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17. Peters, Modern American, 278–326 (see n. 15); Peters, Modern Copper, 442–527 (see n. 16).

18. Peters, Modern American, 390–395 (see n. 15); Peters, Modern Copper, 528–605 (see n. 16). The standard for purity at the time was called “lake copper,” which was the product of the Lake Superior copper mines on Michigan’s Keweenaw Peninsula, where the copper in the mines was in the form of pieces and particles of pure copper. Copper in most ore bodies, including those exploited by Butte’s mines, is chemically bound to other elements like sulfur. The challenge for most metallurgists who design and operate smelters and refineries to process sulfide ores was to produce a product matching “lake copper.”


21); Theobald Smith, testimony, *Bliss v. Washoe*, vol. 47, 18428-18575 (see n. 21); Leonard Pearson, testimony, *Bliss v. Washoe*, vol. 48, 18891-19038 (see n. 21).


29. Quivik, “Industrial Undergirding,” 63-65 (see n. 10).


33. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) set the nationwide program in motion, making polluters responsible for paying the costs of remediation. CERCLA also created a trust fund, called the Superfund, to pay for remediation at sites where a responsible party capable of paying remediation costs could not be identified. Shortly after passage of the act, the entire cleanup program came to be known as Superfund.


