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UNITED STATES DISTRICT COURT
DISTRICT OF NORTHERN IDAHO

United States
v.
ASARCO, et al
Civil Action No. 96-0122-N-EJL

EXPERT REPORT

of

FREDRIC L. QUIVIK, PhD.

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Fredric L. Quivik

28 August 1999

94-4217
94-4244

Table of Contents

INTRODUCTION

I. GENERAL REMARKS

A. Personal Background/Qualifications

I am Fredric L. Quivik, a consulting historian of technology living in Alameda, California. I have worked as a consultant since 1982, when I formed an historic preservation consulting firm, Renewable Technologies, Inc. (RTI), in Butte, Montana. Having been educated in architecture and historic preservation, my historic preservation contracts initially consisted of more conventional projects involving historic buildings of residential, commercial, and institutional nature. Within a few years, however, I grew to specialize in historic sites of engineering or industrial nature, including bridges, dams, and mining facilities. I completed a wide variety of large contracts concerned with analyzing various facets of the history of the industrialization of the American West.

In 1990, I took an extended leave from RTI to pursue a PhD in the Department of History and Sociology of Science at the University of Pennsylvania, specializing in the history of technology. During three years resident in Philadelphia, I completed all coursework and exams necessary for the PhD. During the summers of those years, I worked for the Historic American Engineering Record, National Park Service, writing a business and technological history of the Connellsville coke region in southwestern Pennsylvania, gaining additional expertise in the coal and coke industry and the metallurgy of iron and steel. In spring 1998, I completed my PhD dissertation, titled "Smoke and Tailings: An Environmental History of Copper Smelting Technologies in Montana, 1880-1930." I received the PhD degree from the University of Pennsylvania in August 1998.

Beginning in spring 1994, I began working under contract to the U.S Department of Justice (DOJ) as an expert witness in U.S. v. ARCO, the Clark Fork Superfund litigation in Montana. In that capacity, I prepared expert reports for both the Environmental Enforcement Section of the DOJ and the Environmental Defense Section. The reports provided detailed histories of the production of the metallurgical byproducts of tailings, smoke, and slag by the several historic mining, milling, and smelting companies active in Butte and Anaconda. The reports described how the companies discharged their byproducts, how they managed the byproducts (if they did), and historical events that caused the byproducts to change location or character.

I have not testified at trial in U.S. v. ARCO, but I have testified in deposition relative to my expert reports. I also served as a section 30(b)(6) witness in the case on behalf of the United States.

A detailed list of my education, professional undertakings, and publications is presented in my resume, attached to this report as Appendix A.

B. Compensation

I am being compensated by the United States Department of Justice as an expert witness in the case U.S. v. ASARCO at the rate of $100.00/hr. for pre-trial consulting and at the rate of $150.00/hr. for depositions and trial testimony.

II. SUMMARY OF OPINIONS

The purpose of this report is to provide: 1) a history of the movement of tailings and other potential contaminants through the Coeur d'Alene River basin during the past approximately 115 years, and 2) a history of physical and/or chemical changes those tailings and other potential contaminants may have undergone during that history. My opinions are not based on theoretical projections of what may have happened historically to result in the current set of conditions found in the basin. Rather, my opinions are based on evidence from the historical record. Following is a summary of my opinions:

Mining began in the Coeur d'Alenes with the discovery of placer gold in the North Fork country around Murray in the early 1880s. Beginning in the mid-1880s, some individuals and companies began turning their attention to the silver-lead ore deposits evident along the South Fork Coeur d'Alene River and its tributaries. Initially, rich shipments of ore were hauled out of the basin by mule, wagon, and steamboat and then transported by rail to distant smelters. Mining entrepreneurs quickly turned to crushing and concentration of silver-lead ores as means of reducing the costs of shipping product to smelters. The first successful silver-lead concentrator in the Coeur d'Alene district was that of the Helena Concentrating Company, built in 1886 to concentrate ores from the Bunker Hill and the Sullivan mines in upper Milo Creek. By 1888, there was a boom of mill construction in the Coeur d'Alene district, with most activity taking place in the upper reaches of the South Fork, along Canyon Creek, and up Milo Creek. With the advent of milling and concentration began the nearly continual, daily discharge of thousands of tons of fine solid particles, called tailings, into the hydraulic system of the Coeur d'Alene River. The practice of discharging tailings directly into the river system continued, with few exceptions, until 1968. The history of direct discharge of tailings into the creeks and river may handily be divided into two periods: before the introduction of flotation and after. It must be remembered, though, that the transition from the earlier gravity concentration to near 100% reliance on flotation was gradual, spanning the 1910s and 1920s.

The physical and mineral character of the tailings discharged into the Coeur d'Alene River system did not remain the same throughout the eighty years during which mills made those discharges directly into streams. The character of the tailings changed over time due primarily to two other changes: 1) in the kinds of ores exploited, and 2) in the methods used to mill those ores. In the early years, silver-lead ores were almost exclusively the ores of choice among operators of concentrators in the Coeur d'Alene district. While the ores also often had a significant zinc content, miners tended to ignore orebodies with too much zinc because, prior to the early twentieth century, there was no market for zinc from the Coeur d'Alenes. Furthermore, lead smelters were not fond of zinc and, in fact, they imposed penalties on companies that

delivered ore or concentrate with too much zinc. Because available milling technologies were not adept at recovering lead from lead-zinc ores while separating out the zinc, such ores were often best left in the mine or on a dump.

Shortly after 1900, however, mine developers found economical orebodies rich in metals other than lead and silver, and they began to find markets for those other metals. Early twentieth-century mine developers built successful enterprises, if even for only a few years, producing--in addition to lead-silver ores and concentrates--ores and concentrates bearing marketable amounts of zinc, copper, tungsten, and antimony. Concentrators cannot make a perfect separation. Any time companies employed concentrators in an effort to separate minerals bearing desired metals from minerals thought to have no economic value, those concentrators were less than 100% effective at doing so. Therefore, companies and their concentrators daily discharged thousands of tons of tailings bearing the lead, silver, zinc, copper, tungsten, or antimony that they were not able to separate from the gangue, which itself was comprised of minerals containing iron and other elements.

Modern concentrators are able to operate at levels of very high effectiveness, typically recovering well in excess of 90% of the desired minerals. Nineteenth-century concentrators were not nearly so effective. On particularly troublesome ores, they sometimes recovered less than 60% of the desired minerals. Such poor recoveries meant that the unrecovered minerals were discharged into the creek or river as solid particles ranging in size from small pebbles to extremely fine powder. The transition from relatively poor recovery rates to high recovery rates was gradual.

When ore is crushed and ground, a certain amount of fine dust and sand will be generated, even if the intent is to reduce the material only to pebble-size. Early mill builders and operators knew from experience with Coeur d'Alene lead-silver ores that concentrating machines called jigs were relatively effective at separating galena (lead sulfide) from gangue if the particles sent through the jigs were in the coarse range (small pebbles down to coarse sand). Jigs produced coarse concentrates that were readily marketable to smelters and they produced relatively clean coarse tailings. Jigs, however, did not effect good separation of fines. Operators therefore enacted two sets of strategies: 1) they used methods for crushing and grinding ore that produced a minimum of fine particles, and 2) they continually experimented with new arrays of tables and vanners for separating galena from gangue in the fine particle range. Even with efforts to improve recoveries from fines, mills discharged a tailing stream of fine solids that possessed assay values in lead, silver, and other metals approaching the assay values found in the raw ore.

Early mills in the Coeur d'Alenes, then, discharged two kinds of tailings, broadly speaking, into adjacent streams: 1) coarse tailings, with relatively low assay values in lead and silver, and 2) fine tailings, with relatively high assay values in lead and silver. Because the smelters did not like zinc in the concentrates, mills tried not to recover zinc with the lead and silver. Therefore, if mills were treating ores with zinc, tailings at both ends of the particle-size spectrum also contained zinc. Mill operators looked at these two kinds of tailings in another light. Fine tailings were readily swept away by the river or creek under most conditions, but coarse tailings tended to settle quickly if there was insufficient flow. Large accumulations of tailings (similar to sand or gravel bars) near the tailings discharge point could interfere with the

on-going operation of a mill. Therefore, mills sometimes had railroads haul coarse tailings away, especially in periods of low water. Railroads transported coarse tailings in cars to points as much as a hundred miles away to be used for ballast under their tracks and ties.

Ideally, mills operated constantly. In aggregate, then, mills in the Coeur d'Alene district amounted to an array of distinct sources discharging continuous volumes of solids into the hydraulic system that is the Coeur d'Alene River. The river system was not nearly so consistent, however. There were, and still are, significant fluctuations in the volume of water flowing through the system and in the velocity of flow. There is the general annual fluctuation of high water during spring run-off and lower water during the rest of the year. Then there are special events that may happen in any given year but not in others. Cloudbursts over a particular watershed, even the headwaters of a single small tributary, may cause localized high water of great intensity and short duration. The Coeur d'Alene district is also prone to winter flooding, when considerable snow accumulates in the mountains followed by a warm spell accompanied by heavy rains. At the other extreme, some years in the Coeur d'Alenes are particularly dry, and the volume of water flowing through the river and its tributaries is especially small during late summer and fall. Bitter cold also caused low water during some winters.

These fluctuations in volume and velocity of water caused an erratic, rather than continuous, movement of solids through the system. Solids at the fine end of the particle-size spectrum (slimes) remain suspended in water of even quite low velocity. Indeed, observers of the South Fork and its tributaries reported throughout the history of the district (until all tailings were impounded in 1968) that the water appeared muddy and roily, that it was opaque, that it had a blue-gray color, that it had the appearance of lead. The Coeur d'Alene River system transported slimes down to the slack water of Coeur d'Alene Lake on a year-round basis. Movement of coarser solids was more dependent on fluctuations in flow through the system. Some years, water ran so low that observers noted even fine tailings accumulating along the banks and in the beds of creeks and the river. At the other extreme, the annual spring run-off and occasional other flood events moved sands and even coarse gravels downstream to be deposited at new locations. Indeed, in the early years mill operators depended on this annual cycle to clear jig tailings out of the channel, making way for another year's output.

Tailings from Canyon Creek and the upper South Fork joined at the mouth of Canyon Creek, just above Wallace, where they mixed and continued downstream. As the South Fork gained the flow of other tributaries and continued past the mills in the vicinity of Kellogg, it picked up additional tailings. If the water was low, coarse tailings would settle out at various locations along the river. During high water, many of the tailings deposits were eroded and carried downstream to new locations. Throughout the year, slimes from all the mills operating in the Coeur d'Alene district were carried by the river down to the slow-moving reaches of the Coeur d'Alene River below Cataldo and into the arm of Coeur d'Alene Lake into which the river flows.

Human activity helped send solids of another variety into the Coeur d'Alene River system. Gold along the tributaries of the North Fork continued to attract miners, who established small stamp mills and extensive placer mining operations. Numerous stamp mills operated for short periods of time in the vicinity of Murray, pulverizing ore and recovering gold by the

relatively simple process of pan amalgamation. They discharged relatively small volumes of tailings into the river system. Placer miners, on the other hand, dislodged huge volumes of material, first by hydraulic means and then after the turn of the century by dredges. In neither case did the placer miners crush or otherwise change the physical size of the material they worked. They merely used water to convey thousands of tons of sand and gravel through their plants, hoping to recover profitable amounts of gold in the process. By dislodging all that alluvium, they made the material more susceptible to erosion by the stream flow, especially during periods of high water. While observers described the North Fork as being clear at its confluence with the South Fork most of the year, they described it as muddy during high water. They attributed the solids borne by the North Fork to the sand and gravel dislodged by placer operations upstream.

As the river system carried tailings downstream during the late nineteenth and early twentieth centuries, those tailings began to be deposited on riparian agricultural lands, especially in areas downstream of Cataldo and Mission Flats. Farmers who owned those bottom lands started registering their complaints with the mining companies. Under the auspices of the Mine Owners Association, the largest of the mining companies started in 1901 to build dams of wood pilings and planks intended to impound tailings along Canyon Creek and the South Fork. The Canyon Creek dam in the vicinity of Woodland Park, the Osburn dam on the South Fork near Osburn, and the Pine Creek dam on the South Fork near the mouth of Pine Creek were man-made structures that created large deposits of tailings, especially coarse tailings. Subsequent floods, especially in late 1917, damaged the wood pile tailings dams, and the Mine Owners Association did not make repairs. Meanwhile, millions of tons of tailings had built-up on the flood plains above the dams, and these deposits remained in place for decades. Many are still there.

There was another way that large tailings deposits were established on the landscape around the turn of the century. The Bunker Hill & Sullivan Mining & Concentrating Company (BH&S) and the Empire State-Idaho Mining Company (soon to be acquired by the Federal Mining & Smelting Company) built large mills on the flat adjacent to the South Fork just below Kellogg. Rather than discharging their coarse tailings into the river, both BH&S and Federal elevated their coarse tailings onto dumps that grew to mammoth proportions. Both companies continued to discharge their slimes into the river.

During the first dozen years of milling in the Coeur d'Alene district tailings of relatively high assay values were discharged into the streams. Tailings assay values were high in part because companies were treating relatively high-grade milling ore. Lower-grade ore, made economical to treat only after the introduction of flotation, was initially left in the mine or set aside on dumps because the relatively crude turn-of-the-century milling methods could not recover enough lead and silver from the low-grade ore to make it profitable. The fine tailings and slimes discharged during the early period had quite high assay values, approaching those of raw ore. Mill operators knew they were discharging rich tailings, and they tried to extract as much value as they could from those fine solids, but it reached a point of diminishing returns, where it was more profitable to work fresh ore than it was to continue to try to process fines on tables and vanners. Assay values of coarse jig tailings, although low compared to the assay values of slime tailings, were relatively high compared to later flotation tailings. Mill operators

at the time considered jig tailings relatively clean, but later, deposits of jig tailings in the Coeur d'Alene basin would be recognized as profitable sources of mineral wealth when new technologies, especially flotation, allowed mill operators to achieve very high recovery rates from material of much lower grade.

In the early years of the twentieth century, mills in the district were, in aggregate, daily discharging upwards of 4,000 tons of tailings into the South Fork Coeur d'Alene River and its tributaries. Two important changes gradually took place by 1915: 1) mining companies began to exploit ore bodies rich in copper and especially zinc, and 2) the technology for recovering values from fines took a giant leap in effectiveness with the introduction of flotation. As new ores began to be exploited, the amounts of metals like zinc and copper that were discharged with tailings into the river began to increase. Also, the locations of mines and mills began to diversify into more drainages. Nine-Mile Creek became an important mining area for zinc, and the drainage became a significant source of tailings. New mines also opened in the upper reaches of the South Fork and in small tributaries on the south side of the South Fork, like Big Creek, Lake Creek, and Pine Creek.

On the other hand, the advent of flotation heralded the beginning of a decline in the tailings assays for lead, zinc, silver, copper, and the other sought-after metals. At first, flotation was only applied to the existing stream of fines flowing through the mill, but as operators saw how effective flotation was at recovering minerals, they began to re-grind ever increasing proportions of the jig rejects, until by the end of the 1920s, most mills in the Coeur d'Alenes had abandoned jigging altogether. At that point, nearly all mill feed was ground to a fineness suitable for flotation. As a consequence, virtually all tailings discharges into the South Fork and its tributaries were of a fineness that they were readily carried downstream.

New controversy arose in the early 1930s about the time flotation became nearly the sole means of concentrating ores in the district. With sole reliance on flotation, virtually all the tailings discharged into the river system were fine tailings, and they tended readily to flow downstream. Residents around the perimeter of Coeur d'Alene Lake, and especially in the City of Coeur d'Alene, began to voice strong concern that the Lake was being polluted. After a period of some controversy, featuring field studies by the mining companies and various state and federal agencies, the mining companies decided in 1932 to inaugurate a dredging operation below the Cataldo Mission. A suction dredge, similar to that used in harbor clearance, was used to scour fines from the river channel and pipe them into an adjacent impoundment area. The dredge operated for about six months each year, from sometime in June when high water subsided until sometime in December when freezing weather set in. During the first twenty years of operation, the dredge each year moved an average of about 1.1 million dry tons of material out of the river channel and into the impoundment.

Another trend in operations also served to reduce the volume of coarse tailings along the Coeur d'Alene River system. From the first years of the century, small operators had recognized that coarse tailings deposits offered potential sources of revenue. Individuals established small hand-jigging operations to re-work small, natural (not intentionally saved) deposits of tailings along the banks and beds of the creeks and river, often just below the mill from which the tailings had originated. Small companies built mills and arranged leases to gain the rights to re-

work larger tailings deposits, which were unsorted gatherings of tailings from all the upstream mills. In general, these early operations did not grind the material further; they simply subjected it to another pass through a jig or over tables and vanners. With the advent of flotation, operators recognized that tailings deposits could yield even greater amounts of wealth if the tailings were ground finely and subjected to flotation. Flotation plants were established in the late 1910s to re-treat tailings behind the Pine Creek dam, and BH&S embarked on a campaign to re-work all the tailings on its dump and on Federal's nearby dump, both located on the flat below Kellogg. The re-treatment of tailings peaked during and just after World War II, when the Hecla Mining Company, the Zanetti Brothers, Small Leasing, and others excavated millions of tons of tailings from the Osburn and Canyon Creek tailings impoundments, from Nine-Mile Creek, and from other non-manmade deposits throughout the river system. Excavated tailings were re-ground and run through flotation cells, and significant amounts of lead, zinc, and silver were recovered. Fine tailings from the tailings re-working plants were discharged into the streams and readily carried away.

As tailings had sat on dumps for decades, some of the minerals therein oxidized. Flotation was not adept at recovering oxidized minerals. For example, Hecla estimated that it was able to recover only 50% of the potentially available lead in the Osburn tailings. Therefore, one consequence of the massive tailings re-treatment campaign was that coarse, oxidized tailings, which had been relatively stable, spatially, in large tailings deposits, were ground much more finely and discharged into the river system to be carried downstream.

The Cataldo dredge served as the mining companies' main method of protecting the environment from possible harm from tailings until 1968, when all the remaining operating mills in the Coeur d'Alene district installed tailings impoundments. By that time, some companies pumped some of their tailings back into their mines to backfill old workings. From 1968 until the present, any tailings not pumped into the mines have been impounded in engineered facilities near the respective mills.

Prior to 1968, the companies that discharged tailings into the Coeur d'Alene River and its tributaries--which tailings flowed together, downstream toward and into Coeur d'Alene Lake--included the following corporations and their historic predecessors: Bunker Hill & Sullivan, ASARCO, Hecla, Sunshine, Day Mines, Callahan, and Coeur d'Alene Mines.

Prior to 1968, the United States government made its presence known in the Coeur d'Alene mining district in a variety of ways. The government maintained a constitutionally-mandated postal delivery system. All the land in the district at one time was part of the public domain. Through various means, including the granting of patented mining claims, the government gave title to much of the land in the district to private individuals. Throughout the history of mining in the district, federal agencies, especially the U.S. Geological Survey and the U.S. Bureau of Mines, have collected and published statistical information about the mining industry there. The U.S. Forest Service administers what became National Forest lands, and the Bureau of Land Management administers other public lands within the district. During the two World Wars, the U.S. government fixed metals prices and established other programs to try to insure adequate supplies of resources for the nation's war efforts. During the 1950s, the government implemented a loan program administered by the Defense Minerals Exploration

Administration to encourage mining companies to extend their exploration into deeper ground in the hopes of finding what the government considered strategic reserves. Several mining companies in the Coeur d'Alenes availed themselves of the loans. At times during the history of mining in the Coeur d'Alenes, various federal agencies, including the U.S. Army Corps of Engineers, the U.S. Bureau of Fisheries, the U.S. Bureau of Mines, and the U.S. Public Health Service, have conducted field studies to examine various facets of the impact of continual tailings discharges into the Coeur d'Alene River system.

I have found no evidence in the historical record to suggest, in any of the instances in which the United States government was active in the Coeur d'Alene district prior to 1968, that the government made decisions for the mining companies or in other ways acted in such a manner that it could be construed that the government was an operator of any of the companies' mining or concentrating operations. Specifically, prior to 1968, the government made no decisions about how the mining companies produced tailings, discharged tailings, managed tailings, or reprocessed tailings. I was not asked to inquire into possible federal involvement in the Coeur d'Alene district after 1968, and I have developed no opinion about the topic.

The main body of this report provides a detailed narrative history of the several mining companies' operations in the Coeur d'Alene basin, arranged by mill, and of their production, discharge, and manipulation of tailings over time. Mills are grouped in the report by their geographic location along the upper, middle, or lower reaches of the South Fork or along tributaries of the South Fork.

III. MATERIALS CONSIDERED and METHODS USED

The materials I have considered in preparing this report include documents, artifacts, and landscapes I have studied relative to the Coeur d'Alene mining district. Specific references upon which my findings are based are cited in the footnotes of the report. Documents cited include recent secondary sources, historic secondary sources, historic technical and professional journals and texts, manuscript collections in public archives, and historic corporate collections of the defendant companies provided in discovery by them. I have provided copies to the DOJ of all cited documents I have discovered during my own researches and which are not already part of the databases assembled by DOJ. I have also provided copies of documents I have discovered and which pertain to the Coeur d'Alene district but which I did not cite in this report.

While researching and writing this report, I have employed Jennifer Stevens. Ms. Stevens has a Master of Arts in History from the University of California at Santa Barbara and is a PhD student at the University of California at Davis, specializing in environmental history. She has several years experience working in litigation support on environmental cases. All of Ms. Stevens' work on this expert report has been conducted under my supervision. She has conducted research in the DOJ data base and in primary and secondary sources. She has made copies of all pertinent materials she has found, and those copies are part of the collection I have submitted to the DOJ. I have assigned Ms. Stevens several distinct research topics, and she has written drafts portions of this report based on that research. I have reviewed and edited all of the portions that she has written.

IV. A HISTORY OF MILL TAILINGS IN THE COEUR D'ALENE MINING DISTRICT

HISTORICAL INTRODUCTION TO THE COEUR D'ALENE MINING DISTRICT

Since the beginning of the twentieth century, the Coeur d'Alene mining district has been one of the United States' leading suppliers of lead and silver ores. Until the mid-1910s, when the Bunker Hill & Sullivan Mining & Concentrating Company built a lead smelter near Kellogg, all the ores and concentrates produced by mining companies in the Coeur d'Alenes had to be shipped elsewhere for smelting. The lead smelter brought the issue of smelter smoke to the Coeur d'Alene basin, but smelter smoke is not a topic of this expert report. This expert report addresses the history of another form of industrial pollution that existed in the Coeur d'Alene mining district long before the smelter began discharging smoke. Almost since the beginnings of mining in the district, mining companies have treated their ores in concentrators, which are mills that crush ore and separate, more or less, desired metal-bearing minerals from non-desired minerals. Concentrators yield products, called concentrates, that are much more profitable to ship and smelt because they contain much less of the minerals with no economic value. For more than one hundred years, mining companies in the Coeur d'Alenes have shipped--and still ship--concentrates rich in lead, silver, zinc, copper, and other metals to distant smelters. The other minerals, which have no recognized economic value, are discarded as waste called tailings. Tailings, as understood by their historic character and behavior, are the major topic of this expert report.

Concentrators are very effective at separating metals, but not 100% effective. This means that they are not able, as a matter of practice, to separate all the metal-bearing minerals from the tailings. One hundred years ago, concentrators were much less than 100% effective. Some concentrators had difficulty recovering even 80% of the lead in the ore they treated, meaning that 20% of the lead in the ore was discarded from the concentrator as waste. If the ore treated was 15% lead by weight, then a concentrator showing an 75% recovery would have discarded tailings assaying nearly 5% lead. Such was not uncommon at the turn of the century. Moreover, many mines had considerable zinc in their ore as well. Prior to the early twentieth century, there was not a market for zinc from the Coeur d'Alene district, and lead smelters penalized shippers for ores or concentrates that had too much zinc. Consequently, companies in the Coeur d'Alene district sought, to the extent their concentrators were able, to discard zinc in their tailings. In the early years of mining in the Coeur d'Alene district, then, mining companies discarded significant quantities of lead and zinc from their mills.

In the process of concentrating ore, materials pass continuously through the equipment in a mill. For the process to remain on-going, there must be a continuous supply of fresh ore arriving at the mill and a continuous removal of concentrates and tailings from the mill. Concentrators located adjacent to broad areas of land have the option of conveying tailings there

for disposal. Because most of the concentrators operating in the Coeur d'Alene district were historically located in narrow mountainous valleys and canyons, disposal on dumps did not appear to be a convenient option. Rather, operators of early concentrators typically discharged their tailings into adjacent streams. Operators saw the streams as effective conveyors for removing tailings from the millsite so that more ore could be run through the process. This report is primarily a history of the mills producing tailings in the Coeur d'Alene district, how those mills disposed of their tailings, and what happened to those tailings after they were discharged from the mills.

Tailings were not the only medium in which lead, zinc, and other metals moved through the Coeur d'Alene basin. As just stated, the continuous operation of a mill necessitated not only the continuous removal of tailings from the millsite but also the continuous delivery of ore to the mill and the continuous shipment of concentrates to smelters. Ores and concentrates obviously also contain lead, zinc, and other metals, so spillage during transportation was another way that metals could be introduced to the streams of the district. Some mills were built adjacent to the mine opening, so ore was moved but a short distance. Other mills were some distance from the mine. Companies used several kinds of conveyances to haul ore to the mill, including horse-drawn wagons, surface tramways, aerial tramways, railroads, and motorized trucks. They used the same kinds of conveyances to haul ores and concentrates to smelters. Most mills were served by direct links to railroad lines, and railroads carried the largest volume of ore and concentrates to smelters. In the early years, the rail route to distant smelters included a steamboat link across Coeur d'Alene Lake, between Mission, on the Coeur d'Alene River, and Coeur d'Alene City, which was directly served by outside rail connections. The introduction of railroads to the Coeur d'Alene district was a key feature in the development of mining.

The Coeur d'Alene Railway & Navigation Company (CR&N) was incorporated by Daniel C. Corbin on April 22, 1886. Construction of the CR&N narrow gauge railroad began on August 18, 1886. By 1887, it ran between the steamboat at Mission and Wallace. A year later, in September 1888, the Northern Pacific took a 999-year lease on the CR&N. The Northern Pacific's operation of the CR&N soon faced competition from the Oregon Railway & Navigation Company (OR&N). The OR&N was backed by Union Pacific. In spring 1889, upon finally gaining a right-of-way across the Coeur d'Alene Indian Reservation, the OR&N constructed a standard-gauge line from Farmington to Spokane Falls, northerly across the Coeur d'Alene Reservation, around the south end of Coeur d'Alene Lake and along the Coeur d'Alene River to Mission. From there, the OR&N parallelled the CR&N's tracks to Wallace and Mullan. The OR&N also offered steamboat connections between Coeur d'Alene City and Harrison. The two railroads built competing branchlines up Canyon Creek to Burke. The Northern Pacific soon offered its own rival to the all-rail route of the OR&N. To spoil any plans that Union Pacific might have had to build its line all the way to Missoula, the Northern Pacific built its own line from Missoula west to Mullan. The Northern Pacific abandoned the narrow-gauge branch west of Wallace in 1896 and dismantled it in 1898. Thereafter, the OR&N (Union Pacific) offered the only rail transportation out of the Coeur d'Alene district to the west, and the Northern Pacific offered the only rail route out of the Coeur d'Alene basin to the east.[1]

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[1]John V. Wood, Railroads Through the Coeur d'Alenes (Caldwell: The Caxton Printers, Ltd., 1984) (FLQCA-001-03098-230); Dale Martin, "Historical Context/Narrative" (FLQCA-001-

Despite the fact that railroads and other forms of surface transportation hauled millions of tons of ores, concentrates, and tailings within and out of the Coeur d'Alene district, there is little historical evidence that these conveyances contributed much to the burden of solids carried by the rivers and creeks in the Coeur d'Alene district, especially when compared to the millions of tons of fine solids discharged continuously by the concentrators of the district into the hydraulic system of the Coeur d'Alene basin.

This report describes the history of metal-bearing solids moving through the creeks and rivers of the Coeur d'Alene basin. Individual sections describe the upper, middle, and lower reaches of the South Fork Coeur d'Alene River, the North Fork Coeur d'Alene River, the Coeur d'Alene River itself, and several important tributaries of the South Fork. Within each section, the reader will find individual histories of the mills that operated along that particular stream, followed by a general history of changes over time in the character and behavior of tailings in and along that particular stream.

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UPPER SOUTH FORK DRAINAGE

Mullan downstream to mouth of Canyon Creek
not including Wallace

The South Fork of the Coeur d'Alene River rises at the Continental Divide along the Idaho/Montana border. Flowing west through Mullan and toward Wallace, it gains size as it is joined by small tributaries. Several mines developed on those tributaries during the past century, and the larger of them built concentrators along the upper reaches of the South Fork. These are the eastern-most mines and mills of the Coeur d'Alene Mining District. Like the rest of the Coeur d'Alene District, this upper end has been known mainly for its silver-lead-zinc mines, though there were some copper mines and mills of minor consequence. The first major tributary of the South Fork is Canyon Creek, which flows into the main river just above Wallace. Canyon Creek is also the first tributary of the South Fork, moving downstream, to claim its own set of mills and therefore to have generated its own tailings discharges. This section of the report, then, concerns itself with the mills located along the upper reaches of the South Fork above Canyon Creek, especially in the vicinity of Mullan.

Gold Hunter

The Gold Hunter, also often called simply the Hunter, was one of the first mines in the Coeur d'Alene District and one of the first to build a concentrator. Construction began in fall 1888 at the mouth of Hunter Gulch, about a half-mile upstream of the town of Mullan. The millsite was along the north side of the Northern Pacific Railroad tracks, which were north of the river. The owners ordered equipment for a 150-ton mill, but reportedly built a structure capable of housing a mill of greater capacity. The mill began operating in spring 1889, using water power to treat 100 tons of ore daily with Cornish rolls, jigs, and vanners. An aerial tramway delivered ore from mine to mill. The Gold Hunter Mining Company was one of the Coeur d'Alene district's regular producers during most of the 1890s, sustaining some of the usual closures due to low metals prices, insufficient water, labor unrest, and periodic maintenance and mechanical improvement. In summer 1897, the mill burned, forcing a prolonged suspension of operations. Mine and mill remained closed all of 1898 and 1899.[1]

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[1] M&SP 57 (29 September 1888): 213 (FLQCA-001-01087); 58 (16 March 1889): 185 (FLQCA-001-01105), (11 May 1889): 337 (FLQCA-001-01111); 70 (11 May 1895): 298-299 (FLQCA-001-01353); 71 (23 November 1895): 343 (FLQCA-001-01391); 77 (24 September 1898): 311 (FLQCA-001-01532); 79 (21 October 1899): 467 (FLQCA-001-01600); E&MJ 47 (11 May 1889): 440 (RBUCO-001-0018); 52 (26 December 1891): 732 (RBUCO-001-0078); 53 (30 April 1892): 482 (RBUCO-001-0092); 65 (26 March 1898): 381 (RBUCO-001-0258); "Sanborn Map for Mullan" (1892), sheet 1 (FLQCA-001-02605); "Hunter Mill, Mullan, Idaho 1895" (FLQCA-001-03275).

Construction of the Hunter's new mill finally began late in 1899. Although a report in 1898 stated that the new mill would be built 1,000 feet downstream of the mill that burned, evidence on Sanborn maps shows that the new mill was eventually built directly on the site of the old one. When the new mill opened in spring 1900, it had a capacity to treat 300 tons/day. The Gold Hunter Mining Company continued to haul ore 3/4 mile from mine to mill via an aerial tramway. Each bucket carried 250 pounds. and the tramway could deliver ore at a rate of 10 tons/hour to the grizzlies at the mill. Mine and mill usually operated at a rate of about 150 tons/day, however. By the time of the early twentieth-century tailings litigation, witnesses described sizeable tailings deposits in the Mullan vicinity from the Hunter mill.[2]

The Hunter mill operated using only gravity concentration until 1914. During the period leading up to 1914, the Gold Hunter Mining Company made several changes to the mill, trying to improve recoveries of lead and especially silver, because the Hunter ore was somewhat richer in silver than nearby lead mines. Among the changes in 1904 were enlargements of the slime tanks along the west side of the mill and of the area housing Wilfley tables and vanners for treating slimes at the south end of the mill. In 1907, the Hunter drove a new cross-cut 4,400 feet toward the orebody from the level of the ore crusher. The new adit was located on the hillside north of the mill and connected to the mill by a covered tramway mounted on a trestle. When the new tramway went into service, the Hunter abandoned its aerial tram. Capacity of the mine and mill were increased at the same time. The Hunter again increased its capacity in 1912, reaching 400 tons/day.[3]

With gravity concentration recovering no more than 60% of the metal values, the Gold Hunter company began experimenting with flotation at its mill in 1914, beginning with the installation of a Callow flotation plant in November. The Callow apparatus showed 90% recovery, and overall recovery at the mill was 80%. The mill continued to rely on jigs to perform coarse concentration before sending fines to the flotation plant. Improved operation helped keep mine and mill working into the 1920s, when the Gold Hunter began leasing its mine to others.

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[2]E&MJ 65 (26 March 1898): 381 (RBUCO-001-0258); 68 (28 October 1899): 527 (RBUCO-001-0316); 69 (10 February 1900): 178 (RBUCO-001-0327), (14 April 1900): 448 (RBUCO-001-0333); M&SP 80 (5 May 1900): 495 (FLQCA-001-0007); "Sanborn Map for Mullan" (1892), sheet 1 (FLQCA-001-02605); "Sanborn Map for Mullan" (1901), sheet 1 (FLQCA-001-02607); "Gold Hunter Mine, Mullan, Idaho, Prior 1900" (FLQCA-001-03274); Davis R. Hoderman, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 211 (FLQCA-001-04587).

[3]M&SP 89 (24 September 1904): 214 (FLQCA-001-0166), (22 October 1904): 282 (FLQCA-001-0176), (29 October 1904): 298 (FLQCA-001-0171); 94 (20 April 1907): 484 (FLQCA-001-0273); 95 (19 October 1907):479-480 (FLQCA-001-0305-306); 103 (1 July 1911): 28 (FLQCA-001-0477); 106 (4 January 1913): 75 (FLQCA-001-0537); E&MJ 91 (29 April 1911): 880 (RBUCO-001-0699); 92 (25 November 1911): 1057 (RBUCO-001-0712); "Sanborn Map for Mullan" (1901), sheet 1 (FLQCA-001-02607); "Sanborn Map for Mullan" (1909), sheet 3 (FLQCA-001-02612); "Hunter Mill, Mullan, Idaho - 1910" (FLQCA-001-03272).

By the mid-1920s, the Hunter mill had installed an impoundment into which tailings were sluiced. The strategy served to settle coarser material, but slimes continued to flow into the river. The company continued to operate its mill on Hunter ore, and the mill began treating old tailings in 1923. It is not yet clear whence the tailings were taken. The mill's capacity was 500 tons/day in the 1920s. Beginning in 1930, the Hunter mill also treated ore from the Atlas mine. The Atlas Mining Company built a 2,000-foot aerial tramway to haul material from its own ore bins at the mine to the bins at the Hunter mill. The mill was inactive much of the 1930s, but leasers put it back in service in 1935. It continued to treat ore produced by leasers through the 1940s. The Gold Hunter mine closed in April 1949, and, after treating mine dumps and old tailings for several months, the Hunter mill closed in October.[4]

There is no evidence in the historical record that the United States was an operator of the Gold Hunter mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Morning

Charles Hussey bought the Morning mine at the head of Mill Creek from its locators in 1887. Two years later, he began construction of the Morning mill. The millsite was about one-half-mile downstream of Mullan and about 150 feet from the river. A flume delivered water to the mill from the South Fork, and an aerial tramway delivered ore to the mill from the mine. The mill started in autumn 1889, but it apparently did not operate for long. Hussey's operation suffered financial difficulty when his banks at Wallace and Spokane failed in December 1890. The Morning properties were tied up in financial claims by Hussey's creditors until November 1891, when a group of investors associated with the Milwaukee Mining Company (owner of the Gem in Canyon Creek) formed the Morning Mining Company to acquire the Morning group of mines and the mill.[5]

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[4]M&SP 109 (21 November 1914): 822 (FLQCA-001-0647); 110 (9 January 1915): 85 (FLQCA-001-0657), (27 February 1915): 346 (FLQCA-001-0667); E&MJ 102 (16 December 1916): 1078 (RBUCO-001-0918); 130 (23 August 1930): 197 (RBUCO-001-01163) Claude Rice, "Flotation in the Coeur d'Alenes, E&MJ 105 (20 April 1918): 709 (RBUCO-001-01362); Charles O. Olson, testimony in Jacob Polak v. Bunker Hill & Sullivan, et al, 692-693 (FLQCA-001-04845-846); USGS, Mineral Resources of the U.S., 1915, 553-554 (RBUCO-001-01641-642); Mineral Resources of the U.S., 1923, 398 (RBUCO-001-01703); Mineral Resources of the U.S., 1926, 446 (RBUCO-001-01724); Mineral Resources of the U.S., 1931, 402 (RBUCO-001-01759); Mineral Resources of the U.S., 1941, 354 (RBUCO-001-01790); Mineral Resources of the U.S., 1942, 384 (RBUCO-001-01794); Mineral Resources of the U.S., 1945, 376 (RBUCO-001-01809); Mineral Resources of the U.S., 1949, 1479 (RBUCO-001-01830); The Mining Industry of Idaho for the Year 1935, 230 (RBUCO-001-02481).

[5]Fahey, Hecla, 12; Ransome & Calkins, The Geology and Ore Deposits of the Coeur d'Alene District, 164; Wood, Railroads through the Coeur d'Alenes, 104 (FLQCA-001-03207); M&SP 58 (11 May 1889): 337 (FLQCA-001-01111); 59 (10 August 1889): 105 (FLQCA-001-01124), (28

The Morning company built a new mill about 550 feet to the northwest (downstream).[6] The millsite was a steep hillside set back a few hundred feet from the river. The site afforded the new owners a suitable location for ore bins at the lower terminus of a narrow-gauge railroad they built between mine and mill. The upper terminus, which received ore from the mine, was linked to the hillside portal (known as tunnel no. 4) by a tramway. The millsite also was apparently better situated relative to railroad connections and for the supply of water for power. A portion of the mill was operational in late 1892. Hussey's creditors had not yet been satisfied, however, so on-going financial woes, coupled with a depression in metals prices and the labor unrest in the Coeur d'Alenes, forestalled permanent operation of the mine and mill. Led by Charles Pfister and Charles Kipp, the stockholders of the Morning company reorganized it as the Morning Mining & Milling Company in an effort extricate the property from the financial entanglements. And on the labor front, manager D.B. Huntley briefly implemented a plan in late 1894 intended to circumvent labor-management disputes, whereby workers operated mine and mill under a cooperative plan. The operation lasted little more than a month, however.[7]

The Morning mill got going on a relatively regular basis, initially under lease, in mid-1895. The Longmaids (prominent Western mine operators) may have been the first to get the mill going, but by September it was under lease to Thomas Greenough and Peter Larsen. One of their first changes was to construct a new mine portal, called tunnel no. 5, which was several

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September 1889): 245 (FLQCA-001-01129); 68 (3 February 1894): 88 (FLQCA-001-01276); "Sanborn Map for Mullan" (1892), sheet 1 (FLQCA-001-02605); "Sanborn Map for Mullan" (1901), sheet 3 (FLQCA-001-02609); USGS, "Topographic Map of the Coeur d'Alene District, Idaho" (1901), (FLQCA-001-01990). The 28 September 1889 issue of M&SP reported that, "At Mullan, Charles Hussey has purchased the Evening and started up his concentrator, which means another hundred tons of ore per day." The Evening was a part of the Morning group of claims.

[6]The distance between mills is given on "Sanborn Map for Mullan" (1892), sheet 1 (FLQCA-001-02605). The precise relationship between the two mills may be seen on "Sanborn Map for Mullan" (1927), sheets 2 & 3 (FLQCA-001-02647-654).

[7]Fahey, Hecla, 12; Wood, Railroads through the Coeur d'Alenes, 106 (FLQCA-001-03209); E&MJ 51 (17 January 1891): 97 (RBUCO-001-0049), (18 April 1891): 477 (RBUCO-001-0054), (6 June 1891): 673 (RBUCO-001-0058); 52 (3 October 1891): 393 (RBUCO-001-0074); 53 (6 February 1892): 188 (RBUCO-001-0082), (20 February 1892): 236; 54 (3 December 1892): 542 (RBUCO-001-0113); 55 (1 April 1893): 300 (RBUCO-001-0120), (20 May 1893): 470 (RBUCO-001-0124); 56 (30 December 1893): 672 (RBUCO-001-0146); 57 (3 February 1894): 110 (RBUCO-001-0150), (14 April 1894): 350 (RBUCO-001-0157); 58 (13 October 1894): 337, 348-349 (RBUCO-001-0174-175), (27 October 1894): 398 (RBUCO-001-0176), (17 November 1894): 470 (RBUCO-001-0178), (29 December 1894): 613 (RBUCO-001-0183); M&SP 68 (3 February 1894): 88 (FLQCA-001-01276); 69 (6 October 1894): 209 (FLQCA-001-01316), (17 November 1894): 311 (FLQCA-001-01320), (29 December 1894): 413 (FLQCA-001-01328); Ransome & Calkins, Geology of the Coeur d'Alene District, 164; "Sanborn Map for Mullan" (1892), sheet 1 (FLQCA-001-02605).

hundred feet lower on the hillside. It obviated the need for the tramway linking mine to orebin at the upper end of the narrow-gauge railroad. Minor mishaps, like low water or a derailed ore train, interrupted operations of the mill for brief periods, but through the next few years the Morning became one of the Coeur d'Alene's most important producers. In 1897, Greenough and Larsen bought the mine, mill, and ancillary properties. At the time, the Morning was shipping about 2,500 tons of concentrates each month. Assuming a ratio of concentration of about 6:1, the mill was probably treating about 500 tons of ore daily. The Morning's growth was halted in spring 1898, when the mill burned.[8]

Larsen and Greenough made plans to rebuild the concentrator immediately. The reconstructed mill apparently sat on the foundations of the old one; it had the same proximity to Northern Pacific tracks, flume, ore bins, and narrow-gauge railroad as the earlier mill had.[9] The new mill, which had a capacity to treat about 700 tons of ore daily, had two side-by-side units of equal capacity. It was said to have been the largest lead-silver concentrator in existence. The first unit began producing concentrates in August 1898. Larsen and Greenough operated the Morning mill until 1905. During that time, they made several improvements. Like other mills in the Coeur d'Alene district, Larsen and Greenough periodically added equipment aimed at improving the recovery of metal values from slimes or fine tailings. They also increased the capacity to 1,000 tons/day. The Morning produced concentrates assaying as high as 70% lead and 28 oz. of silver per ton. Mill operatives made no effort to save zinc. In fact, they tried to insure that the concentrates they produced held no more than 10% zinc in order to meet smelter requirements. Larsen and Greenough discharged their tailings along the river bottom a short distance from the South Fork where tailings readily flowed into the stream.[10]

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[8]Fahey, Hecla, 16; Wood, Railroads through the Coeur d'Alenes, 106-107 (FLQCA-001-03209-210); M&SP 70 (1 June 1895): 343 (FLQCA-00101357); 71 (7 December 1895): 375 (FLQCA-001-01394), (28 December 1895): 431 (FLQCA-001-01397); 72 (14 March 1896): 211 (FLQCA-001-01409); 73 (15 August 1896): 131 (FLQCA-001-01435), (7 November 1896): 383 (FLQCA-001-01442); E&MJ 60 (28 September 1895): 306 (RBUCO-001-0207); 64 (4 September 1897): 286 (RBUCO-001-0249); 65 (30 April 1898): 531 (RBUCO-001-0261).

[9]E&MJ 65 (30 April 1898): 531 (RBUCO-001-0261); "Sanborn Map for Mullan" (1892), sheet 1 (FLQCA-001-02605); "Sanborn Map for Mullan" (1901), sheet 1 (FLQCA-001-02607). The differences between the mill that burned in 1898 and the mill built in 1898 are evident in two photographs: M&SP 69 (6 October 1894): 209 (FLQCA-001-01316); and "Morning Mine Mill - 1899" (FLQCA-001-03314).

[10]E&MJ 66 (10 September 1898): 316 (RBUCO-001-0275); 75 (20 June 1903): 946 (RBUCO-001-0388); 77 (9 June 1904): 923 (RBUCO-001-0409); M&SP 77 (2 July 1898): 10 (FLQCA-001-01516), (20 August 1898): 186 (FLQCA-001-01523), 27 August 1898): 203 (FLQCA-001-01524); 80 (10 February 1900): 151 (FLQCA-001-0004); 87 (29 August 1903): 138 (RBUCO-001-0117); 91 (21 October 1905): 283 (FLQCA-001-0225); Davis R. Hoderman, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 211 (FLQCA-001-04587).

Late in 1905, Larsen and Greenough sold the Morning mine and mill to the Federal Mining & Smelting Company. Federal had been formed in 1903 to take over several large Coeur d'Alene mining properties, specifically the Last Chance properties at Wardner, the Tiger-Poorman at Burke, and the Standard-Mammoth at Wallace. Almost immediately after it acquired the 1,000-ton Morning mill, Federal began adding more equipment for recovering values from slimes. By early 1907, Federal had installed new Huntington mills, a Callow system for sizing and settling, and Wilfley tables and vanners for concentrating the fines. With this equipment, the Morning mill daily retreated an additional 200 tons of material, recovering 11 tons/day of fine concentrate assaying at least 40% lead. This was material that heretofore had been discharged into the river. Initially satisfied with the results, Federal's mill manager W. Clayton Miller announced that Federal would install equipment necessary to re-grind all the Morning's jig tailings, so that nothing but slimes would be discharged from the mill. In 1908, while the mine was closed for sixth months, Federal abandoned Morning's tunnel no. 5, from which it had hauled ore via the narrow-gauge railroad, and opened tunnel no. 6, which was two miles long and delivered ore to a portal near the mill.[11]

During this early period of Federal ownership of the Morning mill, the company discharged coarse tailings into the creek by means of a launder emanating from the section of the mill housing the jigs. The launder was elevated on a trestle, which carried the tailings over the railroad tracks to the edge of the creek. Under the end of the launder, a pile of tailings built up on the river bank. This was undoubtedly the coarser material that did not flow immediately to the stream. Historic photos of the period show sandbars in the bed of the stream and along its edge which are probably deposits of tailings. Historic photos of the period do not depict the outlet of a conveyance for slimes.[12]

As Federal extended its Morning mine deeper into the orebody, it encountered ore of adequate lead assay (7-8%), but the ore was very refractory, low in silver, and relatively rich in zinc. Gravity concentration was not recovering sufficient lead and silver due to sliming of the new ore. The mill was only able to recover 50% of the values in the fine pulp and 60% in the mill overall. This spurred Federal to continue its program of trying to develop improved methods for treating slimes, with the target of being able to recover 80% of the values. The Morning tried several innovative methods of gravity concentration and eventually became one of

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[11] M&SP 91 (21 October 1905): 283 (FLQCA-001-0225); 92 (20 January 1906): 45 (FLQCA-001-0237), (16 June 1906): 405 (FLQCA-001-0250); 94 (23 February 1907): 244 (FLQCA-001-0263); 95 (6 July 1907): 6 (FLQCA-001-0295); E&MJ 81 (6 January 1906): 11 (RBUCO-001-0424); Richards, Ore Dressing (1909), 1687-1688 (FLQCA-001-01761); Wood, Railroads through the Coeur d'Alenes, 107-108 (FLQCA-001-03210-211); USGS, Mineral Resources of the U.S., 1906, 264 (RBUCO-001-01556); USGS, Mineral Resources of the U.S., 1908, 432 (RBUCO-001-01571).

[12] Richards, Ore Dressing, 946-947; "The Morning Mill" (FLQCA-001-03304); "The Morning Mine & Mill, Mullan, Idaho - 1907" (FLQCA-001-03305); "Morning Mill, Mullan, Idaho" (FLQCA-001-03306); "Morning Mill, Mullan, Idaho, after Lower Tunnel was Completed" (FLQCA-001-03308).

the first mills in the Coeur d'Alene district to experiment with flotation. The Morning tried Macquisten tubes in late 1910. A.P.S. Macquisten, of Glasgow, Scotland, devised a process using rotating cylinders, set on their sides, through which was passed a mixture of fine mineral particles, water, and very small amounts of soap and oil. Particles of lead and zinc sulfide were supposed to float on the water flowing out the discharge end of the tubes, while gange of siderite (ferrous carbonate) and quartz was supposed to stick to the sides of the tubes and be delivered to a different exit. In early 1911, Federal built an addition onto the Morning mill and installed 119 Macquisten tubes, intending to produce both lead and zinc concentrates. The new Macquisten plant went into service on May 15, 1911. By the end of the year, the Morning mill was producing 300 tons/month of zinc concentrate carrying 49% zinc. This was material that had been going down the stream heretofore. The new method of concentration returned the Morning property to the profit column for Federal, and at the year the company decided to double the size of its Macquisten plant.[13]

The Morning mill operated fairly continuously into 1914, treating about 1,000 tons/day. Federal was not entirely happy with the performance of the Macquisten tubes, because they were only effective on granular materials greater than 150-mesh in particle size. Nevertheless, the company used the tubes until 1920. Meanwhile, Federal continued to experiment with other methods, including types of flotation apparatus, such as the acid-flotation circuit that had proven effective at the old Standard mill on Green Hill-Cleveland ores. Federal closed the Morning mill for the last five months of 1914, due to low metals prices. During that time, the company installed a pneumatic flotation plant after finding that acid-flotation was not applicable to Morning ores. When the Morning mill re-opened in April 1915 under its new flotation scheme, it returned to its normal 1,000 tons/day capacity. In 1916, Federal made arrangements to produce 1,500 tons/day from the Morning mine, intending to continue treating 1,000 tons/day at the Morning mill and to send the other 500 tons/day to the Mammoth mill. The Stewart Mining Company had been leasing the Mammoth, and its lease was about the expire. For a few months at the beginning of 1917, Federal treated Morning ore at the Mammoth, mill, but litigation brought by the Star Mining Company against Federal, claiming Federal was operating in Star ground, forced output from the Morning mine to return to the 1,000-ton/day level, and use of the Mammoth mill was discontinued. Except for strikes and other interruptions, the Morning mill continued to operate at a rate of 1,000 tons/day until 1921. By this time, the size of the Morning mill had grown considerably. Additions included two long wings on the west side of the mill housing equipment for treating slimes. The southern of the two wings dated to the developments that began prior to the introduction of the Macquisten tubes.[14]

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[13]M&SP 97 (22 August 1908): 241 (FLQCA-001-0356); 102 (11 February 1911): 250 (FLQCA-001-0455), (4 March 1911): 349 (FLQCA-001-0458), (20 May 1911): 693-694-695 (FLQCA-001-0469-470); 103 (2 September 1911): 304 (FLQCA-001-0483); 107 (2 August 1913): 195 (FLQCA-001-0570); W.A. Scott, "Tube Concentrator in the Coeur d'Alene," M&SP 103 (23 December 1911): 809 (FLQCA-001-0492); USGS, Mineral Resources of the U.S., 1909, 355 (RBUCO-001-01585); USGS, Mineral Resources of the U.S., 1910, 465 (RBUCO-001-01593); O.B. Hofstrand, "The Macquisten Tube Flotation Process," Trans. AIME 43 (1913): 692-697.

[14]Rice, "Flotation in the Coeur d'Alenes," 709-710 (RBUCO-001-01363); USGS, Mineral

The size of the Morning mill grew again in 1924, when Federal remodelled the flowsheet so that all concentration was accomplished by selective flotation. Capacity of the mill was increased to 1,200 tons/day. Using selective flotation, the Morning mill operated at a ratio of concentration of about 9:1 in producing lead concentrates and about 9.5:1 in producing zinc concentrates. With selective flotation, the Morning was able to recover about 85% of the silver, 90% of the lead, and 80% of the zinc. The alterations took about three years to complete, with the mill working steadily throughout. During this period, the Morning mill discharged its coarse tailings, as long as there were still jigs in use, through the launder described above. When conversion to selective flotation was complete, the launder for coarse tailings was removed from the concentrator's infrastructure. By the time the launder was removed, the Morning had established several piles of coarse tailings adjacent to the river, but Federal made no attempt to keep the river from eroding the stacks away. Fine tailings were discharged directly into the South Fork by means of a 150-foot flume flowing out from the settling tanks at the west end of the mill complex. A small tailings sampling house was built on the north bank of the river, directly over the outlet of the flume. It housed an automatic electric tailings sampler. There is clear evidence in historic photos of a stream of water flowing from this outlet, past sandbars, and into the main channel of the South Fork.[15]

Resources of the U.S., 1913, 781-782 (RBUCO-001-01615-616); Mineral Resources of the U.S., 1914, 630-631 (RBUCO-001-01626-627); Mineral Resources of the U.S., 1915, 553 (RBUCO-001-01641); Mineral Resources of the U.S., 1916, 595 (RBUCO-001-01654); Mineral Resources of the U.S., 1917, 486 (RBUCO-001-01666); Mineral Resources of the U.S., 1918, 489 (RBUCO-001-01676); Mineral Resources of the U.S., 1919, 417-418 (RBUCO-001-01683-684); Mineral Resources of the U.S., 1920, 256 (RBUCO-001-01689); Mineral Resources of the U.S., 1921, 3 (RBUCO-001-01693); E&MJ 102 (2 December 1916): 999 (RBUCO-001-0915); M&SP 122 (5 March 1921): 340 (FLQCA-001-01019); "Sanborn Map for Mullan" (1909), sheet 4 (FLQCA-001-02614); "Sanborn Map for Mullan" (1918), sheet 7 (FLQCA-001-02639-642); M.P. Dalton, "Milling Methods and Costs at the Morning Concentrator of the Federal Mining and Smelting Co., Mullan, Idaho," U.S. Bureau of Mines, Information Circular no. 6587 (April 1932), 2 (FLQCA-001-03360).

[15]The Mining Industry of Idaho for the Year 1924, 150 (RBUCO-001-02413); The Mining Industry of Idaho for the Year 1925, 54 (RBUCO-001-02417); The Mining Industry of Idaho for the Year 1926, 42 (RBUCO-001-02423); The Mining Industry of Idaho for the Year 1927, 179 (RBUCO-001-02431); USGS Mineral Resources of the U.S., 1925, 542 (RBUCO-001-01716); Mineral Resources of the U.S., 1926, 445 (RBUCO-001-01723); Mineral Resources of the U.S., 1928, 677 (RBUCO-001-01732); Charles O. Olson, testimony in Jacob Polak v. Bunker Hill & Sullivan, et al, 725 (FLQCA-001-04852); M.P. Dalton and G.S. Price, "Milling Practice at the Morning Mill," Mining Congress Journal 16 (January 1930): 25-26, 41 (RBUCO-001-03363-365); "Sanborn Map for Mullan" (1927), sheet 2 (FLQCA-001-02647-650); "Morning Mine and Mill Looking East, July 13, 1923" (FLQCA-001-03310); "Morning Mine and Mill Viewed from the South Hill 6/28/23" (FLQCA-001-03311); "Morning Mine and Mill - 1937" (FLQCA-001-03313).

During the 1930s, the Morning mine and mill sustained periods of reduced activity, due to the Great Depression. In the mid-1930s, the Morning had open piles of zinc concentrates sitting on the ground along the railroad sidings west of the concentrator. One pile simply sat between the Dorr thickening tanks and the tracks. The other pile, a bit further west, had wood planks impounding it on three sides. By the late 1930s, production was back to pre-Depression levels. The Morning made no apparent changes in its method of discharging fine tailings into the South Fork. During World War II, Federal re-opened portions of the Frisco mine and began treating Frisco ores at the Morning mill. Although United States Government metals subsidy programs provided an incentive for Federal to re-evaluate its Frisco mine dump during the World War II era to determine if could be worked profitably again, there is no evidence in the historical record that the United States was an operator of the Morning mill. After the war and throughout the 1950s, operations at the Morning mill were slowly reduced. ASARCO and Federal merged in 1953, with ASARCO taking over all Federal operations in the Coeur d'Alene district. ASARCO closed the Morning mine in October 1953 but continued operating the Morning mill on Frisco ore. ASARCO closed the Frisco mine at the end of 1956, after which Morning mill apparently closed. It burned in May 1957 and was completely dismantled in 1960.[16]

When ASARCO dismantled the Morning mill, it sold to the Lucky Friday Silver-Lead Mines Company a tailings flume running 3,100 feet from the Gold Hunter mill down to the Morning mill dam at Mullan. The dam was simply a diversion structure that directed water into the flume supplying the Morning mill. It is likely that the flume served to discharge Hunter tailings into the South Fork at a point below the Morning dam so that the Morning's water supply would not be fouled.[17]

The United States did not at any time own the Morning mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor, prior to 1968, did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Snowstorm

The Snowstorm mine was the first in the Coeur d'Alene district to ship copper ore when, in early 1901, it made a shipment to the Tacoma smelter. The ore assayed at 11.5% copper. Most ore, however, was not of sufficient grade to bear the cost of shipping, so extensive development awaited finding a satisfactory method concentration. The first attempt was a

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[16]Minerals Yearbook, 1953, 347-358 (RBUCO-001-01847-848); Minerals Yearbook, 1956, 386 (RBUCO-001-01861); Minerals Yearbook, 1960, 342 (RBUCO-001-01877); ASARCO Annual Report, 1953, 3 (RBUCO-001-05076); "Remains of Morning Mill after Fire on 5/13/57" (FLQCA-001-03312); "Sanborn Map for Mullan" (1927, up-dated to 1935), sheet 2 (FLQCA-001-02691-694). See also annual reports in Minerals Yearbook for the 1930s, 1940s, and 1950s.

[17]Bill of Sale between American Smelting and Refining Company and Lucky Friday Silver-Lead Mines Company dated 3 August 1960 (HECPR-010-03357- 358).

leaching plant built at Larsen (a railroad siding just east of Mullan) by J.H. Howard & Company, which leased the upper workings of the Snowstorm mine. While shipping 50 tons of first-class ore (oxides and carbonates of copper) to Tacoma daily, Howard made arrangements in summer 1904 with the Waterbury Metal Extraction Company for the leaching technology. Shipments of first-class ore increased to as much as 160 tons/day over the winter. An aerial tramway conveyed ore 1.5 miles from the mine to Larsen. In mid-1905, Thomas Greenough, one of the owners of the Morning Mining Company, purchased the Snowstorm mine. Greenough developed the lower workings of the Snowstorm, while Howard continued leasing the upper workings. In autumn 1905, Howard began trial operation of the leaching plant. That year, the Snowstorm mine shipped more than 65,000 tons of smelting ore, but the leaching plant did not continue operating.[18]

After some modifications and further trials, the leaching plant began operating on a regular basis in February 1907. Treating carbonate ores assaying at about 2.5% copper, the mill had a capacity to treat 200 tons of ore daily. A 10% solution of sulfuric acid and chloride of lime was added to the crushed carbonate ore, forming copper sulfate in solution and a precipitate of silver chloride. The copper was recovered by precipitation on scrap iron. The mill used sodium thiosulfate and filtration to recover the silver. By 1907, the Snowstorm mine was daily shipping about 250 tons of smelting ore, assaying at least 4% copper. An accident at the mill and falling copper prices forced closure of the leaching plant in the fall. The Snowstorm company tried making a few improvements at the mill in early 1908, but the leach plant never operated again using the 1907 flow sheet for treating low-grade carbonates. Meanwhile, output of smelting ore continued to increase--with periodic interruptions due to floods, high freight rates, and market conditions--to 500 tons/day in 1909.[19]

The Snowstorm did not make a serious effort to re-open its mill until late 1911, when design for a new flowsheet began. Throughout that period, the company had continued to ship silicious ore assaying just over 4% copper, and it continued delivering that ore from the mine to the railroad at Larsen via the aerial tramway. As the mine reached greater depth, the workings

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[18]M&SP 82 (2 February 1901): 76 (FLQCA-001-0025); 83 (2 November 1901): 187 (FLQCA-001-0041); 88 (16 April 1904): 274 (FLQCA-001-0141), (25 June 1904): 435 (FLQCA-001-0156); 89 (16 July 1904): 46 (FLQCA-001-0159), (22 October 1904): 282 (FLQCA-001-0170), (17 December 1904): 415 (FLQCA-001-0178); 90 (8 April 1905): 225 (FLQCA-001-0195); 91 (1 July 1905): 14 (FLQCA-001-0206), (18 November 1905): 351 (FLQCA-001-0229), (23 December 1905): 436 (FLQCA-001-0234); 93 (4 August 1906): 132 (FLQCA-001-0252).

[19]M&SP 93 (8 September 1906): 282 (FLQCA-001-0254); 94 (23 February 1907): 243 (FLQCA-001-0262), (15 June 1907): 742 (FLQCA-001-0290), (22 June 1907): 782 (FLQCA-001-0294); 95 (7 September 1907): 292 (FLQCA-001-0299), (5 October 1907): 420 (FLQCA-001-0302), (19 October 1907): 479 (FLQCA-001-0305), (2 November 1907): 543 (FLQCA-001-0307), (2 November 1907): 548 (FLQCA-001-0308); 96 (29 February 1908): 277 (FLQCA-001-0325), (7 March 1908): 312 (FLQCA-001-0327); 99 (11 September 1909): 344 (FLQCA-001-0413).

entered sulfide ore that could not be treated in the leaching process designed for carbonates. A new 100-ton mill went into operation in June 1912, treating low-grade ore (about 2.5% copper) by conventional gravity concentration. A second 100-unit at the mill began operating in September. The Snowstorm mill operated at full capacity throughout 1913 and the first nine months of 1914. When the mill closed, the Snowstorm company began to install flotation equipment. The mine was nearly exhausted, however, and efforts to acquire additional reserves were unsuccessful. Mine and mill operated briefly in 1917, but no more.[20]

There are no known depictions of the Snowstorm mill on Sanborn maps. Two 1907 photos of the Snowstorm mill show neither the South Fork nor tailings discharge apparatus.[21]

There is no evidence in the historical record that the United States was an operator of the Snowstorm mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

National Copper

In 1913, the National Copper Mining Company struck a vein of copper ore similar to that being mined by the nearby Snowstorm mine. The company immediately began laying plans for a 500-ton mill. Built along the South Fork at the mouth of Deadman Gulch, the mill was connected to the mine by an electric railway about two miles long. The company had initially intended to install an aerial tramway but opted for the electric railway, after an engineering study, because its operating cost would be less than that for a tramway. The train that delivered ore from the adit to the mill was the same one that trammed ore from the mine workings out the tunnel, thus eliminating ore handling at the adit. The train was capable of carrying about 70 tons of ore per hour. After being finely crushed, ore was concentrated on tables. Tailings from the tables were reground and sent to the flotation section for further concentration. The new mill went into service in April 1914, operating at a ratio of concentration of about 16:1 and recovering about 85% of the copper in the ore. It was said to have been the first copper concentrator to use the Callow pneumatic flotation process. After two months, though, the mill closed because the

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[20]M&SP 101 (13 August 1910): 223 (FLQCA-001-0438); 102 (13 May 1911): 670, 675 (FLQCA-001-0467-468); 103 (7 October 1911): 466 (FLQCA-001-0487), (16 December 1911): 788 (FLQCA-001-0491); 104 (6 January 1912): 88 (FLQCA-001-0494), (1 June 1912): 772 (FLQCA-001-0506), (15 June 1912): 842 (FLQCA-001-0511); 105 (17 August 1912): 222 (FLQCA-001-0518), (21 September 1912): 385 (FLQCA-001-0525); 106 (4 January 1913): 75 (FLQCA-001-0537), (15 February 1913): 293 (FLQCA-001-0540); M&SP 115 (14 July 1917): 66 (FLQCA-001-0793); E&MJ 100 (9 October 1915): 619 (RBUCO-001-0853); Mineral Resources of the U.S., 1913, 783 (RBUCO-001-01617); Mineral Resources of the U.S., 1914, 632 (RBUCO-001-01628); Mineral Resources of the U.S., 1917, 486 (RBUCO-001-01666).

[21]"Snowstorm Mill, Mullan, Idaho 1907" (FLQCA-001-03332); "Snowstorm Mine, Mullan, Idaho, Viewed from South Hill" (FLQCA-001-03333).

mine could not supply it with enough ore.[22]

The National mill remained closed the remainder of 1914 and did not re-open until November 1915, due to low copper prices. From then until 1920, the mill operated intermittently, rarely at more than half capacity. In April 1920, mine and mill closed, and the company's directors gave orders to disassemble the mill.[23]

There is no evidence in the historical record that the United States was an operator of the National Copper mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Alice

The Alice group of mining claims was located along Ruddy Creek, a tributary on the north side of the South Fork, about three miles east of Wallace. During the first few years of the twentieth century, small amounts of ore were produced by the mine, some of which was milled at the Mammoth. In late 1908, the Alice Mining Company reported a rich new strike of galena at the Alice mine. Richard Wilson and Walter McKay of the Mammoth Mining Company, James McCarthy of the Hecla Mining Company, and Fred Russell of Seattle were the principal owners. In mid-1909, the company purchased the equipment of the Formosa mill, which had operated only briefly on Canyon Creek (see Canyon Creek section of this report). Late that year, the mill began producing concentrates. It operated until July 1910. Thereafter, the company made attempts to revive its operation, even making some improvements to the mill. Leasers ran the mine briefly in 1911 and 1915, and the mill ran for a brief period in 1912-1913. The mill produced 319 tons of concentrates in 1913, meaning it treated on the order of 2,000 tons of ore.[24]

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[22]E&MJ 95 (19 April 1913): 826 (RBUCO-001-0751); 96 (5 July 1913): 40 (RBUCO-001-0757), (2 August 1913): 232 (RBUCO-001-0760), (13 September 1913): 521 (FLQCA-001-0765); M&SP 107 (16 August 1913): 281 (FLQCA-001-001-0574); 108 (24 January 1914): 196 (FLQCA-001-0603), 31 January 1914): 234 (FLQCA-001-0604), (21 February 1914): 335-336 (FLQCA-001-0607-608), (18 April 1914): 669 (FLQCA-001-0615), (23 May 1914): 867 (FLQCA-001-0622), (6 June 1914): 946 (FLQCA-001-0624); Ernest Gayford, "Mill of National Copper Co.," E&MJ 97 (27 June 1914): 1275-1278 (RBUCO-001-05507-510) "Sanborn Map for Mullan" (1918), sheet 1 (FLQCA-001-02615-618).

[23]M&SP 109 (7 November 1914): 735 (FLQCA-001-0643); E&MJ 100 (11 December 1915): 987 (RBUCO-001-0867); 109 (24 April 1920): 991 (FLQCA-001-01070); Mineral Resources of the U.S., 1916, 596 (RBUCO-001-01655); Mineral Resources of the U.S., 1917, 486 (RBUCO-001-01666); Mineral Resources of the U.S., 1918, 489-490 (RBUCO-001-01676-677); Mineral Resources of the U.S., 1919, 418 (RBUCO-001-01684).

[24]M&SP 86 (21 February 1903): 125 (FLQCA-001-0097); 97 (5 December 1908): 759 (FLQCA-001-0377); 98 (6 February 1909): 204 (FLQCA-001-0392), (1 May 1909): 604 (FLQCA-001-0402); 99 (3 July 1909): 8 (FLQCA-001-0406), (23 October 1909): 546 (FLQCA-

Illustrations of the Alice mill, whether photographic or cartographic, are not known at this time, nor is the precise location of the mill.

There is no evidence in the historical record that the United States was an operator of the Alice mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Golconda

The Golconda mill was built in 1928 by the Golconda Lead Mines Company, incorporated in January 1927 to mine properties owned by the Hector Mining Company and the Mayflower Mining & Development Company. The Mayflower group of claims was located less than a mile north of the river. As initially designed, the concentrator had a capacity to treat 200 tons/day by selective flotation. Golconda acquired the Mayflower group in late 1928, shortly after the mill had gone into operation in August. During the earlier part of the year, Golconda had sent its ore to the Hercules custom mill. The Golconda sent its concentrates to Anaconda (zinc) and East Helena (lead). In 1929, its first full year of operation, the Golconda mill treated about 65,600 tons of ore. With the onset of the Great Depression, the Golconda mine and mill closed on 15 March 1930 due to falling metals prices.[25]

The Golconda mill was located about 60 feet from the north bank of the South Fork, just below the mouth of Trowbridge Gulch. The Northern Pacific tracks along that stretch of the South Fork ran along the south side of the river. A spur serving the Golconda left the mainline and bridged the river about 200 feet west of the mill. The spur ran along the south end of the mill. Ore bins and crushers were at the north end of the mill, near the base of a steep hillside.

001-0418), (6 November 1909): 636 (FLQCA-001-0419); 100 (7 May 19010): 661 (FLQCA-001-0430); 104 (9 March 1912): 389 (FLQCA-001-0501); 105 (20 July 1912): 96 (FLQCA-001-0513); E&MJ 89 (12 March 1910): 586 (RBUCO-001-0671); 90 (30 July 1910): 233 (RBUCO-001-0682); 93 (23 March 1912): 619 (RBUCO-001-0721); 94 (19 October 1912): 760 (RBUCO-001-0734); 96 (1 November 1913): 853 (RBUCO-001-0771); Mineral Resources of the U.S., 1909, 354 (RBUCO-001-01584); Mineral Resources of the U.S., 1910, 465 (RBUCO-001-01593); Mineral Resources of the U.S., 1911, 598 (RBUCO-001-01602); Mineral Resources of the U.S., 1913, 783 (RBUCO-001-01617); Mineral Resources of the U.S., 1915, 554 (RBUCO-001-01642); "Alice Mill & Shaft 8/12/1920" (FLQCA-001-03233).

[25]The Mining Industry of Idaho for the Year 1927, 182 (RBUCO-001-02433); The Mining Industry of Idaho for the Year 1928, 171 (RBUCO-001-02449); E&MJ 124 (29 October 1927): 702 (RBUCO-001-01132); 125 (18 February 1928): 310 (RBUCO-001-01136); 126 (24 November 1928): 841; Mineral Resources of the U.S., 1928, 678 (RBUCO-001-01733); Mineral Resources of the U.S., 1929, 401 (RBUCO-001-01741); Mineral Resources of the U.S., 1930, 648 (RBUCO-001-01751).

An elevated tramway ran along the hillside from the mill to the mine adit about 700 feet west.[26]

The Golconda operated intermittently through the 1930s until 1938, when the mill began to serve more as a custom mill, treating tailings and old mine-dump material from the Interstate-Callahan and the Amazon-Manhattan properties and tailings from Canyon Creek. By that time, the mill had a capacity of 250 tons/day. The Golconda company continued to treat some ore from its own mine as well. In the 1940s, in addition to treating its own ore and old tailings, the Golconda mill also treated ore from the Sunshine, Sunset, Lucky Friday, and other mines. In 1945, the Golconda company closed its mine, having exhausted the ore reserves, but continued operating its custom mill. Throughout the remainder of the 1940s and most of the 1950s, the Golconda mill treated tailings and ores from a variety of mines, including, on occasion, small amounts from the Golconda mine. The last record of the Golconda mill operating is 1959, the year the Hecla Mining Company built the Lucky Friday mill. When the Lucky Friday opened, the Golconda custom mill lost a major customer.[27]

There is no evidence in the historical record that the United States was an operator of the Golconda mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Lucky Friday

The Lucky Friday group of claims east of Mullan had been staked by J.F. Ingalls and others in the years around 1900, but had shown little for its owners, Lucky Friday Mines Company (1906-1912) and Lucky Friday Mining Company (1914-1926) and until John Sekulic leased the Lucky Friday, with an option to buy, in 1938. Selling penny stocks to finance the Lucky Friday Silver-Lead Mines Company, Sekulic raised enough money to sink a shaft. He and his investors found enough lead-silver ore, which they treated at the Golconda mill, to pay for further sinking, and in ten years the shaft was 1,400 feet deep. Three years later, the Lucky Friday company paid its first dividend. In 1958, Hecla bought a major share in the Lucky Friday company. The following year, Hecla built a mill at the portal to the Lucky Friday mine. Designed to treat 350 tons/day, it quickly grew to treat 700 tons/day. The mill went into

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[26]"Sanborn Map for Wallace" (1927, updated to 1949), sheet 18 (FLQCA-001-02943).

[27]Mineral Resources of the U.S., 1938, 325-326 (RBUCO-001-01784-785); Mineral Resources of the U.S., 1939, 357 (RBUCO-001-01787); Mineral Resources of the U.S., 1941, 354 (RBUCO-001-01790); Mineral Resources of the U.S., 1942, 382, 384 (RBUCO-001-01793-794); Mineral Resources of the U.S., 1943, 373 (RBUCO-001-01797); Mineral Resources of the U.S., 1944, 357, 360-361 (RBUCO-001-01802, 804); Mineral Resources of the U.S., 1945, 373, 376-377 (RBUCO-001-01807, 809); E&MJ 146 (July 1945): 120 (RBUCO-001-01186); Mineral Resources of the U.S., 1959, 329 (RBUCO-001-01873). See also Mineral Resources of the U.S. for the intervening years.

operation in February 1960, and a year later the mine reached a depth of 5,000 feet.[28]

A 600-foot conveyor links the mine to the mill. Initially, ore assayed at about 10% lead, 1% zinc, and 19 oz. silver per ton. Despite the relatively low zinc assay, the mill was designed with both lead and zinc circuits, so that the lead concentrate would be cleaner (contain relatively less zinc). After material had passed through both lead and zinc circuits, it was sent to one of two sumps, each equipped with a pump. One supplied a pipeline that could return material to the mine for backfilling stopes. Whenever the "sandman" in the mine did not need material for backfilling, the tailings were sent to the other sump, from where they were pumped to waste. The Lucky Friday mill continued to send tailings back into the stopes, and by 1980 the mine had a greater demand for backfill material than the mill could provide.[29] The Lucky Friday mill is still operating.

There is no evidence in the historical record that the United States was an operator of the Lucky Friday mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Historic Movement of Tailings and Other Solids down Canyon Creek

1. Free-Flowing Tailings: 1888-1901

At the beginning of the twentieth century, there were only two mills operating in the Mullan vicinity, the Hunter and the Morning. Each had been operating, with varying degrees of consistency, since about 1890. The Hunter was upstream of the Morning, so when it took water from the South Fork, the water was clear. The inlet to the Morning mill's flume was downstream of the Hunter's tailings outlet, so the water the Morning took from the South Fork was opaque with slimes discharged by the Hunter. James McCarthy, the manager of the Hecla mill on Canyon Creek, testified in 1905 that, by the time water of the South Fork got to the Morning, it

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[28]Fahey, Hecla, 135-141; William T. Folwell, "Lucky Friday Mine: History, Geology, and Development," Mining Engineering (December 1958): 1266-1267 (RBUCO-001-05381-382); "Developing the Lucky Friday," Mining World (? 1947): 17-19 (RBUCO-001-05368-370); "Lucky Friday Mill," Mining World (April 1960): 30-31 (RBUCO-001-05371-372); J.G. Craig, "New Mill and Surface Plant of the Lucky Friday Mine," Mining Congress Journal (April 1961): 46-48 (RBUCO-001-05378-580; Wray Featherstone, "History of Lucky Friday," in The Coeur d'Alene Mining District in 1963 (Moscow: Idaho Bureau of Mines and Geology, 1963), 23-25 (RBUCO-001-02114-116); Charles Kidwell, "The Lucky Friday Mill," in The Coeur d'Alene Mining District in 1963, 31 (RBUCO-001-02121).

[29]Kidwell, "The Lucky Friday Mill," 31-33 (RBUCO-001-02121-123); J. Gordon Craig, "Lucky Friday's New Mill is an Example," Mining World (March 1962): 30-31 (RBUCO-001-05375-376); "Hecla," E&MJ (May 1980): 97 (RBUCO-001-05386).

was in the same murky condition as the already-used water of Canyon Creek was when it reached the Hecla.[30]

James Gearon was the superintendent of the Gold Hunter's works in 1905. He testified that his company tried to recover as much value from slimes as possible on Frue vanners and Wilfley tables, but that tailings from the slimes concentration process went into the South Fork. He testified that the Hunter mill recovered 80-85% of the lead in the ore, but he was of the opinion that most of the lead lost was in the form of coarse tailings. Gearon also described a diversion dam the Morning had placed in the South Fork about a quarter-mile below the Hunter mill. The purpose of the dam, he said, was to divert all the water of the South Fork into the Morning's flume, and the water flowing into the Morning's flume was "muddy." The same was true, Gearon said, of the water flowing from the South Fork into the flume of the Standard and Mammoth mills.[31]

2. Impounded Coarse Tailings, 1901-1917

Beginning in 1901, mining companies in the Coeur d'Alene district began responding to complaints from property owners along the Coeur d'Alene River that tailings from the mills were damaging their property. The companies responded by building tailings impoundments along the South Fork at Osburn and Pine Creek in an effort to prevent tailings from moving downstream to the Coeur d'Alene River (see sections of this report on the middle and lower reaches of the South Fork for descriptions of the two dams). Knowing that their tailings were flowing downstream, both the Morning and the Gold Hunter companies participated in the construction and maintenance of the Osburn and Pine Creek dams, but those two companies made no efforts during this early period to impound tailings above the mouth of Canyon Creek. The fact that tailings from the mills in the Mullan area also settled along the stretch of the South Fork above the mouth of Canyon Creek is evident in the operations that soon developed to re-treat tailings deposits along that stretch.

In 1909, O.H. King, representing a Chicago syndicate, organized the Illinois Western Concentrating Company to erect a mill west of the Morning mill and re-treat tailings deposited in the bed of the South Fork.[32]

In the late 1910s, C.L. Hewitt managed three companies that re-treated tailings deposits in the Coeur d'Alene district. The Mullan Milling Company re-treated tailings on the old Ontario dump in Government Gulch. Its operation is described in the section of this report on the lower South Fork. The Spokane Metals Recovery Company had a short-lived operation on Nine-Mile Creek, which is described in the Nine-Mile section of this report. The Northern Idaho Metals

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[30]James McCarthy, testimony in "McCarthy v. BH&S," 997-998.

[31]James Gearon, testimony in "McCarthy v. BH&S," 1413-1418.

[32]M&SP 99 (6 November 1909): 636 (FLQCA-001-0295.

Company had a tailings re-treating operation on the South Fork roughly midway between Mullan & Wallace. The Northern Idaho company established a settling pond near its plant and, in summer 1917, impounded about 10,000 tons of tailings from the river. The material collected assayed about 5.5% lead, 5.5% zinc, and 2 oz. silver per ton. Northern Idaho had a flotation plant capable of treating about 90 tons of tailings per day, producing both a lead concentrate and a lead-zinc concentrate. In 1917, Northern Idaho Metals shipped concentrates worth $40,000. It is not known how long its tailings re-treating plant operated.[33]

3. Free-Flowing Fine Tailings, 1917-1968

As described above, the mills in the upper reaches of the South Fork gradually shifted away from gravity concentration to rely exclusively on flotation. The two most important consequences of this shift were that: 1) tailings had much lower assay values for lead, zinc, silver, and the other metals recovered, and 2) the tailings were all very fine, and so flowed more readily downstream. There is virtually no discussion in the historical record of how these two consequences affected the upper reaches of the South Fork, but the switch to flotation did have a noticeable ramifications downstream. That history is described subsequent sections of this report.

[33] M&SP 117 (2 November 1918): 607 (FLQCA-001-0890).

CANYON CREEK

Canyon Creek is one of the major tributaries of the South Fork Coeur d'Alene River, both in terms of volume of water and in terms of mining activity, and therefore the contribution of tailings to the river system. Several towns, like Gem, Black Bear, Mace, and Burke, grew up along Canyon Creek near its major mines and mills, such as the Frisco, the Standard-Mammoth, the Hecla, and the Tiger-Poorman. Throughout most of its course, Canyon Creek is quite narrow, and the slopes of the flanking hills are quite steep. Therefore, except in the Woodland Park area, the creek afforded relatively little opportunity for tailings deposits to accumulate along it. Moreover, the flow in the creek was sufficient most years to carry the tailings away. This report will describe the history of operations at the various mills along Canyon Creek and the history of the tailings discharged by those mills.

Tiger-Poorman

The Tiger-Poorman complex at Burke began as two separate sets of mining and milling works. In 1888, the Tiger was the first silver-lead mine in the Coeur d'Alene district to open. Shortly thereafter, the Poorman mine opened as well. Litigation between the two companies ensued, leading to an eventual consolidation of ownership and operation, hence the frequent reference to this property as the Tiger-Poorman. The two predecessor entities will be described here in turn before turning to the operation of the Tiger-Poorman.

Two miners named Carton and Seymour discovered the lode that became the Tiger mine in 1884. By the end of 1885, by which time 3,000 tons of ore had been extracted from the mine and were awaiting adequate transportation facilities, several other individuals, including John Burke and S.S. Glidden had interests in the property as well. The initial access to the Tiger mine was by trail over the mountain from Murray. The narrow-gauge railroad from Wallace did not reach the mine until 1887. The following year, the owners of the Tiger built a concentrator, which by the end of 1888 was daily producing about 25 tons of concentrates. At the end of the following year, however, the Tiger mine was in the hands of a receiver and Burke and Glidden were suing each other. As the owners and the court attempted to sort out legal and financial problems of the mine in 1890, labor controversies overwhelming the Coeur d'Alene district interrupted operations of the Tiger. In the early and mid-1890s, water shortages and poor lead and silver prices also led to the Tiger mill running only intermittently.[1]

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[1]Frederick Leslie Ransome and Frank Cathcart Calkins, The Geology and Ore Deposits of the Coeur d'Alene District, Idaho, USGS Professional Paper No. 62 (Washington, DC: Government Printing Office, 1908), 172; E&MJ 46 (3 November 1888): 317 (RBUCO-001-0012); 49 (18 January 1890): 91; 50 (20 December 1890): 724 (RBUCO-001-0046); 51 (10 January 1891): 72 (RBUCO-001-0048); 55 (25 February 1893): 182 (RBUCO-001-0118); 56 (2 December 1893): 576 (RBUCO-001-0143), (23 December 1893): 648 (RBUCO-001-0145); 57 (20 January 1894):

The Tiger mill of the early 1890s was located in Burke at the base of a steep south-facing mountainside, adjacent to the Poorman mill, which sat directly on the north bank of Canyon Creek. The tracks at the terminus of the Northern Pacific Railroad ran between the two mills. The shafthouse of the Tiger mine was along the sidehill about fifty feet northwest of the mill, and a covered tramway linked mine and mill. Two wooden flumes (one 70 feet in elevation higher than the railroad tracks, the other 130 feet higher) carried water from Gorge Gulch and Canyon Creek to the Tiger's works to drive two Pelton wheels for generating power and to supply water necessary for milling. In the early years, the concentrator apparently operated at a ratio of concentration of approximately 5:1, meaning that for every five tons of ore it treated, it produced one ton of concentrate and discharged four tons of tailings. The 1892 Sanborn map of Burke shows the Tiger mine and mill, but it shows no tailings dump. Nor was there any room available in the tight canyon bottom for any tailings to be stored. Indeed, the mills of Canyon Creek were known to have dumped their tailings directly into the creek so that it could carry them away. When the Tiger mill operated full-time, it could produce 30 tons of concentrates per day and probably treated about 150 tons of ore daily, discharging about 120 tons of tailings each day.[2]

The nearby Poorman mill was also built in 1888, about the time it was purchased by the Coeur d'Alene Silver Lead Mining Company. It also had the capacity to treat about 150 tons/day. Late in 1889, the company increased the mill's capacity to 200 tons/day. During the first couple of years of operation, the Coeur d'Alene Silver Lead Mining Company operated the Poorman mine and mill on steam power generated by burning wood. In 1891, the Coeur d'Alene company built a flume more than two miles long to deliver water to the works. The company also installed two Pelton wheels, which operated off a head of 800 feet and drove two 250-horsepower electrical generators. The Poorman mine and mill apparently operated much more regularly during the late 1880s and the first half of the 1890s than did the Tiger, although it was affected by the same labor unrest of 1892, water shortage in early 1893, and depressed metals prices throughout the period that curtailed operation of the Tiger.[3]

The Poorman mine shaft was located on the south side of Canyon Creek little more than 150 yards upstream of the Tiger shaft. The Poorman mill was located about 50 yards west of the shaft, just across the creek and downstream from the mine. Like the Tiger mill, the Poorman

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62 (RBUCO-001-0149); 59 (12 January 1895): 37 (RBUCO-001-0186).

[2]Sanborn-Perris Map Company, "Burke," (1892) (FLQCA-001-02003); (New York: Sanborn-Perris Map Co., 1892) (hereafter cited as "Sanborn Map for Burke (date)"); E&MJ 57 (24 March 1894): 278 (RBUCO-001-015); 58 (17 November 1894): 470 (RBUCO-001-0178).

[3]E&MJ 46 (28 July 1888): 70 (RBUCO-001-0005), (3 November 1888): 317 (RBUCO-001-0012); 52 (26 December 1891): 732 (RBUCO-001-0078); 54 (26 November 1892): 518 (RBUCO-001-0112); 55 (25 February 1893): 182 (RBUCO-001-0118), (17 June 1893): 566 (RBUCO-001-0127); 56 (23 September 1893): 312, 326 (RBUCO-001-0135, 0136); 57 (30 March 1894): 302 (RBUCO-001-0156), (26 May 1894): 493 (RBUCO-001-0161-162); 58 (17 November 1894): 470 (RBUCO-001-0178).

operated at a ratio of concentration of about 5:1. For example, during the year ending 30 November 1891, the Poorman mill had operated 308 days, treated 60,422 tons of ore, and produced 12,409 tons of concentrates. Therefore, the mill had discharged about 48,000 tons of tailings into Canyon Creek during that year. As with the Tiger mill, the 1892 Sanborn map of Burke shows no tailings disposal dump for the Poorman mill. There was a portion of Canyon Creek immediately upstream of the Poorman mill that was "planked over." This area was taken up, however, with railroad tracks and appears to have been developed mainly to afford some extra room for loading and unloading materials from railroad cars in the otherwise tight confines of the canyon.[4]

In mid-1895, the Consolidated Tiger & Poorman Mining Company incorporated in Washington to acquire and operate both the Tiger and the Poorman properties. Several stockholders, directors, and officers of each of the predecessor companies comprised the stockholders, directors, and officers of the new company. That September, the Tiger-Poorman closed both sets of works to make necessary changes for the consolidation of their operations, including moving the Poorman hoist to the Tiger shaft, from which all ore would be hoisted, and construction of a tramway between the Tiger shaft and the ore bins at the Poorman mill, which henceforth would treat the ore from the consolidated mining operation. Before the changes were completed, however, a March 1896 fire destroyed many of the Tiger-Poorman buildings.[5]

The loss was covered by insurance, so the Tiger-Poorman company proceeded to clear the debris and erect new works during the summer of 1896. The fire allowed the company to achieve a different configuration of buildings than previously. The new 400-ton concentrator was built where the old Tiger mill had been, making it much closer to the ore bins at the Tiger shaft. On the site of the old Poorman mill, the Tiger-Poorman company built a new powerplant, complete with several steam boilers. The old flumes of the Tiger and the Poorman operations continued to serve the consolidated operation from both sides of the canyon. The "planked over" area above the former Poorman millsite was extended upstream to accommodate more railroad sidings and to allow them to extend further up the canyon. A new "planked over" area was created next to the powerplant, but it was apparently intended for storage of mine timbers.[6]

When the Tiger-Poorman mine resumed full production in early 1897, the new plant hoisted 400 tons/day. The ratio of concentration was now between 5:1 and 6:1. During the ten months the mill ran, it treated 91,089 tons of ore and produced 15,819 tons of concentrates,

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[4]"Sanborn Map for Burke" (1892) (FLQCA-001-02003); E&MJ 52 (4 July 1891): 14 (RBUCO-001-0060), (26 December 1891): 732 (RBUCO-001-0078).

[5]E&MJ 60 (7 September 1895): 229 (RBUCO-001-0204), (30 November 1895): 520-521 (RBUCO-001-0216); 61 (28 March 1896): 309 (RBUCO-001-0226); M&SP 72 (21 March 1896): 231 (FLQCA-001-01411).

[6]"Sanborn Map for Burke" (1901), sheets 1 & 2(FLQCA-001-02004-005, FLQCA-001-02006); E&MJ 61 (23 May 1896): 501 (RBUCO-001-0228); 63 (30 January 1897): 122 (RBUCO-001-0241); 64 (24 July 1897): 106 (RBUCO-001-0246).

meaning the Tiger-Poorman discharged about 75,000 tons of tailings into Canyon Creek in 1897. Throughout the remainder of the century, the Tiger-Poorman mill continued to run on a fairly uninterrupted basis, with some curtailments due to labor shortages.[7]

Early in 1900, the stockholders of the Consolidated Tiger-Poorman Mining Company sold nearly all their stock to the Buffalo Hump Mining Company, which continued to operate the mine and mill full-time. Buffalo Hump was a New York corporation with close ties through stockholders with the Empire State-Idaho Mining & Development Company, which had recently acquired the Last Chance mines at Wardner (see discussion for Milo Creek later in this report). Buffalo Hump made several improvements to mine and mill to increase capacity.[8]

About 200 yards downstream of the Tiger-Poorman mill, the 1901 Sanborn Map for Burke shows a 10-foot high dam across Canyon Creek that does not appear in the 1892 map. This could not have been a serious tailings impoundment. First, it is obvious that it did not raise the water level above the previous banks of the creek. There are numerous buildings bridging the creek upstream of the dam. They exist in both 1892 and 1901 with no apparent changes in their configuration. Had the level of the creek been raised by the dam above the banks, necessitating moving the buildings, it should have been evident in the map. Second, although the dam undoubtedly impounded some coarse tailings, the capacity of the impoundment would have been negligible relative to the volume of tailings being discharged. Through Burke, Canyon Creek falls about ten feet every 100 yards. Thus, assuming the creek was an average of 30 feet wide, the impoundment could have held about 1,700 cubic yards of material. Assuming the tailings had a density of 100 pounds per cubic foot (20 cubic feet to the ton, or 1.35 tons to the cubic yard), the impoundment might have retained about 2,300 tons of tailings, or about three percent of the tailings the Tiger-Poorman mill produced in 1897. The rest of the tailings produced at Burke would have been carried downstream.[9]

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[7]E&MJ 63 (19 June 1897): 640 (RBUCO-001-0244; 64 (24 July 1897): 106 (RBUCO-001-0246); 65 (12 February 1898): 201 (RBUCO-001-0256), (28 May 1898): 651 (RBUCO-001-0264); 66 (10 December 1898): 706 (RBUCO-001-0286); 68 (9 September 1899): 316 (RBUCO-001-0309).

[8]E&MJ 69 (20 January 1900): 88 (RBUCO-001-0326), (14 April 1900): 448 (RBUCO-001-0333); M&SP 80 (10 February 1900): 155 (FLQCA-001-0005).

[9]This is a rough estimate based on approximate assumptions. The distance from the mill to the dam and the width of the creek are estimated from the 1901 Sanborn Map for Burke. The fall of Canyon Creek through Burke is estimated from the 1985 USGS 7.5' topographic map for the Burke Quadrangle. The density of tailings is a rough estimate based on an assumption made A.A. Booth in his testimony in Timothy McCarthy, et al, v. The Bunker Hill & Sullivan Mining and Concentrating Company, et al, in the United States Circuit Court for the District of Idaho, Northern District (1905), 1727, and corroborated by Terence McNulty in his 1996 Expert Report (p.66) for ARCO in the U.S. v. ARCO case concerning the Clark Fork Superfund Project in Montana.

Early in 1901, the Buffalo Hump Mining Company in turn sold the Tiger-Poorman properties to the Empire State-Idaho Mining and Development Company. This was amid a time when there was much speculation that many of the major mining companies in the Coeur d'Alene district would consolidate in an effort to resist the control that ASARCO (the lead-smelter trust that treated nearly all the ore and concentrates shipped from the Coeur d'Alene district) was able to exercise over production levels in the district. Although output was apparently reduced during 1902, the Empire State-Idaho company ran the Tiger-Poorman fairly continuously until May 1903, when fire destroyed buildings around the shaft, including the hoist house and crusher. Repairs were quickly made, and mine and mill were soon back in production.[10] During this period, the Tiger-Poorman mill had a capacity to treat 550 tons/day and operated at about a 7.5:1 ratio of concentration. It was treating ore averaging about 10% lead, 5% zinc, and five ounces of silver per ton, recovering about 90% of the lead and 85% of the silver. If the mill ran a month at capacity, it would discharge about ,900 tons of tailings assaying at 1% lead, 4% zinc, and 0.75 ounce of silver per ton. During these early years of the century, railroads carried tailings away at a rate of about three cars per day during non-winter months. A manager of the Tiger-Poorman mill testified that the railroads hauled the tailings as much as 100 miles away to be used for ballast.[11]

The Tiger-Poorman was part of a further consolidation in 1903, when it was acquired by the Federal Mining & Smelting Company, formed by Charles Sweeny of Spokane along with New York interests allied with the Rockefellers. Federal took ownership and operation of the Empire State-Idaho properties at Wardner (Last Chance) and Burke (Tiger-Poorman) as well as of the Standard-Mammoth properties near the mouth of Canyon Creek above Wallace. Federal bought the stock of the predecessor companies late in 1903, and the deeds to the various properties were conveyed to Federal in January 1904. Control of Federal passed from the Rockefellers to the Guggenheims in 1905. Federal operated the Tiger-Poorman mine and mill until September 1908. During that period of operation, there were few noticeable changes in the physical layout of the mill. The mill treated as much as 600 tons of ore per day, and the ratio of concentration was on the order of 8:1. With relatively low-grade ore coming from the mine, however, and with metals prices fluctuating, throughput at the Tiger-Poorman mill also dropped to as low as 250 tons/day.[12]

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[10]E&MJ 71 (2 March 1901): 284 (RBUCO-001-0351); 75 (30 May 1903): 834 (RBUCO-001-0386), (27 June 1903): 982 (RBUCO-001-0389); M&SP 85 (6 December 1902): 331 (FLQCA-001-0086); 86 (17 January 1903): 45 (FLQCA-001-0093); 87 (25 July 1903): 57 (FLQCA-001-0115). M&SP 80 (18 May 1900): 235, describes the rumors of consolidation. Many subsequent issues described actions mine-owners (usually with the exception of Bunker Hill & Sullivan) took jointly, such as refusing to ship at the price dictated by ASARCO and exploring the possibility of cooperating to build their own smelter.

[11]Robert H. Richards, Ore Dressing, Vol. II (New York: The Engineering and Mining Journal, 1906), 958; W. Clayton Miller, testimony in McCarthy v. BH&S, 2226 (FLQCA-001-04782).

[12]USGS, Mineral Resources of the U.S., 1903, 246 (RBUCO-001-01542); M&SP 87 (15 August 1903): 105 (FLQCA-001-0116); 88 (6 February 1904): 102 (FLQCA-001-0131), (14 May 1904): 337 (FLQCA-001-0145); 106 (1 March 1913): 340-341 (FLQCA-001-0542-543);

Late in 1905, changes occurred at Federal that ultimately contributed to the closure of the Tiger-Poorman property. Control of Federal passed into the hands of the American Smelters Securities Company, and Federal bought the Morning mine and mill. The latter development gave Federal another of the larger operations in the Coeur d'Alene district. By 1907, the Tiger-Poorman orebodies appeared to be exhausted, and Federal closed the mill, keeping a small group of miners on the payroll to continue exploration in the mine. A year later, Federal decided to permanently close the works at Burke and to move much of its usable equipment downstream to the Federal works at Mace. Thereafter, until Federal sold the property, only small quantities of ore were produced from the Tiger-Poorman mine by lessees.[13]

The mill operated again, however, under lease to the Hercules Mining Company. Hercules had a very productive mine and a 300-ton mill on Gorge Gulch, a tributary of Canyon Creek the mouth of which was just upstream of Burke. The Hercules company had begun negotiating with Federal to either purchase or lease the Tiger-Poorman mill in mid-1909, but then the Hercules mill burned in September 1909. While the company built a replacement mill at Wallace, it leased the Tiger-Poorman mill, operating it for about a year and treating about 300 tons/day. In 1911, F.A. Heinze's Stewart Mining Company contemplated leasing the Tiger-Poorman mill, but apparently the mill never operated again. After that, the Tiger-Poorman surface plant at Burke was slowly disassembled. By 1918, the east half of the mill building, which had housed the jigs and round tables, was gone, as was the power plant which had been located on the site of the former Poorman mill. In 1920, the Hecla Mining Company bought the Tiger-Poorman property from Federal.[14]

There is no evidence in the historical record that the United States was an operator of the Tiger-Poorman mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

E&MJ 77 (9 June 1904): 924 (RBUCO-001-0410); "Sanborn Map for Burke" (1905), sheet 1 (FLQCA-001-02007-010).

[13]M&SP 91 (21 October 1905): 283 (FLQCA-001-0225), (4 November 1905): 316 (FLQCA-001-0228); 95 (14 September 1907): 322 (FLQCA-001-0301), (12 October 1907): 448 (FLQCA-001-0303); 97 (12 September 1908): 341 (FLQCA-001-0359); E&MJ (6 February 1909): 328 (RBUCO-001-0647).

[14]M&SP 99 (17 July 1909): 75 (FLQCA-001-0407), (18 September 1909): 378 (FLQCA-001-0414), (13 November 1909): 670 (FLQCA-001-0420); 103 (16 September 1911): 367 (FLQCA-001-0485); USGS, Mineral Resources of the U.S., 1910, 466 (RBUCO-001-001594); USGS, Mineral Resources of the U.S., 1920, 256 (RBUCO-001-01689); "Sanborn Map for Burke" (1909), sheet 1 (FLQCA-001-02019-021); "Sanborn Map for Burke" (1918), sheet 2 (FLACA-001-02026-029).

Black Bear

In summer 1888, as four mining companies in the Coeur d'Alenes began construction of concentrators, the Black Bear Mining Company was one of four others making plans to build concentrators that fall. The Black Bear mill was constructed along the south side of the creek just east of the town of Gem. It was located adjacent to the tracks of the Northern Pacific Railroad at the base of the steep hillside forming the narrow canyon. A gravity tramway connected the mill with the mine portal up the hill. The main mill building housed the crusher, rolls, and jigs. The ore bin was at the south (up-hill) end of the mill. Along the west side of the building were the Pelton wheels that powered the mill equipment. Water for the Pelton wheels was supplied by a twelve-inch pipe running down the hillside to the mill. Scales and a loading platform were situated at the north end of the building along side the railroad tracks. By early 1893, the Black Bear mill had a capacity to treat 75 tons/day and was daily producing about 15 tons of concentrates assaying 60% lead with 27 oz. of silver per ton. Sanborn maps show no tailings deposit nor a launder for their discharge. Given the narrow confines of the canyon and the general practice of mills in the district, it is certain that the Black Bear conveyed the 60 tons of tailings it produced each day directly into Canyon Creek, less than 100 feet north of the mill. The mill closed later in 1893, undoubtedly due to the labor unrest in the Coeur d'Alene district.[15]

Although there were efforts to re-open the Black Bear mill in the late-1890s, they were apparently unsuccessful. In 1900, Larson and Greenough (owners of several properties in the Mullan area) deeded the Black Bear property to the Frisco Consolidated Mining Company, which owned and operated a concentrator about 450 feet downstream and on the same side of the creek. The Frisco built a tramway from an adit just up the hillside from the Black Bear mill and running west to the Helena & Frisco mill (see section below). The Frisco also built a set of ore chutes running from the tramway down to a new ore bin along the railroad tracks and about 75 feet west of the Black Bear mill. In 1904 the Bear Top Mining Company purchased the Black Bear mill and moved the equipment to the Bear Top mine near Murray. The Black Bear mill sat empty for about a decade until the Frisco company purchased the building and installed new equipment. Subsequent history of the Black Bear mill, serving as the Frisco concentrator, is described below in the history of the Frisco mill. Meanwhile, a new company called the Black Bear Consolidated Mining Company continued to attempt to develop the Black Bear claims. The Black Bear company, however, never again operated the Black Bear mill.[16]

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[15]Engineering & Mining Journal (hereafter cited as E&MJ) 46 (25 August 1888): 157 (RBUCO-001-0008); 55 (18 February 1893): 158 (RBUCO-001-0117); 65 (19 February 1898): 231 (RBUCO-001-0257); Sanborn-Perris Map Company, "Gem," (New York: Sanborn-Perris Map Co., 1892), (hereafter cited as "Sanborn Map for Gem" and date), (FLQCA-001-02130); "Sanborn Map for Gem" (1896), (FLQCA-001-02133-136); "Sanborn Map for Gem" (1901), (FLQCA-001-02137).

[16]E&MJ 65 (19 February 1898): 231 (RBUCO-001-0257); 70 (25 August 1900): 229 (RBUCO-001-0341); 90 (24 December 1910): 1276 (RBUCO-001-0692); Jay A. Czizek, Report of the Inspector of Mines for the State of Idaho for the Year 1899 31 (RBUCO-001-02198); Mining & Scientific Press (hereafter cited as M&SP) 89 (24 December 1904): 430 (FLQCA-001-0180); 96 (30 May 1908): 723 (FLQCA-001-0340); 99 (17 July 1909): 75 (FLQCA-001-0407);

There is no evidence in the historical record that the United States was an operator of the Black Bear mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Frisco

In early 1890, Helena capitalists formed the Helena and Frisco Mining Company. One of the mines it operated was the Badger at Gem. Early in its operation, miners accessed the orebody through tunnels extending 1200 feet from openings on the hillside above Gem. The company transported ore from mine to mill via a 600-foot gravity tramway. In 1891, as the upper workings were exhausted, the Helena & Frisco drove another tunnel toward the orebody from the level of the orebin at the mill, obviating the need for the tramway. That year, the mill operated 302 days, producing 6,471 tons of concentrates. The mine produced 51,604 tons of ore. A report early in the year stated that all ore was run through the mill. If that situation obtained throughout the year, then the Frisco mill produced about 45,000 tons of tailings that year.[17]

The Frisco mill is perhaps most famous for having been dynamited by union activists on 11 July 1892 because the Helena & Frisco Mining Company employed non-union workers. The company quickly rebuilt the mill that fall, and began working again in October. The mine and mill operated fairly continuously throughout the rest of the decade. One major closure occurred in 1897, shortly after the Exploration Company, Ltd., an English company, bought 51% of the Helena & Frisco stock. Operations were suspended for more that half the year, and the capacity of the mill was increased to 800 tons/day in the course of a major overhaul. The new owners also bought the nearby Gem mine.[18]

The Frisco mill was located along the south side of Canyon Creek at the base of a steep hillside. Between the time it was rebuilt in 1892 and 1901, when it closed again due to labor unrest, the mill was enlarged and a number of ancillary buildings were built in its vicinity. West

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106 (26 April 1913): 632 (FLQCA-001-0552); 109 (28 November 1914): 856 (FLQCA-001-0648), (26 December 1914): 1008 (FLQCA-001-0653); "Sanborn Map for Gem" (1901), (FLQCA-001-02137); "Sanborn Map for Gem" (1905), (FLQCA-001-02143-146); "Sanborn Map for Gem" (1908), (FLQCA-001-02147); U.S. Geological Survey, Mineral Resources of the United States, 1914 (Washington, DC: Government Printing Office, 1916), 631 (RBUCO-001-01627)..

[17]E&MJ 49 (1 March 1890): 256 (RBUCO-001-003); 51 (11 April 1891): 451 (RBUCO-001-0053); 53 (12 March 1892): 310 (RBUCO-001-0086).

[18]E&MJ 54 (8 October 1892): 350 (RBUCO-001-0107), (12 December 1892): 590 (RBUCO-001-0114); 62 (12 December 1896): 565 (RBUCO-001-0240); 63 (8 May 1897): 460 (RBUCO-001-0242), (29 May 1897): 550 (RBUCO-001-0243).

of the mill sat a boiler house, on the second floor of which was a carpenter shop and a tailings mill, in which the company tried to recover additional values. The tailings mill was abandoned in the mid-1890s, when the boiler house was enlarged and a compressor plant installed. On the hillside south of the boiler house sat the machine shop. The 1897 overhaul included construction of a new concentrator wing on the east side of the mill. There was a distance of only about 50 feet between the mill and the creek, and that space was largely occupied by two sets of railroad tracks. At the base of the hill directly across the creek from the mill sat two more sets of tracks, along with the company office, superintendent's house, assay office, mess hall, and bunk houses. There was therefore no ground near the mill for tailings disposal. Given the narrow confines of the canyon and the general practice of mills in the Coeur d'Alene district at the time, it is certain that the Black Bear conveyed the tailings it produced directly into Canyon Creek.[19]

In late 1899, the Frisco Consolidated Mining Company, incorporated in New Jersey, took over the Helena-Frisco property, and acquired the Gem, Black Bear, and Galena mines. The new company ran its mines and mill steadily until April 1901, when poor conditions in the lead market induced ASARCO, which was receiving more concentrates than it could economically handle, to pay Frisco to cease operations. The Frisco mill remained closed until December 1902, when the 650-ton facility was briefly put back into full operation. By February, though, the Frisco company reduced the crew at the mill to only the night shift, due to a lack of ore that was economically worth treating. In September 1903, miners at the Frisco mine walked out, claiming unsafe working conditions, and a month later the Frisco company announced that it was closing mine and mill indefinitely. At the end of the year, D.M. Hyman, a New Yorker who owned most of the bonds securing the mortgage on the property, bought the Frisco mine at sheriff's sale.[20]

In September 1904, Hyman joined with two men from Spokane to form the Frisco Mining Company, Ltd., and consolidate the nearby Flynn and Bernier groups of claims, intending to access those orebodies through the Frisco tunnel. Mine and mill operated intermittently for the next several years, occasionally in the hands of leasers. In late 1906 Hyman's group enlarged and remodelled the Frisco mill in an attempt to recover zinc as well as lead from the ore, which ran about 15% zinc. Equipment added included Callow screens, circular settling tanks, Wilfley tables, and a magnetic separator. Nevertheless, Hyman and the Frisco Mining Company continued to experience financial difficulties, and this particular version of the Frisco mill never resumed full-scale operations. During this period, there was also no build-up of tailings near the mill. Indeed, due to the shortage of space near the mill, the Frisco company had built a timber platform more than 200 feet long over the creek adjacent to the boiler house. This afforded the

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[19]"Sanborn Map for Gem" (1892), (FLQCA-001-02130); "Sanborn Map for Gem" (1896), (FLQCA-001-02133-136); "Sanborn Map for Gem" (1901), (FLQCA-001-02137); photo of Frisco mill in Wood, Railroads through the Coeur d'Alenes, 84 (FLQCA-001-03187).

[20]E&MJ 68 (18 November 1899): 618 (RBUCO-001-0319); 69 (13 January 1900): 58 (RBUCO-001-0325); M&SP 85 (9 August 1902): 79 (FLQCA-001-0065), (6 December 1902): 331 (FLQCA-001-0086); 86 (28 February 1903): 141 (FLQCA-001-0098); 87 (19 September 1903): 191 (FLQCA-001-0120), (7 December 1903): 310 (FLQCA-001-0124); 88 (9 January 1904): 31 (FLQCA-001-0128).

company additional space for storage of mine timbers and other supplies needed in the operations.[21]

In early 1913, the Federal Mining & Smelting Company bought the Frisco's properties, including the mill. Federal owned and operated the Morning mine, just east of the Frisco mine. At the Morning mill (on the other side of the ridge, closer to Mullan), Federal had recently succeeded in using flotation to recover zinc from the lead-concentrator tailings. Federal had also just acquired the Green Hill-Cleveland properties at Mace on Canyon Creek. Rather than remodel the Frisco mill, Federal decided to build a new 300-ton concentrator by remodelling the old neighboring Black Bear mill, which was by then part of the Frisco property. Federal transferred some of the equipment from the old Frisco mill to the Black Bear mill, leaving the Frisco mill largely vacant. The newly remodelled mill went into operation in April 1914, working one shift per day. After two months, though, the mine and mill closed due to difficulty in successfully treating the lead-zinc ore. Remodelling the mill again, Federal supplemented the Morning method of treating lead tailings with pneumatic flotation and installed magnetic separators and a rotating roasting furnace, located in a wing extending from the east side of the new Frisco (old Black Bear) mill. Federal also built a covered tramway to convey ore to the new Frisco mill from the mine adit and ore bin at the upper end of the old Frisco mill. Federal ran the new Frisco mill most of 1915. Despite more changes being made at the mill that year, it operated at a loss. Federal operated the Frisco mill throughout 1916, closing the facility on December 15.[22]

At about the same time Federal was making the above changes to the old and new Frisco mills, a party placed a log and earthen dam in Canyon Creek roughly midway between the two

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[21]M&SP 89 (24 September 1904): 214 (FLQCA-001-0166); 90 (22 April 1905): 259 (FLQCA-001-0197); 91 (5 August 1905): 99 (FLQCA-001-0218); 92 (3 March 1906): 149 (FLQCA-001-0242); 93 (8 September 1906): 282 (FLQCA-001-0254); 94 (2 February 1907): 142 (FLQCA-001-0258), (23 February 1907): 244 (FLQCA-001-0263), (27 April 1907): 521 (FLQCA-001-0274), (4 May 1907): 552 (FLQCA-001-0275); 98 (30 January 1909): 172 (FLQCA-001-0391), (27 February 1909): 302 (FLQCA-001-0395); "Sanborn Map for Gem" (1905), (FLQCA-001-02143-146); "Sanborn Map for Gem" (1908), (FLQCA-001-02148).

[22]M&SP 106 (8 February 1913): 258 (FLQCA-001-0539); 107 (9 August 1913): 247 (FLQCA-001-0573), (1 November 1913): 701 (FLQCA-001-0595), (29 November 1913): 870 (FLQCA-001-0598); 108 (21 February 1914): 349 (FLQCA-001-0609); (25 April 1914): 710 (FLQCA-001-0616); (23 May 1914): 867 (FLQCA-001-0622); 109 (12 December 1914): 931 (FLQCA-001-0651); E&MJ 99 (5 June 1915): (RBUCO-001-0827); U.S. Geological Survey, Mineral Resources of the United States, 1913 (Washington, DC: Government Printing Office, 1914), 783 (RBUCO-001-01617); USGS, Mineral Resources of the United States, 1914 (Washington, DC: Government Printing Office, 1916), 631 (RBUCO-001-01627); USGS, Mineral Resources of the United States, 1915 (Washington, DC: Government Printing Office, 1917), 555 (RBUCO-001-01643); Mineral Resources of the United States, 1916 (Washington, DC: Government Printing Office, 1919), 597 (RBUCO-001-01656); "Sanborn Map for Frisco" (1916), (FLQCA-001-02177).

mills. The dam was apparently intended only to divert a portion of the creek through a flume which passed between the mills and continued in a southerly direction. It is not known whose flume it was. The evidence depicted on the 1916 Sanborn Map for Frisco suggests that the dam was not intended to impound tailings.[23]

Early in 1916, the owners of the Rex mine in Nine-Mile Creek contemplated resuming operations there. With that possibility in mind, the company did not renew the lease allowing the Tamarack & Custer Consolidated Mining Company to operate the Rex mill, also in Nine-Mile Creek. With the Rex mill no longer available to the Tamarack & Custer, that company closed its mine on May 31 and began negotiating to acquire the 500 ton/day Frisco mill in Canyon Creek. In the fall of 1916, Tamarack & Custer bought the Frisco mill from Federal. The deed transferring the mill from Federal to Tamarack & Custer was filed early in 1917. As part of the deal, Tamarack & Custer received both the old and new mills, the Hardy mining claim, and various surface rights, buildings, and equipment associated with operation of the mill. The Tamarack & Custer mine remained closed until the company completed construction of a two-mile aerial tramway between the mine and the new Frisco mill. Facilities for unloading ore from the tramway were constructed along the east side of the mill. The company placed flotation equipment in the north end and east wing of the mill, where the roasting furnace had been. Just across the tracks from the mill was a structure identified on the 1927 Sanborn Map for Gem as a tailings bin. Measuring only about 20' x 30', it obviously did not have the capacity to impound all the tailings discharged. Both mining and milling operations resumed in mid-1917, delayed a few months by labor troubles. The mill operated at full capacity.[24]

Tamarack ore assayed about 10.7% lead, 3.2% zinc, and 5.5 oz. silver per ton. The company sorted the ore at the mine, eliminating waste. Milling ore was hauled in 800-pound buckets over the tramway. After the ore passed through the rolls and trommels, the coarse material was sent to the jigs, which produced concentrate, middling, and tailing. The middling was ground further and the coarse tailing was discharged directly into the creek. The mill used both tables and flotation to concentrate fine material. Fine tailings were also discharged directly into the creek.[25]

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[23]"Sanborn Map for Frisco" (1916), (FLQCA-001-02177).

[24]E&MJ 101 (19 February 1916): 372 (RBUCO)-001-0881), (17 June 1916): 1093 (RBUCO-001-0895); 102 (2 September 1916): 444 (RBUCO-001-0905), (28 October 1916): 807 (RBUCO-001-0910); 103 (3 February 1917): 245 (RBUCO-001-0922); 104 (21 July 1917): 149 (RBUCO-001-0940); Robert N. Bell, "Mining in Idaho in 1917," E&MJ 105 (19 January 1918): 146 (RBUCO-001-0962); USGS, Mineral Resources of the U.S., 1916, 597-598 (RBUCO-001-01656-657); Mineral Resources of the U.S., 1917, 488-489 (RBUCO-001-01668-669); "Sanborn Map for Gem" (1927), (FLQCA-001-02153-156).

[25]Sigurd Laurence Sampson, "Tamarack Mill," in "The Milling Practice of the Coeur d'Alene District" (unpublished masters thesis, University of Idaho, Moscow, 1923), 1-4 (RBUCO-001-0552-566); "Tamarack & Custer Consolidated Mining Company's Mill," Mining Industry of Idaho for the Year 1925, 25-29 (RBUCO-001-05568-570).

Tamarack & Custer closed its operations during the post-war slump that ensued at the end of 1918. Although the Tamarack & Custer restarted at the Frisco mill on a part-time basis in May 1919, operations were intermittent until mid-1922. For the next several years, Tamarack & Custer operated the Frisco mill nearly full-time. In 1923, for example, the company treated more than 100,000 tons of ore at Frisco. Coincident with the re-opening of the Tamarack & Custer mine and mill in 1922, Harry L. Day was elected president of ASARCO, and there was a report that the company had obtained the right from Federal (an ASARCO subsidiary) to use a former Standard-Mammoth tunnel opening on Canyon Creek to access the Tamarack & Custer mine in Nine-Mile Creek. After a couple years of development work, Tamarack & Custer made the necessary tunnel extension to the orebody and began extracting ore from the tunnel in 1924, sending it to the mill at Gem. Nevertheless, until May 1928, Tamarack & Custer continued to haul ore to the mill by the aerial tram as well. By that time, the structure that had housed the old Frisco mill had disappeared from the landscape. In May 1928, Tamarack & Custer began shipping its ore from the Mammoth tunnel by rail to the Hercules mill in Wallace, also controlled by the Days. The Frisco mill apparently never operated again, and it was destroyed by fire in 1937.[26]

In 1939, in the light of promising developments in the Tamarack & Custer's Chesapeake vein, the company announced plans to build a new 300-ton concentrator on Canyon Creek near its Dorn tunnel portal. Since 1928, Tamarack & Custer had continued to treat its intermittent ore output at the Hercules mill in Wallace. The new flotation mill began operating in March 1940 and ran at full capacity throughout the remainder of the year. It is described below in the section on the Dorn mill.[27]

There is no evidence in the historical record that the United States was an operator of the Frisco mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

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[26]E&MJ 107 (22 March 1919): 551 (RBUCO-001-01032), (10 May 1919): 853 (RBUCO-001-01039); 114 (15 July 1922): 119 (RBUCO-001-01100); 125 (4 February 1928): 220 (RBUCO-001-01134), (5 May 1928): 749)RBUCO-001-01141); USGS, Mineral Resources of the U.S., 1922, 441-442 (RBUCO-001-01697-698); Mineral Resources of the U.S., 1923, 400 (RBUCO-001-01704); Mineral Resources of the U.S., 1924, 282 (RBUCO-001-01710); Mineral Resources of the U.S., 1928, 681 (RBUCO-001-01734); Thirty-Ninth Annual Report of the Mining Industry of Idaho for the Year 1937, 213 (RBUCO-001-02489); "Milling at Day Mines" (unpublished report dated 28 November 1953), 3 (HECBO-020-00399); "Sanborn Map for Gem" (1927), (FLQCA-001-02153-156).

[27]E&MJ 140 (November 1939): 74 (RBUCO-001-01225); 141 (November 1940): 78 (RBUCO-001-01183); Forty-First Annual Report of the Mining Industry of Idaho for the Year 1939, 250 (RBUCO-001-02502); Forty-Second Annual Report of the Mining Industry of Idaho for the Year 1940, 183 (RBUCO-001-02505).

Gem/Hecla

Amasa Finch, John Campbell, Albert Gross, and Charles and Bernard Kipp formed the Milwaukee Mining Company in August 1888 to own and operate the Gem mine and other properties. The first shipments of concentrates from the Gem mine were the product of miners using hand jigs. Construction of the Gem mill may have begun in 1888, but serious work did not commence until late spring 1889. The mill was located at the base of a steep hill along the south side of Canyon Creek, at the west end of Gem, and about 200 feet from the creek itself. The owners built a 2,500-foot flume for delivering water from the South Fork of the Coeur d'Alene River to the mill for power. Two inclined tramways connected the mill to the two mine adits up the hill to the south of the mill. Each adit served a different level of the mine workings. In 1893, the Gem added new jigs to increase the capacity of its mill. Thereafter, however, the mine and mill operated intermittently, responding to labor troubles, water shortages, poor metals prices, and exhaustion of the Gem orebody.[28]

The next phase of operation for the Gem mill began in 1897, when it became the Hecla mill. Although the Hecla Mining Company did not purchase the Gem mill until 1903, Hecla began treating its ore there in 1896. The next year, 1897, after the Gem mill had been closed a brief time, the Milwaukee company leased the mill to the Mammoth Mining Company. The latter reached an agreement with the nearby Standard Mining Company to use Standard's tunnels and its tramway for extracting ore from the Mammoth orebody and shipping it to the Gem.[29]

The Hecla mine was at Burke, a short distance up Canyon Creek. The Hecla Mining Company was incorporated in Idaho in 1891 by several of the Milwaukee's incorporators and a group of other Canyon Creek mining entrepreneurs. Although the Hecla mine shipped some ore in the early 1890s, serious production did not begin until 1896, when the mine was operated by leasers, who sent their ore to the Gem mill. They completed their work in spring 1897. Later that year, the Hecla Mining Company began developing its own mine, storing milling ore with the intention of milling it at the Gem. In 1898, the remaining stockholders reorganized the Hecla Mining Company as a Washington corporation. For two years, Hecla concentrated its ore at the Standard mill near Wallace. In 1900, Hecla bought the Gem mill from the Milwaukee Mining

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[28]John Fahey, Hecla: A Century of Western Mining (Seattle: University of Washington Press, 1990), 9; E&MJ 46 (25 August 1888): 157 (RBUCO-001-0008); 47 (11 May 1889): 440 (RBUCO-001-0018); 55 (1 April 1893): 302 (RBUCO-001-0120);57 (1 January 1894): 38 (RBUCO-001-0148), (24 March 1894): 278 (RBUCO-001-0155); 59 (12 January 1895): 37 (RBUCO-001-0186); 60 (23 November 1895): 497 (RBUCO-001-0215); 61 (15 February 1896): 166 (RBUCO-001-0221); 62 (4 July 1896): 12 (RBUCO-001-0231); "Sanborn Map for Gem" (1891), (FLQCA-001-02130); "Sanborn Map for Gem" (1896), (FLQCA-001-02133-136).

[29]Fahey, Hecla, 16, 28; W.L. Zeigler, "Concentration of Lead-Silver Ore at Hecla Mine, Gem, Idaho," Transactions of the AIME 79 (1928): 175 (FLQCA-001-01993); E&MJ 64 (3 July 1897): 16 (RBUCO-001-0245).

Company. Within a short time, the Gem mill was treating its full daily capacity of 200 tons of Hecla ore.[30]

Hecla shipped milling ore from its mine at Burke to the mill at Gem by railroad, specifically the Oregon Railway & Navigation Company. Just east of the mill, a railroad spur ascended the sidehill and mounted a trestle, which carried the tracks over an ore bin at the head (south end) of the mill. Milling ore assayed at 10-13% lead and 5.5-7 oz. silver per ton. The mill was able to recover about 90% of the lead and 80% of the silver. Of every 100 tons of ore extracted from the mine, less than 2% was hand-picked as smelting ore. Of the remaining ore that passed through the mill, the jigs and tables yielded about 16 tons of concentrates and discharged about 82 tons of tailings. Assaying 1-1.5% lead and 1.5-2 oz. silver per ton, the tailings were sent along a 200-foot launder to the creek. When Hecla took over the Gem mill, it built a structure along the west side of the building to house a slime tank, which was part of the company's strategy for recovering values otherwise lost in the discharge of slimes with the tailings. By 1905, Hecla had added an additional slime tank and vanners for the recovery of values from slimes.[31]

Shortly after the Hecla Mining Company bought the Gem mill in 1903, it began a steady process of expanding its capacity and up-grading its equipment. That included shifting the ore-sorting operation to the mine in 1906 and adding a Huntington mill to grind the ore more finely. The following year, Hecla replaced its process of hydraulic sizing with Callow screens and settlers. With those changes, the mill had a capacity to treat 300 tons/day. Another intention of the changes was to better recover values heretofore being lost as slimes in the tailings stream. For the next eight years or so, the Hecla operated its mill regularly, closing it for several periods of some months due to low metals prices. During 1911, for example, the mill's average production was 1,050 tons of concentrates per month, treating an average of 8,000 tons of ore monthly. Thus, the mill discharged an average of nearly 7,000 tons of tailings into Canyon Creek each month.[32]

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[30]James F. McCarthy, "History of the Hecla Mine, Burke, Idaho," Mining and Metallurgy 5 (June 1924): 276-277 (FLQCA-001-03383-384); Fahey, Hecla, 10, 16-17; E&MJ 62 (25 July 1896): 85; (19 September 1896): 277 (RBUCO-001-0235); 63 (8 May 1897): 460 (RBUCO-001-0242); 64 (27 November 1897): 646 (RBUCO-001-0253); 66 (30 July 1898): 136 (RBUCO-001-0270); 67 (15 April 1899): 449 (RBUCO-001-0298); 73 (1 February 1902): 190 (RBUCO-001-0363), (19 April 1902): 564 (RBUCO-001-0366); 74 (25 October 1902): 560 (RBUCO-001-0371); M&SP 84 (25 January 1902): 54 (FLQCA-001-0049); 85 (23 August 1902): 108 (RBUCO-001-0067).

[31]Report of the Mining Districts of Idaho for the Year 1907, 165 (RBUCO-001-02250); Richards, Ore Dressing, 940-942; "Sanborn Map for Gem" (1901), (FLQCA-001-02137); "Sanborn Map for Gem" (1905), (FLQCA-001-02143-146).

[32]Fahey, Hecla, 28; Report of the Mining Districts of Idaho for the Year 1904, 117-118 (RBUCO-001-02215-216); Report of the Mining Districts of Idaho for the Year 1906, 145 (RBUCO-001-02237); Report of the Mining Districts of Idaho for the Year 1907, 164-166 (RBUCO-001-02249-251); USGS, Mineral Resources of the U.S., 1906, 265 (RBUCO-001-

In 1914, Hecla modified its mill, adding to its capacity and installing Callow flotation equipment. During 1915, the mill operated for 333 days at a capacity of 425 tons/day. It treated 112,646 tons of ore that year (indicating it did not run at full capacity every day it operated), yielding 15,199 tons of concentrates and, therefore, discharging more than 97,000 tons of tailings into the creek.[33]

During the second half of the 1910s, Hecla's mining output increased faster than the capacity of the mill. Although Hecla expanded the mill capacity at Gem, so that by the end of the decade it was about 700 tons/day, the company also leased other mills, both the Marsh mill on Nine-Mill Creek (200 tons/day) and the Mammoth mill at Wallace, to satisfy the market for its concentrates. In 1919, Hecla milled 175,102 tons of ore, producing 19,746 tons of concentrates and discharging more than 155,000 tons of tailings into tributaries of the South Fork. Production was even greater in 1920, leading to a discharge of more than 160,000 tons of tailings.[34]

Output of milling ore from the Hecla mine continued to increase in 1921 and 1922, and 1923 was going well until a fire on July 13 destroyed the entire surface plant at Burke. Six months later, in late January 1923, Hecla had its surface plant rebuilt and was again shipping ore to the concentrator at Gem. The concentrator still relied heavily on gravity concentration, only re-grinding middling and treating fines by flotation. Coarse tailings from the jigs, assaying about 1.2% lead, were still discharged from the plant, either into railroad cars to be hauled away for ballast, road surfacing, or concrete aggregate, or into buckets of an aerial tramway, which disposed of them in a nearby (unnamed) gulch. In 1924, Hecla and the Bunker Hill & Sullivan Company began extracting ore from the Star mine, which they owned jointly, through Hecla workings. They shipped the ore to Kellogg for treatment, however, so the ore did not add to the tailings burden of Canyon Creek.[35]

01557); Mineral Resources of the U.S., 1907, 309 (RBUCO-001-01565); Mineral Resources of the U.S., 1909, 355 (RBUCO-001-01585); Mineral Resources of the U.S., 1910, 466 (RBUCO-001-01594); Mineral Resources of the U.S., 1911, 599 (RBUCO-001-01603); Mineral Resources of the U.S., 1913, 784 (RBUCO-001-01618); M&SP 92 (20 January 1906): 45 (FLQCA-001-0237), (17 March 1906): 188 (FLQCA-001-0243); E&MJ 88 (4 December 1909): 1138 (RBUCO-001-0661).

[33]Mineral Resources of the U.S., 1914, 633 (RBUCO-001-01629); Mineral Resources of the U.S., 1915, 555 (RBUCO-001-01643); Zeigler, "Concentration of Lead-Silver Ore at Hecla Mine," 175 (FLQCA-001-01993); M&SP 109 (3 October 1914): 535 (FLQCA-001-0640); "Sanborn Map for Gem" (1915), (FLQCA-001-02149-152).

[34]E&MJ 103 (20 January 1917): 167 (RBUCO-001-0921); M&SP 116 (2 March 1918): 313 (FLQCA-001-0848); Mineral Resources of the U.S., 1918, 491 (RBUCO-001-01677); Mineral Resources of the U.S., 1919, 419 (RBUCO-001-01684); Mineral Resources of the U.S., 1920, 257 (RBUCO-001-01689); Mining Industry of Idaho for the Year 1920, 100 (RBUCO-001-02396).

[35]Zeigler, "Concentration of Lead-Silver Ore at Hecla Mine," 175-176, 178 (FLQCA-001-

In 1925, Hecla added a separate flotation plant to its Gem mill to treat jig tailings, further enhancing the recovery of values from material passed through the concentrator. The tailings mill was built directly over Canyon Creek and adjacent to the original mill. Hecla built an ore bin straddling a set of railroad tracks between the new and the original mills. Covered conveyors linked the ore bin to both mills. All coarse jig tailings from the gravity section of the old mill were conveyed to the new tailings mill, where they were ground more finely and treated by flotation. Hecla continued making improvements to its old mill as well, gradually replacing gravity concentration machinery with flotation equipment.[36]

With the advent of the Great Depression, Hecla curtailed its operations somewhat during the 1930s, and especially during 1932, 1933, and 1934. The company nevertheless often milled more than 200,000 tons of ore in a year and typically discharged well over 150,000 tons of tailings into the river system annually. During the summer of 1939, Hecla closed the Hecla mill to replace the last of its gravity concentration machinery with flotation apparatus. While the mill was closed, Hecla treated its ore at the Star mill at Burke. When the remodelled Hecla mill opened in December 1938, it had a capacity to treat 900 tons/day.[37]

Entering the 1940s, Hecla recognized that the spectacular production from its mine was likely drawing to an end. The company curtailed its mining operations and began to take ore at the Gem mill from the Silver Cable mine in Montana and from the Osburn tailings dump. Hecla built a sink-and-float plant near the Osburn tailings (described in a separate section of this report) to perform a preliminary separation of valuable material from waste prior to shipping the former to a conventional flotation mill. The product of that sink-and-float plant, which began operating in mid-1943, was sent to both the Hecla concentrator at Gem and the Polaris mill. Meanwhile, output from the Hecla mine in 1943 dropped to half the 1942 output (140,400 tons, compared to 274,938 tons). Hecla's Gem mill was able to operate a full capacity, however, because of the supply of Osburn tailings. After producing only 26,000 tons more in 1944, the Hecla mine

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01993-995); E&MJ 117 (2 February 1924): 219)RBUCO-001-01112); Mineral Resources of the U.S., 1921, 4 (RBUCO-001-01693); Mineral Resources of the U.S., 1922, 241 (RBUCO-001-01697); Mineral Resources of the U.S., 1923, 399-400 (RBUCO-001-01703-704); Mineral Resources of the U.S., 1924, 279-280 (RBUCO-001-01709-710).

[36]Zeigler, "Concentration of Lead-Silver Ore at Hecla Mine," 178-181 (FLQCA-001-01995-996); Mineral Resources of the U.S., 1925, 544 (RBUCO-001-01717); Mineral Resources of the U.S., 1926, 447 (RBUCO-001-01724); Mineral Resources of the U.S., 1929, 402 (RBUCO-001-01742); "Sanborn Map for Gem" (1927), sheet 2 (FLQCA-001-02157).

[37]Mineral Resources of the U.S., 1931, 402 (RBUCO-001-01759); Minerals Yearbook, 1932-33, 121 (RBUCO-001-01763); Minerals Yearbook, 1935, 95 (RBUCO-001-01775); Minerals Yearbook, 1937, 402 (RBUCO-001-01782); Minerals Yearbook, 1938, 326 (RBUCO-001-01785); Minerals Yearbook, 1939, 357 (RBUCO-001-01787); Mining Industry of Idaho for the Year 1938, 199 (RBUCO-001-02498).

closed in July of that year, its ore reserves exhausted. From then through 1948, when the Osburn sink-and-float plant burned, Hecla's mill at Gem operated primarily on tailings.[38]

There is no evidence in the historical record that the United States was an operator of the Gem/Hecla mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

At a recent 30(b)(6) deposition taken in the U.S. vs. Hecla case, Larry Drew, representing the Hecla Mining Company, answered "no" when asked if the government ever did "operate or own any of the mills that resulted from the disposal of tailings that you claim resulted from an act of war." He also answered that the government had not specifically directed the Hecla to operate during WWII under price incentives.[39]

Granite

The Granite mine was on the Nine-Mile Creek side of the ridge, but it initially hauled its ore by wagon to the railroad on Canyon Creek at a point about 1.5 miles above Wallace. Granite ore was then shipped to the smelter by rail via Lake Coeur d'Alene. The Granite built its mill along Canyon Creek near Gem in 1888. The mill was located on the north side of the creek about a half-mile downstream (southwest) of the town of Gem. It was said to have been the first in the Coeur d'Alene district to install automatic feeders for the crusher and rolls, equipment that greatly facilitated the movement of material through the mill. An aerial tramway carried ore from the mine to the mill. Although in 1891 the mill was described as derelict, mine and mill resumed operations in 1893, shipping concentrates to Kansas City. By 1896, it was shut down; by 1901, it was dismantled and abandoned; and by 1905, it had been demolished.[40]

There is no evidence in the historical record that the United States was an operator of the Granite mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

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[38]Minerals Yearbook, 1942, 384-385 (RBUCO-001-01794); Minerals Yearbook, 1943, 376 (RBUCO-001-01799); Minerals Yearbook, 1944, 360 (RBUCO-001-01804).

[39]Larry Drew, Deposition taken on 7/8/99, USA vs. Hecla, pp. 149-150.

[40]E&MJ 46 (28 July 1888): 70 (RBUCO-001-0005), (25 August 1888): 157 (RBUCO-001-0008); 48 (31 August 1889): 189 (RBUCO-001-0023); 56 (23 September 1893): 326 (RBUCO-001-0136), (11 November 1893): 504 (FLQCA-001-0141); M&SP 59 (23 November 1889): 395 (FLQCA-001-01135); 79 (23 December 1899): 724; 88 (28 May 1904): 370 (FLQCA-001-0146); "Sanborn Map for Gem" (1891), (FLQCA-001-02130); "Sanborn Map for Gem" (1896), (FLQCA-001-02133-136); "Sanborn Map for Gem" (1901), (FLQCA-001-02137); "Sanborn Map for Gem" (1905), (FLQCA-001-02143-146); photo of Granite mill in Wood, Railroads through the Coeur d'Alenes, 80 (FLQCA-001-03182).

Standard-Mammoth

The Standard-Mammoth facility of the Federal Mining & Smelting Company began as two separate mills, the Standard and the Mammoth. When Federal bought them in 1903, it began to coordinate their operation. Prior to that, the Standard and the Mammoth mills were owned and operated by two distinct corporations. Those histories will be described in turn.

The Standard mine was located along Canyon Creek at a location that came to be know as Mace. Amasa Campbell and John Finch, developers of the Hecla and other mines on Canyon Creek, bonded the Standard mine in 1890. By the mid-1890s, Campbell and Finch had acquired the Standard mine and begun producing ore profitably. In 1895, they began milling the Standard's ore at the Union mill near Wallace on the east side of Canyon Creek just above its confluence with the South Fork of the Coeur d'Alene River. The Union mill was owned by the Coeur d'Alene Mining & Concentrating Company, another concern in which Campbell and Finch had interests. Coeur d'Alene Mining & Concentrating owned the Union mine at Burke, shipping ore from mine to mill by rail. From the north (upstream), a railroad spur ascended the hillside east of the mill, where an ore bin was located. An inclined tramway conveyed ore from the bin to the primary crusher in the mill. Two sets of railroad tracks came up the east side of Canyon Creek from Wallace. These terminated at the west end of the mill and were used for shipping concentrates from mill to smelter. The Union mill was powered by Pelton wheels, supplied with water by a flume that took water out of the South Fork and approached the mill from the south at an elevation a little higher than the tracks to the ore bin.[41]

By 1895, the Union mine had already exhausted nearly all its ore reserves, and the Standard Mining Company made arrangements to treat its ore at the Union mill. By summer 1895, the mill was treating about 200 tons/day of Standard ore, and by the end of the year it was known as the Standard mill. During the winter of 1895-96, the Standard mine and mill closed for several months, allowing improvements to be made at the mill, among which was the construction of a flume to the mill from farther up Canyon Creek. The flume delivered water to an electrical generator at the mill that was used to power a compressor for the mine and other equipment. New milling equipment was also added, including additional round tables and vanners, which allowed the Standard to make better recoveries of lead and silver from fines. After the improvements, the mill operated at a ratio of concentration of about 4:1.[42]

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[41]Fahey, Hecla, 8-16; M&SP 69 (29 December 1894): 413 (FLQCA-001-01328); "Sanborn Map for Wallace" (1892), sheet 1 (FLQCA-001-02760).

[42]Fahey, Hecla, 16; M&SP 70 (2 March 1895): 138 (FLQCA-001-01341); 71 (3 August 1895): 79 (FLQCA-001-01369), (7 December 1895): 375 (FLQCA-001-01394), (28 December 1895): 430-431 (FLQCA-001-01397); 72 (4 April 1896): 271 (FLQCA-001-01415), (18 April 1986): 323 (FLQCA-001-01418); "Sanborn Map for Wallace" (1896), sheet 1 (FLQCA-001-02767).

In March 1897, the Standard mill was treating about 250 tons daily, but that was not considered its full capacity. One cause that prevented the mine and mill from achieving full production was a series of cave-ins that interrupted operations. Despite those setbacks, the Standard was one of the more profitable mines in the district, and in 1898 the company expanded the mill, adding a crusher and more tables and vanners. By the end of the 1890s, the mill's capacity was about 550 tons/day. Among the other changes was a modification to the railroad spur that delivered ore to the mill. It was relocated about 50 feet east, making it higher on the hill than the flume from the South Fork (but still below the new flume from upstream on Canyon Creek). Among other things, this shift allowed room for the construction of the Mammoth mill about 200 feet north of the Standard mill. It also allowed the Standard's crushers to be located between the existing mill and the new ore bin, now farther east. During the late 1890s, the Standard mill also treated ore from the Hecla, another mine in which Campbell and Finch had prominent interests. Although the Standard mill dumped its fine tailings and usually its coarse tailings into Canyon Creek, as early as 1901 it was loading some of its coarse tailings into railroad cars. The railroads used coarse tailings as ballast for roadbed under tracks and ties. The 1901 Sanborn map shows a ballast bin on the west side of Canyon Creek and just downstream of the Standard mill. The bin was linked to the Standard mill complex by a flume or like conveyance.[43]

The Mammoth Mining Company had a mine opening at Mace, near the Standard mine. The company began developing the mine in 1891, but showed little progress until the mid-1890s, when the Mammoth began shipping high-grade ore and placing milling ore on a dump in anticipation of eventually operating a concentrator. In 1897, the Mammoth acquired the upper tunnels of the Standard mine, which had accessed worked-out stopes of the latter. The Mammoth drove those tunnels further into its own orebody. To treat its ore, the Mammoth leased the Gem mill from the Milwaukee Mining Company for about year. In April 1899, there were reports that the Hecla Mining Company was building a 200-ton concentrator near the Standard mill, and that it would use the same flumes as the Standard mill to deliver water from the South Fork and Canyon Creek for power and processing. Because Finch and Campbell had interests in the Hecla, Standard, and Mammoth properties, the potential for confusion concerning which company was actually undertaking the construction was great. Moreover, it may be that the Hecla company initiated the construction, and construction was discontinued and then completed by the Mammoth company. At any rate, there are no known references to the beginning of construction of a "Mammoth" mill, yet it is clear that, by 1900, the Mammoth company had a mill near the Standard mill, that the mill was already being enlarged to increase its capacity to about 300 tons/day, and that the company was installing Frue vanners to better treat fine particles before they were discharged as tailings.[44]

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[43]M&SP 74 (20 March 1897): 239 (FLQCA-001-01457); 75 (16 October 1897): 368 (FLQCA-001-01480); 76 (19 February 1898): 211 (FLQCA-001-01495); 77 (20 August 1898): 186 (FLQCA-001-01523), (3 September 1898): 234 (FLQCA-001-01527); E&MJ 66 (17 September 1898): 346 (RBUCO-001-0276); 67 (22 April 1899): 479 (RBUCO-001-0299); "Sanborn Map for Wallace" (1901), sheets 4 & 6 (FLQCA-001-02772, 774); "Sanborn Map for Wallace" (1905), sheets 4 & 6 (FLQCA-001-02778, 780).

[44]E&MJ 52 (1 August 1891): 131): RBUCO-001-0064); 61 (23 May 1896): 501 (RBUCO-

The Mammoth mill was located about 200 feet north of the Standard mill. It had an ore bin along the same hillside spur used to deliver ore to the Standard mill. The primary crusher was next to the ore bin. The main mill building sat at the base of the hillside and housed the rolls, jigs, tables, and vanners for concentrating ore. The two creekside spurs that shipped concentrates from the Standard mill were extended upstream as necessary to also accommodate the loading of cars at the Mammoth mill. Scales and other loading facilities were at the west end of the mill. During the 1900 enlargement, the Mammoth added a 20-foot-wide additional along the north side of the mill to accommodate Frue vanners to concentrate fines. Another improvement made jointly by the Standard and the Mammoth companies was to line Canyon Creek with wood piling from just above the Mammoth mill to just below the Standard mill. The canyon was very narrow at this location, and there were railroad tracks on both sides of the creek. This left no room for bank erosion as the swift current of Canyon Creek flowed past the two mills. The pile bank lining may have helped forestall such a problem.[45]

The Standard and the Mammoth companies were part of an important consolidation of Coeur d'Alene mining operations in 1903, when they were acquired by the Federal Mining & Smelting Company, formed by Charles Sweeney of Spokane along with New York interests allied with the Rockefellers. Federal took ownership and operation of the Empire State-Idaho properties at Wardner (Last Chance) and Burke (Tiger-Poorman) as well as of the Standard-Mammoth properties near Wallace. Federal bought the stock of the predecessor companies late in 1903, and the deeds to the various properties were conveyed to Federal in January 1904. In 1905, control of Federal passed from the Rockefellers to the Guggenheims, who were prominent in ASARCO. Federal operated the Standard and Mammoth mills side-by-side, with a combined capacity of 1,000 tons/day, until 1910.[46]

During that early period of ownership, one of the first things Federal did at the Standard mill was to experiment with methods for recovering more values from the tailings before they were discharged into Canyon Creek. For about two years, the Standard had been using canvas

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001-0228); 62 (4 July 1896): 12 (RBUCO-001-0231); 64 (3 July 1897): 16 (RBUCO-001-0245); 67 (15 April 1899): 449 (RBUCO-001-0298); 70 (20 October 1900): 468 (RBUCO-001-0345); M&SP 72 (27 June 1896): 527 (FLQCA-001-01429); 74 (19 June 1897): 519 (FLQCA-01464); 76 (8 January 1898): 40 (FLQCA-001-01491).

[45]E&MJ 70 (20 October 1900): 468 (RBUCO-001-0345); "Sanborn Map for Wallace" (1901), sheet 4 (FLQCA-001-02772); "Sanborn Map for Wallace" (1905), sheet 4 (FLQCA-001-02778); "Mammoth and Standard Mills, Wallace, Idaho - 1907" (FLQCA-001-03337); "Mammoth Mine and Standard Mine, Concentrators, near Wallace, Idaho - Prior 1907" (FLQCA-001-03340).

[46]USGS, Mineral Resources of the U.S., 1903, 246 (RBUCO-001-01542); M&SP 87 (15 August 1903): 105 (FLQCA-001-0116); 88 (6 February 1904): 102 (FLQCA-001-0131), (14 May 1904): 337 (FLQCA-001-0145); 106 (1 March 1913): 340-341 (FLQCA-001-0542-543); E&MJ 77 (9 June 1904): 923-924 (RBUCO-001-0409-410); "Sanborn Map for Wallace" (1905), sheet 4 (FLQCA-001-02778); "Sanborn Map for Wallace" (1908), sheet 3 (FLQCA-001-02785).

tables to try to recover additional values from slimes before they were lost to the creek. The mill was the last in the district to be using canvas tables. In February 1904, after two months of experiments, the Standard decided to replace the canvas plant and to install Wilfley tables and Frue vanners to effect additional separation of concentrates from slimes before discharge. The new vanners and tables were installed in a wing extending south of the main mill building. During this period, the Standard was intent on recovering only lead and silver and minimizing the zinc content of the concentrates. Tailings discharged by the mill assayed about 2% zinc.[47]

Despite improved methods for recovering values from fine tailings, the Standard and Mammoth mills still rejected some coarse materials at early stages in the milling process. An advantage to this method was that coarse tailings tended to relatively clean, meaning their assay values in lead and silver were quite low. A disadvantage was that coarse tailings were not so readily carried away by streams, especially during periods of low flow. This proved problematic for the Standard and Mammoth mills. During the fall of 1904, for example, when the flow of water in Canyon Creek was the lowest in memory. Instead of discharging coarse tailings into the creek, both mills loaded such material into railroad cars, and the railroads hauled it away to be used for ballast. During these early years of the century, railroads carried tailings away at a rate of about nine cars per day during non-winter months. A manager of the Standard-Mammoth mills testified that the railroads hauled the tailings as much as 100 miles away to be used for ballast. Nevertheless, the water level was so low in Canyon Creek that the companies had difficulty disposing of fine tailings. The problem extended below the confluence with the South Fork as well: tailings were building up in the bed of the South Fork where it passed through Wallace to a depth of four or five feet.[48]

In July 1910, Federal started leasing the Mammoth mill (capacity of 350 tons/day at the time) to the Stewart Mining Company. Controlled by F. Augustus Heinze, the Stewart company owned the Stewart group of mines on Grouse Gulch west of Wardner. Mining began there on a small scale in 1904, and in 1907 the Stewart Company built a 150-ton mill on the Silver King claim, near the Stewart mine. It operated only a few days, however, before mine and mill closed in the face of litigation and financial problems. Stewart operations remained dormant until 1910. For unknown reasons (perhaps because the Silver King claim on which Heinze had built the Stewart mill, was central to the litigation), the Stewart began shipping ore to the Mammoth mill rather than using its own mill when mining resumed. During the remainder of 1910, Stewart ore

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[47]E&MJ 75 (13 June 1903): 910 (RBUCO-001-0387); 76 (17 December 1903): 944 (RBUCO-001-0397); 77 (11 February 1904): 256 (RBUCO-001-0405), (21 April 1904): 661 (RBUCO-001-0407), (9 June 1904): 924 (RBUCO-001-0410); M&SP 88 (23 January 1904): 69 (FLQCA-001-0130), (26 March 1904): 219 (FLQCA-001-0138), (23 April 1904): 289 (FLQCA-001-0142); Richards, Ore Dressing, 1685-1687 (FLQCA-001-01761).

[48]M&SP 89 (12 November 1904): 332 (FLQCA-001-0173); W. Clayton Miller, testimony in Timothy McCarthy, William Raney, and Elmer Doty v. The Bunker Hill and Sullivan Mining and Concentrating Company, et al, United States Circuit Court for the District of Idaho, Northern Division (hereafter cited as McCarthy v. BH&S) 2226 (FLQCA-001-04782).

shipments to the Mammoth mill averaged about 200 tons/day, with the mill operating at half-capacity.[49]

From then until 1917, the Stewart used the Mammoth mill fairly continuously, with many periods during which the mine was able to sustain shipments to the mill of 500 tons/day. During October 1912, for example, the Mammoth treated 16,933 tons of Stewart ore (averaging 546 tons/day), operating at a ratio of concentration of about 8.3:1. As a consequence, the Mammoth mill discharged nearly 15,000 tons of tailings into Canyon Creek that month. In 1912, the Stewart built an inclined gravity tramway to carry ore 2.5 miles from a new mine adit on Deadwood Gulch to ore bins at a railroad station near the Bunker Hill & Sullivan mine. The railroad hauled the material 16 miles to the mill. By 1914, the Stewart had installed some flotation equipment at its leased mill. The company exhausted the ore supply at the Stewart mine in early 1916, relinquishing its lease on the Mammoth mill. Shortly hereafter, the Stewart company bought the Nabob Mining Company and its Denver mine on Pine Creek. During 1917, the Stewart again leased the Mammoth mill briefly to treat ore from the Denver.[50]

At the end of 1916, while the Stewart had suspended its use of the Mammoth mill, Federal began an enlargement of the Mammoth mill and a conversion of its equipment to flotation. The purpose of the modifications was for treatment of some of Federal's ore produced by the Morning mine. Early in 1917, the remodelled Mammoth mill, now called Morning mill no. 2, began operating on Morning ore, but it soon closed due to litigation brought by the Star Mining Company against Federal, claiming the latter was illegally mining in Star ground.[51]

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[49]M&SP 88 (11 June 1904): 402 (FLQCA-001-0151); 94 (2 March 1907): 262 (FLQCA-001-0265), (23 March 1907): 357 (FLQCA-001-0266); 95 (6 July 1907): 6 (FLQCA-001-0295), (3 August 1907): 132 (FLQCA-001-0297), (17 August 1907): 195 (FLQCA-001-0298), (12 October 1907): 453 (FLQCA-001-0304); E&MJ 89 (28 May 1910): 1132 (RBUCO-001-0677); USGS, Mineral Resources of U.S., 1906, 311 (RBUCO-001-01567); Mineral Resources of U.S., 1910, 468 (RBUCO-001-01596). The mill built by the Stewart on land owned by the Coeur d'Alene Development Company is depicted on the "Sanborn Map for Wardner" (1908), sheet 2 (FLQCA-001-03055).

[50]M&SP 102 (14 January 1911): 120-121 (FLQCA-001-0452), (4 March 1911): 349 (FLQCA-001-0458), (29 April 1911): 607 (FLQCA-001-0465); 103 (1 July 1911): 28 (FLQCA-001-0477); 104 (3 February 1912): 219 (FLQCA-001-0498), (17 February 1912): 291 (FLQCA-001-0500); 105 (7 December 1912): 743 (FLQCA-001-0532); 106 (12 April 1913): 561 (FLQCA-001-0550); 109 (17 October 1914): 619 (FLQCA-001-0641); 111 (24 July 1915): 145 (FLQCA-001-0687); E&MJ 101 (26 February 1916): RBUCO-001-0882), (24 June 1916): 1134 (FLQCA-001-0896); 103 (16 June 1917): 1087): RBUCO-001-0935).

[51]M&SP 113 (16 December 1916): 888 (FLQCA-001-0772); 114 (24 March 1917): 424-425 (FLQCA-001-0785); E&MJ 102 (2 December 1916): 999 (RBUCO-001-0915); 103 (14 April 1917): 687 (RBUCO-001-0930).

Meanwhile, back at the Standard mill, Federal operated it until 1912, when the orebodies in the Standard-Mammoth mine were exhausted. Federal then leased the Standard mill to the Green Hill-Cleveland Mining Company, newly formed by Federal, Harry L. Day, and others to mine a continuation of the Mammoth vein. Federal owned half of the Green Hill-Cleveland stock and leased its entire mining plant at Mace to the new company. Green Hill-Cleveland immediately began experimenting with flotation at the Standard mill to recover zinc as well as lead from its ores. By 1914, during which the mill treated an average of 500 tons/day, it was regularly producing both a lead concentrate with good silver values and a lead-zinc concentrate. The company progressively added more flotation cells to treat tailings coming off the tables in the concentrator, effecting ever better recoveries. The improved effectiveness of milling at the Green Hill-Cleveland mill allowed the company to extract some low-grade ores from the old Standard-Mammoth workings as well, which had been left in place because it had been uneconomical to treat them under the previous milling scheme. The Green Hill-Cleveland mill treated an average of 500 tons/day during 1915 and 400 tons/day during 1916. After operating all of 1917, it closed in December, when the ore in the mines at Mace was exhausted.[52]

As already stated the Mammoth mill had also ceased operating in 1917. Neither the Standard nor the Mammoth are known to have treated ore after that year. Both mills stood until at least 1927, but by 1949 they had been demolished.[53]

There is no evidence in the historical record that the United States was an operator of the Standard-Mammoth mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products. In answer to Department of Justice attorney Daniel R. Dertke's questions at a recent 30(b)(6) deposition, John C. Pfahl, representing ASARCO, answered negatively to all questions concerning whether the United States Government ever operated the Standard-Mammoth mine and mill.[54]

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[52]E&MJ 94 (26 October 1912): 809 (RBUCO-001-0735); M&SP 106 (22 February 1913): 325 (FLQCA-001-0541), (14 June 1913): 918 (FLQCA-001-0564); 107 (9 August 1913): 247 (FLQCA-001-0573); USGS, Mineral Resources of the U.S., 1913, 782, 784 (RBUCO-001-01616, 01618); Mineral Resources of the U.S., 1914, 631-634 (RBUCO-001-01627-630); Mineral Resources of the U.S., 1915, 555 (RBUCO-001-01643); Mineral Resources of the U.S., 1916, 597 (RBUCO-001-01656); Mineral Resources of the U.S., 1916, 485 (RBUCO-001-01665).

[53]"Sanborn Map for Wallace" (1927), sheet 10 (FLQCA-001-02837); "Sanborn Map for Wallace" (1927, up-dated to 1949), sheet 10 (FLQCA-001-02909).

[54]Deposition of John C. Pfahl in USA v. ASARCO, June 4, 1999, pp. 180-201.

Formosa

The Formosa mill was built by Gies and Burke on Canyon Creek about 2.5 miles above Wallace and a short distance downstream of Gem. Construction began in 1896, and the 75-ton concentrator began operating in April 1897. The portal to the Formosa mine tunnel was high on the hillside. Ore was conveyed from the adit to the mill via a trestle to the upper end of a chute. Shortly after the mill opened, Gies and Burke began driving a new tunnel from the level of the mill toward the ore body, but the mill operated little thereafter. In 1909, the Alice Mining Company bought the equipment from the Formosa mill, moving it to the Alice mine on Ruddy Creek between Wallace and Mullan.[55]

There was no further activity on the Formosa property until 1931, when the Mutual Mines Development Company built a 100-ton flotation mill there and treated ore from the Formosa mines for about six months. Mutual treated only about 2,000 tons of ore before it was forced to close by low metals prices. In late 1942, the Small Leasing Company, formed by James E. Small and Leo J. Hoban, got the Formosa mill in operating condition with a capacity to treat 140 tons of tailings per day. The company obtained a lease from the Canyon Creek Tailings Association to re-work tailings on association ground. Initially, Small Leasing simply used a jig in the Formosa mill to obtain satisfactory recoveries to be economical. With declining assays of available tailings, however, the company decided to install a ball mill and flotation cells to more fully re-treat the material. Tailings were first screened where excavated, to remove rocks and trash, and then hauled by truck to the mill. The screening operation was later moved to the mill.[56]

The flotation mill operated throughout 1943, treating 46,000 tons of old tailings deposited along Canyon Creek. The tailings assayed at 2-3% lead, 4.5% zinc, and 2-2.5 oz. silver per ton. Small Leasing also shipped about 8,500 tons of Canyon Creek tailings to the Golconda mill for treatment that year. In 1944, Small Leasing treated nearly 37,000 tons of old tailings in the Formosa mill and shipped nearly 19,000 tons of tailings to Golconda. In 1945, Small Leasing treated about 56,000 tons of old tailings in the Formosa mill and shipped more than 11,000 tons of tailings to Golconda. With the end of the war, the amount of tailings Small Leasing treated in 1946 and 1947 actually increased to about 80,000 tons per year, divided between its own mill and the Golconda. Assay values of the tailings being treated, however, declined to less than 2% lead, less than 2.5% zinc, and about an ounce of silver per ton. With the installation of sink-float apparatus to give the material a preliminary treatment before sending it through the flotation

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[55]M&SP 72 (25 April 1896): 343 (FLQCA-001-01419), (2 May 1896): 363 (FLQCA-001-01420); 74 (17 April 1897): 327 (FLQCA-001-01459); 99 (3 July 1909): 8 (FLQCA-001-0406); E&MJ 62 (4 July 1896): 12 (RBUCO-001-0231); 64 (2 October 1897): 405 (RBUCO-001-0251); Report of the Inspector of Mines for the State of Idaho for the Year 1899, 29 (RBUCO-001-02197).

[56]Mineral Resources of the U.S., 1931, 403 (RBUCO-001-01759); "Small Leasing Co.," Mining World 5 (November 1943): 24-26 (FLQCA-001-04952); "Successful Tailings Reclamation," Mining World 9 (February 1947): 29-32 (RBUCO-001-05529-532).

plant, Small Leasing could economically treat old tailings assaying as low as 1% lead, 1% zinc, and 1 oz. silver per ton. Of the first 200,000 tons of Canyon Creek tailings the company treated, it produced about 3,500 tons of lead concentrates and 15,000 tons of zinc concentrates. After treating about 60,000 tons of tailings (from the Elgin property along Canyon Creek) at the Formosa mill in 1948, Small Leasing ceased operations at the end of the year.[57]

There is no evidence in the historical record that the United States was an operator of the Formosa mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Hercules

The Hercules Mining Company[58] built a large concentrator along the South Fork of the Coeur d'Alene River in 1910-11. Most of the history of the Hercules' milling activity took place at that facility and is described in another section of this report. The first Hercules mill, however, was built in 1905 near the Hercules mine on Gorge Gulch, a tributary of Canyon Creek. It operated only four years before being destroyed by fire. That brief history is described here.

The first reports of rich ore discovered at the Hercules mine appeared in August 1901, more than a decade after other mines along Canyon Creek began prospering. The mine began shipping ore to a smelter at Perth Amboy, NJ, in October. It must have been a difficult haul from the mine to the railroad at Burke, because until the summer of 1902, there was not yet a county road between Burke and the Hercules. After shipping ore for more than a year over what must have been a crude wagon road, the Hercules Mining Company began negotiations with the Northern Pacific Railroad to extend its tracks 1,000 beyond its current terminus at Burke and into the lower reaches of Gorge Gulch. The Hercules company hoped to build an aerial tramway from the mine about 7,000 feet to that new terminus. Apparently negotiations were unsuccessful, and during the summer of 1903, the company continued to haul high-grade ore, assaying about

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[57]Mineral Yearbook, 1943, 377 (RBUCO-001-01799); Mineral Yearbook, 1944, 361 (RBUCO-001-01804); Mineral Yearbook, 1945, 377 (RBUCO-001-01809); Mineral Yearbook, 1946, 1445 (RBUCO-001-01814); Mineral Yearbook, 1947, 1413 (RBUCO-001-01819); Mineral Yearbook, 1948, 1507 (RBUCO-001-01825); "Successful Tailings Reclamation," 30-32 (RBUCO-001-05530-532); W.L. Zeigler, "Tailings and Mine-Dump Reclamation in the Coeur d'Alenes during World War II," Mining Technology 11 (Mach 1947): 6 (FLQCA-001-03687).

[58]The Hercules Mining Company apparently was not an incorporated entity. As late as 1914, a legal document named the following: "Harry L. Day, Eugene R. Day, Jerome J. Day, Eleanor Day Boyce, Sylvester Markwell, Damian Cardoner, L.W. Hutton, August Paulsen, Frank M. Rothrock, Charles A. Markwell and Frank P. Markwell, partners doing business under the name of Hercules Mining Company;" see Indenture between Spokane & Eastern Trust Company and H. Haff, dated 1 August 1914 (SEAWA-002-00253-256).

60% lead and 50 oz. silver per ton, by wagon to the railroad at Burke. At the time the Hercules mine was shipping about 1,000 tons of smelting ore per month.[59]

Hercules began construction of a concentrator on the steep east-facing slope of Gorge Gulch in 1905. The mill was about a mile north of Burke. In anticipation of its new mill, the company began stockpiling lower-grade ore, both on dumps and in stopes. Milling ore averaged about 6.5% lead and 7 oz. silver per ton. The mill began operating in May 1906 with a capacity of 300 tons/day. Ore stored in bins at the mine was conveyed to the ore bin at the mill on a surface tramway. Another tramway transferred ore from that bin down an incline to the grizzlies and crusher at the head of the mill. Jigs, tables, and vanners produced a concentrate assaying 60-65% lead. Tailings were simply sluiced to the gulch. The Hercules built a wood culvert along the bottom of the gulch so that tailings could be dumped on top of the culvert. The intention was to allow the normal flow of the gulch to pass beneath the tailings without carrying them away. An investigation by a rival mining company revealed that an average of 25% of the Hercules tailings flowed down the gulch nevertheless. During the first year of operation, unwatered concentrates were hauled by wagon down the steep grade to the railroad at Burke. In 1907, the Hercules company began construction of an aerial tramway to transport first-class ore, concentrates, and coarse tailings to Burke. The ore and concentrates went to the Selby smelter in California, and the coarse tailings, bearing about 0.7% lead, were loaded into railroad cars to be used elsewhere for road surfacing. Fine tailings still going into the creek contained about 1.7% lead and 3% zinc. Immediately after the mill opened, the Hercules company began experimenting with improved methods and making changes as appropriate. In early 1907, the company also began experimenting with recovering zinc from its ore (containing about 3% zinc).[60]

Fire destroyed the Hercules mill on Labor Day 1909.[61] Rather than rebuilding in the Burke area near the Hercules mine, the company decided to build its new mill near Wallace. As already mentioned, the history of that mill is described elsewhere in this report.

There is no evidence in the historical record that the United States was an operator of the Hercules mill on Canyon Creek. The United States did not own the mill, did not manage the

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[59]E&MJ 72 (24 August 1901): 238 (RBUCO-001-0358), (26 October 1901): 547 (RBUCO-001-0360); 76 (18 July 1903): 102 (RBUCO-001-0390); M&SP 83 (28 December 1901): 291 (FLQCA-001-0046); 85 (23 August 1902): 108 (FLQCA-001-0067); 88 (14 May 1904): 337 (FLQCA-001-0145), (4 June 1904): 386 (FLQCA-001-0147).

[60]Scott Turner, "The Hercules Mill," M&SP 94 (4 May 1907): 568-570 (FLQCA-001-0276-278); Gen. Supt. of Mines (Federal Mining & Smelting Co.) to W. Clayton Miller, letter dated 24 March 1907 (ASAID-082-00019); Mineral Resources of the U.S., 1905, 240 (RBUCO-001-02550); Mineral Resources of the U.S., 1906, 265 (RBUCO-001-02557); Mineral Resources of the U.S., 1907, 309 (RBUCO-001-02565); "Sanborn Map for Burke" (1909), sheet 1 (FLQCA-001-02019).

[61]M&SP 99 (18 September 1909): 378 (FLQCA-001-0414).

mill, and did not own any of the materials processed at the mill. Nor, prior to 1968, did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Hull Lease

Hull Leasing Company first appears in the record in 1928, when it worked the Frisco group of claims owned by Federal Mining & Smelting Company. Hull treated the ore it mined at its own 75-ton flotation mill at Gem, located on ground leased from Federal on the south side of Canyon Creek about 750 feet upstream of the Hecla concentrator. This location was downstream of the old Frisco mill, which, as already mentioned, had been demolished by 1927. The Hull Leasing mill was less than 50 feet from the banks of Canyon Creek, where it undoubtedly dumped its tailings. In 1929, Hull shipped 1,500 tons of lead concentrates to East Helena (ASARCO) and 3,900 tons of zinc concentrates to Great Falls (ACM). In the 1940s, Hull leased the upper workings of Federal's Morning mine, still treating the ore it mined under lease at its own concentrator, by then with a daily capacity of 90-100 tons. During the early 1940s, Hull typically treated 20,000-30,000 tons of Morning ore each year, with an annual production of about 1,500 tons of lead concentrates and 3,000 tons of zinc concentrates. In 1954, Hull's output declined considerably, with a corresponding reduction in the operation of the mill. Hull's lease with Federal ended on March 15, 1957, and there is no record of the mill operating after that.[62]

There is no evidence in the historical record that the United States was an operator of the Hull Lease mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Dorn (Tamarack & Custer)

Shortly after Tamarack & Custer's old Frisco mill burned in 1937 (see description elsewhere in this section), the company laid plans to build a new mill on Canyon Creek next to the portal to its tunnel no. 7 at Mace. The canyon was quite constricted at that point. In addition to compressor house, blacksmith and machine shops, and a timber shed, the Tamarack company already had a sorting plant, crusher, and ore bins for loading railroad cars at that location. The mine adit was on the north side of the creek, the railroad tracks ran along the south side of the creek, and the creek itself passed beneath a conveyor linking the sorting plant with the ore bins

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[62]Mineral Resources of the U.S., 1928, 680 (RBUCO-001-01734); Mineral Resources of the U.S., 1929, 403 (RBUCO-001-01742); Mineral Yearbook, 1941, 356 (RBUCO-001-01791); Mineral Yearbook, 1942, 384 (RBUCO-001-01794); Mineral Yearbook, 1944, 360 (RBUCO-001-01804); Mineral Yearbook, 1945, 376 (RBUCO-001-01809); Mineral Yearbook, 1949, 1479 (RBUCO-001-01830); Mineral Yearbook, 1954, 376 (RBUCO-001-01852); Mineral Yearbook, 1957, 380 (RBUCO-001-01865); "Sanborn Map for Gem" (1927), sheets 1 & 2 (FLQCA-001-02153-160).

and crusher. which were situated directly over the tracks. As mentioned in the section on the Frisco mill, the Tamarack company had been treating its ore at the Hercules mill since 1928. Construction of the new 300-ton flotation mill began in 1939. Called the Dorn mill, it began operating in February 1940.[63]

By 1941, the Dorn mill was treating 97,000 tons/year. The Dorn mill produced both lead and zinc concentrates. Because of labor shortages during World War II, Tamarack & Custer could employ only about 75% of the men it needed during much of 1943. Responding in September, the War Department furloughed several hundred soldiers to the Coeur d'Alene district, of whom 72 were allotted to Tamarack & Custer. Nevertheless, the company continued to produce at less than capacity because of the labor shortage. Curtailed production due to labor shortage continued in 1944 and 1945. Operations remained at about the same level in 1946 and 1947--approximately 65,000 tons mined and treated--as the Tamarack company had been able to maintain during the war. There was a brief surge in production to 87,595 tons in 1948, but output returned to about 60,000 tons in 1949 and then began a steady decline until the mill closed in 1958. Beginning in 1953, the Tamarack company turned its mining activity over to leasers, and from then until the Dorn mill closed it treated only that ore produced by leasers. In 1958, leasers completed mining of all the known reserves in the Tamarack mine.[64]

The Dorn mill was still standing along Canyon Creek in 1970, a dozen years after it apparently ceased operating. In a 1910 photograph, there is no sign of a tailings deposit surviving near the mill, and indeed the canyon appears to be so narrow and the flow of the creek swift enough as to preclude the build-up of tailings below the mill, where they would have been discharged during the 1940-1958 period.[65]

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[63]Mining Industry of Idaho for the Year 1939, 250 (RBUCO-001-02502); Mining Industry of Idaho for the Year 1940, 183 (RBUCO-001-02505); E&MJ 140 (November 1939): 74 (RBUCO-001-01225), 141 (November 1940): 78 (RBUCO-001-01183); "Sanborn Map for Burke" (1927), sheet 7 (FLQCA-001-02122).

[64]Mineral Yearbook, 1941, 356 (RBUCO-001-01791); Mineral Yearbook, 1942, 385 (RBUCO-001-01794); Mineral Yearbook, 1943, 377-378 (RBUCO-001-01799-800); Mineral Yearbook, 1944, 361 (RBUCO-001-01804); Mineral Yearbook, 1945, 377 (RBUCO-001-01809); Mineral Yearbook, 1946, 1446 (RBUCO-001-01815); Mineral Yearbook, 1947, 1414 (RBUCO-001-01820); Mineral Yearbook, 1948, 1508 (RBUCO-001-01826); Mineral Yearbook, 1949, 1480 (RBUCO-001-01831); Mineral Yearbook, 1953, 348 (RBUCO-001-01848); Mineral Yearbook, 1954, 377 (RBUCO-001-01852); Mineral Yearbook, 1955, 364 (RBUCO-001-01857); Mineral Yearbook, 1956, 387 (RBUCO-001-01861); Mineral Yearbook, 1957, 381 (RBUCO-001-01865).

[65]"Tamarack Mine & Mill, Burke Canyon, July 22, 1970" (FLQCA-001-03347).

There is no evidence in the historical record that the United States was an operator of the Dorn mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Sherman

The Sherman Lead Company was another of several corporations controlled by the Days. It had its origins as the Sherman Development Company, which was incorporated in Nevada in 1916 and owned several mining claims in the Burke area. When the company encountered financial difficulty in 1918, it was bought by the Days, who also owned the Hercules Mining Company, and reorganized as the Sherman Lead Company. In 1919, Sherman Lead bought the old Union group of claims near Burke from the Finch and Campbell estates. Sherman Lead actually began producing ore in 1928, reaching its orebodies through Hercules mine openings. Ore from the Sherman mining operations was treated at the Hercules mill.[66]

After intermittent production from the mine during the 1920s and 1930s, the mine re-opened in 1930. In mid-1940, the Sherman Lead Company began construction of a 300-ton flotation mill at Burke, installed in the old Hercules rock house at the portal to the Hercules mine. The Tamarack & Custer Mining Company owned 2,000,000 shares of Sherman stock. The previous year, the Tamarack company had also built a 300-ton mill at Dorn, a short distance downstream from Burke. When construction began on the Sherman mill, the new Dorn mill was operating at full capacity. In 1941, the Sherman mill's first year of full operation, it treated 52,066 tons of ore. The mill started producing zinc concentrate in 1942, prior to which it had only produced lead concentrate. In 1943, Sherman Lead returned to producing only lead concentrate, realizing a greater return from zinc shipped in the lead concentrate (because of the premium paid by the War Production Board for zinc in that form) than could be realized from zinc shipped as zinc concentrate. Output in 1944 was cut nearly in half because of the war-induced labor shortage and despite efforts of the federal government to help secure enough workers for the Sherman and other companies in the Coeur d'Alene district. The labor shortage and curtailed production continued through the end of the war and beyond, dropping to less than 19,000 tons in 1946. Production increased thereafter, reaching about 34,000 tons in 1947 and more than 55,000 tons in 1949. Sherman Lead continued to produce a single zinc-lead-silver concentrate, for example totalling about 6,500 tons in 1947.[67]

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[66]Terry Abraham and Richard C. Davis, eds., Day to Day: A Guide to the Records of the Historic Day Mines Group in the University of Idaho Library (Moscow: University of Idaho Library, 1992), 37-38; E&MJ 104 (15 December 1917): 1063 (RBUCO-001-0955); 105 (2 February 1918): 263 (RBUCO-001-0965); 108 (12 July 1919): 78 (RBUCO-001-01050); 128 (28 September 1929): 520 (RBUCO-001-01148); The Mining Industry of Idaho for the Year 1928, 174 ((RBUCO-001-02451).

[67]E&MJ 140 (November 1939): 74 (RBUCO-001-01225); 141 (September 1940): 68 (RBUCO-001-01182), (November 1940): 78 (RBUCO-001-01183); "Milling at Day Mines" (unpublished report dated 28 November 1953), 7 (HECBO-020-00403); Mineral Yearbook,

Beginning in about 1950, the Sherman mill also began to treat ore from the Hercules mine, also owned by Day Mines. Thereafter, the Sherman mill treated ore from both the Hercules and the Sherman mines until 1953, when Day Mines closed the Hercules. Day Mines resumed limited mining at the Hercules in 1954. After that, operation of the Sherman mill became intermittent, treating ore from the Days' Sherman and Hercules mines, often produced by leasers. In 1957, leasers mined the last of the ore known to exist in the Sherman mine. Day Mines ceased operations at the Hercules mine in 1959 and pulled the pumps. Presumably, that is also the year the Sherman mill closed.[68]

Beginning in 1953, the DMEA began making loans to mining companies in the Coeur d'Alene district to assist them in exploring at deeper levels for ore reserves. Day Mines used such assistance to conduct exploration deeper into its Hercules mine, thus temporarily closing the supply of ore from that mine to the Sherman mill. With DMEA assistance, Day Mines was successful in opening at least one new, deeper ore body in the Hercules mine.[69]

Although Day Mines benefitted from DMEA loans, there is no evidence in the historical record that the United States was thereby an operator of the Sherman mill. Though ore discovered during exploration undertaken with the financial assistance from a DMEA loan was run through the Sherman mill, the United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Through the DMEA program, the United States did not in any way dictate operations at the Sherman mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

1939, 357 (RBUCO-001-01787); Mineral Yearbook, 1941, 355-356 (RBUCO-001-01790-791); Mineral Yearbook, 1942, 384 (RBUCO-001-01794); Mineral Yearbook, 1943, 377 (RBUCO-001-01799); Mineral Yearbook, 1944, 360-361 (RBUCO-001-01804); Mineral Yearbook, 1945, 377 (RBUCO-001-01809); Mineral Yearbook, 1946, 1445-46 (RBUCO-001-01814-815); Mineral Yearbook, 1947, 1414 (RBUCO-001-01820).

[68]Minerals Yearbook, 1950, 1498 (RBUCO-001-01835); Minerals Yearbook, 1951, 1495 (RBUCO-001-01840); Minerals Yearbook, 1952, 304 (RBUCO-001-01844); Minerals Yearbook, 1953, 348 (RBUCO-001-01848); Minerals Yearbook, 1954, 376 (RBUCO-001-01852); Minerals Yearbook, 1955, 364 (RBUCO-001-01857); Minerals Yearbook, 1956, 386 (RBUCO-001-01861); Minerals Yearbook, 1957, 381 (RBUCO-001-01865); Minerals Yearbook, 1959, 329-330 (RBUCO-001-01873-874).

[69]Mineral Yearbook, 1953, 348 (RBUCO-001-01848); Mineral Yearbook, 1955, 364 (RBUCO-001-01857); Mineral Yearbook, 1956, 386 (RBUCO-001-01861).

Star

The Star group of claims was located west of the Morning mine. The claims were tied up in litigation early in the twentieth century. Eventually, they came to be jointly owned by the Hecla Mining Company and the Bunker Hill & Sullivan by means of the Sullivan Mining Company, of which Hecla and BH&S each owned exactly half. The two companies agreed to mine the Star's zinc orebody through the Hecla workings and to have BH&S operate the Sullivan electrolytic zinc plant at Kellogg. Initially, they treated the Star ore at the BH&S South mill at Kellogg. The Great Depression brought low metals prices, so the Star mine closed in 1930. When rising prices made it possible to re-open the mine in 1935, the South mill was fully occupied treating other BH&S ores, so the Sullivan company leased the Hercules mill at Wallace to treat Star ores until a new flotation mill could be built. The Sullivan company chose Burke as the location for its new 750-ton mill, adjacent to the Hecla mine's surface plant. The Star mill began operations in July 1937, treating about 600 tons/day. Because of unsteady prices late in the Depression, the mill closed between August 1938 and October 1939, during which time its capacity was increased to 900 tons/day. From then until the recent past, it operated almost continuously. During most years, the Star mill typically treated more than 200,000 tons of ore per year. Among the important experiments that took place in the Star mill were those associated with the "sink-and-float" process for making a preliminary separation of waste from the desired mineral. In the 1940s, Hecla periodically trucked lead concentrate to its Osburn tailings sink-float plant. The galena content of the concentrate was used as "medium" in the Huntington-Heberlein process at the Osburn plant.[70]

An important corporate change occurred in 1954, when Hecla traded its half-interest in the Sullivan Mining Company to BH&S in exchange for 275,000 shares of BH&S stock, giving Hecla a 17.37% interest in BH&S. As the only stockholder in the Sullivan Mining Company, BH&S dissolved the Sullivan and took over its assets and liabilities effective 31 December 1955. BH&S then paid Hecla to continue operating the Star mine and mill. For the first six years, BH&S simply paid Hecla a flat fee. Thereafter, Hecla received 30% of the Star's output.[71]

There is no evidence in the historical record that the United States was an operator of the Star mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. There is no record of any wartime programs affecting the

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[70]Fahey, Hecla, 36-38, 52-65, 97-98; The Mining Industry of Idaho for the Year 1937, 217 (RBUCO-001-01713); E&MJ 140 (January 1939): 79 (RBUCO-001-01219); 141 (August 1940): 107 (RBUCO-001-01181); C.Y. Garber, "Preparation and Reconditioning of Sink-Float Media," Mining Technology 10 (May 1946): 4 (FLQCA-001-03693); William Anderson, "Star Mine," in The Coeur d'Alene Mining District in 1963 (Moscow: Idaho Bureau of Mines and Geology, 1963), 15-16 (RBUCO-001-02107-108); Gordon Craig, "Star and Polaris Mills," in The Coeur d'Alene Mining District in 1963 (Moscow: Idaho Bureau of Mines and Geology, 1963), 17-18 (RBUCO-001-02109-110). Annual figures for ore treated may be found in Minerals Yearbook for the years after 1939.

[71]Fahey, Hecla, 125; Minerals Yearbook, 1955, 363 (RBUCO-001-01856).

way the Hecla Company operated the Star mill during that period. Nor, prior to 1968, did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Historic Movement of Tailings and Other Solids down Canyon Creek

Prior to the construction of mills along Canyon Creek and the discharge by those mills of tailings into the stream, there had always been some relocation of solids caused by the movement of water. Such solids would have represented the full range of particle sizes, ranging from very fine dirt and sand through gravel and river cobbles to boulders. The flow of the stream moved solids from one location to another as part of the natural processes of erosion and deposition in the drainage. Those movements were not constant, but rather increased and decreased due to a variety of natural phenomena, including landslides, spring run-off, thunderstorms, and the activity of beaver. Beginning in about 1888, those natural phenomena were joined by a new contributor to the erosion and deposition of solids throughout the Canyon Creek drainage: the mining industry and its relatively constant discharge of tailings into the stream from concentrators located at various points along the banks.[72]

The century and more during which contributions by human activity played a major role shaping the dynamics of solids moving through the Canyon Creek drainage may be divided into several periods: 1) 1888 to 1901, when humans merely dumped jig tailings into the stream and paid little attention to where they went; 2) 1901 to about 1917, when humans continued to dump jig tailings into the stream but made some effort to manage how those tailings behaved; 3) 1917 through 1968, when humans dumped solids of a much finer range of particle sizes into the stream; 4) the World War II era, when humans made a concerted effort to excavate and reprocess a significant proportion of the tailings that had deposited along certain sections of the valley bottom; and 5) after 1968, the year that all companies in the Coeur d'Alene district impounded their tailings.

1. Free-Flowing Tailings: 1888-1901

During this early period, mills in the Canyon Creek drainage simply wanted to get rid of their tailings. Because of the technologies used for crushing, grinding, and concentrating, there was a fairly wide range of particle sizes discharged in the tailings stream. As ore is ground and crushed, even to relatively coarse size, there is always a certain amount of very fine particles

[72]The author does not present himself as an expert in fluvial geomorphology. The introductory remarks presented in this paragraph represent a lay understanding of the natural processes of erosion and deposition along a mountain stream and of the role human activity in the form mining and milling had on those processes. The ensuing narrative will describe the consequences of that human participation in the dynamics of erosion and deposition in the Canyon Creek drainage as they can be understood from the historical record, rather than a theoretical projection of what the consequences should have been.

produced. These very fine solids are often called slimes. Relative to coarser materials, slimes bear metal values in proportions often approximating that of the raw ore itself. Early mill operators had a difficult time separating desired minerals from gangue in slimes, so considerable values were lost to the tailings stream in the form of slimes. The advantage, in terms of the long-term operation of a mill, was that slimes readily remained in suspension and so were easily carried away by a stream of even modest flow. Slimes therefore did not build up near the plant and interfere with on-going operations. Coarser solids could be concentrated more effectively, so coarse tailings were usually much cleaner than slimes, meaning coarse tailings typically had lower assay values than slimes. On the other hand, it took a stronger current to carry coarse tailings away from the mill. As a consequence mills in Canyon Creek could not always rely on the stream to carry their coarse tailings away. To prevent coarse tailings from building-up near the mill and interfering with on-going operations, mill operators often loaded their coarse tailings on railroad cars to be hauled away

Between Burke and a quarter mile below Gem, a distance of about 3 miles. Canyon Creek falls about 600 feet. The canyon is quite narrow, and there are no broad areas where significant tailings, whether coarse or fine, would have been inclined to settle out of the stream. Moreover, there is no historic evidence of appreciable amounts of tailings building-up along the banks or in the bed of the stream during this early period. Early Sanborn maps for Burke and Gem show buildings, often built right alongside the creek, and platforms and other buildings spanning the creek. There is no evidence that rising banks or rising waters, caused by a bed filling with tailings, forced any early buildings to move. Early photographs show a swift creek flowing through the towns and past the mills, often with small boulders sitting in the bed. The photographic evidence offers no support for a notion that a bed of gravel- and sand-sized tailings accumulated to any significant depth in the bed of the creek. For much of the distance between Wallace and Burke, the Northern Pacific and the Union Pacific railroads ran their tracks and roadbeds up each side of the creek. In some locations, where there was not enough room for tracks between the creek and the base of the hillside, both sets of tracks ran along the same side of the creek. In both situations, the presence of the railroads served to further confine the flow of the stream, to prevent it from widening out in such a way that it could have deposited significant volumes of coarse tailings.[73]

About a quarter mile below Gem, the Canyon Creek canyon begins to widen a bit, and the valley bottom grows quite wide in the vicinity of Woodland Park (perhaps as much as 1,500 feet

[73]USGS, "Topographic Map of the Coeur d'Alene District, Idaho" (1901), FLQCA-001-01988-991); USGS, "Burke Quadrangle" (1985), 7.5 minute series; Sanborn Map for Burke" (1892), (FLQCA-001-02003); "Sanborn Map for Burke" (1901), (FLQCA-001-02004); "Sanborn Map for Gem (1892), (FLQCA-001-02130); "Sanborn Map for Gem (1896), (FLQCA-001-02133-136); "Sanborn Map for Gem (1901), (FLQCA-001-02137); "Standard Mine and Upper Workings, Mace, Idaho, 1909 (FLQCA-001-03335); "Standard Mine, Mace, Idaho, 1912 (FLQCA-001-03334); "Mace Standard Mine, Idaho, 1912 (FLQCA-001-03336); "Gem Idaho" (no date), (FLQCA-001-03262); "Frisco Mill, Frisco, Idaho" (no date), FLQCA-001-03263); photos of locations along Canyon Creek in Wood, Railroads through the Coeur d'Alenes, 80-84 (FLQCA-001-03182-187).

at its widest). In a three-mile stretch from just below Gem to just above the Mammoth mill, the gradient of the stream also flattens, falling about 400 feet in that distance. The area around Woodland Park was the one place, then, where coarse tailings could have settled out of the creek. There is no record, however, of mining companies or others attempting to impound tailings in the Woodland Park area prior to the twentieth century.

As described in the next section, complaints by farmers induced the mining companies to build tailings impoundments in the Coeur d'Alene district. Those complaints also led to litigation. During the trials, witnesses testified about the practices of mills along Canyon Creek with respect to the disposal of tailings, and they testified about the behavior of tailings.

One such witness was James F. McCarthy, manager of the Hecla Mining Company. He testified that Canyon Creek was a clear stream of pure water above Burke. Downstream of Burke, however, the stream was "filled with dirt," "opaque," and "charged with the tailings that the water carries from the mill into the river." Before the Hecla mill could use it, the water of Canyon Creek had already been used by the Tiger, Frisco, and other mills upstream of the Hecla. For most of the year, McCarthy testified, the stream was charged nearly to its carrying capacity with solids. He testified that the Hecla added its tailings to the flow, and then downstream the Standard and Mammoth mills did the same (prior to 1900, it would have been only the Standard mill). At the point where the Standard-Mammoth flume left the stream, there was a dam to settle some of the solids before they passed through the Standard system. McCarthy estimated that Hecla placed about one third of its tailings, the coarsest portion, in railroad cars to be hauled away. (It is uncertain from his testimony when this practice began.) He estimated that another third of the tailings was coarse jig tailings discharged into the creek. The final third was fine solids, which would have included slimes. Some coarse tailings therefore built-up along Canyon Creek during periods of low flow and were not carried away until high-water events. During both high- and low-water, the stream remained opaque. McCarthy testified that fine tailings were relatively richer in lead than the coarse tailings.[74]

Hecla paid no attention to the zinc in its ore or the zinc in its tailings. McCarthy knew there was zinc in the ore, and he knew that Hecla's concentrates assayed at 3-7% zinc, but he testified that Hecla made no effort to save that zinc. Hecla's ore assayed at about 9% lead, and the mill was able to recover 83-87% of that lead. The rest was lost to tailings. Hecla recovered 75-80% of the silver. The metal-bearing solids were harmful to fish: McCarthy testified that there were no fish living in Canyon Creek below Burke, but there were still fish in the stream above Burke. According to McCarthy's testimony, the tailings did not discourage cows from drinking out of Canyon Creek. While he was assayer at the Gem mill during the time it was leased by the Mammoth Mining Company (about 1897), he witnessed a cow drink daily from the stream 100 feet downstream of the outlet where the mill dumped its tailings.[75]

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[74]James F. McCarthy, testimony in McCarthy v. BH&S, 995-997, 999-1000, 1007-1010, 1080.

[75]James F. McCarthy, testimony in McCarthy v. BH&S, 1000-1002, 1020, 1074, 1079-1080.

Another witness testifying to the discharge of tailings into Canyon Creek was Edward H. Moffitt, who had managed the Standard, Hecla, and Sixteen-to-One mines and supervised construction of the Osburn tailings dam. He had been in Burke when milling began there, and he had first-hand knowledge of the Tiger, Poorman, Frisco, Gem, and Granite mills, testifying that they all sent their tailings into Canyon Creek, which washed them into the South Fork. He testified that, since the spring of 1888, virtually all the water in the creek was used continuously by the mills, in succession, for the treatment of ores and the discharge of tailings. Exceptions were during high-water, when there was greater flow than the mills needed, and during strikes or cold weather, when the mills were closed.[76] We can conclude from the testimony of James McCarthy and Edward Moffitt that, by the time tailings flowed through the mouth of Canyon Creek and into the South Fork, there had been a nearly complete mixing of the discharges of the Tiger, Frisco, Gem, Standard, and other mills along Canyon Creek.

At the beginning of the twentieth century, the major mines of the Coeur d'Alene district produced about 4,500 tons of ore daily, most of which was concentrated first. About half of that production (2,400 tons/day) came from the Canyon Creek mines (Frisco, 750 tons/day; Standard, 700 tons/day; Tiger-Poorman, 500 tons/day; Mammoth, 300 tons/day; Hecla, 150 tons/day). Assuming a ratio of concentration of 6:1, about 2,000 tons of tailings were being discharged daily by the mills of Canyon Creek. If one third of those tailings were carried away by rail, at least about 1,400 tons went into the creek daily. In 1901, the Mining and Scientific Press published an estimate that, due to the imperfection of gravity concentration, 125 tons of galena ore went into the South Fork river system daily. Those losses contained 66 tons of lead and 4,200 ounces of silver. If that estimate was accurate, then half of the totals were discharged into Canyon Creek, during a time when virtually no attention was given to the destiny of those losses.[77]

The Coeur d'Alene basin was hit by one of its worst floods to date in November 1906. Wallace was especially hard hit. The channel of the South Fork passing through Wallace was already clogged with tailings from Mullan and Canyon Creek, which, according to local observers forced the flood waters to spill over the banks more readily during the flood. During the flood, the torrent of water rushing down Canyon Creek scoured more tailings from that drainage, discharging them into Wallace, reportedly making matters worse.[78]

2. Impounded Coarse Tailings, 1906-1917

Early in the twentieth century, farmers who owned land along the Coeur d'Alene River below Cataldo--and therefore downstream of the mines and mills of the Coeur d'Alene Mining

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[76]Edward H. Moffitt, testimony in McCarthy v. BH&S, 1099-1105.

[77]M&SP 80 (9 June 1902): 646 (FLQCA-001-0012); 82 (30 March 1901): 161 (FLQCA-001-0030); 84 (1 February 1902): 68 (FLQCA-001-0050).

[78]"Wallace Flooded," The Idaho Press (17 November 1906): 2 (FLQCA-001-04483).

District--began to complain that concentrators were polluting the river, thereby damaging property along the river and harming livestock. The farmers filed their first lawsuit against the mining companies in 1904, seeking to enjoin the companies from operating in such a way that the concentrators continued to pollute the river. In 1906, ruling on one of the cases, Judge James H. Beatty denied the farmers' request for an injunction, so the farmers appealed to the Ninth Circuit Court. Other cases were settled out of court.[79] Meanwhile, in an effort to prevent tailings from reaching those farmers' lands, several mining companies, working cooperatively under the auspices of the Mine Owners Association, built tailings dams along the South Fork, one at Osburn and one at Pine Creek. Those dams are described in other sections of this report.

In 1906, following claims for damages to property in Wallace caused by tailings and high water, the companies operating the Frisco, Hecla, Hercules, and Tiger mills decided to try to control the flow of tailings out of Canyon Creek. They formed the Canyon Creek Tailings Association and built an impoundment at the lower end of the Woodland Park area. Four companies, Federal, Frisco, Hecla, and Hercules, shared in the costs of the Canyon Creek dam, with each company paying in proportion to the amount of ore it milled. The Canyon Creek Tailings Association also acquired the land that would serve as the tailings reservoir. Construction of the dam was completed in spring 1907. Later that year, Frank Franz of the Hercules supervised the strengthening of the dam so that it could hold more tailings. In the vicinity of Woodland Park, the companies also moved the tracks of the Oregon Railway & Navigation Company to the north to provide more area for tailings to accumulate. Apparently, cooperation among the members of the Canyon Creek Tailings Association was short-lived. By the end of 1907, Federal and Frisco had quit paying their share of the Association's costs, and Hercules quit in early 1908. For several years thereafter, Hecla was the only company making contributions to the Association's budget.[80]

During this period, the mills along Canyon Creek continued to haul their coarse tailings away by rail. W. Clayton Miller, manager of the Federal Mining & Smelting Company, testified that in 1905 his company was daily shipping about three railroad cars of tailings from the Tiger mill at Burke and about nine cars of tailings from the Standard and Mammoth mills above Wallace.[81]

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[79]M&SP 89 (17 December 1904): 415 (FLQCA-001-0178); 92 (20 January 1906): 45 (FLQCA-001-0237); 93 (8 September 1906): 282 (FLQCA-001-0254); 97 (31 October 1908): 587.

[80]Harry L. Day to W. Clayton Miller, letter dated 26 September 1906 (ASAID-082-00012); Day to W.G. Adams, letter dated 17 November 1906 (ASAID-082-00011); James F. McCarthy to Miller, letter dated 18 December 1906 (ASAID-082-00018); McCarthy to R.B. Miller, letter dated 4 May 1907 (PHRCA-017-00111); McCarthy to W.J. Wall, letter dated 19 May 1911 (AZAID-082-00001-003); M&SP 95 (14 December 1907): 737 (FLQCA-001-0314); Norman Visnes to C.E. Nelson, letter dated 18 June 1965 (ASANJ-005-00074).

[81]James F. McCarthy, testimony in McCarthy v. BH&S, 1010-1011; W. Clayton Miller, testimony in McCarthy v. BH&S, 2226.

In the early years of the twentieth century, while the major mining operations were conducted by companies backed by considerable capital resources, individuals and small partnerships came to recognize that, by installing small hand-jigging plants, they could make money by recovering mineral values from new deposits that had come to exist on the landscape. Canyon Creek was the scene of much such activity. One source of small amounts of mineral wealth was the mine dumps adjacent to operating mines. Small operators made arrangements with the mining companies to work some of the dumps. In 1905, the largest jigging operation in Canyon Creek was said to have been that of W.R. Swicegood, D.L. Hoppins, and J. Kelly, who were working dump no. 4 of the Standard mine at Mace. They had set their operation in motion in 1904. Others in 1905 were working mine dumps at Gem, Frisco, and upper Mace. Another source of mineral wealth was the tailings deposits along the creek. Bannister & Company operated two small jigs just below the tailings discharge of the Hecla mill. The same outfit made arrangements to work tailings deposits in Canyon Creek between the Standard mill and the mouth of the stream on the South Fork. Others worked deposits along the stream banks near the Frisco and the Granite mills. These small operations did not crush or grind the material at all; they simply used jigs, with the aid of water, to separate galena from gangue. Thus, when working old tailings deposits, they lowered the metal content of the materials in the stream bed. On the other hand, when working old mine dumps, they added metal-bearing solids to the stream bed. A report stated that five tailings plants in the Coeur d'Alene district (Canyon Creek, the South Fork, and Milo Creek) produced 1,000 tons of concentrates worth $50,000 in 1905, yielding net revenues of $25,000.[82]

In 1906, Bannister & Company moved their jigging plant from below the Standard mill to a point along Canyon Creek above the Mammoth mill. In March 1906, a fellow named Logan was able to ship a carload of ore he had recovered with jigs from mill tailings in the stream below the Hecla mill. Jig operators often installed small dams in the stream to encourage tailings to settle in the pool behind the dam. Apparently, these small jig operations were very sensitive to water availability in the creek. Not surprisingly, cold weather and ice could preclude their operation in winter for lack of water. On the other hand, high water in spring also forced them to suspend operations.[83]

Because of the need in an on-going milling operation to constantly carry tailings away, low water also caused problems for concentrators along Canyon Creek. In 1904, low water during summer and fall was said to have been the worst in Coeur d'Alene history. Low water caused the stream bed of Canyon Creek to fill with tailings, forcing water to spread beyond its banks and causing property damage. The Federal Mining & Smelting Company put men at the Standard-Mammoth mills in the creek to move solid material in an effort to keep the stream within its banks. It is unclear from descriptions whether the problem was upstream of the mills,

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[82]M&SP 90 (6 May 1905): 290-291 (FLQCA-001-0199); 92 (7 April 1906): 248 (FLQCA-001-0246), (2 June 1906): 372 (FLQCA-001-0248).

[83]M&SP 90 (6 May 1905): 291 (FLQCA-001-0199); 92 (17 February 1906): 114 (FLQCA-001-0241), (17 March 1906): 188 (FLQCA-001-0243), (7 April 1906): 248 (FLQCA-001-0246).

caused by tailings from Burke and Gem, or below the mills, caused by insufficient flow to carry the Standard-Mammoth tailings away. It may have been both. The Standard and Mammoth mills had the railroads haul all their coarse tailings away, but water in the creek was so low that it was not adequate to carry fine tailings away. Testifying at trial, James McCarthy of the Hecla described conditions during summer 1904, when the flow in Canyon Creek was so low that tailings build-ups were threatening to interfere with operations at Gem as well.[84]

The tailings accumulating in Canyon Creek were especially rich in zinc. In 1905, when the Success mill on Nine-Mile Creek became the first in the Coeur d'Alene district to successfully produce a zinc concentrate, the Mining and Scientific Press noted that all the other mills in the district typically sought to reject as much zinc as possible during concentration. As a consequence, the South Fork and its tributaries, including Canyon Creek, were loaded with tailings rich in zinc.[85] This fact was corroborated by the experience of the Small Leasing Company on the Canyon Creek tailings deposit in the 1940s.

3. Free-Flowing Fine Tailings, 1917-1940

After the Canyon Creek dam was damaged in the 1917 flood, there was no effort made to repair it. Meanwhile, significant changes were occurring in the technologies used to concentrate ores from the Coeur d'Alene mines. Flotation was proving to be the most effective means of recovering metal values from finely crushed ore, but the complete switch to flotation was gradual, not immediate. For years, mining companies had been installing new kinds of tables and vanners in their concentrators in an effort to recover additional values for the fine portion of their tailings streams. As methods of gravity concentration for fine solids improved, the companies also increased the extent to which they re-ground coarser materials and subject them to further stages of concentration as well. In 1907, W. Clayton Miller, general manager of the Federal Mining & Smelting Company, predicted that within two years all the mills in the Coeur d'Alene district would be regrinding their coarse tailings, and that no mill would discharge coarse tailings, because of improved methods for recovering values from fines. He also predicted that an added benefit of mills discharging nothing but slimes would be the alleviation of the tailings problem.[86] (Undoubtedly, the problem he addressed was the build-up of coarse tailings in stream beds, not the contamination of the river system by metal-bearing solids.) The change was not as rapid as he predicted, mining companies continued to lose considerable values in lead to tailings, and until around 1910 they paid little attention to the zinc values they lost to tailings.

At first, flotation served merely as an additional means to recover values from fine

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[84]M&SP 89 (24 September 1904): 214 (FLQCA-001-0166), (12 November 1904): 332 (FLQCA-001-0174), (24 December 1904): 430 (FLQCA-001-0180); McCarthy testimony in McCarthy v. BH&S, 1010-1011.

[85]M&SP 91 (4 November 1905): 316 (FLQCA-001-0228).

[86]M&SP 95 (6 July 1907): 6 (FLQCA-001-0295).

tailings before they were discharged into the creek. After 1910, flotation also served as a means to recover zinc from fine materials after lead had been recovered by means of jigs from coarser materials. Gradually, mining companies began to move "upstream" in their concentrator flow sheets, replacing more and more pieces of gravity-concentration equipment with flotation equipment. Nevertheless, in the late 1920s, much concentration was accomplished by gravity. At the Hecla mill in 1928, for example, 66% of the concentrates produced were from jigs, largely because smelters liked the coarser concentrate for the furnaces.[87]

There were two significant consequences of the gradual shift in practice toward flotation: 1) particle sizes of virtually all the tailings discharged by mills were at the fine end of the spectrum, and 2) assay values of tailings, in both lead and zinc, were much lower than they had been for jig tailings because flotation was so much more effective at separating metal-bearing minerals from gangue. Tailings from flotation were quite readily flushed downstream by the flow of Canyon Creek.

4. Re-Working Coarse Tailings during the World War II Era

In the 1930s, parties again turned their attention to recovering metal-bearing minerals from the tailings of Canyon Creek. The main tailings deposit was behind the dam built in 1904. Although the dam had been damaged by the flood of 1917, much of the material behind the dam was still in place in the 1930s. According to Hecla's metallurgist W.L. Zeigler, the Canyon Creek tailings were the highest in zinc content of any of the major tailings deposits in the Coeur d'Alene district, because of the character of the Tiger-Poorman and the Frisco orebodies. During the depths of the Great Depression, James Small set up a screening operation on Canyon Creek to recover zinc. Experience had shown him that 80% of the zinc in the old tailings existed in minus 3/8-inch material. By simply screening old tailings, he could elevate the zinc assay from about 3% to about 8%. He also operated a Bendelari jig (a portable device that uses a diaphragm to cause water to pulsate through a screen to bring about a separation of desired mineral and gangue), which allowed him to produce a 20% zinc concentrate. He trucked both his screened product and his jigged product to the Golconda custom mill. By 1940, the Canyon Creek Tailings Association had received more than $20,000 from royalties paid by leasers who recovered values from tailings and from direct sales of tailings.[88]

The largest tailings reprocessor in Canyon Creek was the Small Leasing Company (described under Formosa in this section), which put the Formosa mill in operation in late 1942 treating old tailings. The mill was located about a mile above the main tailings deposit, which Zeigler estimated at 200,000 tons. After Small Leasing had treated the higher-grade portions of

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[87]Zeigler, "Concentration of Lead-Silver Ore at Hecla Mine," 181 (FLQCA-001-01996).

[88]Zeigler, "Tailings and Mine-Dump Reclamation in the Coeur d'Alenes during World War II," Mining Technology 11 (March 1947): 3, (FLQCA-001-03685); "Small Leasing Co.," Mining World (November 1943): 25 (FLQCA-001-04953); "Report on Canyon Creek Tailings Association," letter dated 15 April 1941 (PHRCA-028-01528-541).

the deposit, the company installed a 400-ton sink-float plant to make a preliminary separation of ore from gangue before subjecting the ore to grinding and flotation. Thus, some portion of the coarse material deposited along Canyon Creek was again rejected to lie there for several more decades. Only the material subjected to flotation was ground finely. Tailings from Small's flotation plant were likely carried away the current. Between 1938 and 1949, upwards of 500,000 tons of old tailings from deposits along Canyon Creek were treated in the Formosa mill or hauled to the Golconda and Hercules custom mills for treatment. Small and the other operators recovered lead, zinc, and silver from the old tailings.[89]

The Canyon Creek Tailings Association disbanded in 1952. At the time, because of corporate consolidations, there were only three remaining members of the Association: Hecla, Day Mines, and ASARCO. The remaining companies each acquired an interest in land formerly owned by the Association along Canyon Creek in the following proportions:

Hecla Mining Company	40.5%
Day Mines, Inc.	30.0%
ASARCO	29.5%

In the mid-1960s, as Hecla began planning to impound all its tailings, the company offered to purchase the Day Mines and ASARCO interests in that land along Canyon Creek. Hecla intended to use the area near Woodland Park to impound tailings from the Star mill in Burke. Although, ASARCO did not immediately sell its interest, by 1981, Hecla owned all of the ground on which the impounded Canyon Creek tailings had settled.[90]

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[89]Zeigler, "Tailings and Mine-Dump Reclamation in the Coeur d'Alenes during World War II," 5-6 (FLQCA-001-03686-687); USGS, Minerals Yearbook, 1937, 402 (RBUCO-001-01782); Minerals Yearbook, 1938, 326 (RBUCO-001-01785); Minerals Yearbook, 1939, 356 (RBUCO-001-01787); Minerals Yearbook, 1942, 385 (RBUCO-001-01794); Minerals Yearbook, 1943, 377 (RBUCO-001-01799); Minerals Yearbook, 1944, 361 (RBUCO-001-01804); Minerals Yearbook, 1945, 377 (RBUCO-001-01809); Minerals Yearbook, 1946, 1445-1446 (RBUCO-001-01814-815); Minerals Yearbook, 1947, 1413 (RBUCO-001-01819); Minerals Yearbook, 1943, 1507-1508 (RBUCO-001-01825-826); Minerals Yearbook, 1949, 1479-1480 (RBUCO-001-01830-831).

[90]Norman Visnes to C.E. Nelson, letter dated 18 June 1965 (ASANJ-005-00074); W.E. Crandall to Norman Visnes, letter dated 9 August 1956 (ASAID-124-00233); W.C. Rust to P.E. Hyde, letter dated 4 September 1980 (ASAID-183-00001); "Mines are Cooperating in Stream Cleanup," Kellogg News (22 January 1965) n.p. (ASAID-191-00472); "Summary - Canyon Creek Tailings Association" (HECCD-009-00393).

NINE-MILE CREEK DRAINAGE

Nine Mile Creek rises southwest of Dobson Pass and flows virtually due south until its confluence with the East Fork of Nine Mile Creek. The headwaters of the East Fork are southeast of Sunset Peak. The East Fork flows southwest before meeting the main stem of Nine-Mile Creek. The two forks meet above Blackcloud, Idaho, and continue to flow south until joining the South Fork Coeur d'Alene River at Wallace. The stream is perennial, but often in the late summer, the flow is minimal. Many of the mills located on this creek -- including the Interstate-Callahan, Success, and Rex, which are all located on the East Fork -- relied on water power for their operation, and at one time or another had to close because of low water. The mines on this creek lay in one of two districts: the Placer Center district (Black Cloud/Pittsburg/ Marsh, Success, and Interstate-Callahan) and the Lelande district (Custer/Sixteen-to-One/Rex), both located north of Wallace.[1]

Custer/Sixteen-to-One/Rex Mill

In August 1888, the owners of the Custer property -- J.M. Porter, C.D. Porter, Peter Porter, W.H. Claggett, and W.H. Taylor -- announced that they intended to build a concentrator that fall. By August 1890, the partners had nearly completed excavation for the millsite, located approximately two miles below the mine. The Custer mill-site was located on the East Fork of Nine-Mill Creek, about a mile above the confluence with Nine-Mile Creek. The mill was to be run by water power, and the owners obtained a head of 300 feet.[2]

In March 1891, newspapers reported that the mill was operating. It had the capacity to treat 75-80 tons of ore per day, and generally turned out 15-20 tons of concentrate per day, assaying 60-70% lead and 60-65 ounces of silver per ton. The ore was conveyed two miles from mine to mill via a Hudson tramway. The buckets were suspended on a stationary cable and moved by a smaller one.[3]

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[1] M&SP 89 (24 September 1904): 214 (FLQCA-001-0166); 90 (18 February 1905): 110 (FLQCA-001-0187); 90 (4 March 1905): 143 (FLQCA-001-0190); 91 (5 August 1905): 98 (FLQCA-001-0217); 91 (12 August 1905): 115 (FLQCA-001-0219); Some of the Interstate-Callahan property was also located in the Beaver district, and therefore is often described in that section of reports.

[2] M&SP 61 (16 August 1890): 107 (FLQCA-001-01153); E&MJ 46 (25 August 1888): 157 (RBUCO-001-0008).

[3] E&MJ 51 (21 March 1891): 359 (RBUCO-001-0052).

Despite good ore reserves and strong showings, the Custer mine, located on the east fork of Nine-Mile Creek, closed in 1892, most likely due to labor disputes. It lay idle until July 1895, when John Finch and Amasa Campbell secured a bond on it, and hired a force of miners. Through the remainder of the decade, the mine was worked periodically, but the mill apparently did not operate.[4]

Late in 1899, Finch and Campbell purchased the Custer mill. They had recently purchased the Custer mine and were claimants in litigation to title to the Sixteen-to-One mine, north of the Custer mine. Finch and Campbell completed alterations to the mill, thereafter referring to it as the Sixteen-to-One mill. Additions to the concentrator included a Huntington mill to grind the tailings and four double-deck Wilfley tables. The partners also obtained a right-of-way for two tramways: one to be a bucket line from the lower Sixteen-to-One tunnel to the mill, and the other a car line from the upper tunnel to the mouth of the lower for temporary use until underground connections were made between the two tunnels. By the end of the year, the tramway cables were in place and the mill was ready for work.[5]

The mill was running steadily by January 1900, but high zinc content of the ore proved problematic. Fine crushing was tried to aid separation of the lead from the zinc, which made it difficult for the mill to handle its full capacity of 250 tons of ore. Nevertheless, the mill was turning out 20-30 tons of concentrates daily. Attempting to improve efficiency, facilities for treating slimes and tailings were installed in April 1900. These alterations proved unsatisfactory, and in May, the mill closed.[6]

The record suggests that the mill did not run again until 1905, probably due to the continuing Sixteen-to-One litigation, which had begun in 1899. In October 1904, the Rex Mining Company was incorporated, taking over the mine and mill. Improvements were made, and the Sixteen-to-One mine and mill, now called the Rex, began operations during 1905 under lease to Theodore Anderson, a stockholder of the Rex company.[7]

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[4]M&SP 69 (1 September 1894): 138 (FLQCA-001-01312); 71 (27 July 1895): 63 (FLQCA-001-01368); E&MJ 64 (21 August 1897): 226 (RBUCO-001-0248); 68 (30 September 1899): 407 (RBUCO-001-0312).

[5]M&SP 79 (30 September 1899): 383 (FLQCA-001-01598); 79 (11 November 1899): 532 (FLQCA-001-01603); 79 (2 December 1899): 639 (FLQCA-001-01608); E&MJ 68 (2 September 1899): 287 (RBUCO-001-0308); 68 (11 November 1899): 587 (RBUCO-001-0318); 84 (26 October 1907): 803 (RBUCO-001-0597).

[6]E&MJ 69 (20 January 1900): 88 (RBUCO-001-0326); 69 (10 February 1900): 178 (RBUCO-001-0327); 69 (24 February 1900): 238 (RBUCO-001-0328); 69 (7 April 1900): 418 (RBUCO-001-0332).

[7]M&SP 89 (29 October 1904): 298 (FLQCA-001-0171); 90 (10 June 1905): 380 (FLQCA-001-0202); E&MJ 77 (7 April 1904): 580 (RBUCO-001-0406); 77 (9 June 1904): 923 (RBUCO-001-0409); 77 (23 June 1904): 1021 (RBUCO-001-0412); 78 (8 September 1904): 407

When Anderson began operating, he made additional improvements to the tramway between the mine and the 300-ton concentrator. The mill was operated by water power and lay at the terminus of the Nine-Mile branch of the Northern Pacific Railroad. Anderson's lease included the mill, the Sixteen-to-One mining claim, the tramway, water rights, and machinery. The agreement stipulated that Anderson work steadily and continuously with a reasonable labor force and that the ore be treated immediately upon extraction. The company, in turn, was to receive a 25% royalty of the net smelter returns.[8]

During July 1905, the mill produced 200 tons of concentrates, assaying 62% lead and 30 ounces of silver. The ore also carried about 14% zinc, but little of that metal was saved. Despite the success of the mine, however, Anderson was forced to close in August 1905 due to low water. The mill remained closed until March 1906, then produced a high-grade concentrate for at least a portion of the remainder of the year.[9]

In September 1907, certain individual stockholders of the Rex Mining Company secured a controlling interest in the company, and opened the mine immediately, putting three shifts of men to work. They also re-opened the mill, initially treating ore from an old dump. The first complete month's run of the Rex mill was completed on 29 February 1908 and produced nine cars of concentrate and one car of crude ore. Concentrates ran about 60% lead and about 5-6% zinc. The mill treated 190 tons of ore per day, but could have treated another 60 tons if water were available in a sufficient quantity. The mill produced 25 tons of concentrate daily; lead product was sent to the East Helena smelter while zinc product was stored until the market improved.[10]

(RBUCO-001-0414); 80 (29 July 1905): 181 (RBUCO-001-0421). During the second half of 1904, it was reported that electric motors were to be installed to operate the mill, hoist, and air compressor. Installation was never confirmed, and the closure of the mill in August 1905 due to low water suggest that the mill continued to run on water power.

[8]M&SP 90 (15 April 1905): 243 (FLQCA-001-0196); 90 (10 June 1905): 380 (FLQCA-001-0202).

[9]M&SP 91 (5 August 1905): 98 (FLQCA-001-0217); 91 (12 August 1905): 115 (FLQCA-001-0219); 91 (23 December 1905): 436 (FLQCA-001-0234); 92 (3 March 1906): 149 (FLQCA-001-0242); 92 (17 March 1906): 188 (FLQCA-001-0243); Mineral Resources of the U.S., 1906, 265 (RBUCO00101557).

[10]M&SP 95 (14 September 1907): 322 (FLQCA-001-0301); 95 (30 November 1907): 672 (FLQCA-001-0313); 96 (14 March 1908): 341 (FLQCA-001-0329); 96 (21 March 1908): 876 (FLQCA-001-0330); E&MJ 84 (24 August 1907): 374 (RBUCO-001-0594); 85 (22 February 1908): 429 (RBUCO-001-0605); They also announced that they would remodel the mill, but there is no evidence that such a remodelling took place until 1910.

By May 1908, enough ore had been blocked out that the mill could run one shift per day until the contemplated development work was complete. Thus, the mill began to treat only 100 tons of ore daily. Shortly thereafter, the Rex was closed down by new management, who made a decision not to re-open the mill until more development occurred in the mine. Financial troubles and more litigation set the company back even further. Development work ceased temporarily, and in 1909, the stock of Rex was purchased by a corporation simply named the Silver-Lead Company.[11]

In 1910, sliming equipment was added to the mill and it was operated for a portion of the year. Concentrate and crude ore were both shipped that year. The mill then underwent a complete remodelling in 1911, increasing its capacity to 400 tons daily, but operating only a portion of the year.[12]

Matters changed in July 1912 when Tamarack & Custer Consolidated Mining Company formed to take over both the Tamarack & Chesapeake Mining Company and the Custer Mining Company. Late in the year, it was agreed that the Rex mill and the long aerial tramway would be leased to the new company. By 1913, Tamarack & Custer was shipping approximately 1500 tons of silver-lead ore per month from the Tamarack & Custer mine to the Rex mill. In 1914, metals recovery -- without flotation -- was reported to be about 83%. In August, Tamarack & Custer shipped 730 tons of lead ore and milled 5,598 tons of ore, yielding 1,090 tons of concentrates.[13]

In 1915, Tamarack & Custer and the Rex Mining Company decided to sever their ties when the mill lease expired in 1916. Tamarack & Custer pondered whether to build its own concentrator on Nine-Mile Creek together with the Ray-Jefferson Company or purchase a different mill. In 1916, Tamarack & Custer instead arranged to purchase the Frisco mill, located on Canyon Creek, from the Federal company. The company built a three-mile aerial tram to

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[11] M&SP 96 (9 May 1908): 615 (FLQCA-001-0335); 96 (30 May 1908): 723 (FLQCA-001-0340); 96 (6 June 1908): 759 (FLQCA-001-0342); 97 (21 November 1908): 687 (FLQCA-001-0372); 101 (13 August 1910):223 (FLQCA-001-0438); E&MJ 85 (25 April 1908): 878 (RBUCO-001-0612); 85 (6 June 1908): no page (RBUCO-001-0616); 86 (1 August 1908): 249 (RBUCO-001-0625); 86 (17 October 1908): 783 (RBUCO-001-0636); 88 (20 November 1909): 1044 (RBUCO-001-0659); 88 (27 November 1909): 1089 (RBUCO-001-0660).

[12] Mineral Resources of the U.S., 1910, 467 (RBUCO00101595); Mineral Resources of the U.S., 1911, 600 (RBUCO00101604).

[13] In Bunker Hill & Sullivan v. Jacob Polak, litigated in 1925, the attorney for Bunker Hill asserted that Tamarack & Custer "stacked" its tailings on Nine Mile Creek and did not dump them in the creek, but no other evidence can be found to substantiate the assertion, and the attorneys on the opposing side did not believe Bunker Hill's attorney. Mr. Beale, attorney comments, Bunker Hill v. Sullivan, et al, v. Jacob Polak, 696 (FLQCA-001-04849); M&SP 105 (20 July 1912): 96 (FLQCA-001-0513); 105 (19 October 1912): 511 (FLQCA-001-0527); 107 (8 November 1913): 743 (FLQCA-001-0596); Mineral Resources of the U.S., 1913, 785 (RBUCO00101619); Mineral Resources of the U.S., 1914, 634 (RBUCO00101630).

connect the Tamarack workings with the Frisco mill. (See discussion of Frisco Mill in this report's section on Canyon Creek).[14]

Meanwhile, the Rex mine and mill were part of a corporate re-organization, being transferred from the Rex Mining company to the Rex Consolidated Mining Company. When Tamarack's lease on the Rex mill finally expired in the second half of 1916, the Rex Consolidated Mine Company made some improvements to the tramway and mill. A new Riblet aerial tram was ready to carry ore in late November, and two crushers and a sorting belt were also installed, allowing the mill to begin operations. That same year, the Rex company also purchased six claims adjoining the Rex group in the Nine-Mile district. A fire in the mine in the summer of 1917 forced the mill to work only half time while the mine lay idle in November and December. N.C. Sheridan leased the Rex mill in 1918, but apparently only for a short period.[15]

In the 1920s, the Rex mine was often worked by lessees, and the property shipped only ore, not concentrates. The 1927 Sanborn map shows the loading station for the aerial tramway to the "old concentrator," the buildings of which were vacant, with all machinery removed. The map also shows that, by 1927, the Rex property had been taken over by the Delaware Mines Corporation. Ore obtained from the Rex mine as well as tailings recovered nearby from Nine-Mile Creek were concentrated at the custom Hercules flotation mill. In 1930, the Associated Mines Company took over the property from the Delaware Corporation, and eight years later, ownership again passed to the Callahan Mining Company.[16]

In 1943, the Callahan Consolidated Mines Company (most likely the same company with a name change) built a 100-ton flotation mill on the East Fork of Nine-Mile Creek, much closer to the mine (only about 450 feet away from the opening) than the original site of the Custer/Rex

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[14]M&SP 113 (16 September 1916): 437 (FLQCA-001-0761).

[15]Charles O. Olsen, testimony in Bunker Hill & Sullivan, et al, v. Jacob Polak, 683-727 (FLQCA-001-04836-854); M&SP 113 (11 November 1916): 716 (FLQCA-001-0767); 113 (9 December 1916): 855 (FLQCA-001-0771); 116 (19 January 1918): 103 (FLQCA-001-0833); 116 (20 April 1918): 561 (FLQCA-001-0861); E&MJ 102 (1 July 1916): 73 (RBUCO-001-0898); 102 (29 July 1916): 242 (RBUCO-001-0903); 102 (2 September 1916): 444 (RBUCO-001-0905); 102 (25 November 1916): 961 (RBUCO-001-0914); 103 (13 January 1917): 127 (RBUCO-001-0920); 104 (25 August 1917): 365 (RBUCO-001-0944); 105 (23 February 1918): 399 (RBUCO-001-0969); 105 (13 April 1918): 703 (RBUCO-001-0976); Mineral Resources of the U.S., 1916,598 (RBUCO00101657); Mineral Resources of the U.S., 1918, 492 (RBUCO00101678).

[16]"Milling at Day Mines, Inc.," November 28, 1953, page 3 (HECBO020-00397); E&MJ (May 1938): 76 (RBUCO00101204); Mineral Resources of the U.S., 1928, 682 (RBUCO00101735); Mineral Resources of the U.S., 1929, 404 (RBUCO00101743); Mineral Resources of the U.S., 1930, 654 (RBUCO00101754); see annual Mineral Resources of the U.S. from 1919-1930; "Sanborn Map for Wallace" 1927, sheets 15, 16 (FLQCA-001-02859, FLQCA-001-02864).

mill had been. The new plant, also called the Rex mill, proceeded to treat about 11,900 tons of zinc-lead ore that year, resulting in 327 tons of lead concentrate and 545 tons of zinc concentrates. In 1944, the ore treated in the mill averaged .85 ounces of silver to the ton, 2.83% lead, and 4.54% zinc. The mill continued to operate until mid-1946. Tailings from the Rex property were treated in 1947, and concentrate from tailings became a major portion of shipments after 1948, when the Zanetti Brothers worked the Interstate and Callahan dumps, hauling 21,634 tons of low-grade zinc-lead-silver ore to the Rex mill. In 1949, waste-dump ore from the Rex mining property began to be hauled to the Hecla mill at Gem for treatment, while the Rex mill continued to treat ore from other dumps as well as ore from the Success and the Mountain Goat groups of mines.[17]

In 1959, the Rex mill was purchased by Bill Kennedy and Herb Zanetti, who had been operating the Mountain Goat and Interstate mines under lease from Day Mines since 1955. Before purchasing the Rex mill, the ore had been concentrated at a local custom mill. But upon purchasing the Rex, Kennedy and Zanetti made plans for enlarging and updating it. After testing the ore, they discovered that the sink-float method of concentration would work in the plant, increasing its capacity to 400 tons per day by rejecting 75% of the mill feed as an uneconomic float product. Excavation for construction of the new addition was complete in November. In the meantime, the existing flotation plant was modernized. Taking old fill from abandoned stopes in the Interstate mine and ore from the Mountain Goat, Zanetti and Kennedy trucked the material to the Rex mill, where the sink-float plant operated a ten-hour shift daily and the flotation section operated three shifts per day, five days a week, to process about 350 tons per day. The mill continued to operate until at least 1963.[18]

There is no evidence in the historical record that the United States was an operator of the Rex mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Black Cloud/Pittsburg/Marsh Mill

The Black Cloud ore body was located by O.B. Wallace in 1884. Mining began at the Black Cloud mine as early as 1891. However, it was not until July 1898, after the Black Cloud lode was purchased by the Wallace Mining Company, that the Black Cloud mill was built and

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[17]Minerals Yearbook 1943, 378 (RBUCO00101800); Minerals Yearbook 1946, 1446 (RBUCO00101815); Minerals Yearbook 1947, 1414 (RBUCO00101820); Minerals Yearbook 1948, no page, (RBUCO00101824); Minerals Yearbook 1949, 1480 (RBUCO00101831); Minerals Yearbook 1956, 384 (RBUCO00101860); "Sanborn Map for Wallace" (1949 revision of 1927 sheet), sheet 16 (FLQCA-001-02936).

[18]Robert A. Rice, "Hard Work and Persistence Pay Off for Idaho's Mountain Goat Leasers," Mining World (November 1963) 16-27 (RBUCO00105524-5528); Minerals Yearbook 1962, 358 (RBUCO00101882); Minerals Yearbook 1963, 355 (RBUCO00101886).

operated. Situated on Nine-Mile Creek, about 2-1/4 miles upstream from Wallace, the Black Cloud mill began as a 150-200 ton per day mill. An aerial tramway was built to haul ore the half-mile between mine and mill. Additionally, a water right was obtained and a two-mile flume was built to the mill site.[19]

Upon running the newly built mill, the Wallace Mining Company found that the carbonate ore could not be economically concentrated. Thus, the mill lay idle until April 1899, when it began to treat ore from the California mine. Two years later, in 1901, the Wallace Mining Company's holdings (Black Cloud and Iowa lodes) and the California mine were sold together to James Viles, Jr. for $79,870.[20]

Viles, together with Arthur E. Hedstrom, Frank S. McGraw, Joseph P. Keane, and A.H. Featherstone, filed articles of incorporation almost immediately for the California Consolidated Mining Company. In 1902, the Black Cloud mill operated briefly, but by 1903, the mill was closed yet again. The mill operated only intermittently in 1904.[21]

In 1905, the properties were bonded to men from Pittsburgh, Pennsylvania, operating as the Heinz Lead & Silver Mining Company (more often referred to as the Pittsburg Lead Mining Company). The company purchased the Black Cloud, California, and Panhandle mines, and promised to operate the Black Cloud concentrator as soon as the water supply was sufficient. The California ore bins were said to have over 500 tons of milling ore at the time of sale. By May 1905, the mill was running on Black Cloud ore and shipments of concentrates were being made. The owners intended to equip its mines and mill with electric power so that low water would not hamper their operation in the dry season.[22]

Pittsburg Lead Mining Company began to develop the mines, and set about overhauling and improving the mill and tramway in the summer of 1905. Soon after, the mill was shut down

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[19]E&MJ 51 (14 March 1891): 332 (RBUCO-001-0051); 65 (23 April 1898): 501 (RBUCO-001-0260); 66 (9 July 1898): 47 (RBUCO-001-0268); 66 (13 August 1898): 197 (RBUCO-001-0272); 68 (29 April 1899): 509 (RBUCO-001-0300); 72 (17 August 1901): 208 (RBUCO-001-0357).

[20]E&MJ 67 (29 April 1899): 509 (RBUCO-001-0300); E&MJ 72 (17 August 1901): 208 (RBUCO-001-0357); E&MJ 71 (7 September 1901): 308 (RBUCO-001-0359).

[21]M&SP 83 (31 August 1901): 93 (FLQCA-001-0039); 85 (16 August 1902): 94 (FLQCA-001-0066); 86 (18 April 1903): 253 (FLQCA-001-0105); 88 (28 May 1904): 370 (FLQCA-001-0146); 89 (24 September 1904): 214 (FLQCA-001-0166); E&MJ 71 (7 September 1901): 308 (RBUCO-001-0359).

[22]M&SP (90 (18 February 1905): 110 (FLQCA-001-0187); M&SP 90 (6 May 1905): 290 (FLQCA-001-0199); M&SP 90 (3 June 1905): 361 (FLQCA-001-0201); M&SP 90 (17 June 1905): 398 (FLQCA-001-0203).

again by low water. During the shutdown, the company continued overhauling the mill, adding a new set of rolls and four six-foot vanners.[23]

In November 1905, the mill was re-opened, and the California mine resumed shipments. The mill treated an average of 200 tons of ore daily, and concentrates aggregated 600 tons monthly. A short spur connected the mill to the Nine-Mile branch of the Northern Pacific Railroad.[24]

The mill's operation for the next several years was sporadic. In January 1911, the Marsh Mining Company, which owned five silver-lead claims near Burke, obtained an eighteen-month lease on the Pittsburg mill. After running the mill for a while, the Marsh company discovered that its mine had not been developed enough to keep the mill running at capacity. Marsh shut the mill down until more development work could be completed and new machinery could be installed in the mill.[25]

By August 1912, Marsh was shipping 100 tons of ore per day to the Pittsburg mill. In 1913, Marsh produced 200-300 tons of concentrates per month. Early in 1914, the Marsh company decided to install a sorting plant at the mine so that high-grade ores could be shipped directly to the smelter instead of being sent to the concentrator first. Then, the company closed on 31 May 1914 to make further improvements to the mine and mill.[26]

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[23]M&SP 91 (22 July 1905): 67 (FLQCA-001-0214); M&SP 91 (12 August 1905): 115 (FLQCA-001-0219); M&SP (91 (19 August 1905): 130 (FLQCA-001-0220); M&SP 91 (26 August 1905): 146 (FLQCA-001-0221);

[24]M&SP 91 (2 December 1905): 388 (FLQCA-001-0232); 91 (23 December 1905): 436 (FLQCA-001-0234).

[25]M&SP 94 (23 February 1907): 245 (FLQCA-001-0264); 102 (21 January 1911): 154 (FLQCA-001-0454); 103 (1 July 1911): 28 (FLQCA-001-0477); E&MJ 88 (25 December 1909): 1292 (RBUCO-001-0662); 91 (21 January 1911): 189 (RBUCO-001-0693); 92 (16 December 1911): 1199 (RBUCO-001-0715); Mineral Resources of the U.S., 1906,265 (RBUCO00101557); Mineral Resources of the U.S., 1907, 310 (RBUCO00101566); Mineral Resources of the U.S., 1908, 433 (RBUCO00101572); Mineral Resources of the U.S., 1911, 600 (RBUCO00101604); The Mining Industry of Idaho for the Year 1908, 121 (RBUCO00102287); The Mining Industry of Idaho for the Year 1912, 155 (RBUVO00102342); There is a possibility that the during the fourth week of each month, the mill was used by S.L. Shonts and Oscar Nordquist, who were leasing the Pittsburg Lead mine at the same time that the Marsh company was leasing the mill.

[26]M&SP 110 (19 June 1915): 965 (FLQCA-001-0683); 94 (31 August 1912): 420 (RBUCO-001-0730); 97 (17 January 1914): 201 (RBUCO-001-0784); Mineral Resources of the U.S., 1913, 784 (RBUCO00101618); Mineral Resources of the U.S., 1914, 634 (RBUCO00101630); The Mining Industry of Idaho for the Year 1912, 155 (RBUCO001012342).

Marsh installed a tube-mill, seven additional concentrating tables, a Callow flotation plant, and other accessories, bringing the mill's capacity to about 200-250 tons per day. The mill finally began operating again in July 1915 and sent its first shipment of lead-silver concentrate to the smelter that month. In September, the company shipped 600 tons of concentrate.[27]

The Marsh Mining Company showed a loss for 1914 and 1915. Despite the improvement of the mill and high recoveries in the early part of 1916, the company closed the mine and mill and reorganized. The new company was called the Consolidated Marsh Mines Company, and took over all holdings of the old company as well as those of the Green Mountain Mining Company. Additionally, the new Consolidated Marsh company arranged a ten-year lease on certain claims of the Federal Mining Company and agreed to pay a royalty of thirty-five cents per ton milled on ore averaging 9% lead or less. For any ore above 9% lead, Marsh was to pay Federal a royalty of twenty-five cents per ton. Marsh also paid all taxes on the leased properties. The new executive committee included W.M. Lee, Edward Pohlman, and W. Earl Greenough.[28]

In January 1917, Hecla Mining Company began leasing the Marsh mill part-time subject to cancellation on a month's notice. Use of the mill increased Hecla's milling capacity by over 200 tons daily. When Marsh's mine was finally dewatered in May, it shared the mill jointly with Hecla, with Marsh using it to mill ore from its own property one-third of the month and Hecla to mill its own ore the other two-thirds. Both ran 100 tons of ore per day through the mill.[29]

Early in 1918, ore in the Marsh mine was exhausted. The mill was run by Hecla full-time until May, when Hecla relinquished its Marsh mill lease. Hecla instead leased the Green Hill-Cleveland mill, located much closer to its mine and thus saving money to transfer ore to mill and concentrates to smelter. Although development on the Marsh mine continued sporadically

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[27]M&SP 109 (22 August 1914): 310 (FLQCA-001-0634); 110 (10 April 1915): 597 (FLQCA-001-0674); 111 (10 July 1915): 64 (FLQCA-001-0686); 111 (16 October 1915): 608 (FLQCA-001-0700); E&MJ 100 (23 October 1915): page? (RBUCO--01-0855); Mineral Resources of the U.S., 1914, 634 (RBUCO00101630); Mineral Resources of the U.S., 1915, 555 (RBUCO00101643).

[28]M&SP 112 (1 January 1916): 26 (FLQCA-001-0713); 112 (13 May 1916): 724 (FLQCA-001-0731); 112 (10 June 1916): 878 (FLQCA-001-0744); 113 (1 July 1916): 28 (FLQCA-001-0749); 113 (9 September 1916): 399 (FLQCA-001-0760); E&MJ 101 (13 May 1916): 878 (RBUCO-001-0890); 101 (3 June 1916): 1006 (RBUCO-001-0893); 101 (24 June 1916): 1134 (RBUCO-001-0896); Mineral Resources of the U.S., 1915, 555 (RBUCO00101643); The royalty on Federal properties was to apply when the New York price was 5.5 cents per pound. When higher than that, the royalty was to be increased at the rate of thirty cents per ton for each cent above five cents per pound fractions proportionately.

[29]E&MJ 103 (20 January 1917): 167 (RBUCO-001-0921); E&MJ 103 (14 April 1917): 689 (RBUCO-001-0931); E&MJ 103 (5 May 1917): 812 (RBUCO-001-0932); E&MJ 103 (19 May 1917): 911 (RBUCO-001-0933); Mineral Resources of the U.S., 1916, 597 (RBUCO00101656); Mineral Resources of the U.S., 1917, 488 (RBUCO00101668).

through the 1920s, the mill appears to have never been re-activated, even after being purchased by Dayrock Mining Company in 1930 (see discussion on page 17 below). The 1927 Sanborn map notes that the mill was not in operation at the time and that the open tailings bin was also inactive. By 1949, another Sanborn map shows that the mill buildings were no longer standing.[30]

There is no evidence in the historical record that the United States was an operator of the Marsh mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Success Mill

The Success Mining Company was formed in 1905 to work the Granite mine on the East Fork of Nine-Mile Creek. The mine had operated only intermittently since about 1892 because of the high content of zinc in the ore and the inability to treat it profitably. H.F. Samuels, one of the founders of Success Mining Company, took an option on the property, experimented with the ores, and learned that they could be worked by a new process. Samuels, together with J.L. Bailor, C.F.O. Merriam, J.J. Burch, and A.H. Featherstone, formed the Success Mining Company and set about building a mill of 100 tons daily capacity, located about two miles upstream from the East Fork's confluence with Nine-Mile Creek. The mill was designed to treat lead, silver, and zinc ores. The mill was equipped with one rock crusher, three sets of rolls, eight Wilfley tables, a magnetic separator, separate ore bins for lead and zinc concentrates, and settling tanks. The mill was to fine-crush all the ore, and none of the feed was to pass the rolls until it could pass through at least a 30-mesh screen. The object of the fine crushing, the oxidizing roast (which was given before separation), and the electric separator was to produce both lead and zinc concentrates.[31]

The mill went into operation in late August 1905. Three weeks later, the company announced that it would add twelve jigs to the mill to increase its capacity. Furthermore, concentrating tables were also put in to work over the settlings from the settling tanks. When the mill went into operation, the feed averaged 20 ounces of silver, 25% lead, and 25% zinc. The lead concentrates ran 40-45 ounces of silver and 50-65% lead, with almost no zinc. The zinc concentrates ran about 3% lead, and 45-50% zinc, with almost no silver value. In October 1905, the Success mill shipped the first zinc concentrates ever shipped from the Coeur d'Alenes. All

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[30] E&MJ 105 (25 May 1918): 981 (RBUCO00101001); Mineral Resources of the U.S., 1918, 491 (RBUCO00101677); Mineral Resources of the U.S., 1930, 652 (RBUCO00101753); "Sanborn Map for Wallace" 1927, sheet 16 (FLQCA-001-02863); "Sanborn Map for Wallace" (1949 revision of 1927 sheet), sheet 16 (FLQCA-001-02935).

[31] M&SP 90 (6 May 1905): 290 (FLQCA-001-0199); 90 (20 May 1905): 326 (FLQCA-001-0200); 90 (3 June 1905): 361 (FLQCA-001-0201); 91 (5 August 1905): 98-99 (FLQCA-001-0217-0218); E&MJ 80 (29 July 1905): 181 (RBUCO-001-0421).

the other lead mines in the district with high zinc content in their ores got rid of as much of it as possible in their milling processes, resulting in creeks laden with tailings rich in zinc.[32]

By November, the Success mill was shipping about 100 tons of ore and concentrates per month. During 1906, a new milling plant was installed that could handle 200 tons daily. The mill was then closed for three weeks in 1907 to permit the installation of new jigs, rolls, and vanners.[33]

From 1908 to September 1909, the Success mine and mill were inoperative, due primarily to a price slump. It continued to produce both zinc and lead concentrates (lead gradually gaining as new ore was struck), and the mill's capacity was increased again (225-250 tons daily) in 1911 by adding rolls, jigs, and tables. The company reported 80% recoveries from its ores and shipped a 42% zinc concentrate.[34]

In 1913, the Success Mining Company added a new magnetic separator to its mill. The separator was for the purpose of extracting iron from the finely crushed zinc and lead concentrate, thereby raising the grade of the shipping product, saving freight costs on worthless material, and avoiding or reducing smelter penalties on the iron.[35]

The high price of zinc in 1915 induced the Success to develop its mine further, driving a shaft to the 1100-foot level. But later that year, the president, founder, and general manager of Success Mining Company, H.F. Samuels, sold his controlling shares of the company to Duluth people who had also acquired control of the Reindeer-Queen property at Mullan. A year later, in August 1916, the new owners remodelled and enlarged the mill, again to take advantage of the high zinc prices. They replaced the disc-crushers with rolls and built an additional flotation plant. The ore was jigged for lead concentrate in fourteen jigs after a preliminary crushing, and then further concentrated by seventeen Wilfley tables. The tailing was then sent to the flotation annex for treatment. The jig product was sent to the rolls to be crushed to ten millimeters, taken

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[32]M&SP 91 (16 September 1905): 198 (FLQCA-001-0222); 91 (28 October 1905): 299 (FLQCA-001-0227); 91 (4 November 1905): 316 (FLQCA-001-0228).

[33]M&SP 91 (4 November 1905): 316 (FLQCA-001-0228); 93 (27 October 1906): 499 (FLQCA-001-0256); 95 (2 November 1907): 543 (FLQCA-001-0307).

[34]Mineral Resources of the U.S., 1908, 434 (RBUCO00101573); Mineral Resources of the U.S., 1909, 356 (RBUCO00101586); M&SP 96 (11 January 1908): 59 (FLQCA-001-0318); 99 (11 September 1909): 344 (FLQCA-001-0413); 101 (27 August 1910): 283 (FLQCA-001-0443); 102 (20 May 1911): 708 (FLQCA-001-0472); 104 (6 January 1912): 88 (FLQCA-001-0494); 105 (24 August 1912): 254 (FLQCA-001-0519); The Mining Industry of Idaho for the Year 1909, 120 (RBUCO00102312).

[35]M&SP 107 (6 September 1913): 393 (FLQCA-001-0576); 108 (17 January 1914): 157 (FLQCA-001-0601); 108 (16 May 1914): 825-826 (FLQCA-001-0619-0620); 110 (30 January 1915): 197 (FLQCA-001-0663).

by belt-conveyor to a rotary dryer, and then iron was extracted magnetically. The capacity of the mill was, by that time, 300 tons of ore per day.[36]

In November 1917, the Success was taken over by new management. The new managers quickly turned the company around from the losses it had recently posted by cutting costs and workforce. The mill, operating only one shift per day after the new management took over, dressed 97 tons daily, with mill feed averaging 14% zinc, 4% lead, and 10 ounces of silver per ton. The tailing contained 1.6% zinc and .14% lead. Nevertheless, the mill ran only one shift daily, if at all, due to high operating costs. Despite good returns and the discovery of a rich lead-zinc orebody in 1918, the poor zinc market of 1919 combined with the high costs forced the mine and mill to close, despite a brief period when lessees operated the mine and mill.[37]

From the time the mill closed in 1919 to the time the plant began to be dismantled in 1927, it operated intermittently, lying idle during most of 1920 and 1921, but producing and shipping concentrates between 1923-1926. All operations were suspended in July 1926, at which time all underground equipment was removed, and in 1927, the company began to dissemble the mill. A 1927 Sanborn map shows the buildings still standing on the east side of the creek, but the 1930 annual report of the U.S. Bureau of Mines reported that the mill was dismantled that year.[38]

There is no evidence in the historical record that the United States was an operator of the Success mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

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[36]M&SP 111 (3 July 1915): 27 (FLQCA-001-0685); 113 (5 August 1916): 217-218 (FLQCA-001-0754-0755); E&MJ 99 (6 February 1915): n.p. (RBUCO-001-0814); 100 (10 July 1915): no page (RBUCO-001-0832).

[37]M&SP 116 (20 April 1918): 561 (FLQCA-001-0861); 118 (4 January 1919): 28 (FLQCA-001-0895); 118 (22 February 1919): 265 (FLQCA-001-0901); 118 (3 May 1919): 616 (FLQCA-001-0911); 119 (27 September 1919): 446 (FLQCA-001-0938); E&MJ 105 (23 February 1918): 399 (RBUCO-001-0969); 105 (30 March 1918): 616 (RBUCO-001-0974); 106 (24 August 1918): 372 (RBUCO00101007); 107 (22 March 1919): 551 (RBUCO00101032); 108 (26 July 1919): 162 (RBUCO00101051).

[38]Mineral Resources of the U.S., 1920, 257 (RBUCO00101689); Mineral Resources of the U.S., 1921, 4 (RBUCO00101693); Mineral Resources of the U.S., 1922, 242 (RBUCO00101698); Mineral Resources of the U.S., 1923, 401 (RBUCO00101704); Mineral Resources of the U.S., 1924, 281 (RBUCO00101710); Mineral Resources of the U.S., 1925, 546 (RBUCO00101718); Mineral Resources of the U.S., 1926, 448 (RBUCO00101725); Mineral Resources of the U.S., 1928, 682 (RBUCO00101735); Mineral Resources of the U.S., 1930, 654,(RBUCO00101754); Mineral Resources of the U.S., 1931, 248 (PHRCA019-00925); Sanborn Map for Wallace" 1927, sheet 16 (FLQCA-001-02861); "Sanborn Map for Wallace" (1949 revision of 1927 sheet), sheet 16 (FLQCA-001-02933).

Interstate-Callahan Mill

The Interstate-Callahan mill was the farthest upstream of the Nine-Mile Creek mills. Located near the head of the East Fork, about four miles above the confluence and seven miles northeast of Wallace, the Interstate property comprised 1,030 acres. In late 1912, the Consolidated Interstate-Callahan Mining Company announced that it would build a 300-ton mill there to treat ore from its newly acquired group of Amazon-Manhattan mines. All three properties -- Amazon-Manhattan, Interstate, and Callahan -- were connected by underground tunnels so that all of the ore could be taken out on the Nine-Mile side of the divide, where better transportation existed. The mill was built a half mile below the mine opening, which was connected to the mill by an aerial tramway capable of handling forty tons per hour. By June 1913, the mill was running. Equipment included 3 sets of rolls, a six-foot Hardinge mill, and six Callow tanks. By 1914 the mill was treating 300 tons per day, treating both the lead-silver ore from one vein and the zinc-lead ore from another.[39]

The European war soon boosted the demand for zinc. The Interstate-Callahan hoped to take advantage of the improved market and announced plans to build a larger mill. Meanwhile, five flotation machines were added to the existing mill later in 1914 to increase output. The process boasted a 90% lead recovery rate and 70% zinc recovery rate. Losses were carried primarily in slimes. Interstate-Callahan impounded its slimes behind tailings dams, due to the fact that Interstate's waste water was used by the Success Mining Company, located two miles downstream.[40]

In 1915, the Consolidated Interstate-Callahan Mining Company made numerous improvements to its property. In May, a two-mile aerial tramway was constructed connecting the mill with the railway at Sunset station on the Northern Pacific's Nine-Mile branch, a fall of 800 feet. The tramway eliminated the thirteen four-horse teams previously used to haul ore and concentrate to the rail head. By October, the tramway was complete. A new unit was also added

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[39]Different accounts exist of the mill's capacity, ranging from 200-500. 300 seems to be accurate based on number of times cited and other evidence. M&SP 105 (28 December 1912): 841 (FLQCA-001-0533); 106 (26 April 1913): 632 (FLQCA-001-0552); 107 (5 July 1913): 28 (FLQCA-001-0567); 108 (14 February 1914): 309 (FLQCA-001-0606); E&MJ 94 (2 November 1912): 859 (RBUCO-001-0736); 94 (21 December 1912): 1193 (RBUCO-001-0738); 96 (12 July 1913): (no page) (RBUCO-001-0758); 96 (15 November 1913): (no page) (RBUCO-001-0775);Mineral Resources of the U.S., 1929, 397 (RBUCO00101739); The Mining Industry of Idaho for the Year 1912, 172 (RBUCO00102353).

[40]Sigurd Laurence Sampson, "The Milling Practice of the Coeur d'Alene District," M.S. Thesis, University of Idaho, 1923; M&SP 109 (5 September 1914): 384 (FLQCA-001-0637); 109 (24 October 1914): 658 (FLQCA-001-0642); 109 (14 November 1914): 777 (FLQCA-001-0645); E&MJ 98 (5 September 1914): (no page) (RBUCO-001-0802); Mineral Resources of the U.S., 1914, 629 (RBUCO 00101625).

to the mill, bringing its capacity to 400 tons per day. Profits continued to increase during the year because of high zinc prices. Weekly output (before the mill addition) totalled 1400 tons of concentrate assaying 50% zinc, and 100 tons assaying 50% lead. For the quarter ending September 1915, the ratio of milling ore to total concentrates was 1.93 to 1.[41]

By April 1916, the company had acquired a mill-site for its new zinc mill between Enaville and the north fork. But despite the plentiful water supply, tailings disposal site, and improved railroad access, the new mill was never built. Instead, the original mill was subject to frequent improvements and additions.[42]

For instance, in July 1916, construction of a 300-ton flotation annex was begun to treat concentrate and to re-treat accumulated tailings from a 200,000-250,000-ton tailings impoundment. Tailings from the dump were to be removed to the plant by a "continuous automatic drag." The tailings were ground in a tube-mill and passed on to the flotation section. With the new flotation plant, recovery was expected to increase from 90% to 93-95%. Fine tailings from the flotation process were disposed of behind tailings dams. The ore fed to the mill averaged 28% zinc and 6% lead. In 1917, Interstate-Callahan enlarged the grinding department and installed a cable-tram to haul tailings from the old dump. In June 1918, the plant was closed for additional alterations, which brought the capacity to 600 tons per day and allowed for better separation of the lead and zinc and improved metal recovery.[43]

The mine's production discontinued from June-October because the smelting company with which Interstate had a contract requested a reduction in tonnage shipped. The flotation plant continued to process tailings from the old dump, which carried 12% zinc. In 1918, the mill treated 20,082 tons of tailings during the second quarter of the year, and 42,661 tons of tailings

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[41] M&SP 110 (6 March 1915): 385 (FLQCA-001-0668); 110 (8 May 1915): 741 (FLQCA-001-0677); 110 (29 May 1915): 850 (FLQCA-001-0680); 111 (3 July 1915): 27 (FLQCA-001-0685); 111 (9 October 1915): 569 (FLQCA-001-0699); E&MJ 99 (13 February 1915): no page (RBUCO-001-0815); 99 (27 March 1915): 593 (RBUCO-001-0821); 99 (17 April 1915): no page (RBUCO-001-0825); E&MJ 99 (5 June 1915): no page (RBUCO-001-0829); 100 (30 October 1915): no page (RBUCO-001-0856); 100 (27 November 1915): no page (RBUCO-001-0864); Mineral Resources of the U.S., 1915, 552 (RBUCO00101640).

[42] M&SP 110 (5 June 1915): 887 (FLQCA-001-0681); E&MJ 101 (22 April 1916): 753 (RBUCO-001-0888).

[43] M&SP 113 (8 July 1916): 67 (FLQCA-001-0750); 113 (28 October 1916): 647 (FLQCA-001-0765); 113 (18 November 1916): 752 (FLQCA-001-0768); 116 (23 March 1918): 430 (FLQCA-001-0856); 117 (31 August 1918): 295 (FLQCA-001-0885); E&MJ 102 (29 September 1917): 579 (RBUCO-001-0947); 102 (8 December 1917): 1019 (RBUCO-001-0954); 107 (15 March 1919): 500 (RBUCO00101031); Mineral Resources of the U.S., 1918, 486 (RBUCO00101675); Another company, the Spokane Metals Recovery Company, also arranged to secure tailings from the Interstate Callahan; see M&SP 115 (15 December 1917): 877 (FLQCA-001-0832).

during the third quarter. The slime tailings milled during that time assayed 13.96% zinc and 2.16% lead, while the stockpile tailings assayed 7.5% zinc and 2.4% lead. By early 1919, the concentrator was again treating 500 tons of ore per day.[44]

In March 1919, the company decided to shut down temporarily because of high operating costs and its inability to operate profitably, "in spite of the splendid condition of the mine, and a highly efficient milling plant." The war's end had caused a drop in metal prices and a coincident rise in labor and material costs, causing many mining companies to make similar decisions in the early part of the year. An increase in zinc prices to seven cents per pound led the Interstate-Callahan to re-open later in 1919. Prior to closing, the mill manager had been conducting successful experiments in an attempt to improve lead recovery. Thus, upon re-opening, the company added a new lead flotation section to the mill as well as new classifiers and a ball mill. Additionally, prior to the shutdown, ore had been conveyed directly from mine to mill. Upon re-opening, however, a sorting plant was built at the mine where the waste would be removed before the ore reached the tramway. Another sorting plant was added at the mill, where first-class ore would be separated for direct shipment. Interstate-Callahan started hiring again in August, but a short labor strike delayed resumption of full-scale operations.[45]

The strike was declared over in October, and by November, Interstate-Callahan was running at new full capacity. Methods of recovery continued to improve at the mill. In January 1920, the company's 4200 dry tons of zinc concentrate averaged 50% zinc and less than 4% lead -- a vast improvement in lead separation over previous zinc concentrates, which ran between 8-9% lead. Lead concentrates were averaging about 20 ounces of silver per ton.[46]

The mill ran successfully for most of 1920. But in November, a strike at the smelter to which Interstate-Callahan was contracted caused the company (now called Callahan Zinc-Lead Company) to close the mill indefinitely while maintaining development work in the mine. Operations were somewhat irregular from then until September 30, 1923, when the mill closed permanently after a precipitous drop in zinc prices. In 1922, the Callahan Zinc-Lead Company merged with the Galena Mining Company. Thereafter, Callahan invested most of its development labor and money on the Galena mill, located southwest of Wallace and described elsewhere in this report. In 1940, the Zanetti Brothers constructed a coarse-jigging plant at the

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[44]M&SP 117 (31 August 1918): 295 (FLQCA-001-0885); 116 (15 June 1918): 838 (FLQCA-001-0870); 117 (14 December 1918): 806 (FLQCA-001-0892); 118 (4 January 1919): 21 (FLQCA-001-0894); 118 (11 January 1919): 63 (FLQCA-001-0896); Mineral Resources of the U.S., 1918, 488 (RBUCO00101676).

[45]M&SP 118 (15 March 1919): 369 (FLQCA-001-0902); 119 (23 August 1919): 279 (FLQCA-001-0928); 119 (27 September 1919): 446 (FLQCA-001-0938); E&MJ 107 (15 March 1919): 500 (RBUCO00101031); 108 (12 July 1919): 76 (RBUCO00101049).

[46]M&SP 119 (8 November 1919): 689 (FLQCA-001-0940); 120 (3 January 1920): 29 (FLQCA-001-0943); 120 (27 March 1920): 469 (FLQCA-001-0950); E&MJ 108 (25 October 1919): 704 (RBUCO00101058).

site of the razed Interstate-Callahan mill to treat remaining jig tailings and a large dump of hand-sorted waste containing .4 ounces of silver, 1% lead, and 2% zinc. In total, about 100,000 tons were treated there. The rough jig concentrate was then hauled by truck to the Galena mill, which the Zanetti brothers had purchased in 1941. The brothers also treated 30,000 tons of tailings from the Interstate-Callahan dump (which they leased) in 1941. By 1949, Sanborn maps reveal that all buildings on the Interstate-Callahan mill site had been removed, and that the plant was "in ruins." By 1961, maps show that the entire property had been demolished.[47]

Although the lessees of the Interstate mine received payments for production under the Federal Small Mines Aid Bill (PL 87-347) in 1963, there is no evidence in the historical record that the United States was an operator of the Interstate-Callahan mill, which by then was demolished. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor, prior to 1968, did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.[48]

Spokane Metals Recovery Company

As one of three companies under C.L. Hewitt's management, the Spokane Metals Recovery Company was incorporated in 1917 with its principal place of business at Mullan. The company obtained a lease on a flat along Nine-Mile creek, where 50,000 tons of tailings from the Rex mine had accumulated. The company also arranged to secure tailings from the Interstate-Callahan, Success, and other mills.[49]

Spokane Metals began construction of a mill on the East Fork of Nine-Mile Creek to treat the tailings in 1918. The site was three-and-a-half miles from Wallace, and was located just below the large tailing dump which had resulted from Tamarack & Custer's operation of the Rex Mill (see page 4 above). In that location, the plant was also in a position to receive tailings from the creek that flowed from the Interstate-Callahan, Success, and Rex properties. The average

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[47]W.L. Zeigler, "Tailings and Mine-Dump Reclamation in the Coeur d'Alenes During World War II," Mining Technology 11 (March 1947): 1-10 (FLQCA-001-03683: FLQCA-001-03689); M&SP 120 (27 March 1920):469 (FLQCA-001-0950); 121 (13 November 1920): 715 (FLQCA-001-0978); 123 (16 July 1921): 100 (FLQCA-001-01039); E&MI 110 (20 November 1920): 1009 (RBUCO00101083); Minerals Yearbook 1941, no page (RBUCO00101790); See Mineral Resources of the U.S. annual reports for the years 1923-1930, especially 1928, 1929, 1930 The Mining Industry of Idaho for the Year 1922, 20 (RBUCO001012404); "Sanborn Map for Wallace" (1949 revision of 1927 sheet), sheet 17 (FLQCA-001-02937); "Sanborn map for Wallace" (1961 or 1951? revision of 1927 sheet), sheet 17 (FLQCA-001-0313).

[48]Minerals Yearbook 1963, 355 (RBUCO00101866).

[49]M&SP 115 (15 December 1917): 877 (FLQCA-001-0832).

content of the material was said to be 6% lead and 9% zinc. A 500-foot long flume was built to convey the water and minerals from the creek to the plant. Late in 1918, just as the company had completed installing rolls, jigs, tables, and flotation cells, the mill burned. Although it was reported that the machinery was still useable, there is no record that the mill was ever re-built.[50]

There is no evidence in the historical record that the United States was an operator of the Spokane Metals Recovery Company mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Dayrock

Stratton & Stratton had been creatively financing and promoting the McPhillips property on Nine-Mile Creek when a promising strike of lead-silver was made in late 1923. The mine was located three miles north of Wallace on the west side of the creek. As development followed the strike, it became clear that a company needed to be organized. Thus, the Stratton Mines Company was incorporated in 1924. Soon after, the Day interests, who also controlled the Hercules, purchased a majority of the outstanding shares, giving them control of the new Stratton company. In 1925, the company also acquired the Panhandle mine, located up Nine-Mile Creek, and re-opened the old workings.[51]

Late in 1928, the Dayrock Mining Company (still under control of the Days) succeeded Stratton Mines Company in title to the Stratton's mines. That same year, the Hercules Mining Company modelled the Hercules mill at Wallace to serve as a custom mill, adding a zinc flotation unit, and began to treat ore from the Dayrock Mining Company. All of the ore was hand-jigged before being sent to the Hercules mill in Wallace. Dayrock continued to develop the Stratton Mine for the next several years, becoming one of the important producers of the district, and sending all ore to be concentrated at Hercules.[52]

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[50]M&SP 116 (2 February 1918): 176 (FLQCA-001-0845); 116 (29 June 1918): 903 (FLQCA-001-0874); 117 (2 November 1918): 607 (FLQCA-001-0890); Mineral Resources of the U.S., 1918, 492 (RBUCO00101678).

[51]E&MJ 117 (8 March 1924): 416 (RBUCO00101115); The Mining Industry of Idaho for the Year 1924, 152 (RBUCO001012414); The Mining Industry of Idaho for the Year 1925, 56 (RBUCO001012418).

[52]"Milling at Day Mines, Inc." November 28, 1953, page 4 (HECBO020-00400); Mineral Resources of the U.S., 1928, 681 (RBUCO00101734); The Mining Industry of Idaho for the Year 1928, 169-171 (RBUCO00102448-2449); see annual report of the U.S. Bureau of Mines 1929-1931.

Despite the 1930 acquisition of the old property of the California Consolidated Mining Company, including the Marsh mill on Nine-Mile Creek, Dayrock continued to send its ore to the Hercules until 1941, when it built its own 200-ton flotation mill on the Dayrock property. The new mill was positioned astride the creek, and was equipped with a jaw crusher, a Symons Cone Crusher, a ball mill, and flotation equipment. It was operated continuously throughout the 1940s and most of the 1950s. The Days increased its capacity to 350 tons per day in 1948. Ore averaged between 4-6% lead and 0.4-0.9% zinc.[53]

In 1958, low metal prices kept the Dayrock property running at only a quarter of its capacity. Nevertheless, ore was milled at the concentrator until at least 1965.[54]

There is no evidence in the historical record that the United States was an operator of the Dayrock mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor, prior to 1968, did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Historic Movement of Tailings and Other Solids down Nine-Mile Creek

1. Free-Flowing Tailings: 1888-1901

Only two mills operated during this early period in Nine-Mile Creek: the Custer and the Black Cloud. Jig tailings, relatively lean in lead but often quite rich in zinc, readily settled along the banks and in the bed of Nine-Mile Creek. Fine tailings were easily flushed out of the Nine-Mile drainage, but the creek probably had insufficient flow to move them during dry summer and fall months. Nine-Mile Creek carried slimes into the South Fork on a year-round basis, as long as the Nine-Mile mills were in operation. It can be safely assumed that the owners simply disposed of tailings in the creek, which was the standard practice throughout the Coeur d'Alene district. Because of the low volume of water often flowing in Nine-Mile Creek, however, tailings deposits accumulated over time, and were later treated for profit by other entities.

In 1899 and again in 1900, the Custer owners added equipment to their mill for the grinding of tailings. The difficulty in separating the zinc from the lead concentrate indicated that the tailings from this mill had a relatively high content of zinc. The added equipment and

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[53] Mineral Resources of the U.S., 1930, 652 (RBUCO00101753); Minerals Yearbook, 1941, no page (RBUCO00101791); Minerals Yearbook 1949, 1480 (RBUCO00101831); The Mining Industry of Idaho for the Year 1942, 138 (RBUCO001012931); "Sanborn map for Wallace" (1949 revision of 1927 sheet), sheet 18 (FLQCA-001-02942); See annual Minerals Yearbooks from 1943-1949.

[54] Mineral Resources of the U.S., 1958, 311 (RBUCO00101869; The Mining Industry of Idaho for the Year 1965, 277 (RBUCO00101892).

improved process undoubtedly reduced the percentage of lead present in the tailings, but this mill never produced zinc concentrate and the value of that metal was never intentionally saved.

2. Impounded Coarse Tailings, 1901-1917

Beginning in 1901, mining companies in the Coeur d'Alene district began to cooperate in finding responses to complaints by property owners along the Coeur d'Alene River that tailings were damaging their property. One such response was to build tailings impoundments at Osburn and Pine Creek. In 1907, the companies operating on Canyon Creek built an impoundment there as well. In 1907, there was also discussion building a dam to impound tailings on Nine-Mile Creek. Stanly Easton, manager of Pittsburg Lead Mining Company, hoped that such a dam would impound debris for many years that it could be built before more "high water moves tailings which may now be in the bed of the stream." It remains unclear whether the dam was ever built.[55]

In November 1906, a winter flood hit the Coeur d'Alene district. Wallace was especially hard hit. The channel of the South Fork passing through Wallace was already clogged with tailings from Mullan and Canyon Creek. During the flood, the torrent of water rushing down Canyon and Nine-Mile creeks scoured more tailings from those drainages, discharging the material into Wallace, reportedly making matters worse.[56]

During the first two decades of this century, two new mills opened: the Success mill opened in 1905, and the Interstate-Callahan opened in 1912. There is evidence beginning in 1909 that at least some concentrates were being made from tailings along Nine-Mile Creek, although the locations of the deposits were unspecified. It is likely that such attempts at recovery continued throughout this period, as similar evidence was reported in 1915 and 1916, when the U.S. Bureau of Mines reported that a "considerable quantity of old tailings was concentrated on Nine-Mile to make a zinc product." In 1917, the agency reported that mills primarily located along Nine-Mile creek had treated 2948 tons of old tailings.[57]

The Success mill was the first in the Coeur d'Alene district to focus on producing zinc concentrates. Even though the Success intentionally recovered zinc, its operation undoubtedly caused an increase in zinc discharge into the creek because the Success ores were relatively rich in zinc (25%) and, in the period prior to the introduction of flotation, recovery rates for zinc were relatively poor (no better than 80%). The Interstate-Callahan also began producing zinc concentrates in 1914, after the Success mill had already been doing so for about ten years.

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[55]Stanly Easton to W. Clayton Miller, 3 April 1907 (ASAID082-00004).

[56]"Wallace Flooded," The Idaho Press (17 November 1906): 2 (FLQCA-001-04483).

[57]Mineral Resources of the U.S., 1909, 356 (RBUCO00101586); Mineral Resources of the U.S., 1915, 556 (RBUCO00101644); Mineral Resources of the U.S., 1916, 598 (RBUCO00101657); Mineral Resources of the U.S., 1917, 489 (RBUCO00101669).

Because the Interstate-Callahan was upstream of the Success, the latter required that the Interstate-Callahan keep its tailings, including slimes, out of the Nine-Mile water supply. The Interstate-Callahan was one of the first mills located on a tributary of the South Fork to store its mill tailings behind dams. Like the Success, the Interstate-Callahan also had a flotation process beginning in 1914 which reduced the percentage of lead and zinc in the tailings. Additionally, by 1916, an annex was added to the mill to re-treat tailings from its 200,000-250,000 tailings dump.

3. Free-Flowing Fine Tailings, 1917-1968

Despite the Osburn and Pine Creek dams, farmers owning property along the Coeur d'Alene River continued to register complaints against the mining industry that fine tailings from mills along the South Fork and its tributaries were damaging their farmland. Only companies with mills along the South Fork and Canyon Creek participated in programs associated with the Osburn and Pine Creek dams. The Nine-Mile operations were not involved in the construction or maintenance of the dams, at least financially. In 1910, the five companies participating in maintenance of the dams took a further step in responding to the tailings problem: they began acquiring easements on river-front property downstream of the Pine Creek dam. The easements released the named companies from liability for damage caused by tailings. The five companies assessed themselves for the cost of acquiring easements on a pro-rated basis, according to the amounts of ore each had milled over the previous five years. In 1913, those companies enlisted the participation of several other mining companies in the Coeur d'Alene district, including three companies operating mills on Nine-Mile Creek. They also changed the assessment formula, with each participating company agreeing to make monthly contributions to the coordinated effort based on two cents per ton of ore milled. The three Nine-Mile companies were Interstate-Callahan, Tamarack & Custer, and Marsh.[58]

The strategy of the mining industry was to accept the fact that each mill was dumping tailings into the river system and to accept the fact that those tailings, especially slimes, were making their way downstream to the Coeur d'Alene River below Cataldo. The strategy sought not to limit the movement of tailings downstream, but rather to limit the liability to the companies for damages those tailings might cause to property as they moved downstream. By participating in the plan, the companies operating on Nine-Mile Creek acknowledged their responsibility for tailings flowing out Nine-Mile Creek and into the South Fork, where they mixed with the tailings of the other companies in the district. The Nine-Mile Companies also availed themselves of the release from liability afforded by the easements and other coordinated activities of the mining industry.[59]

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[58]"Coeur d'Alene River Valley Easements," financial records of the companies cooperating in the endeavor, 18 August 1913 through 27 January 1915 (ASAID-084-00013-028).

[59]Indenture between Spokane & Eastern Trust Company and H. Haff, dated 1 August 1914 (SEAWA-002-00253-256).

Three of the four mills operating in Nine-Mile Creek were closed by 1920, and the Interstate-Callahan mill closed in 1923. Thereafter, there were no mills treating ore in the Nine-Mile drainage until the Dayrock mill opened in 1941. Thus, no new tailings were generated in the Nine-Mile drainage over a period of nearly twenty years. Nevertheless, important changes continued to occur to the tailings already deposited in the drainage. In addition to the normal, gradual movement of tailings downstream due to the annual cycle of spring run-off and occasional other high-water events, mining companies also altered the tailings in the drainage, specifically by means of re-working them. The lead and especially zinc carried by the tailings continued to attract operators, who leased tailings deposits, excavated material, ground it more finely, and ran it through flotation apparatus. Whether such tailings were reprocessed in the Nine-Mile drainage or elsewhere, the net result was that old deposits were reduced to a smaller particle size, significant proportions of lead and zinc values were recovered, and new discharges of very fine tailings were sent into the South Fork system, to be washed downstream.

When the Dayrock joined the list of operating mills in 1941, its flotation process meant that it, too, was discharging very fine tailings into the stream, to be carried downstream. By that time, the Cataldo dredging operation was in full swing, so fine tailings from the Nine-Mile, whether from the Dayrock or from re-worked tailings, would have encountered no other industrial facility to retard the flow of tailings until the Cataldo dredge.

4. Re-Working Coarse Tailings during the World War II Era

Throughout the World War II era, tailings from the various Nine-Mile deposits were treated for metals recovery. The Zanetti brothers seemed to be the most active of those treating tailings in the region. In 1941, they purchased the Galena mill from the Callahan Zinc-Lead Company and began to treat zinc-lead tailings from the Interstate-Callahan dump which was under lease to them. That year, the brothers processed 30,000 tons of old tailings from the Interstate-Callahan dump.[60]

Beginning in at least 1947, the flotation mill built in 1943 by the Callahan Consolidated Mines Company near the old Rex mill treated tailings from the old property. Such production became a major portion of that company's shipments, especially after the Zanetti Brothers leased the mill and hauled tailings from the Interstate-Callahan dumps there.

In 1950, the Zanetti Brothers treated Nine-Mile tailings deposit, shipping the material to their mill at Osburn. The Interstate mine dump and Rex tailings dump continued to be treated throughout 1951 at the Rex mill and other custom flotation mills.[61]

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[60] Minerals Yearbook 1941, n.p. (RBUCO00101790).

[61] Minerals Yearbook 1950, 1499 (RBUCO00101835); Minerals Yearbook 1951, 1494-1495 (RBUCO00101839-1840).

The net result of all the tailings re-treatment undertaken in the Nine-Mile drainage, whether those tailings were re-treated in Nine-Mile mills or elsewhere (like the Galena mill) was two-fold: 1) lead and zinc levels were reduced in some of the solids residing in the Coeur d'Alene basin, and 2) the particle size of many of those solids was reduced by re-grinding prior to flotation.

BIG CREEK DRAINAGE

Big Creek rises southwest of Polaris Peak and flows north, forming a tributary of the South Fork Coeur d'Alene River. Big Creek enters the South Fork just west of Osburn, flowing perennially. Big Creek, while flowing through some steep canyons, also opens into small valleys at several places along its course. These valleys have provided areas for tailings to build up, especially at the north (downstream) area of its course; but other tailings have historically been discharged directly to the creek, causing at least one known dispute between the mining companies and the local town of Kellogg.

Big Creek forms the dividing line between the Evolution mining district on the stream's east side, and the Yreka mining district on the creek's west side. The Sunshine mill, located on the east side (Evolution district) of Big Creek, is located 750 feet upstream from the Crescent millsite, which is located on the opposite side of the creekbed and therefore falls in the Yreka district.

Sunshine Mill

In September 1884, True and Dennis Blake discovered the Yankee lode on the south or "dry" side of the South Fork. The Blake brothers hand picked the ore from tiny stringers (usually less than an inch thick), and at times hand-jigged their product before shipping it to East Helena. In approximately 1914, the Blakes gave up their mining activities to leasers.[1]

In December 1920, mining engineer E.C. Tousley organized the Sunshine Mining Company in Spokane and took over the Yankee Boy and Yankee Girl mines, located on Big Creek. The new company incorporated on January 3, 1921 and quickly shipped the mines' first car of ore, assaying 100 ounces of silver per ton. Until 1921, the high-grade ore from the Yankee mines had been hand-sorted, leaving an accumulation of many tons of mill ore. The ore was primarily gray copper with galena, containing a high silver content, and much of it was taken out by lessees. In 1921, however, Sunshine planned the construction of a new mill on Big Creek to treat such ore near the Yankee Boy mine. Construction work was complete by late August. The new mill was equipped with ball-mills and flotation and its initial processing capacity was 50 tons of ore per day. The mill's recovery was only about 80% and its concentrate averaged 150 ounces of silver per ton.[2]

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[1]H.W. Schulze, "A Brief History of the Sunshine Mine Operations," The Coeur d'Alene Mining District in 1963 (Moscow: Idaho Bureau of Mines and Geology, December 1963), 65.

[2]Sunshine Mining Company, 3 (SUNSH008-00003); The Mining Industry of Idaho for the Year 1931, 250 (PHRCA019-00926); M&SP 121 (18 December 1920): 891 (FLQCA-001-0985); M&SP 122 (8 January 1921): 71 (FLQCA-001-01008); M&SP 122 (12 February 1921): 240

By October 1921, the new mill was receiving forty tons of ore daily. After producing three tons of concentrate per day from this ore, the mill discharged 37 tons of tailings. Additionally, the mine produced high-grade ore that did not require milling. In October 1921, jigs and vanners were installed, and in December, larger, eight-ton rolls and a new ball-mill were installed, by which the mill's capacity was increased to 75 tons of ore per day. The company also put up a two-bucket aerial tramway (taken from the Stemwinder at Wardner) to remove its ores from number three and four levels of the mine to the mill. Additionally, when the town of Kellogg began proceedings against Big Creek Mining Company for polluting its domestic water supply, Sunshine joined with Big Creek Mining Company to construct an 11,000-foot flume to carry slime away from the mill to a point downstream of Kellogg's domestic water intake. The flume was to carry tailings and slime to the outlet of Big creek in the Coeur d'Alene. During these changes, the Sunshine mill ceased operations for two months.[3]

By January 1922, the mill had resumed operations, and continued to ship both ore and concentrate. Between 1923 and 1924, hundreds of tons of lead concentrate, rich in silver, were shipped to the Bunker Hill smelter. In 1925, additional equipment was added to the mill, and the company finally operated profitably. The added equipment increased the capacity of the flotation mill yet again, so that it could handle between 100-120 tons of ore per day. During that year, the mill produced 1,000 tons of lead concentrate.[4]

The record shows that over the next five years, the mill's capacity was increased to 500 tons of ore per day. The increase was due in part to a complete remodelling in 1929 during which Sunshine equipped its mill with crushers, a new eight-foot Hardinge ball mill, and Minerals Separation flotation machines. Once the new equipment was installed, the two old ball mills previously used for fine grinding were put on reserve and used as auxiliaries until mine improvements were made to bring capacity to 500 tons of ore per day. A major flood in 1933 destroyed or damaged most of the Sunshine's mill buildings. Nevertheless, until 1935, the mill

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(FLQCA-001-01015); E&MI (9 July 1921): 71 (RBUCO00101097)); M&SP 123 (16 July 1921): 100 (FLQCA-001-01039); M&SP 122 (25 June 1921): 888 (FLQCA-001-01038); M&SP 123 (6 August 1921): 207 (FLQCA-001-01043); M&SP 123 (27 August 1921): 305 (FLQCA-001-01044).

[3]M&SP 123 (22 October 1921): 582 (FLQCA-001-01047); M&SP 123 (31 December 1921): 942 (FLQCA-001-01051); M&SP 124 (21 January 1922): 100 (FLQCA-001-01053); M&SP 124 (28 January 1922): 136 (FLQCA-001-01055); E&MI 109 (26 June 1920): 1432 (RBUCO00101076); 110 (7 August 1920): 281 (RBUCO00101078).

[4]Mineral Resources of the U.S., 1922, 239 (RBUCO00101696); Mineral Resources of the U.S., 1923, 397 (RBUCO00101702); Mineral Resources of the U.S., 1924, 277 (RBUCO00101708); The Mining Industry of Idaho for the Year 1925, 55 (RBUCO00102417); Mineral Resources of the U.S., 1925, 541 (RBUCO00101715); Mineral Resources of the U.S.1926, 444 (RBUCO00101723).

was one of very few companies in the Coeur d'Alene district that ran continuously and often at capacity, despite low silver prices.[5]

In 1934, Sunshine was taken over by a New York development firm. In late 1934, Sunshine made plans to enlarge the mill again, in order to handle the additional high-grade silver ore discovered at lower levels of the mine. The new additions increased concentrating capacity by 50% to 750 tons per day, and were completed in March 1935. For the remainder of that year, the mill continued to operate at capacity. In 1937, Sunshine milled an average of 701 tons of ore per day, and produced about 33 tons of concentrates daily. By 1939, the mill (having been enlarged again) was handling up to 1000 tons of ore per day. Nevertheless, the company decided two years later that an additional plant was needed to treat the silver-copper-antimony concentrates, and set about building the new structure in 1941. Because the War Production Board had listed antimony as a strategic metal, the 1200-ton differential flotation plant was intended to recover the antimony contained in the high-grade silver-copper-antimony concentrate through leaching and electrolytic deposition. This would save the company money on smelter schedules and penalties; the sale of antimony metal improved the company's financial picture. The plant was complete and operating by mid-September 1942. The silver-lead mill continued to operate.[6]

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[5]The Mining Industry of Idaho for the Year 1927, 180 (RBUCO00102432); The Mining Industry of Idaho for the Year 1928, 173 (RBUCO00102450); Mineral Resources of the U.S., 1928, 676 (RBUCO00101732) Mineral Resources of the U.S. 1929, 398 (RBUCO00101740); Mineral Resources of the U.S., 1930, 645 (RBUCO00101749); The Mining Industry of Idaho for the Year 1929, 196 (RBUCO00102456); The Mining Industry of Idaho for the Year 1930, 202 (RBUCO00102462); The Mining Industry of Idaho for the Year 1931, 195 (RBUCO00102467); The Mining Industry of Idaho for the Year 1932, 193 (RBUCO00102472); The Mining Industry of Idaho for the Year 1933, 177 (RBUCO00102475); The Mining Industry of Idaho for the Year 1934, 203 (RBUCO00102478); E&MJ 128 (14 December 1929): 941 (RBUCO00101152); E&MJ 129 (8 February 1930): 140 (RBUCO00101154); E&MJ 129 (24 February 1930): 266 (RBUCO00101156); M&SP 131 (23 February 1931): 189 (RBUCO00101170); E&MJ 129 (7 April 1930): 369 (RBUCO00101160); E&MJ 130 (23 August 1930): 199 (RBUCO00101164); Sunshine Mining Company, 5 (SUNSH008-00005).

[6]E&MJ 135 (November 1934): 531 (RBUCO00101177); E&MJ 136 (March 1935): 143 (RBUCO00101190); E&MJ 139 (February 1938): 94 (RBUCO00101200); E&MJ 140 (January 1939): 79 (RBUCO00101219); The Mining Industry of Idaho for the Year 1931, 195 (RBUCO001012467); The Mining Industry of Idaho for the Year 1936, 227 (RBUCO00102485); The Mining Industry of Idaho for the Year 1938, 198 (bates); Minerals Yearbook 1941, 355 (RBUCO00101790); Minerals Yearbook 1942, 383 (RBUCO00101793); "Sanborn Map for Kellogg" (1944), sheet 28 (FLQCA-001-02429-FLQCA-001-02430); Franklin H. Sharp, "Sunshine Metallurgy," The Coeur d'Alene Mining District in 1963 (Moscow: Idaho Bureau of Mines and Geology, December 1963), 79 (RBUCO00102167); Sunshine Mining Company, 8, 16 (SUNSH008-00008, SUNSH008-00016).

In addition to leaching silver-copper-antimony ore mined from the Sunshine mine, Sunshine Mining Company signed a contract on 1 May 1943 with the Coeur d'Alene Mines Corporation to purchase all silver-copper-antimony concentrates produced at the latter's Mineral Point mill. But shortly thereafter, the labor shortage induced by World War II prompted Sunshine to cease mining silver-copper-antimony ore and devote all its available labor to mining lead-silver ore. In 1944, the amount of silver-copper-antimony ore mined from the Sunshine mine dropped to 3298 tons from 141,955 tons the year before. Sunshine also then closed its leaching plant in March 1944. Coeur d'Alene Mines Corporation continued to ship its silver-copper-antimony concentrates to Sunshine during the first quarter of 1944. Once Sunshine's plant closed, the Coeur d'Alene Mines Company proceeded to ship its concentrates directly to the smelter in Tacoma, Washington. During that same year, 13,231 tons of silver ore from the Polaris vein were hauled to Sunshine's silver-lead mill for treatment.[7]

The Sunshine mill continued to operate regularly, treating ore from properties of Polaris Mining Company, Silver Syndicate, Inc., Silver Dollar Mining Company, and Metropolitan Mines Corporation. By 1949, its capacity was 1350 tons, and Sunshine reported that its mill had operated 237 days that year on ore averaging 30.89 ounces of silver to the ton, 2.47% lead, and a little copper and zinc. The tailings that year averaged .57 ounce of silver per ton, and .06% lead. Despite the operation of the silver-lead mill, there continued to be no mention of re-starting Sunshine's silver-copper-antimony plant until 1953.[8]

In April 1953, Sunshine finally decided to re-activate the antimony leaching plant to improve smelter returns. Additionally, milling practice was altered so that two kinds of concentrates were recovered: 1) a copper-silver-antimony concentrate (aimed mainly at the recovery of antimony) and 2) a lead-silver-iron concentrate. In September, work began enlarging the Sunshine mill, replacing the old flotation cells, adding new circuits, and revising the mill's entire flowsheet. By 1955, Sunshine's mill operated 259 days of the year and produced 3405 tons of copper residue, 4612 tons of lead concentrate, 486 tons of iron concentrate. Between 1949 and 1969, the mill treated between 114,467 and 271,515 tons of mine ore annually.[9]

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[7]Minerals Yearbook 1943, 374 (RBUCO00101798); Minerals Yearbook 1944, 357-359 (RBUC00101802-RBUCO00101803); The Mining Industry of Idaho for the Year 1945, 247-248 (RBUCO00102538-RBUCO00102539).

[8]Minerals Yearbook 1948, (page-illegible) (RBUCO00101824); Minerals Yearbook 1949, 1477-1478 (RBUCO00101829-RBUCO00101830); Minerals Yearbook 1950, 1496-1500 (RBUCO00101833-RBUCO00101836); Minerals Yearbook 1951, 1494 (RBUCO00101839).

[9]These mill changes do not appear on the Sanborn maps of 1951 or 1961. "Sanborn map of Kellogg" (1951 revision of 1935 sheet), sheet 28 (FLQCA-001-02517-FLQCA-001-02520); "Sanborn map of Kellogg" (1961 revision of 1935 sheet), sheet 28 (FLQCA-001-02597-FLQCA-001-02600);0 Minerals Yearbook 1953, 346-347 (RBUCO00101847); Minerals Yearbook 1954, 375 (RBUCO00101851); Minerals Yearbook 1955, 362 (RBUCO00101856); see Minerals Yearbooks for years 1949-1969.

Ore continued to be processed on a regular basis for the next twenty-plus years in both the mill and the electrolytic plant. During that period, Sunshine made only one major alteration to its operation. In 1960, the company chose to fill its stopes with tailings instead of mine waste.[10] The Sunshine mill still operates today.

Sunshine's antimony electrolytic plant was no doubt spurred by the war effort and the increasing demand for antimony production. But the plant's opening and later its cessation of production in 1944 was in response to the market, not directives from the federal government. While Sunshine undoubtedly strove to take advantage of the wartime antimony market, there is no evidence that the United States ever operated, owned, or managed the mill. Nor did the United States ever regulate the mill and its operations, including its generation and discharge of waste products.

Sunshine Mining Company's participation in a federal government stockpiling program in the late 1950s also did not result in any ownership or managerial activities by the United States in the day-to-day operations of the Sunshine mill.[11]

Crescent Mill

Big Creek Mining Company was mining ore on Big Creek as early as 1913, when it shipped silver chloride ore. Over the next few years, it also shipped crude lead sulfide ore and copper sulfide ore.[12]

In 1919, Big Creek Mining Company announced that it would build a 60-ton mill for lead-silver ore at its mine on Big Creek. As part of the region south of the South Fork Coeur d'Alene that was commonly referred to as the "dry belt," the mines along Big Creek had begun to show real promise. In addition to Big Creek Mining Company shipping ore, Big Creek Leasing Company was also shipping high-grade silver ore obtained from the Yankee Boy mine, which was later taken over by Sunshine Mining Company. By November, the concentration/flotation mill was under construction, designed to supplant hand-jigs and intended to handle 75-100 tons of ore daily. Shortly, the mill was in operation on the west side of Big Creek. Connected to the mill by a two-bucket aerial tramway, Big Creek Mining company's mine initially ran dump-ore through the mill, producing a high-grade silver concentrate averaging 100 ounces of silver per ton. Output averaged one to two cars of concentrate per week.[13]

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[10]Minerals Yearbook 1960, 342 (RBUCO00101877);

[11]Minerals Yearbook 1957, 379 (RBUCO00101864).

[12]Mineral Resources of the U.S., 1913,787 (RBUCO00101621); Mineral Resources of the U.S. 1917, 491 (RBUCO00101671); Mineral Resources of the U.S., 1918, 495 (RBUCO00101679); Mineral Resources of the U.S., 1919, 483 (RBUCO00101686).

[13]M&SP 118 (31 May 1919): 758 (FLQCA-001-0917); M&SP 119 (23 August 1919): 279 (FLQCA-001-0928); M&SP 121 (30 October 1920): 641 (FLQCA-001-0975); M&SP 121 (20

The town of Kellogg brought legal action against the company in 1920 for polluting its domestic water supply, Big Creek. This suggests that, prior to 1920. Big Creek Mining Company dumped its mill tailings directly into Big Creek near or at the millsite. Kellogg obtained an order enjoining the company from its present practice, prompting Big Creek Mining Company to build a flume to carry slimes to a "point sufficiently removed from the creek to prevent anything foul reaching it." In late 1921, probably in an attempt to implement a more permanent solution, Big Creek company joined with Sunshine Mining Company (whose mill was just upstream and across the creek) in the construction of an 11,000-foot flume to carry slimes away to the mouth of Big Creek on the South Fork.[14]

It was also in May 1923 that the Bunker Hill Company took charge of the mining operations at Big Creek. Under Bunker Hill's control, Big Creek ore was milled at the Big Creek property's mill. During 1925, the Big Creek mill ran only one month and the production was relatively small. Ore from the nearby Crescent mine was milled at a 75-ton flotation plant on Elk Creek owned by the Alhambra Company but under lease to Bunker Hill. In 1927, however, the Alhambra mill had burned. When Bunker Hill & Sullivan acquired the Big Creek Mining Company property during a foreclosure proceeding that same year, the new owner entirely re-built the Big Creek mill to treat ore from both the Alhambra and Crescent mines. By 1929, the new flotation plant, now called the Crescent mill, operated the entire year.[15]

The mill continued to treat between 10,000 and 30,000 tons of ore annually until 1943. That year, the Crescent mill was leased to E.G. Smith, who used it to treat 28,000 tons of tailings. He treated another 10.000 tons of tailings at the mill during the first six months of 1944. After that time, the mill no longer appears in the record. A 1944 Sanborn map shows that the mill's equipment had been removed from the buildings, and a tailings pile had accumulated on the west bank of the creek, south of the mill buildings. Sanborn maps show that the buildings and tailings

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November 1920): 747 (FLQCA-001-0979); M&SP 122 (2 April 1921): 470 (FLQCA-001-01022); E&MJ 110 (7 August 1920): 281 (RBUCO00101078); M&SP 124 (21 January 1922): 100 (FLQCA-001-01053); Mineral Resources of the U.S. 1921, 5 (RBUCO00101694); The Mining Industry of Idaho for the Year 1919, 52 (RBUCO00102388).

[14]M&SP 121 (30 October 1920): 641 (FLQCA-001-0975); M&SP 121 (20 November 1920): 747 (FLQCA-001-0979); M&SP 122 (2 April 1921): 470 (FLQCA-001-01022); E&MJ 110 (7 August 1920): 281 (RBUCO00101078); M&SP 124 (21 January 1922): 100 (FLQCA-001-01053).

[15]Mineral Resources of the U.S., 1922, 242 (RBUCO00101698); Mineral Resources of the U.S., 1923, 403 (RBUCO00101705); Mineral Resources of the U.S., 1924, 284 (RBUCO00101712); Mineral Resources of the U.S., 1925, 549 (RBUCO00101719); Mineral Resources of the U.S., 1926, 201 (?) (RBUCO00101726); Mineral Resources of the U.S., 1928, 684-5 (RBUCO00101736); Mineral Resources of the U.S., 1929, 408 (RBUCO00101745); The Mining Industry of Idaho for the Year 1927, 177 (RBUCO00102430); The Mining Industry of Idaho for the Year 1929, 201 (RBUCO00102458).

were present until at least 1951, but that sometime between that date and 1961, both the buildings and the tailings were removed.[16]

There is no evidence in the historical record that the United States was an operator of the Crescent mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products. The Bunker Hill & Sullivan Company did take advantage of a DMEA loan in 1955-1956 to explore for new ore bodies. Through that program, however, the United States did not in any way dictate operations at the Crescent mill.[17]

Historic Movement of Tailings and Other Solids down Big Creek

1. Free-Flowing Tailings: 1888-1920

The Blake Brothers operated their mining discoveries with hand jigs until the Sunshine Mining Company took over and built a mill on the creek in 1921. Thus, coarse jig tailings high in metal content were discharged into the creek before that time.

2. Free-Flowing Fine Tailings, 1920-1968

The start of legal action against Big Creek Mining Company prompted the Sunshine to join with that company and build a flume to carry slime away from the mills and away from the creek. Although the sources are unclear as to exactly where the tailings were discharged, it is clear that they flowed into the South Fork Coeur d'Alene River. The record indicates that tailings did accumulate at the downstream end of Big Creek, but these may have been tailings settling out of the waters of the South Fork and accumulating in the vicinity of the mouth of Big Creek.

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[16]"Sanborn Map for Kellogg" (1944 revision of 1935 sheet), sheet 28 (FLQCA-001-02432); "Sanborn Map for Kellogg" (1951 revision of 1935 sheet), sheet 28 (FLQCA-001-02519); "Sanborn Map for Kellogg" (1961 revision of 1935 sheet), sheet 28 (FLQCA-001-02599); Minerals Yearbook 1943, 378 (RBUCO00101800); Minerals Yearbook 1944, 362 (RBUCO00101805).

[17]Minerals Yearbook 1955, 360, 365 (RBUCO00101855-857); Minerals Yearbook 1956, 387 (RBUCO00101861).

3. Re-Working Coarse Tailings during the World War II Era

Federal Mining & Smelting Company worked the Big Creek tailings deposit during 1947-1948, trucking the material to be milled at the Polaris mill in Osburn. In 1948, Federal hauled 37,290 tons of material, and in 1949, it hauled 99,600 tons of material. The resulting concentrates in 1949 contained thirty-two ounces of gold and 63,154 ounces of silver. By 1950, the Big Creek tailings deposit along the South Fork was being intermittently worked by unnamed lessees, hauling only 3908 tons of old tailings to the Zanetti Brothers mill in Osburn. In 1951 and 1952, the tailings deposit was worked by Zanetti Brothers, who trucked an undisclosed amount in 1951 and 9183 tons of old zinc-lead tailings in 1952 to the company's tailings mill in Osburn.[18] It is unclear whether these tailings came from operations on Big Creek or from points along the South Fork upstream of Big Creek.

[18] Minerals Yearbook 1948, n.p. (RBUCO00101825); Minerals Yearbook 1949, 1478 (RBUCO00101830); Minerals Yearbook 1950, 1498 (RBUCO00101835); Minerals Yearbook 1951, 1494 (RBUCO00101839); Minerals Yearbook 1952, 303 (RBUCO00101843).

MIDDLE SOUTH FORK DRAINAGE

Wallace downstream to Wardner/Kellogg
not including Wardner/Kellogg

For purposes of this report, the middle stretch of the South Fork Coeur d'Alene River extends from the mouth of Canyon Creek, just above Wallace, to the mouth of Milo Creek, just above Kellogg. Through much of this stretch, the river bottom is fairly narrow and is flank by the steep mountain slopes typical of the district. The major exception is the relatively broad stretch in the vicinity of Osburn, roughly midway between Wallace and Kellogg. This was the site of a tailings impoundment built in the early twentieth century by members of the Mine Owners Association in an effort to keep tailings from damaging the property of downstream property owners. Along this middle stretch of the South Fork, the river gained the flow, and the tailings, of several important tributaries, including Canyon Creek, Nine-Mile Creek, Lake Creek, and Big Creek. Mills built along the main stem of the South Fork and some minor tributaries also contributed tailings to the flow of the river.

Hercules Mill

The Hercules mine on Gorge Gulch (a tributary of Canyon Creek above Burke) began producing rich ore in 1902. The Hercules Mining Company[1] shipped high-grade galena ore, assaying as high as 60% lead, directly to the smelter. In 1906, the company opened a concentrator on Gorge Gulch. It operated for a little over three years before burning in 1909. The history of that mill is described in the Canyon Creek section of this report. In November 1909, two months after the mill on Gorge Gulch burned, Hercules leased the idle Tiger-Poorman mill at Burke. A year later, construction began on the Hercules' new mill, located on the north bank of the South Fork, just below Wallace. When the new mill opened in April 1911, Hercules discontinued using the Tiger-Poorman mill.[2]

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[1]The Hercules Mining Company apparently was not an incorporated entity. As late as 1914, a legal document named the following: "Harry L. Day, Eugene R. Day, Jerome J. Day, Eleanor Day Boyce, Sylvester Markwell, Damian Cardoner, L.W. Hutton, August Paulsen, Frank M. Rothrock, Charles A. Markwell and Frank P. Markwell, partners doing business under the name of Hercules Mining Company;" see Indenture between Spokane & Eastern Trust Company and H. Haff, dated 1 August 1914 (SEAWA-002-00253-256).

[2]M&SP 99 (13 November 1909): 670 (FLQCA-001-0420); 101 (5 November 1910): 622 (FLQCA-001-0449); 102 (13 May 1911): 669 (FLQCA-001-0466); E&MI 89 (1 January 1910): 38 (RBUCO-001-0663); 90 (29 October 1910): 879 (RBUCO-001-0688); 91 (6 May 1911): 927 (RBUCO-001-0700), (17 June 1911): 1226 (RBUCO-001-0702).

The new Hercules mill opened with a capacity to treat 400 tons of lead-silver ore daily. The company crushed its milling ore at the mine to 2.5-inch size, then conveyed it by means of a 3,500-foot aerial tramway to a railroad loading facility at Burke. Bottom-dump railroad cars carried the ore to bins at the mill. A short time after the Hercules mill opened. the company leased the tunnel of the Humming Bird mine, which had its portal in Burke. The Humming Bird group of claims was located at Burke and controlled by the owners of the Hercules. The Humming Bird lease allowed the Hercules to drive the Humming Bird tunnel toward the deeper levels of the Hercules ore body, build an ore shipping facility along the railroad tracks in Burke, and abandon the aerial tramway serving the mine. This improved the shipment of large tonnages of ore to the Hercules mill.[3]

The mill featured two main buildings, one housing the crusher, rolls, and jigs and the other housing the slime plant with tables and vanners for recovering additional values from the fine tailings of the jigs. Everything treated in the slime plant was finer than 20-mesh. Ratio of concentration at the mill was 8:1. The Hercules mill was equipped with a shipping bin consisting of three compartments, one each for jig concentrates, concentrates made from slimes, and tailings. In a brief article about the mill shortly after it opened, W.A. Scott said the tailings were either hauled away or laundered to a dump, but not dumped in the South Fork. He must have been referring only to coarse tailings, because the shipping bin does not appear to have possessed adequate size to settle all the fine tailings the mill would have produced. No mill in the Coeur d'Alene district is known, to this date, to have done anything but dump slime tailings into the creek.[4]

As was typical of other mills in the Coeur d'Alene district, the Hercules immediately began experimenting with techniques aimed at improving the recovery of values from the fine tailings. One of the first changes the Hercules made was to install a Wyman acid flotation process in the mill in 1913 to allow the option of recovering zinc from tailings. This quickly led in 1914 to the application of flotation technologies to the treatment of fine tailings from the jigs to enhance lead recoveries as well. To implement flotation, the Hercules built a third building to house a Callow pneumatic flotation plant, which became a standard feature of concentrators in the Coeur d'Alenes in the mid-1910s. The flotation plant was northwest of the building housing the vanners and tables. In 1914, the Hercules mine produced the greatest gross value in lead of any mine in the region. The following year, its average monthly output was 1,000 tons of smelting ore and 17,000 tons of milling ore. Beginning in 1915, the Hercules Mining Company began a period with several intervals of reduced output, first because of a dispute with ASARCO over the contract for smelting Hercules ore and concentrates, and then because of a labor shortage after World War I. In 1916, members of the Day family, who had interests in other mines in the Coeur d'Alene district, took controlling interest in the Hercules company. The Days

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[3]W.A. Scott, "The Hercules Mill," M&SP 102 (27 May 1911): 724 (FLQCA-001-0473); Fahey, The Days of the Hercules, 95-96 (RBUCO-001-05306-307).

[4]W.A. Scott, "The Hercules Mill," 724 (FLQCA-001-0473); M&SP 106 (4 January 1913): 75 (FLQCA-001-0537); "Hercules Mill, Wallace, Idaho - Put in Operation May 1911" (FLQCA-001-03291).

also owned a smelter at Northport, Washington, to which the Hercules began sending concentrates. To supply that smelter with flux, the Hercules began experimenting with recovering as much iron as possible in the lead concentrates. The company also continued experimenting with other flotation machines, installing some Janney equipment in 1916.[5]

As the United States anticipated entering the Great War in 1916, the government made preparations to insure an adequate supply of strategic resources, among them lead. Congress authorized the government to mobilize industries for the war effort by means of the Council of National Defense. Bernard Baruch, one of the members of the Council's advisory commission, was placed in charge minerals and metals. He established trade committees for voluntary regulation of production. To the committee on lead, he appointed Harry Day, one of the owners of the Hercules, Northport smelter, and other Day interests in the lead industry. After the U.S. declared war on Germany in April 1917, Day served with Baruch and other members of the lead committee to allocate how much lead each company, with few exceptions, would supply the government. During the course of the war, as Congress changed the mechanisms by which the government worked with the lead industry to insure ample supply and reasonable prices, Day continued to participate as one of the lead industry's representatives. Although there were several suggestions during the war that the government nationalize various facets of the metals industry, including lead, it did not happen. The government regulated to whom the lead producers could sell the metal, for example prohibiting sales of lead to paint manufacturers and to sports-ammunition plants, but the government did not actually take over the lead industry. Some of the government programs to insure adequate supplies of metals remained in place briefly after the war in an effort to stabilize prices. During the war, Hercules and other lead producers in the Coeur d'Alene district achieved voluminous output and enjoyed unprecedented profits.[6]

Entering the 1920s, the Hercules mill had a capacity of 700 tons/day. The mill still used jigs to concentrate material of particle size greater than 1.5 mm, but coarse tailings were no longer discharged. All middlings and tailings from the jigs were ground more finely and subjected to tables and flotation. Eventually, all material that had not already been separated into the concentrates stream was sent to the flotation plant, where they were pulverized to a very fine particle size before passing through the flotation cells. To accommodate all that material, the

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[5]E&MJ 92 (11 November 1911): 962 (RBUCO-001-0710); 101 (22 April 1916): 753 (RBUCO-001-0888); 107 (10 May 1919): 853 (RBUCO-001-01039); Mineral Resources of the U.S., 1913, 784 (RBUCO-001-01618); Mineral Resources of the U.S., 1914, 633 (RBUCO-001-01629); Mineral Resources of the U.S., 1915, 554 (RBUCO-001-01642); J.M Callow, "Callow Flotation Process," E&MJ 100 (4 December 1915): 919 (RBUCO-001-0570); Rice, "Flotation in the Coeur d'Alenes," E&MJ 105 (20 April 1918): 710 (RBUCO-001-01363); M&SP 110 (12 June 1915): 926 (FLQCA-001-0682); 111 (11 September 1915): 413 (FLQCA-001-0695); 113 (9 December 1916): 855 (FLQCA-001-0771); 118 (3 May 1919): 616 (FLQCA-001-0911); "Sanborn Map for Wallace" (1927), sheet 1 (FLQCA-001-02801-804); "Hercules Mill, Wallace, Idaho" (FLQCA-001-03292); Fahey, The Days of the Hercules, 163-169 (RBUCO-001-05325-328).

[6]Fahey, The Days of the Hercules, 169-176 (RBUCO-001-05328-332).

Hercules built several Dorr thickener tanks, one at the southeast end of the jig plant, several smaller ones inside the flotation plant, one at the northwest end of the flotation plant, and one across the river. There was even an another small flotation mill across the river. Any fine material not recovered as concentrate by flotation was discharged into the South Fork.[7]

The Days closed their Northport smelter in 1922 and dismantled it, shipping three blast furnaces to ASARCO's lead smelter at East Helena, Montana. Thereafter, the Hercules mill shipped its concentrates to East Helena. In 1924, the Days exhausted the ore in the Hercules mine, and the following year the mine closed. Until 1932, the Hercules mill served as a custom concentrator for other Day mines, like Sherman Lead and the Ambergis. In the mid-1930s, when metals prices began to rise again, the Days again began to use the Hercules mill for custom work. It closed permanently in 1942, by which time a number of its customers had built their own new mills. Equipment was not removed until 1968, and the Hercules mill burned in 1976.[8]

As noted above, the Hercules did benefit from the need for lead during World War I. But despite the United States' regulation of prices during this period, there is no record of these war-time programs affecting the way the Hercules Company operated the Hercules mill.

There is also no evidence in the historical record that the United States was an operator of the Hercules mill during the World War II era. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products. During the 1950s, Day Mines, Inc. did take advantage of a DMEA loan to explore for new ore bodies at the Hercules mine. By that time, the Hercules mill was closed.[9]

Galena Mill

The Galena mine consists of 91 mining claims in the vicinity of Lake Creek. The principal mine openings were located along the east side of the creek. Callahan Zinc-Lead Company acquired the property in 1922. After developing the mine for several years, the company built a 150-ton flotation mill just downstream of the mine in 1926. The mill was built

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[7]Sigurd Laurence Sampson, "Hercules Mill," in "The Milling Practice of the Coeur d'Alene District" (unpublished Masters Thesis, University of Idaho, 1923), 1-4 (RBUCO-001-05268-272); "Sanborn Map for Wallace" (1927), sheet 1 (FLQCA-001-02801-804).

[8]Mineral Resources of the U.S., 1922, 241 (RBUCO-001-01697); Mineral Resources of the U.S., 1923, 399 (RBUCO-001-01703); Mineral Resources of the U.S., 1924, 279 (RBUCO-001-01709); Mineral Resources of the U.S., 1925, 544-545 (RBUCO-001-01717); Fahey, The Days of the Hercules, 239-241, 254 (RBUCO-001-05339-341).

[9]Minerals Yearbook 1953, 348 (RBUCO00101848); Minerals Yearbook 1954, 377 (RBUCO00101852).

along the east side of Lake Creek, less than 100 feet from the stream. A surface tramway along the sidehill delivered ore from the mine to the top of the ore bin at the mill. The mill began operating in October 1926. The ore bin and crusher were located against the base of the hillside. A covered conveyor carried crushed ore to the ore bin serving the ball mill. All the feed ore was run through the crusher and ball mill before being charged through the classifier and flotation cells. After being dewatered to about 6% moisture, the concentrates (about 50% lead and 39 oz. silver per ton) were loaded into trucks to be hauled about a mile to the railroad. The mill only recovered lead and silver, sending as much zinc as possible to waste. After an abundant production record in 1927, Callahan reduced its mining and focused on exploration and development within the mine. The effort revealed a new vein with good lead and silver values and virtually no zinc, but the rate of output continued to decline until 1931, when, with the added hardship of the Great Depression, the Galena closed in February.[10]

The Galena mill next operated in 1936, when the Callahan company treated 13,000 tons of lead-zinc ore from waste dumps of the Interstate-Callahan mine in Nine-Mile Creek. The following year, the Callahan company re-opened the Interstate-Callahan mine, idle since 1923, and sent about 17,000 tons of lead-zinc ore to the Galena mill for treatment. That campaign was short-lived, as the Interstate-Callahan mine closed in February 1938. It would remain idle for about ten years. Meanwhile, the Callahan company started custom milling at the Galena mill in June 1938, treating ore produced by leasers of the St. Elmo mine in the Evolution district. There followed a period during which the Galena mill operated under lease. In 1939, the Silver Dollar Mining Company leased the Galena mill to treat ore from its mine, also in the Evolution district, and the following year, William Zanetti leased the mill. In 1941, Zanetti Brothers purchased the Galena flotation mill and operated it on old tailings and as a custom mill. That first year the Zanettis owned the Galena, for example, it treated 16,000 tons of ore mined by the Interstate Lease from the Interstate-Callahan mine and 30,000 tons of zinc-lead tailings from the Interstate-Callahan dump, which the Zanettis leased. They operated the mill into 1944, mainly on materials, both ore and tailings, from the Interstate-Callahan property. Zanetti Brothers produced both lead and zinc concentrates. In 1945, the Monitor Mining Company bought the Interstate-Callahan group of claims and made plans to treat that ore at their Carlisle mill. Feed for the Galena diversified thereafter. The Zanettis effected few structural changes at the Galena mill.[11]

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[10] Mineral Resources of the U.S., 1926, 448-449 (RBUCO-001-01725); Mineral Resources of the U.S., 1928, 681-682 (RBUCO-001-01734-735); Mineral Resources of the U.S., 1929, 404-405 (RBUCO-001-01743); Mineral Resources of the U.S., 1930, 653-654 (RBUCO-001-01753-754); Mineral Resources of the U.S., 1931, 404 (RBUCO-001-01760); E&MJ 124 (17 September 1927): 464; 125 (12 May 1928): 794 (RBUCO-001-01142); "Galena Mill West of Wallace, Idaho, 5/31/29" (FLQCA-001-03271); "Sanborn Map for Wallace" (1927), sheet 17 (FLQCA-001-02865-868).

[11] Minerals Yearbook, 1937, 401 (RBUCO-001-01734-781); Minerals Yearbook, 1938, 325 (RBUCO-001-01784); Minerals Yearbook, 1939, 356 (RBUCO-001-01787); Minerals Yearbook, 1941, 354 (RBUCO-001-01790); Minerals Yearbook, 1942, 382 (RBUCO-001-01793); Minerals Yearbook, 1943, 373 (RBUCO-001-01797); Minerals Yearbook, 1944, 357 (RBUCO-001-01802); Minerals Yearbook, 1945, 373 (RBUCO-001-01807); The Mining Industry in Idaho for the Year 1937, 216 (RBUCO-001-02491); The Mining Industry in Idaho for

In 1945, the Zanettis used their Galena mill to treat ore from the Crystal Lead Lease near Murray and from the Tamarack & Custer mine in Nine-Mile Creek. They also treated tailings from the Osburn tailings impoundment. Through the remainder of the 1940s, most of the material they treated was old tailings. In addition to tailings from the Osburn dump, they treated considerable material from Big Creek and from a deposit called the De Block dump near the mouth of Lake Creek. The Zanettis also worked some old mine dumps. They continued using the Galena mill for this purpose until 1954, when they sold it to ASARCO. By this time, the Callahan company had put the Galena mine in the hands of the Vulcan Silver-Lead Company, of which Callahan owned 63%. In 1947, Vulcan had leased the Galena mine to ASARCO. ASARCO in turn formed a joint venture with Day Mines, Inc., to explore the Galena mine. ASARCO held the controlling interest (75%) and assumed the role of operator. Among the terms of the lease, ASARCO agreed to pay Vulcan a 10% royalty on smelter or mill returns for any ore produced. ASARCO explored the deep levels of the Galena mine, finding some low-grade lead ore. The more important discovery was a silver-copper ore body at the 3,000-foot level. For a period prior to purchasing the Galena mill, ASARCO leased the mill from the Zanettis to treat ore produced during mine development. Mine and mill began full-scale production of silver-copper ore (about 350 tons/day) in early 1955.[12]

When ASARCO bought the mill, the company increased mill capacity to 350 tons/day. This included construction of an addition along the northwest side of the mill, nearly doubling the size of the concentrator area. ASARCO also made improvements to the tramway connecting mine and mill.[13]

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the Year 1938, 197 (RBUCO-001-02497); The Mining Industry in Idaho for the Year 1939, 251 (RBUCO-001-02502); The Mining Industry in Idaho for the Year 1940, 183, 214, 216 (RBUCO-001-02888, 904-905); Callahan Zinc-Lead Company, Inc., Annual Report, 1945, 4 (RBUCO-001-05161); W.L. Zeigler, "Tailings and Mine-Dump Reclamation in the Coeur d'Alenes during World War II," Mining Technology 11 (March 1947): 4-5 (FLQCA-001-03686); "Sanborn Map for Wallace" (1927, up-dated to 1949), sheet 17 (FLQCA-001-02937-930).

[12]Minerals Yearbook, 1945, 373, 377 (RBUCO-001-01807, 809). Subsequent annual editions of Minerals Yearbook (1946-1954) report the on-going activities of the Zanetti Brothers to treat old tailings and mine dumps. For reports of the sale of the Galena mill to ASARCO and the ASARCO/Day Mines joint venture at the Galena mine, see Minerals Yearbook, 1953, 349 (RBUCO-001-01848); Minerals Yearbook, 1954, 377 (RBUCO-001-01852); Minerals Yearbook, 1955, 364 (RBUCO-001-01857); Minerals Yearbook, 1956, 386 (RBUCO-001-01861); Annual Report of Callahan Zinc-Lead Company, Incorporated, 1952, 3, 8 (RBUCO-001-05163-164); N. Visnes, "The Galena Operation," in The Coeur d'Alene Mining District in 1963 (1963), 85 (RBUCO-001-02173); E&MJ 181 (May 1980): 94 (RBUCO-001-05389).

[13]Minerals Yearbook, 1954, 377 (RBUCO-001-01852); "Sanborn Map for Wallace" (1927, up-dated to 1961), sheet 17 (FLQCA-001-03013-016).

After 1954, the joint venture continued operating the Galena mine and mill at capacity. By 1959, the Galena was the second largest silver producer in Idaho. As ASARCO operated the Galena property, ore was hauled from the Galena shaft to the mill over the short surface tramway. The mill, which by then had a capacity to treat 460 tons/day and routinely handled 400 tons/day, crushed all ore in ball mills and sent the pulp through the flotation cells. ASARCO shipped silver-copper concentrates to its copper smelter at Tacoma. ASARCO began construction of dams to impound tailings in Lake Gulch in summer 1965. The impoundments began receiving the full output of Galena mill tailings in October 1968. The company expanded the Galena mill's capacity to 750 tons/day in 1968-69, by which time the Galena mine was the nation's second-largest silver producer. An important corporate reorganization of the operations at the Galena property occurred in 1995. By that time, the Galena mine was owned by Coeur d'Alene Mines Corporation, by dint of Coeur d'Alene Mines acquiring the Callahan Mining Corporation. Coeur d'Alene Mines also owned the Coeur mine. ASARCO and Coeur d'Alene Mines formed Silver Valley Resources, each taking a 50% ownership position. Silver Valley Resources in turn consolidated the Idaho silver properties of the two parent companies, including the Galena and the Coeur. Neither mine was operating at the time due to low silver prices. The Granite mine and mill were expected to resume operating again in 1997.[14]

There is no evidence in the historical record that the United States was an operator of the Galena mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor, prior to 1968, did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Polaris Mill

The Polaris mine is located in the upper reaches of Spring Gulch (formerly called Polaris Gulch). Development of the mine began in the late 1880s. It was owned by Weldon B. Heyburn and two partners, whom he soon bought out. As attorney for Charles Sweeney in several apex suits and then as one of Idaho's U.S. Senators (1903-1912), he took little interest in promoting or developing his mine. After Heyburn's death in 1912, the Polaris languished in the hands of his nephew and then Harry Woodward. Woodward did make some effort to develop the mine, incorporating the Polaris Development & Mining Company in 1915. The mine appeared to be rich in silver, but the precious metal was accompanied by copper, not lead. The Polaris company shipped several carloads of silver-copper ore in 1915-1916. In the late 1920s, Hecla Mining Company acquired some shares in the Polaris Development & Mining Company when

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[14]Visnes, "The Galena Operation," 86 (RBUCO-001-02174); George A. Deshler to J.P. Bingham, memorandum dated 27 August 1975 (ASAID-137-00007); Minerals Yearbook, 1956, 386 (RBUCO-001-01861); Minerals Yearbook, 1959, 330 (RBUCO-001-01874); ASARCO Annual Report, 1968, 11 (RBUCO-001-05089); ASARCO Annual Report, 1969, 6 (RBUCO-001-05090); ASARCO 1994 Annual Report, 11 (RBUCO-001-05154); ASARCO 1995 Annual Report, 11 (RBUCO-001-05156); ASARCO 1996 Annual Report, 17 (RBUCO-001-05159); Coeur d'Alene Mines Corporation 1994 Annual Report, 9 (RBUCO-001-05178).

Woodward failed to repay a loan from Hecla. He had used some of the Polaris stock as collateral. By 1930, Hecla had negotiated to acquire the rest of the Polaris stock.[15]

Hecla took an option in 1935 on the Silver Summit Mining Company and its mine near the mouth of Rosebud Gulch, just east of Spring Gulch. The Polaris company then drove a tunnel from the Silver Summit portal to the Polaris orebody. Beginning in October 1936, the Polaris company, under Hecla management, built a 200-ton flotation mill next to the Silver Summit portal. The mill started operating in May 1937, treating Polaris ore and shipping silver-copper concentrates to several smelters. The mill reportedly yielded excellent recoveries of silver and copper, but the Polaris company had difficulty selling its concentrates, because they were also rich in antimony and arsenic. In 1942, for example, Polaris concentrates contained nearly as much antimony as copper (by weight) and more antimony than lead (by weight). After a few years, the company began shipping its concentrates to the Sunshine mill, which had a plant specializing in recovering antimony from concentrates. This continued until 1942, when the Polaris mine was nearly exhausted. In 1942, the Polaris company modified the flotation apparatus at the mill to treat lead-zinc ore, increasing its capacity to 300 tons/day, and Hecla began shipping material from the Osburn sink-float plant to the Polaris for concentration by flotation. That became the Polaris mill's main source of feed through 1948.[16]

Beginning in 1948, the Polaris and Silver Summit companies began a joint effort to explore and develop deeper levels of the Silver Summit mine. The Hecla mill at Gem treated several thousand tons of silver-copper ore produced that year by the joint venture. The next year, the mine sent its silver-copper ore to the Polaris mill, which was still primarily treating old tailings. In 1949, in addition to about 95,000 tons of tailings from the Osburn tailings dump, the Polaris mill treated nearly 100,000 tons of tailings from a Big Creek tailings deposit for the Federal Mining & Smelting Company. In the early 1950s, the Polaris company negotiated an agreement with the Sunshine Mining Company under which the latter would operate the lower workings of the Polaris mine. Meanwhile, the Polaris and Silver Summit companies merged (September 30, 1952), and the Polaris Mining Company assumed operation of the Silver Summit mine. The Polaris mill apparently closed for a few years. It re-opened in 1953, treating Silver Summit ore. That year, the Polaris company obtained a loan from the DMEA to explore ground

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[15]Fahey, Hecla, 80-81; M&SP 58 (12 January 1889): 29 (FLQCA-001-01097), (22 June 1889): 457 (FLQCA-001-01120); E&MJ 53 (27 February 1892): 260 (RBUCO-001-0085); 100 (25 December 1915): 1067 (RBUCO-001-0870); 102 (23 December 1916): 1117 (RBUCO-001-0919); 103 (24 February 1917): 363 (RBUCO-001-0924).

[16]Gordon Craig, "Star and Polaris Mills," in The Coeur d'Alene Mining District in 1963 (Moscow: Idaho Bureau of Mines and Geology, 1963), 19 (RBUCO-001-02111); Fahey, Hecla, 90; Minerals Yearbook, 1938, 326 (RBUCO-001-01785); Minerals Yearbook, 1939, 356 (RBUCO-001-01787); Minerals Yearbook, 1941, 355 (RBUCO-001-01790); Minerals Yearbook, 1942, 383 (RBUCO-001-01793); Minerals Yearbook, 1943, 375 (RBUCO-001-01798); Minerals Yearbook, 1944, 358 (RBUCO-001-01803); The Mining Industry of Idaho for the Year 1936, 229 (RBUCO-001-02486); The Mining Industry of Idaho for the Year 1937, 216 (RBUCO-001-02491).

east of the Silver Summit mine. To conduct the exploration, the Polaris entered into operating agreements with seven other companies to explore their properties. The DMEA exploration program conducted by Polaris east of its property continued through at least 1956. In 1958, the Polaris company and its property and operations were merged into the Hecla Mining Company. Throughout this period, the Silver Summit was producing, and the Polaris mill was treating, about 50,000 tons/year.[17]

In 1959, as ore available in the Silver Summit mine decreased, Hecla entered an agreement with Bunker Hill & Sullivan to treat ore from the Crescent mine at the Polaris mill as well. The two companies maintained this arrangement until October 1962, when BH&S began concentrating Crescent ore in its own mill at Kellogg. Thereafter, the Polaris mill ran almost exclusively on Silver Summit ore. In 1969, Hecla consolidated its Silver Summit mine with seven adjacent properties and formed the Consolidation Silver Corporation to operate them. The Polaris mill apparently closed at that time.[18]

There is no evidence in the historical record that the United States was an operator of the Polaris mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Although Polaris took advantage of a DMEA loan to explore for new ore bodies in the 1950s, that program did not involve the United States directly in any of the operations at the Polaris mill. Nor, prior to 1968, did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.[19]

Mineral Point Mill & Coeur Mill

The Mineral Point mining claim is located in McFarren Gulch, south of Osburn. Ore production at the Mineral Point mine goes back to 1892, when William Osburne and his partners bonded it some St. Paul parties, who in turn developed at least three tunnels to the ore body, extracted some ore, and sacked and shipped it. The Mineral Point mine was not an important producer for several decades, but parties persisted trying to develop it. By the end of the 1920s, the Mineral Point and some adjoining mines were owned by the Mineral Point Mining Company,

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[17]Minerals Yearbook, 1948, 1506 (RBUCO-001-01825); Minerals Yearbook, 1949, 1478 (RBUCO-001-01830); Minerals Yearbook, 1952, 303 (RBUCO-001-01843); Minerals Yearbook, 1953, 347 (RBUCO-001-01847); Minerals Yearbook, 1955, 363 (RBUCO-001-01856); Minerals Yearbook, 1956, 384-385 (RBUCO-001-01860); Minerals Yearbook, 1958, 310-311 (RBUCO-001-01869).

[18]Craig, "Star and Polaris Mills," 19 (RBUCO-001-02111); Minerals Yearbook, 1959, 329 (RBUCO-001-01873); Minerals Yearbook, 1962, 361 (RBUCO-001-01883); Minerals Yearbook, 1969, 249 (RBUCO-001-01907).

[19]Minerals Yearbook 1953, 347 (RBUCO00101847); Minerals Yearbook 1955, 363 (RBUCO00101856); Minerals Yearbook 1956, 385 (RBUCO00101860).

which had developed several more tunnels into the property, the longest of which was 1,800 feet. The Coeur d'Alene Mines Corporation formed in late 1928 and took an option on the Mineral Point group. By the following year, it had built an new surface plant at the Mineral Point mine. In 1930, Coeur d'Alene Mines conducted an extensive development program in both the Mineral Point and the St. Elmo groups of mines. With the onset of the Great Depression, however, the Mineral Point mine did not become a producer during the 1930s. Increasing prices in the late 1930s brought renewed vigor to the Coeur d'Alene Mines development program, and in 1940 the company built a mill. It began operating at the end of October. Capacity of the mill was increased to 600 tons/day in 1941, and the mine produced 87,672 tons of silver-copper ore, which the mill treated. Mineral Point output that year made it Idaho's largest copper producer and third-largest silver mine. The ore was also rich in antimony.[20]

The main mine portal was located in a narrow creek bottom. To allow additional room for surface plant, Coeur d'Alene Mines installed a 5-foot culvert in the creek and then filled the creek bottom with mine waste to create a relatively level mineyard. Other than this, most waste rock produced in the mine was used to backfill stopes. The mill was built 1,800 feet downstream. A surface tramway hauled ore from mine to mill. After passing through crushers and a ball mill, all the ore was run through the flotation plant. The company hauled concentrates to the Bunker Hill & Sullivan smelter by truck, travelling on the public highway. Tailings were discharged into the creek.[21]

Production at the Mineral Point exceeded 122,000 tons in 1942, but then output began to decline steadily due to a war-induced labor shortage and declining grade of the ore. In 1945, the mine only produced about 12,500 tons of ore, and the mill operated intermittently. Until early 1944, Coeur d'Alene Mines shipped its concentrates to the Sunshine Mining Company's works, which recovered antimony. Thereafter, concentrates were shipped directly to ASARCO's copper smelter at Tacoma. Through the second half of the 1940s and into 1951, Coeur d'Alene Mines focused mainly and exploration and development of the Mineral Point mine, running the mill only occasionally to treat ore of sufficiently high grade, when it was found, or to re-treat tailings for parties, like the Shoshone Leasing Company, that were in the business of leasing old tailings deposits. The Mineral Point mine and mill apparently closed in 1951.[22]

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[20]Earl Bennett, "Coeur d'Alene Mines Corporation," (unpublished, undated ms.), 1-5 (SUNSH-008-00247-251); E&MJ 54 (27 August 1892): 182 (RBUCO-001-0101); Mining Industry of Idaho for the Year 1929, 198 (RBUCO-001-02457); Mining Industry of Idaho for the Year 1930, 204 (RBUCO-001-02463); Mining Industry of Idaho for the Year 1941, 212 (RBUCO-001-02914); Minerals Yearbook, 1941, 355 (RBUCO-001-01790).

[21]Robert D. Baily, "Idaho Mine Increases Strategic Mineral Output," E&MJ 143 (July 1942): 52-54 (RBUCO-001-05225-227).

[22]Minerals Yearbook, 1942, 383 (RBUCO-001-01793); Minerals Yearbook, 1943, 374 (RBUCO-001-01798); Minerals Yearbook, 1944, 358-359 (RBUCO-001-01803); Minerals Yearbook, 1945, 375 (RBUCO-001-01808); Minerals Yearbook, 1946, 1444 (RBUCO-001-01814). For descriptions of the diminished operations at Mineral Point in the late 1940s and into 1951, see subsequent reports in Mineral Yearbook, 1946-1951.

Coeur d'Alene Mines Corporation conducted some minimal new development in the Mineral Point mine in 1952, exploring radioactive material for the Atomic Energy Commission. The effort evidently came to naught.[23]

The Mineral Point property sat idle for several years. Meanwhile, Coeur d'Alene Mines turned its attention to some other properties it had acquired in the vicinity, notably the Rainbow group of claims, purchased in 1941. During the 1950s, Coeur d'Alene Mines cooperated with several other mining companies to explore deep levels of ground east of the Silver Summit mine, owned by the Polaris Mining Company. The DMEA assisted the effort by providing a loan for the costs of exploration. The Polaris company (owned by Hecla) actually undertook the work. In 1957, the exploration drift entered Rainbow ground and tapped a vein of silver-copper ore. Coeur d'Alene Mines extracted about 25,000 tons of ore before work halted in 1958 due to a legal dispute that erupted between Coeur d'Alene Mines and Hecla concerning exploration costs. After the Court ruled on the case in 1963, Coeur d'Alene Mines turned to ASARCO for a partner in exploring and developing the Rainbow property. Work under a joint venture began in 1964. After a decade of exploration and development of what came to be called the Coeur project, ASARCO and Coeur d'Alene Mines began construction of a mill and surface plant for a mine that would become a major producer. The ten-year relationship had not been without its troubles, though. In 1971, ASARCO decided to terminate its role in the joint venture. Coeur d'Alene Mines contested the decision in court. After differences were resolved, development went ahead, and construction of a 450-ton mill began in 1975.[24]

Coeur mine and mill went into production in 1976 with concentrates going to the ASARCO smelters at El Paso and East Helena. ASARCO hauled concentrates by truck from the mill to the railroad along the South Fork. The company sent about half the tailings back into the mine to backfill stopes, piping the other half to the Osburn tailings pond. In 1980, Coeur was the fourth largest silver producer in the U.S., by which time the Coeur mill had a 600-ton/day capacity. Ownership of the joint venture changed in 1990. Prior to that year, Hecla Mining Company and Callahan Mining Corporation each owned small portions of the joint venture. In 1990, Coeur d'Alene Mines acquired Hecla's 5% share. The following year, Coeur d'Alene Mines acquired Callahan, and with it Callahan's 5% share in the joint venture. Those transactions gave Coeur d'Alene Mines a 50% share. Throughout those ownership changes, ASARCO remained as the operating partner. ASARCO closed the Coeur mine and mill in April 1991 due to low silver prices. As already mentioned in the section describing the Galena mill, Coeur d'Alene Mines and ASARCO consolidated their Coeur and Galena operations through the

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[23]Mineral Yearbook, 1952 303 (RBUCO-001-01843). This is the only known reference to the Coeur d'Alene Mines Corporation cooperating with the AEC in this regard.

[24]Bennett, "Coeur d'Alene Mines Corporation," 5-11 (SUNSH-008-00251-257); ASARCO 1964 Annual Report, 13 (RBUCO-001-05085); ASARCO 1972 Annual Report, 10 (RBUCO-001-05093); ASARCO 1974 Annual Report, 17 (RBUCO-001-05097).

creation in 1995 of Silver Valley Resources Corporation, of which each parent company owns 50%. Silver Valley re-opened the Coeur property in June 1996.[25]

There is no evidence in the historical record that the United States was an operator of the Mineral Point or the Coeur mill. The United States did not own either mill, did not manage either mill, and did not own any of the materials processed at either mill. Nor, prior to 1968, did the United States inspect or in any way regulate the mills and their operations, including their generation and discharge of waste products. As noted above, the Mineral Point Company did cooperate during the 1950s with the Atomic Energy Commission and explore for radioactive material. Through that program, however, the United States did not in any way dictate operations at the Mineral Point mill.[26]

Osburn Tailings

In 1904, in response to complaints from downstream farmers that tailings were damaging their property, the major mining companies in the Coeur d'Alene district cooperated to build impoundments in an effort to keep tailings from flowing downstream. One such tailings impoundment was at Osburn. The dam at Osburn was severely damaged by a flood in 1917. Because the Osburn flat was already filled with tailings and other alluvium, the mining companies did not repair the dam. By that time, the amount of coarse tailings discharged directly into the South Fork and its tributaries had been greatly reduced because of the introduction of flotation. The historic alterations to the dam made by the mining companies and the movement of the tailings brought about by "natural" causes are described further below. The focus here is on the intentional re-treatment of the Osburn tailings.

Over the two decades after the 1917 flood, there were several minor attempts to re-treat materials in the Osburn dump, but none were of consequence. With the advent of high metals prices brought by the outbreak of World War II, some companies and metallurgists turned their attention to the Osburn and other tailings dumps in the South Fork basin. It was estimated that the Osburn dump (approximately one mile long and a half-mile wide) held upwards of 3,000,000 tons of tailings from upstream mills, including the Snowstorm, National, Morning, and Gold Hunter on the upper reaches of the South Fork; the Hercules, Tiger-Poorman, Frisco, Hecla, Standard, Mammoth, and smaller mills along Canyon Creek; the Interstate, Success, Rex, and smaller mills on Nine-Mile Creek; and the Hercules on the South Fork below Wallace. Hecla Mining Company built the most important tailings re-treatment plant at the Osburn dump.[27]

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[25]E&MJ 177 (July 1976): 23 (RBUCO-001-05168); 181 (May 1980): 94 (RBUCO-001-05389); ASARCO 1994 Annual Report, 11 (RBUCO-001-05154); ASARCO 1995 Annual Report, 11 (RBUCO-001-05156); ASARCO 1996 Annual Report, 17 (RBUCO-001-05159); Coeur d'Alene Mines Corporation 1995 Annual Report, 10-11 (RBUCO-001-05174-175); Coeur d'Alene Mines Corporation 1996 Annual Report, 17 (RBUCO-001-05172).

[26]Minerals Yearbook 1952, 303 (RBUCO00101843).

[27]Zeigler, "Tailings and Mine-Dump Reclamation in the Coeur d'Alenes during World War

In April 1943, Hecla built a small plant next to the Osburn dump to test a British method, called sink-float, for beneficiating the tailings and thereby make it economical to treat them by flotation. The plant quickly proved profitable, and Hecla expanded it to be able to process about 3,000 tons of material daily. That first year of operation (1943), Hecla treated 126,000 tons of Osburn tailings. Feed to the mill averaged about 2% lead, 2% zinc, and 1.6 oz. silver per ton. Power shovels excavated and loaded the tailings into bottom-dump trucks. The trucks dumped the material over a grizzly, which separated the tailings from river cobbles and driftwood. Large material was transported back to areas from which tailings had already been excavated. Once through the grizzly the excavated material was sent to screens and then a Huntington-Heberlein (H-H) sink-float plant, such as had been put in use at Bunker Hill & Sullivan's West mill near Kellogg. The H-H separator allowed Hecla to make a preliminary separation between coarse tailings that were more dense and merited further treatment and coarse materials that were less dense and could be discarded. Fines were also saved for re-treatment. Hecla's Osburn mill had its own 500-ton flotation plant, but much of the material separated in the sink-float process was hauled to Hecla's mill at Gem and the Polaris mill, which Hecla owned. Material shipped to Gem was hauled in railroad cars, while material shipped to the Polaris mill went by truck. Because of oxidation of tailings, especially of finer particles and especially of galena, recoveries were not as high as with unoxidized ore direct from a mine. This is because flotation was not effective at recovering oxidized mineral. Hecla estimated that it recovered about 50% of the lead, 65% of the silver, and 75% of the zinc.[28]

There was so much material available on the Osburn dump, and Hecla's sink-float plant was of sufficient capacity, that in 1945 Hecla's Osburn operation was the second only to Sunshine as a silver producer in Idaho, second only to BH&S as a lead producer in Idaho, and second only to the Star mine as a zinc producer in Idaho. The operation recovered those mineral values from 974,433 tons of tailings treated in 1945. By the end of 1948, Hecla had treated over 3,800,000 tons of Osburn tailings. But in December 1948, Hecla's plant was destroyed by fire. In 1946, the Zanetti Brothers had also begun excavating old tailings from the Osburn dump, hauling their material to the Galena mill, which they owned and operated, and to the Polaris mill. The Zanettis also began working the DeBlock tailings deposit upstream of the Osburn dump, near the mouth of Lake Creek.[29]

II," 1-3, 7 (FLQCA-001-03684-685, 687).

[28]Zeigler, "Profits for Hecla from 40-Year-Old Tailings," E&MJ 145 (May 1944): 68-71 (FLQCA-001-04349-352); Zeigler, "Tailings and Mine-Dump Reclamation in the Coeur d'Alenes during World War II," 7-10 (FLQCA-001-03687-689); R.R. Knuckey, "The Huntington-Heberlein Sink-and-Float Process," Mining Technology 7 (July 1943): 1 (FLQCA-001-04354); C.Y. Garber, "Preparation and Reconditioning of Sink-Float Media," Mining Technology 10 (May 1946): 4 (FLQCA-001-03693); Minerals Yearbook, 1943, 375 (RBUCO-001-01798); Minerals Yearbook, 1944, 357 (RBUCO-001-01802).

[29]Zeigler, "Tailings and Mine-Dump Reclamation in the Coeur d'Alenes during World War II," 9 (FLQCA-001-03688); Minerals Yearbook, 1943, 375 (RBUCO-001-01798); Minerals Yearbook, 1944, 357 (RBUCO-001-01802); Minerals Yearbook, 1945, 374 (RBUCO-001-

There is no evidence in the historical record that the United States was an operator of the Osburn mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Historic Movement of Tailings and Other Solids down the South Fork

Because of the ample and continuous supply of tailings being discharged into the upper reaches of the South Fork in the vicinity of Mullan and into Canyon Creek, and because those two streams joined just upstream of Wallace, that city frequently experienced problems caused by tailings accumulating in the bed of the South Fork as it passed through town. At least by 1906, a pile-and-plank retaining wall had been built along the banks of the river as it passed through town, perhaps to prevent water from flowing out of the banks, and perhaps to confine the channel in hopes the consequent increased velocity would help keep the channel clear of tailings.[30] While Wallace struggled with its tailings problem, mining companies continued to discharge tailings into streams. After 1901, however, the companies did take steps to impound tailings at several points in the Coeur d'Alene River system. Those and other actions taken by the mining companies and others, with regard to the middle reaches of the South Fork, are described in this section.

1. Free-Flowing Tailings: 1888-1903

For the first fifteen years of mining in the Coeur d'Alenes, when there was no effort to impound tailings along Canyon Creek or the South Fork, fine tailings tended to flow downstream toward Cataldo and coarser tailings tended to settle out along the river banks or in the river bed. This was the behavior of tailings as described by witnesses on both sides in the early twentieth-century litigation brought by farmers against the mining companies. Davis Holderman, one of the witnesses for the plaintiffs, and a land-owner along the Coeur d'Alene River, testified that only fine tailings made it as far as his place. Describing conditions along the South Fork between Wallace and Wardner, he said that during low water, lots of tailings deposits developed along bottom land through the middle reaches of the South Fork. During high water, the increased

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01808); Minerals Yearbook, 1946, 1443 (RBUCO-001-01813); Minerals Yearbook, 1947, 1412 (RBUCO-001-01819); Minerals Yearbook, 1948, 1506 (RBUCO-001-01825); Minerals Yearbook, 1949, 1478 (RBUCO-001-01830).

[30]Joseph P. Keane to W. Clayton Miller, letter dated 12 December 1906 (ASAID-082-00032-00037); RHK to W. Clayton Miller, letter dated 2 May 1907 (ASAID-082-00026-027); "Sanborn Map for Wallace" (1908), sheets 2 & 7 (FLQCA-001-02783-792); "Flood, Wallace, Idaho" (FLQCA-001-04988); "South Fork of Coeur d'Alene River" (FLQCA-001-04992); "South Fork of Coeur d'Alene River" (FLQCA-001-04993) "South Fork of Coeur d'Alene River" (FLQCA-001-04994).

flow, he said, tended to move the coarse tailings further downstream and to shift the deposits from place to place. In testimony, the manager of the Federal Mining & Smelting Company, W. Clayton Miller, corroborated the tendency of the greater current during high water to erode tailings deposited along the banks of streams during periods of low water.[31]

Because of the large output of tailings from the upper South Fork and especially Canyon Creek, tailings began to accumulate near the mouth of Canyon Creek, just above Wallace, very early in the history of the mining district. In 1900, Thrasher & Saulsbury established a mill for re-working tailings at Wallace. Their plant housed four vanners and several settling tanks in which feed for the vanners was allowed to precipitate. Two of the tanks were each 100 feet long. The description of the Thrasher & Saulsbury mill matches a depiction on the 1901 Sanborn Fire Insurance Map for Wallace, which is labeled the Idaho Concentrating Company Silver & Lead Concentrator, about which no other record has been found. The facility shown on the Sanborn Map was located along the south side of the South Fork just below the mouth of Canyon Creek, which would have given the mill ready access to tailings. A flume on a trestle delivered water (and perhaps tailings) to the mill from Canyon Creek. A tailrace exited the middle of the north side of the building and discharged directly into the creek. The mill was not running when the 1901 Sanborn survey was done, and by 1905, when the next Sanborn map appears, the mill was abandoned. The flume on a trestle was also gone.[32]

In 1908, there was a concentrator at that location, but it may have been a different structure. The outline of the building on the 1908 Sanborn map is slightly larger than that in 1901/1905, and it is shifted some twenty feet downstream. The building, now identified as the silver and lead concentrator of the Mitchell Concentrating Company, housed jigs at its upstream (east) end, tables in the middle section, and settling tanks at the downstream end. In 1909, the Mitchell Concentrating Company had a plant for treating tailings from the South Fork. After a period of experimentation to find a profitable method, the plant re-opened in April 1909 with two vanners and five tables. Although the plant was owned by Mitchell, it was operated during that period under a lease by Thomas Cameron. By 1912, the mill of the Mitchell Concentrating Company was gone.[33]

Apparently, other tailings re-treatment took place in Wallace besides that just below the mouth of Canyon Creek. In spring 1906, the Wallace city council accepted bids for the privilege of treating tailings in the bed of the South Fork where it passed through town. It was reported

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[31]Davis R. Holderman, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 210 (FLQCA-001-04586); W. Clayton Miller, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 2222-2223 (FLQCA-001-04778-779).

[32]E&MJ 70 (20 October 1900): 468 (RBUCO-001-0345); "Sanborn Map for Wallace" (1901), sheet 6 (FLQCA-001-02774); "Sanborn Map for Wallace" (1905), sheet 6 (FLQCA-001-02780).

[33]M&SP 98 (17 April 1909): 538 (FLQCA-001-0399), (24 April 1909): 571 (FLQCA-001-0401); "Sanborn Map for Wallace" (1908), sheet 7 (FLQCA-001-02792); "Sanborn Map for Wallace" (1908, up-dated to 1912), sheet 7 (FLQCA-001-02800).

that the town possessed a bed of tailings between four and seven feet deep. R.B. Bohannon and George Bannister were the two bidders for the privilege, with Bohannon getting the work with a $450 bid. Bannister, who had been jigging tailings in Canyon Creek for more than a year, bid $50 less. In 1907, Herman Hueman and Richard Emmons made plans to install a tailings plant at Wallace as well. They intended to treat about 15 tons of tailings per day by using two 14-inch buckets to hoist material from the river bed.[34] There is no known connection between these small efforts and the work that was done at the Idaho Concentrating/Mitchell location described above.

2. Impounded Coarse Tailings, 1901-1917

In 1901, responding to complaints from downstream property owners that their property was being damaged by tailings flowing down the river, the Mine Owners Association built a pile-and-plank dam just above the village of Osburn to impound tailings at that point. Designer of the dam and supervisor of construction was Edward H. Moffitt, who, since 1899, had managed such mines as the Standard, Hecla, and Sixteen-to-One for John Finch and Amasa Campbell. He was not an engineer. He selected a dam site where the river bottom narrowed, just downstream of the Osburn flats. Construction began at the end of January and was completed in September 1901. At the time, Moffitt testified, there were no tailings deposited at the dam site, but tailings had already built up naturally through the Osburn flat. Moffitt's crews used a pile driver to set a line of wood piles into the river bed. Each pile was a minimum twelve inches in diameter and 24-34 feet long. Spaced eight feet apart, piles were driven 8-12 feet into the ground. Three-inch and four-inch wood planks were afixed along the upstream side of the piles. The planks extend about two feet below the original river bed. There were also some diagonal pilings driven against the dam to provide addition lateral stability. At a point about 100 feet north of the river channel, Moffitt's crews installed a spillway, built of log rip-rap set 4-5 feet into the river bed. The dam was about 1,100 feet long. The height of the upper lip of the spillway gave the initial dam a head of 12 feet. Cost of the structure was $7.007.47. Moffitt estimated that, at the time he built the dam, the anticipated reservoir had an area of 300-400 acres.[35]

According to Moffitt, when the dam first began impounding water, he had trouble getting tailings to migrate all the way to the dam. Rather, the tailings were prone to settle out as soon as they hit the slack water of the impoundment, a point that moved upstream as the reservoir filled.

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[34]M&SP 92 (7 April 1906): 248 (FLQCA-001-0246); 94 (9 February 1907): 167 (FLQCA-001-0259).

[35]Edward H. Moffitt, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 1086-1094 (FLQCA-001-04706-714); "Diagram Showing Sectional View of Proposed Re-Inforcement Etc. of Osburn Dam," sketch dated June 1909 (ASAID-082-00041); W.L. Berglund to W.J. Hall, letter dated 15 January 1918 (ASAID-082-00007).

To counteract this tendency, Moffitt had his crews divert the flow of the river first to one side of the valley and then the other in an effort to transport tailings all the way to the face of the dam.[36]

As the companies were building the dam, they also acquired about 300 acres of land along the South Fork that would become the tailings reservoir. Members of the Association that helped pay for the cost of land, construction, and maintenance included the Standard Mining Company, Mammoth Mining Company, Hecla Mining Company, Buffalo Hump (Tiger-Poorman) Mining Company, Morning Company (Larsen and Greenough), and Gold Hunter Mining and Smelting Company. The Frisco mill was not operating at the time, so the Frisco Consolidated Mining Company did not contribute to the construction costs. By the time of the McCarthy v. BH&S trial in December 1905, the Federal Mining & Smelting Company had consolidated the Standard, Mammoth, Buffalo Hump, and Morning companies. Shortly before the McCarthy v. BH&S trial, the companies raised the height of the dam, and Hecla's manager testified that the companies intended to continue doing so as appropriate.[37]

At the end of 1906, by which time a considerable volume of tailings had collected behind the Osburn dam, the tailings problem persisted at Wallace. A deep bed of tailings kept accumulating in the channel of the South Fork, which ran along the north edge of town. There was apparently some local belief that the Osburn dam was now contributing to Wallace's tailings problem. The Federal Mining & Smelting Company asked a mining engineer to investigate. By examining tailings depositions between Wallace and the dam, he concluded that the Osburn dam was not contributing to the problem. He did identify the tailings coming down Canyon Creek and flowing into the South Fork just above Wallace as a major source of the problem, and he recommended construction of a tailings impoundment on Canyon Creek. His recommendation contributed to the formation of the Canyon Creek Tailings Association and the construction of a dam in the Woodland Park area.[38] The Canyon Creek tailings impoundment is described in another part of this report.

In November 1906, a winter flood hit the Coeur d'Alene district. Wallace was especially hard hit. The channel of the South Fork passing through Wallace was already clogged with tailings from Mullan and Canyon Creek, which, according to local observers, forced the flood waters to spill over the banks more readily during the flood. During the flood, the torrent of

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[36]Moffit testimony, 1093 (FLQCA-001-04713).

[37]James F. McCarthy, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 936-940, 1014, 1068-1069 (FLQCA-001-04653-657, 682, 692-693); Moffitt testimony, 1087-1088, 1095-1097 (FLQCA-001-04708-709, 04715-717); Complaint, in Jacob Polak v. Bunker Hill & Sullivan, et al, 22 (FLQCA-001-04826).

[38]Joseph P. Keane to W. Clayton Miller, letter dated 12 December 1906 (ASAID-082-00032-037); 14 December 1906 (ASAID-082-00016); James F. McCarthy to Miller, letter dated 18 December 1906 (ASAID-082-00018); Keane to Miller, letter dated 19 December 1906 (ASAID-082-00017).

water rushing down Canyon and Nine-Mile creeks scoured more tailings from those drainages, discharging the material into Wallace, reportedly making matters worse.[39]

Shortly after the flood had crested, a Federal Mining & Smelting Company employee inspected damage to the Osburn dam. The current had begun to erode the north abutment of the dam, and further damage had been averted during the crest by dumping stone into the river at that point. An eddy downstream of the south end of the spillway had begun to undermine the spillway. By the time the flood occurred, the impoundment had filled with tailings, so the Federal company inspector noted that even coarse tailings were being washed over the spillway. The following summer, Federal used log wingdams to divert the flow of the river, beginning in the vicinity of the mouth of Argentine Gulch (about 1-1/3 miles above the dam), and throw it against the base of the hills along the north side of the valley. This strategy allowed the current to carry tailings to a part of the valley that had yet to fill behind the dam.[40]

By 1909, the Osburn dam had begun to deteriorate. Pilings were failing and planking along the lower courses was rotting. W.L. Berglund, who inspected the dam for Federal, recommended to his company that a second line of pilings be driven about nine feet downstream of the existing dam, that planks be afixed to the new set of pilings, and that tailings from behind the dam be placed between the two lines of pilings, thus reinforcing the original dam. Berglund was authorized to make the improvements he recommended, and he apparently did add a second line of piles to the Osburn dam. By 1909, the Osburn impoundment had fairly filled with tailings, and tailings were flowing over the spillway. Berglund reported that banks of tailings had accumulated below the spillway.[41]

By 1917, the Osburn dam was in poor repair, but the Mine Owners Association continued to maintain it. The spillway had been partially eroded away. Just as Federal company crews began making spring repairs, spring run-off brought high water down the South Fork, damaging the diversion structure at Argentine Gulch, washing out dikes the company had built to protect low land adjacent to the impoundment, and then on May 12th destroying a portion of the dam. Federal made some repairs, but then an even more devastating flood hit late in the year. In December 1917, high water and fast-moving current took out the spillway at the Osburn dam. The dam was 16 feet high at the time. The flood and subsequent flow of the river eroded a deep

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[39]"Wallace Flooded," The Idaho Press (17 November 1906): 2 (FLQCA-001-04483).

[40]Rush J. White to W. Clayton Miller, letter dated 21 November 1906 (ASAID-082-00046-048); Berglund to Miller, letter dated 14 August 1907 (ASAID-082-00050-051); Berglund to Burbidge, letter dated 5 June 1909 (ASAID-082-00058-059).

[41]W.L. Berglund to Frederick Burbidge, letter dated 14 June 1909 and accompanying drawing (ASAID-082-00038-00041; Berglund to Burbidge, letter dated 6 September 1909 (ASAID-082-00044-045). A view of the Osburn dam, believed to be from 1920 and showing its damaged state after the 1917 flood, clearly shows the second line of piling just downstream of the first; see "Mine tailings," photo in The Shoshone News Press (31 January 1992): n.p. (ASAID-082-01112).

channel through the tailings that had been impounded behind the dam. The flood altered the location of the river channel by several hundred feet in some locations, both above and below the dam. The flood also eroded away tailings that had built up immediately behind the dam, and for the entire height of the dam, along about 800 feet of its 1,100-foot length. Charles Olson, a mining and civil engineer testifying in a 1923 tailings case, estimated that at the time there were still about 6,000,000 tons of tailings behind the dam. He also estimated that about the same amount had been eroded from the impoundment during and since the 1917 flood. Olson also testified that the material impounded behind the Osburn dam was considerably more coarse than that impounded behind the Pine Creek dam, about eleven miles downstream and described in another section of this report.[42]

3. Free-Flowing Fine Tailings, 1917-1968

Because the tailings impounded behind the Osburn dam were relatively coarse, those that eroded through the channel opened by the 1917 flood migrated relatively slowly downstream. A decade later, much of that eroded material was still spread across the valley bottom immediately below the dam.[43]

Meanwhile, 1917 was also near beginning of the era of flotation. Thereafter, companies discharged ever smaller amounts of coarse tailings into the streams. By 1930, virtually all tailings being discharged into the Coeur d'Alene River system were very fine flotation tailings, which flowed readily through the middle reach of the South Fork.

4. Re-Working Coarse Tailings during the World War II Era

As described in the section above on Hecla's Osburn tailings plant, much of the galena in the old tailings along the South Fork and its tributaries had oxidized and was therefore not readily recovered by flotation during the re-treatment campaign of the 1940s. Hecla estimated that it only recovered about 50% of the total lead in the old tailings. The remainder was re-introduced into the river system, but now in the form of much more finely ground solids. Rather than redepositing on areas like the Osburn flats, these fine particles were carried downstream with the other fine tailings produced by the flotation mills of the Coeur d'Alene district.

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[42]Berglund to Hall, letter dated 4 June 1917 (ASAID-082-00053-055); Berglund to Hall, 15 January 1918 (ASAID-082-00007-008); Charles O. Olson, testimony in Bunker Hill & Sullivan, et al, v. Jacob Polak, 132-134 (FLQCA-001-04821-823).

[43]Shonts, testimony in Bunker Hill & Sullivan, et al, v. Jacob Polak, 1086-1087 (FLQCA-001-04856-857).

MILO CREEK

Milo Creek is an important tributary of the South Fork. It drains a sizeable basin of steep mountain slopes south of Kellogg, and it carries a substantial flow of water year-round. That flow cascades down a relatively steep gradient through what has become the town of Wardner, one of the earliest mining settlements in the Coeur d'Alene mining district. More importantly, the Milo Creek basin is the location of the Bunker Hill, the Sullivan, and related claims upon which were built the Bunker Hill & Sullivan Mining & Concentrating Company (BH&S), owner of the largest mining operation in the Coeur d'Alene district and the largest single producer of tailings discharged into the Coeur d'Alene River system. The Milo Creek basin is also the location of the Last Chance and related claims that came to be owned by the Federal Mining & Smelting Company, another of the larger operating companies in the district. Federal came to be owned by ASARCO. Both BH&S and a historic predecessor of Federal had important early concentrators on Milo Creek above Wardner. Both mills discharged their tailings directly into the creek, which carried fines down to the South Fork. Some deposits of coarse jig tailings were left above Wardner, and these deposits became small sources of mineral value for early tailings re-treatment plants.

Bunker Hill & Sullivan Mill

Four prospectors, Noah S. Kellogg, Philip O'Rourke, Cornelius Sullivan, and Jacob Goetz, filed and acquired several claims in upper Milo Creek in summer 1885. Those claims included the Bunker Hill and the Sullivan. James F. Wardner joined forces with them that fall to raise capital to develop the claims.[1] With financing from Helena capitalists, including Anton M. Holter and Samuel T. Hauser (who soon also acquired interests in the Helena & Frisco mine on Canyon Creek), Wardner formed the Helena Concentrating Company to build a mill and concentrate 50,000 tons of ore from the Bunker Hill and the Sullivan mines. Construction of the mill began in April 1886, and the mill began operating by August 1. The mill had a capacity of 100 tons/day and reportedly operated at ratio of concentration of about 5:1. Simeon G. Reed was soon brought into the deal as well. After further development of the mines and on the basis of a favorable report from Clayton, Reed formed the Bunker Hill & Sullivan Mining & Concentrating Company, incorporated at Portland, Oregon, in July 1887. The BH&S paid the original locators for their claims in stock, but in a short time they all had sold their shares. From the beginning of operation through mid-1889, BH&S and its predecessors mined about 144,000 tons of ore and hauled about 24,000 tons of ore and concentrates by wagon from the mill to a boat landing at

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[1]The origins of the Bunker Hill & Sullivan and the discoveries of its first claims are shrouded in myth. Only the main names and dates are provided here, as recounted in T.A. Rickard, "The Bunker Hill Enterprise," M&SP 120 (24 January 1920): 109-116 (FLQCA-001-03972-979).

Cataldo, where they were loaded on boats for shipment down the Coeur d'Alene River and across the lake. The remainder was presumably tailings dumped into Milo Creek.[2]

BH&S management said the cause of the mine and mill closure in May 1889 was the excessive rates being charged by the railroad to ship ore and concentrates to the smelter in Montana. During the closure, BH&S decided to build a new mill near the railroad line. Ore would be hauled from mine to mill by means of an aerial tramway almost two miles long. During the period of suspended production, BH&S continued an intensive program of development in the mine, putting a substantial amount of ore aside for treatment later. The original mill above Wardner did not operate again. The new mill, which came to be known as the South mill, began running in mid-1891.[3] It is described elsewhere in this report.

There is no evidence in the historical record that the United States was an operator of Bunker Hill's Milo Creek mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Last Chance Mill

In the midst of the claims owned by the Bunker Hill & Sullivan empire at the head of Milo Creek, Charles Sweeney owned two adjoining claims, the Last Chance and the Emma, which he developed intensively during summer 1889. He also began construction of a mill to concentrate ores from his mines. The mill was built on the west side of Milo Creek at the upper (south) end of Wardner. An inclined gravity tramway conveyed ore from mine to mill. The mill was operating by October. It closed during the winter of 1888-1889, while development of the Last Chance and Emma mines continued. Operations at the mill resumed in late May 1889. The Last Chance Mining Company enlarged the mill later that summer to a capacity of 120 tons/day, also adding automatic equipment aimed at reducing labor needs. As a part of the 1889 improvements, the company also re-built the tramway between mine and mill, installing a system of automated ore cars. Reflecting a trend throughout the Coeur d'Alene district, the company periodically added equipment aimed at recovering additional values from fine tailings before they were discharged into the creek. Also typical of other operations in the district, the Last Chance

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[2]Rickard, "The Bunker Hill Enterprise," M&SP 120 (3 April 1920): 485-486 (FLQCA-001-04007-008), (15 May 1920): 703-704 (FLQCA-001-04030-031); "First Bunker Hill Mill, Wardner, Idaho" (FLQCA-001-03251); "Sullivan Mine and 1st Concentrator" (FLQCA-001-03254); Bunker Hill and Sullivan Mining and Concentrating Company, Twenty-Ninth Annual Report for Year Ended December 31, 1916, 40 (FLQCA-001-04438).

[3]M&SP 58 (11 May 1889): 337 (FLQCA-001-01111); 63 (8 August 1891): 85 (FLQCA-001-01185); Rickard, "The Bunker Hill Enterprise," M&SP 120 (3 April 1920): 485 (FLQCA-001-04007), (15 May 1920): 704 (FLQCA-001-04031).

occasionally suspended production or ran at less than full capacity due to depressed metals prices, labor conflict, high freight rates charged by the railroads, etc.[4]

In late 1892, there was a report that the Last Chance Mining Company was contemplating building a new mill of larger capacity. This did not happen, however, until 1900-1901, when the Empire State-Idaho Mining & Development Company, by then owner of the Last Chance properties, built the Sweeney mill at the mouth of Government Gulch (see Lower South Fork section of this report). Meanwhile, the Last Chance mill above Wardner continued to treat ore from the Last Chance and Emma mines, with occasional periods of diminished activity, through the remainder of the 1890s. By the time the mill closed in 1901, its size had grown to the extent that the structure bridged Milo Creek. An ore bin for receiving material from the mine via the inclined tramway sat about 100 feet west of the mill. A covered tramway, elevated on a trestle, carried ore from that bin across Wardner's Main Street to the mill. Slime tanks were housed in a portion of the mill that had been added on the east side of Milo Creek. The Last Chance mill recovered 75-80% of the lead and silver in the ore, the remainder being discharged with the slimes and coarse tailings into the creek. The Empire State-Idaho company began removing equipment from the old Last Chance mill immediately after the Sweeney mill opened in 1901, and the entire mill was demolished by 1905. The only structures that remained on the site were associated with an air-compressor plant Empire State-Idaho had built across Main Street from the Last Chance mill. The compressor plant continued to be used by the Federal Mining & Smelting Company (successor to Empire State-Idaho) after the mill was gone.[5]

There is no evidence in the historical record that the United States was an operator of the Last Chance mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

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[4]M&SP 57 (8 September 1888): 157 (FLQCA-001-01084), (22 September 1888): 197 (FLQCA-001-01086), (13 October 1888): 241 (FLQCA-001-01089); 58 (9 March 1889): 165 (FLQCA-001-01104), (1 June 1889): 397 (FLQCA-001-01117); 62 (25 April 1891): 261 (FLQCA-001-01171); E&MJ 48 (6 July 1889): 13 (RBUCO-001-020), (31 August 1889): 189 (RBUCO-001-0023), (21 September 1889): 253 (RBUCO-001-0025); 54 (8 October 1892): 350 (RBUCO-001-0107), (5 November 1892): 446 (RBUCO-001-0111), (24 December 1892): 614 (FLQCA-001-0115); Richards, Ore Dressing (1906), 945-946 (FLQCA-001-04877-878); "Sanborn Map for Wardner" (1901), sheet 3 (FLQCA-001-03026).

[5]E&MJ 54 (24 December 1892): 614 (RBUCO-001-0115); M&SP 89 (19 November 1904): 348 (FLQCA-001-0174); Richards, Ore Dressing (1906), 946 (FLQCA-001-04878); "Sanborn Map for Wardner" (1901), sheet 3 (FLQCA-001-03026); "Sanborn Map for Wardner" (1905), sheet 2 (FLQCA-001-03035-038).

Peeples and Cooperative Mills

In 1917, D.W. Peeples obtained a ten-year lease from Bunker Hill & Sullivan to treat an old dump covering ten acres near the Bunker Hill mine. This was apparently an old low-grade ore dump, not a tailings dump. It was material, assaying 3-5% lead, that had been mined in the 1880s but not milled. Peeples' original 200-ton mill was a conventional gravity concentrator, but he announced his intentions to add flotation cells soon. He remodelled the mill in 1921, but its not known if that included the installation of flotation apparatus. After the remodelling, Peeples turned his attention to old workings from the Stemwinder, Last Chance, and Sierra Nevada workings, also up Milo Creek above Wardner. Another flotation plant had also been built in upper Milo Creek. Originally called the Cooperative concentrator, it was located near Bunker Hill & Sullivan's Reed adit about 800 feet downstream (northeast) of the Peeples concentrator. In 1921, the Reed Level Mining Company consolidated the Cooperative mill and several leases granted by BH&S to extract ore from the old upper workings in the mine. The Reed company also installed a pump capable of conveying some 15,000 tons of slimes from an impoundment below the mill back through the flotation plant. The slimes were from earlier milling operations, presumably by the Cooperative mill before flotation equipment was installed. Situated in a narrow canyon, the Peeples and Cooperative mills undoubtedly discharged their fine flotation tailings directly into Milo Creek to be carried downstream.[6]

There is no evidence in the historical record that the United States was an operator of either the Peeples mill or the Cooperative mill. The United States did not own the mills, did not manage the mills, and did not own any of the materials processed at the mills. Nor did the United States inspect or in any way regulate the mills and their operations, including their generation and discharge of waste products.

Tailings Re-Treating Mills on Milo Creek

Shortly after the Last Chance mill closed, J.L. Safford and G. Safford set up a small jigging operation downstream of the mill. During fall 1904, they sluiced solids from the creekbed, from the millsite down to their jigging plant. In a two-week period, they produced 20 tons of concentrates assaying about 50% lead. A report describing the jigging operation noted that, in addition to the Last Chance mill, the city of Wardner dumped its waste into creek, and the Safford's recovered an wide assortment of other artifacts besides tailings. The Safford brothers resumed their sluicing of Milo Creek and jigging of tailings in spring 1905. There are no further reports of the Saffords re-working tailings, although they were involved in litigation with Bunker Hill & Sullivan over the right to treat tailings.[7]

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[6]M&SP 155 (28 July 1917): 141 (FLQCA-001-0795); 122 (26 February 1921): 304 (FLQCA-001-01017), (16 April 1921): 544 (FLQCA-001-01025), (28 May 1921): 758 (FLQCA-001-01033).

[7]M&SP 89 (19 November 1904): 348 (FLQCA-001-0174); 90 (8 April 1905): 225 (FLQCA-001-0195); 97 (7 November 1908): 618 (FLQCA-001-0370); "Sanborn Map for Kellogg" (1928), sheet 18 (FLQCA-001-02313-216).

In fall 1907, the Shoshone Concentrating Company formed to build a 300-ton mill for the purpose of re-treating tailings from the Last Chance mill at Wardner. Directors of the company were M.C. Murphy, Julius Zittel, and William A. Bradley. A report at the time speculated that there were 1,600,000 tons of tailings available, but the estimate is certainly inaccurate, given the capacity of the Last Chance mill and the length of time it operated.[8] The record does not indicate how much material Shoshone Concentrating worked during the short time it operated. The Shoshone company's mill was destroyed by fire in May 1909, just before it was schedule to resume operations, presumably after being closed for the winter when it was not possible to excavate tailings from the creek bed.[9]

There is no evidence in the historical record that the United States was an operator of the tailings mills on Milo Creek. The United States did not own the mills, did not manage the mills, and did not own any of the materials processed at the mills. Nor did the United States inspect or in any way regulate the mills and their operations, including their generation and discharge of waste products.

Historic Movement of Tailings and Other Solids down Milo Gulch

There is little information about tailings in Milo Creek. That some old tailings deposits survived in the creek bed at least a few years after the 1890s mills closed can be seen by the re-treatment campaigns the material inspired in the first decade of this century. The rest of the tailings discharged by the Milo Creek mills must have flowed out into the South Fork.

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[8] M&SP 95 (2 November 1907): 543 (FLQCA-001-0307). For the Last Chance mill to have *treated* 1,600,000 tons of material, it would have had to have milled about 450 tons/day continuously for ten years. The Last Chance mill only had a capacity of 150 tons/day, and it did not run continuously during the 1890s.

[9] M&SP 97 (12 December 1908): 797 (FLQCA-001-0382); 98 (15 May 1909): 678 (FLQCA-001-0403).

LOWER SOUTH FORK DRAINAGE

Kellogg downstream to confluence with North Fork

For purposes of this report, the lower stretch of the South Fork Coeur d'Alene River extends from the mouth of Milo Creek, just above Kellogg, to the confluence with the North Fork Coeur d'Alene River. Through most of this stretch, the river bottom is fairly wide. At about the mouth of Mile Creek, the South Fork, flowing westward, exits a narrow canyon and enters the broadest valley along its course. For about five miles, from the mouth of Milo Creek to the mouth of Pine Creek, the valley's breadth ranges from as little as 1,500 feet in some areas to as wide as about 4,000 feet in the vicinity of Smelterville. The valley is enclosed by steep mountains, similar to those found throughout the rest of the district. Kellogg, the former Bunker Hill & Sullivan smelter site, and large, historic tailings impoundments occupy the valley. Several concentrators also occupied ground in the valley, either along the South Fork or a short distance up some of the small tributaries that flow into the valley. Just below the mouth of Pine Creek, at the western end of the valley, the South Fork enters another canyon with steep sides but a flat floor narrowing to no less than 250 feet. After flowing a couple of miles through this canyon, the South Fork then flows out into another valley where it meets the North Fork. Almost from the beginning of mining and milling in the Coeur d'Alene district, concentrators occupied ground in the Kellogg valley, piling tailings on the valley floor and discharging tailings into the South Fork and its tributaries.

Stemwinder Mill

The earliest mines to be exploited in the immediate vicinity of Kellogg were up Milo Creek in the Wardner area. The Last Chance and the Bunker Hill & Sullivan companies built their first mills above Wardner. The Stemwinder Mining Company, however, built its mill just above Kellogg, at the base of a bluff along the Coeur d'Alene River near the mouth of Milo Creek. Built in 1887, it was one of the early lead-silver concentrators in the Coeur d'Alene district. It employed an array of jigs, vanners, and buddles typical of lead-silver concentrators in the district. George B. McAulay managed the Stemwinder operation, as well as that of the Granite mine up Canyon Creek. The Stemwinder hauled ore from its mine in Milo Creek to the mill at Kellogg by means of an aerial tramway about two miles long. The system featured 175 buckets attached to the cable for carrying ore. Operations of mine and mill in the late 1880s and 1890s were intermittent due to technical problems with the tramway and freight rate disputes with the railroad. Despite its troubles, the Stemwinder company reportedly doubled its mill capacity in 1891 to about 120 tons/day. A report in 1892, however, said the mill had a capacity of 80 tons/day, and Richards said the mill's capacity was 75 tons/day. In early 1893, after several months of brisk production, the Stemwinder closed mine and mill. Later that year, the company tried, on at least two occasions, to lease its mine to individuals who, it was hoped, could develop new ore bodies, load ore onto the Stemwinder tramway, and deliver it to the mill, where the

Stemwinder company would treat it. These attempts were not successful, and mine and mill sat idle for a couple years.[1]

The Stemwinder property did not operate again until late 1895, when both mine and mill were leased by J.E. Bascombe and perhaps others. The mill produced about 250 ton of concentrates monthly, maintaining that output at least into mid-1896. The resurgence was short-lived, however, and the property was soon acquired by Bunker Hill & Sullivan. By October 1897, BH&S had begun mining Stemwinder ground through its own workings and had taken the machinery out of the mill.[2] Given its location along the South Fork, the Stemwinder mill undoubtedly discharged both its coarse and its fine tailings directly into the river.

There is no evidence in the historical record that the United States was an operator of the Stemwinder mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Bunker Hill & Sullivan's Mills

The history of the Bunker Hill & Sullivan Mining & Concentrating Company's concentrators is complex, because there were several of them, with interlocking histories, but it is also important, because the Bunker Hill & Sullivan milled more ore than any other company in the Coeur d'Alene district, and it produced more tailings than any other company. Those tailings were a significant part of the dynamic movement of fine, metal-bearing solids through the South Fork of the Coeur d'Alene River system.

The first Bunker Hill & Sullivan (BH&S) mill, built in 1886, was located in Milo Gulch adjacent to the Reed tunnel (see section of this report on Milo Gulch). BH&S built another mill

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[1]Richards, Ore Dressing, 951-954 (FLQCA-001-04880-882); Timothy McCarthy, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 653 (FLQCA-001-04629); E.H. Moffitt, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 1119-1120 (FLQCA-001-04735-736); M&SP 57 (8 September 1888): 157 (FLQCA-001-01084), (29 September 1888): 213 (FLQCA-001-01087); 58 (16 March 1889): 185 (FLQCA-001-01105), (11 May 1889): 337 (FLQCA-001-01111); 59 (21 December 1889): 469 (FLQCA-001-01138); 63 (26 September 1891): 199 (FLQCA-001-01188); 67 (16 September 1893): 190 (FLQCA-001-01253), (2 December 1893): 366 (FLQCA-001-01265); 69 (14 July 1894): 19 (FLQCA-001-01302); E&MJ 49 (18 January 1890): 91 (RBUCO-001-0031), (1 February 1890): 143 (FLQCA-001-0032); 52 (26 September 1891): 366 (RBUCO-001-0073); 54 (17 September 1892): 275 (RBUCO-001-0104), (1 October 1892): 326 (RBUCO-001-0106), (15 October 1892): 374 (RBUCO-001-0108), (5 November 1892): 446 (RBUCO-001-0111), (24 December 1892): 614 (FLQCA-001-0115).

[2]M&SP 71 (16 November 1895): 322 (FLQCA-001-01389); 72 (14 March 1896): 211 (FLQCA-001-01409), (2 May 1896): 363 (FLQCA-001-01420).

in 1890 along the Oregon Railway & Navigation Company's tracks through Kellogg. The new mill, which came to be known as the South mill, was linked to the mine by means of an aerial tramway two miles long. Primary crushing took place at the mine. BH&S employed an elaborate system to move ore from the various mine workings to the crusher and to move crushed ore to the mill. Ore from a mountain-side open cut was delivered to the crusher by means of 1,200-foot aerial tramway having a capacity to move 25 tons/hour. Ore from other upper workings was delivered from mountain-side adits by means of a three-rail gravity tramway. Ore from the lowest workings was delivered from an adit at about the level of the crusher, to the crusher, by means of a surface tramway. Crushed ore was then delivered to the mill by means of the two-mile aerial tramway, which passed directly over the town of Wardner. The mill had a capacity to treat 400 tons/day, and the tramway could haul that much crushed ore in a ten-hour shift. Ratio of concentration varied between 4:1 and 8:1, depending on the tenor of the ore being treated. The mill produced concentrates assaying at more than 50% lead, but recoveries were relatively poor. In 1894, BH&S discharged 76,776 tons of tailings assaying at 4.19% lead. Recoveries improved during the ensuing years. In 1899, for example, BH&S discharged 151,917 tons of tailings assaying at 2.46% lead. During a labor strike in April 1899, dynamiters destroyed the mill.[3]

BH&S immediately rebuilt the concentrator on the same site and in much the same configuration as the 1890 mill. The new 750-ton mill went into operation on 10 September 1899. A wooden flume, elevated on a trestle, approached the mill from the east to supply it with water. Two flumes carried tailings away from the mill: an elevated launder headed north carrying coarse tailings to a dump; a tailrace headed northwest carrying slimes out onto the flat between Kellogg and the river. Coarse tailings ranged from 1/8-inch to 1-1/2-inch in size. In the early years of operation, the flat north of the mill was relatively densely timbered, and only a small area immediately north of the mill had been cleared for the tailings dump. The South Fork flowed near the BH&S tailings dump along the south side of the flat, rather than along the north side where it flows today. BH&S opened its Kellogg tunnel in 1902, allowing the company to tram ore underground a distance of two miles to a portal near the South mill, obviating the need for the tramway, which had proved troublesome. The portal to the Kellogg tunnel was about 600 feet south of the crusher house for the South mill and was connected to the crusher house by surface and elevated tramways. In 1906, under the direction of Gelasio Caitani, BH&S remodelled the mill, especially in the department treating fine tailings. The mill continued to use vanners, but Wilfley tables replaced buddles. These changes helped improve recoveries of lead and silver by the mill.[4]

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[3]V.M. Clement, "Description of Ore Handling at the Bunker Hill and Sullivan Mines, Wardner, Idaho," E&MJ 52 (25 July 1891): 99 (FLQCA-001-0063); "New Bunker Hill and Sullivan Mill," Mines and Minerals (March 1900): 343 (FLQCA-001-01901); Frederick Burbidge, testimony in Doty v. Bunker Hill & Sullivan, et al, 436-437 (FLQCA-001-06522-523); T.A. Rickard, "The Bunker Hill Enterprise," M&SP 120 (3 April 1920): 485 (FLQCA-001-04007).

[4]"New Bunker Hill and Sullivan Mill," Mines and Minerals (March 1900): 343 (FLQCA-001-01901); Burbidge testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 435, ,441, 445 (FLQCA-001-06514, 518, 524); Richards Ore Dressing (1906), 939 (FLQCA-001-

By the time of the early twentieth-century tailings litigation, the BH&S tailings had grown to a height of about 40 feet by one account and 70-80 feet by another. In late-1905 trial testimony, Stanley Easton of the BH&S estimated that about 1,500,000 tons sat on the company's tailings dump. He stated that about 60% of the tailings discharged by the BH&S mill was of a particle size greater than 10 mm, which he compared to coarse gravel. The Oregon Railway & Navigation Company had a railroad spur built onto the flat adjacent to the BH&S tailings dump, from which railroad cars could be loaded. From time to time, BH&S and the OR&N used a steam shovel to transfer large quantities of tailings from the dump to cars. One summer, for example, the railroad excavated about 180,000 tons of BH&S tailings for use as ballast along the Idaho & Northern line being built to Murray.[5]

In 1907, BH&S built another mill, known as the North mill, to re-treat old tailings stored on the dump from the South mill. It was located about 600 feet northwest of the South mill. As the South mill soon came to be overcrowded with new equipment, BH&S converted the North mill to serve as an annex for the South mill, installing an elevated flume to convey slimes from the South mill to the North mill for further treatment. The North mill treated 185 tons of fine tailings from the South mill each day, producing a concentrate assaying 43% lead and daily discharging 168 tons of slimes still assaying 4.5% lead. Even though the BH&S could have attempted to recover even more lead from these slimes, the economics of the operation made it more profitable to keep treating more raw ore rather than trying to recover more lead from slimes.[6]

04874); Richards Ore Dressing (1909), 1684 (FLQCA-001-01760); Rickard, "The Bunker Hill Enterprise," 485-490 (FLQCA-001-04007-012); "Sanborn Map for Wardner" (1901), sheet 5 (FLQCA-001-03029); "Bunker Hill Mill Before April 29, 1899," (FLQCA-001-03257); USGS, "Topographic Map for the Coeur d'Alene District" (1901), (FLQCA-001-001986). Richards (1906) described fine tailings going directly into the creek, not onto the dump with the coarse tailings. Burbidge asserted that the fine tailings were elevated onto the dump, and as the water filtered down through the coarse tailings most of the fines were captured. Burbidge allowed that some fines probably made their way to the South Fork. Richards (1909) corroborated that the fine tailings were elevated onto the dump with the coarse tailings. The key difference in the accounts is whether fine tailings were discharged onto the dump or directly into the river. The change in practice from direct discharge to "filtering" fine tailings through the coarse tailings dump probably occurred in the first few years of this century.

[5]Davis R. Hoderman, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 211 (FLQCA-001-04587); W. Clayton Miller, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 2222, 2226 (FLQCA-001-04778-782); Stanley A. Easton, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 2322-323, (FLQCA-001-04795-796); Easton, testimony in Doty v. BH&S, 946 (FLQCA-0010-0613); Burbidge testimony in Doty v. Bunker Hill & Sullivan, et al, 450 (FLQCA-001-06509).

[6]Rickard, "The Bunker Hill Enterprise," 490 (FLQCA-001-04012); "Sanborn Map for Wardner" (1908), sheets 1 & 2, (FLQCA-001-03051-055).

BH&S opened a new concentrator, called the West mill, in November 1909. Even as the South mill's capacity was pushed to its limits by BH&S output during the years 1907 to 1909, Caitani also used the plant to experiment with improved methods of concentration. Results of his experiments were embodied in the design for the West mill. In the period after 1909, both the South and West mills continued to use jigs for coarse concentration, because the BH&S ores were conducive to such treatment, yielding a relatively clean coarse tailing. Coarse tailings from the jigs assayed about 1.5% lead, considerably lower than the assay values for slime tailings. BH&S also found that if it used rolls to gradually reduce the particle size of the material moving through the mill, rather than trying to produce a fine particle size in relatively few stages, the company could minimize the production of slimes, and therefore minimize the loss of values due to the difficulty of concentrating slimes.[7]

In spring 1912, BH&S closed the South mill and opened West mill no. 2, built on the west side of the original West mill, which then came to be known as the no. 1 plant. The no. 2 plant was a mirror image of no. 1, and it was equipped with nearly the same array of mills, jigs, vanners, and tables. Each was capable of treating about 550 tons/day. R.S. Handy, the BH&S mill superintendent at the time, presented a paper to the AIME in 1912 showing, among other things, assay values for various portions of the overall tailings stream. After preliminary crushing, all the ore could pass a 30-mm screen. It was divided in two by sending it through 15-mm trommels. All of the oversized, meaning material between 15 and 30 mm, was sent to Harz jigs. This portion of the material passing through the mill amounted to about 260 tons/day. The coarse jigs daily produced about 25 tons of concentrates at 53% lead, about 80 tons of middling assaying about 9.8% lead and sent to other parts of the mill for further processing, and about 155 tons of tailings assaying about 0.4% lead. Two things are noteworthy about these tailings: 1) they were the coarsest the mill produced and therefore the least likely to flow very far from the end of the tailings launder, and 2) they were the cleanest portion of the tailings stream leaving the mill. Every other segment of the mill's flow sheet produced tailings richer in lead than that first set of jigs. The vanners discharged about 82 tons of tailings daily assaying about 5.4% lead, by far the richest portion of the tailings stream. Vanner tailings, along with the other slime tailings, were discharged into the tail race rather than onto the tailings dump. The tail race led to the South Fork. Overall, the mill daily discharged about 491 tons of tailings (ratio of concentration of 9.3:1) with an average assay of 1.92% lead.[8]

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[7]Rickard, "The Bunker Hill Enterprise," 490-493 (FLQCA-001-04012-015); "Sanborn Map for Wardner" (1908), sheets 1 & 2, (FLQCA-001-03051-055).

[8]Rickard, "The Bunker Hill Enterprise," 483, 493 (FLQCA-001-04015, 018); R.S. Handy, "The No. 2 Unit of the Mill of the Bunker Hill & Sullivan Mining & Concentrating Company," Trans. AIME 43 (1913): 685-692 (FLQCA-001-03437-441); "Sanborn Map for Kellogg" (1915), sheets 2 & 3, (FLQCA-001-02185-192); "Bunker Hill Mine Dump, Mill in Background, Kellogg, Idaho" (FLQCA-001-03244); "Historical Property Map," accompanying Bunker Hill and Sullivan Mining and Concentrating Company, Twenty-Ninth Annual Report for Year Ended December 31, 1916 (FLQCA-001-04420-421).

In 1911, BH&S remodelled the North mill again to resume re-treating old South mill tailings. These were coarse tailings that were first run through Harz jigs to: 1) produce tailings, which were returned to a dump, and 2) middlings, which were ground further and then concentrated on tables and vanners. During the summers of 1911, 1912, and 1913, BH&S re-treated 300,000 tons of old tailings in this manner. The impact of the re-treatment was that a small portion of the dump was ground to a finer particle size, the overall lead assay of the tailings dump was lowered, and some newly ground fine material was discharged into the river system. After the old tailings had been re-treated, BH&S remodelled the North mill again, installing experimental equipment for roasting and leaching metal-bearing materials. During the last half of the 1910s, BH&S experimented in the North mill with techniques for leaching, as an alternative to conventional metallurgical methods. Until 1917, the company was cooperating with the Salt Lake City Station of the U.S. Bureau of Mines in the conduct of the experiments. The North mill burned in January 1920.[9]

After the South mill closed in 1912, BH&S leased it for several months to leasers of the Tyler mine above Wardner. The Tyler lease used an aerial tramway to haul ore from the mine to a loading station in the Wardner vicinity and then a motor truck to haul ore from the end of the tram to the mill. The five-ton Packard truck also pulled a three-ton trailer. Working sixteen hours per day, it hauled 80-90 tons of ore daily. Given the attention it received, this may have been the first use of a motor vehicle to haul ore between mine and mill in the Coeur d'Alene district.[10]

BH&S remodelled the South mill in 1914 to serve as a concentrator for ores from the Sierra Nevada and Caledonia mines. By this time, BH&S had found flotation to be a much more effective means for concentrating the very fine fraction of material passing through the mill. BH&S installed a flotation annex at the South mill to treat Sierra Nevada and Caledonia ores. After the remodelling, the South mill was sometimes called the East mill. Fire destroyed it in summer 1920.[11]

BH&S also introduced flotation to its West mills in 1915. By that time, they each had a capacity to treat about 600 tons/day. Tailings discharges amounted to about 517 tons/day (ratio of concentration of about 7.3:1), and the average assay of the tailings was about 1.2% lead. With the introduction of flotation to treat the finest fraction of solids moving through the mills, no

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[9]Rickard, "The Bunker Hill Enterprise," M&SP 120 (10 April 1920): 528, 530 (FLQCA-001-04023, 025); Oliver C. Ralston, "Hydrometallurgy of Lead," Trans. AIME 70 (1924): 459-460, 467 (FLQCA-001-03498-499, 502); "Sanborn Map for Kellogg" (1915), sheets 2 & 3 (FLQCA-001-02181-188); M&SP 120 (24 January 1920): 135 (FLQCA-001-0945).

[10]M&SP 106 (3 May 1913): 669 (FLQCA-001-0555), (31 May 1913): 840 (FLQCA-001-0562), (28 June 1913): 1005 (FLQCA-001-0566).

[11]Rickard, "The Bunker Hill Enterprise," 528 (FLQCA-001-04023); M&SP 122 (28 May 1921): 758 (FLQCA-001-01033); "Sanborn Map for Kellogg" (1915), sheet 3, (FLQCA-001-02189-192); "Sanborn Map for Kellogg" (1918), sheet 3, (FLQCA-001-02237-240).

fraction of the tailings stream had a lead assay higher than 2.5%. The flotation cells discharged about 85 tons of tailings daily, assaying about 1% lead, a marked improvement over the slime tailings discharges by the vanners a few years earlier. To discharge coarse tailings from the West mills, BH&S had to elevate the material to convey it to the launder that carried it northwest of the North mill. The railroad continued to take some of the coarse tailings away in open gondola cars, using the material for ballast.[12]

As previously mentioned, the old South mill, sometimes called the East mill, burned in 1920. The fire apparently did little or no damage to the coal-fired steam power plant just west of the South mill. Due to depressed metals prices, BH&S did not rebuilt immediately. Reconstruction occurred in summer 1921. The new South mill was somewhat smaller than the old one. There had formerly been a Pelton wheel powerhouse within the old South mill, supplied by a flume carrying water from Milo Creek. A new Pelton wheel powerhouse, supplied by the same flume, was constructed on the east end of the coal-fired powerhouse. Nearly everything about the new South mill was smaller in plan than it had been, including the ore bin at the south end. The rock house and crusher remained intact about 200 feet south of the South mill's ore bin and remained connected to the bin by an elevated conveyor. An elevated flume still carried tailings away from the mill to the north. When BH&S began to treat ore from the Star mine (jointly owned with the Helca Mining Company) at the South mill in early 1925, BH&S built a new ore bin for Star ore west of the crusher. That year, the South mill also treated some lead-zinc ore for the Sidney Leasing Company from the Sidney mine on Pine Creek, as BH&S prepared for a prolonged relationship as the concentrator of Sidney ores. Thereafter, the South mill was sometimes called the Star mill. BH&S treated Star ores at the South mill until 1937, when the Star mill opened at Burke. In 1933, BH&S also began extracting complex lead-zinc-iron ore from its own mine and treating that material at the South mill as well. When the South mill closed in January 1938, BH&S treated its own complex ores at the West mill. Thereafter, the company removed the concentration machinery from the South mill and used the building for auto repair.[13]

The West mill remained Bunker Hill & Sullivan's main facility for concentrating BH&S ores. By 1930, other mills in the Coeur d'Alene district had, nearly without exception,

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[12]Rickard, "The Bunker Hill Enterprise," 528-530 (FLQCA-001-04023-025). Photographs of the facilities for loading coarse tailings into railroad cars ar shown on p. 524 (FLQCA-001-04029) of M&SP, immediately preceding the Rickard article.

[13]M&SP 122 (28 May 1921): 758 (FLQCA-001-01033), (18 June 1921): 855 (FLQCA-001-01037); Mineral Resources of the U.S., 1921, 6 (RBUCO-001-0694); Mineral Resources of the U.S., 1924, 279 (RBUCO-001-0709); Mineral Resources of the U.S., 1925, 549 (RBUCO-001-0719); The Mining Industry of Idaho for the Year 1937, 217 (RBUCO-001-01713); R.S. Handy, "The Evolution of a Flowsheet," E&MJ 140 (August 1939): 56 (RBUCO-001-01212); "Sanborn Map for Wardner" (1915), sheet 3, (FLQCA-001-02189-192); "Sanborn Map for Kellogg" (1918), sheet 3, (FLQCA-001-02237-240); "Sanborn Map for Kellogg" (1928), sheet 4, (FLQCA-001-02289-292); "Sanborn Map for Kellogg" (1928, up-dated to 1944), sheet 4, (FLQCA-001-02365-368).

completely abandoned gravity concentration in favor of flotation. Bunker Hill & Sullivan, however, continued to used jigs at the West mill to produce coarse concentrates. The mill did not discard any coarse tailings, though, as all material rejected by the jigs was further ground and subjected to flotation. BH&S continued to elevate its flotation tailings onto the giant tailings dump accumulating on the flat north of the mill. As noted in the previous paragraph, the West mill was modified in 1938 to handle complex lead-zinc-iron ores. During World War II, to expand the mill's capacity and increase the company's output of lead, BH&S installed a Huntington-Heberlein sink-float plant. This apparatus allowed BH&S to make a preliminary separation of galena from gangue prior to subjecting the selected material to fine crushing and flotation. This effectively increased the mill's capacity from 1,000 tons/day to 1,500 tons/day. Tailings from the sink-float section had a lower assay value in lead than did tailings discharged from the flotation section. Although the BH&S boasted that the improvement allowed the company to increase the amount of a crucial material it supplied the nation's war effort, there is nothing in the record to suggest that BH&S made the change in response to any government directive. After the war, the company steadily up-graded the West mill's equipment and expanded its capacity. In 1947, for example, capacity was increased from 1,800 tons to 3,200 tons.[14]

Through the late 1950s, BH&S continued retreating old tailings on its dumping ground. The company also continued to up-grade the manner in which it impounded tailings from its on-going milling operations.[15]

During both World Wars, the United States regulated prices for metals and in some instances limited the customers to whom metals could be sold. There is some evidence suggesting that during World War II, the Sullivan Mining Company (jointly owned by Hecla Mining Company and Bunker Hill & Sullivan) participated in the government's premium price plan for zinc. There is no record of this wartime program or any others affecting the way the Bunker Hill & Sullivan Company operated its concentrator during that period.

BH&S Iron Mill

As concentration technologies improved, lead concentrates sent to the BH&S smelter at Kellogg featured ever lower iron content. A certain amount of iron is desirable in the furnace charge to achieve proper slagging. To alleviate the problem, Bunker Hill & Sullivan began charging scrap iron to its smelting furnaces. During World War II, BH&S experienced a shortage of scrap iron. As an alternative, BH&S developed a flow sheet for a facility to re-treat,

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[14]J.W. Gwinn, "Milling Practice at the Bunker Hill & Sullivan," Mining Congress Journal 17 (November 1931): 609 (NEWDN-001-00550); Handy, "The Evolution of a Flowsheet," 55 (RBUCO-001-01211); "Sink-Float Separation," Mining World 4 (July 1942): 11-15 (FLQCA-001-04927); E&MJ 150 (July 1949): 109 (FLQCA-001-01898); Minerals Yearbook, 1950, 1499 (RBUCO-001-01835).

[15]Minutes of Management Committee Meeting (3 April 1957), n.p. (HECBO-005-00334).

once again, old jig tailings discharged by the South and West mills. Called the Iron mill, the new facility was built about 100 yards north of the power house adjacent to the South mill. The old jig tailings assayed about 2.72% lead, 22.38 iron, and 1.34 oz. silver per ton. The Iron mill used jigs and Wilfley tables to produce a concentrate suitable for flux assaying 5.17% lead, 34.57% iron, and 2.51 oz. silver per ton. The tailings from the process were then sent to a small flotation section to produce a low-grade lead concentrate (about 30% lead). Operating eight months of the year, the Iron Plant could supply the annual flux requirements at the BH&S smelter. In 1949, BH&S treated 43,600 tons of old jig tailings to produce the iron concentrate. That is the last year for which operation of the Iron mill was reported. By 1961, the Iron mill had been demolished.[16]

There is no evidence in the historical record that the United States was an operator of the BH&S Iron mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Sweeney Mill

The Sweeney mill was built by the Empire State-Idaho Mining Company in 1901 and was deeded to Bunker Hill & Sullivan in 1918. Through most of its history, both before and after its acquisition by BH&S, it was known as the Sweeney mill. The Sweeney mill originally treated ore from the Last Chance mine, one of Charles Sweeney's major producers. The Last Chance group of claims was located in upper Milo Creek, south of Wardner, and was surrounded by BH&S claims. Prior to construction of the Sweeney mill, Last Chance ore was treated at the Last Chance mill on Milo Creek, just above Wardner. In 1899, by which time Sweeney had formed the Empire State-Idaho Mining & Development Company to operate his Last Chance properties, he announced plans to drive a tunnel more than a mile from Government Gulch to deeper levels of the Last Chance mine. The plan required construction of a new mill on Government Gulch. Construction of the new mill did not begin until summer 1900, when Empire State-Idaho let a contract to build a 16-mile flume from Pine Creek to supply water, for both power and processing, to the mill on Government Gulch. The mill began operating in summer 1901.[17]

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[16]John B. Huttl, "Tailings Re-treatment Plant Produces Flux for Lead Smelter," E&MJ 143 (November 1942): 56, 65 (FLQCA-001-01903-904); "The 'Iron Plant'," Mining World 4 (September 1942): 18-20 (FLQCA-001-04942-944); Zeigler, "Tailings and Mine-Dump Reclamation in the Coeur d'Alenes during World War II," 4 (FLQCA-001-03686); Minerals Yearbook, 1943, 378 (RBUCO-001-01800); Minerals Yearbook, 1944, 362 (RBUCO-001-01805); Minerals Yearbook, 1945, 378 (RBUCO-001-01810); Minerals Yearbook, 1949, 1481 (RBUCO-001-01831); "Sanborn Map for Kellogg" (1928, up-dated to 1944), sheet 3 (FLQCA-001-02361-364); "Sanborn Map for Kellogg" (1928, up-dated to 1961), sheet 3 (FLQCA-001-02537-540).

[17]M&SP 78 (8 April 1899): 380 (FLQCA-001-01568); 80 (23 June 1900): 706 (FLQCA-001-0016); 81 (21 July 1900): 70; 82 (5 January 1901): 10 (FLQCA-001-0021); E&MJ 71 (18 May 1901): 630 (RBUCO-001-0354); 72 (13 July 1901): 47 (RBUCO-001-0355).

The Sweeney mill was built along the south side of the tracks of the Oregon Railway and Navigation Company near the mouth of Government Gulch and about 1.5 miles west of the BH&S mill near Kellogg. At the time, the South Fork flowed along the south side of the valley, rather than the north side as it does today. A flume supplying the mill with water approached form the east, and a pipe supplying water under pressure to a Pelton wheel approached the mill from the south. Ore was delivered to ore bins at the south end of the mill by means of an elevated trestle. The mill had a capacity of about 500 tons/day. Empire State-Idaho operated the mill fairly continuously until 1903, when the Federal Mining & Smelting Company consolidated several of the major producers in the Coeur d'Alene district, including Empire State-Idaho and the Standard and the Mammoth mining companies. By that time, Empire State-Idaho had already acquired the Tiger-Poorman properties at Burke, so that group also became part of Federal's consolidation. For the next 15 years, despite litigation with BH&S, the Last Chance mine above Wardner and the Sweeney mill remained significant contributors to Federal's total output.[18]

Two conveyances served to carry coarse tailings from the jig room of the concentrator: an elevated launder and a tramway on a trestle. These served to "stack" the tailings on the flat adjacent to the mill and to load tailings into railroad cars, respectively. The flat was covered with underbrush, which was said to help retard the flow of tailings across the flat. Testifying at one of the tailings trials in 1905, Federal manager W. Clayton Miller asserted that all of the Sweeney mill's tailings were either stacked or hauled away by the railroad. During non-winter months, Miller said, the railroad carried away between two and six carloads of tailings daily. He stated that the Sweeney mill's coarse tailings pile was about 70 feet high at the time of the trial. Miller accounted little, however, for slime tailings. A distinct flume flowed away from the slime house along the west side of the mill, where fine tailings received further treatment before being discharged. This flume was about 3,500 feet long and discharged into the South Fork. Miller testified that water flowing through this flume to the river was charged slime tailings.[19]

Bunker Hill & Sullivan had filed suit against Empire State-Idaho in 1902, claiming that, under apex law, BH&S was entitled to the ore body Empire State-Idaho was working in the lower levels of the Last Chance mine. As already mentioned, Federal acquired the Empire State-Idaho properties and operations in 1903. Federal assumed the adversarial position against BH&S

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[18]"Sanborn Map for Wardner" (1901), sheet 4 (FLQCA-001-03028); "Sanborn Map for Wardner" (1905), sheet 3 (FLQCA-001-03039-042); "Sanborn Map for Wardner" (1908), sheet 7 (FLQCA-001-03063); "Sanborn Map for Kellogg" (1915), sheet 8 (FLQCA-001-02209-212); USGS, "Topographic Map for the Coeur d'Alene District" (1901), (FLQCA-001-001986); M&SP 89 (16 July 1904): 46 ((FLQCA-001-0159); 94 (23 February 1907): 244 (FLQCA-001-0263); 102 (13 May 1911): 669 (FLQCA-001-0466).

[19]"Sanborn Map for Wardner" (1901), sheet 4 (FLQCA-001-03028); "Sanborn Map for Wardner" (1905), sheet 3 (FLQCA-001-03039-042); W. Clayton Miller, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 2200, 2218-2222, 2226 (FLQCA-001-04769, 774-778, 782); Stanley A. Easton, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 23323, (FLQCA-001-04796).

in the apex suit. In 1910, Federal and BH&S settled their legal differences, with Federal turning much of its property in the Wardner area over to BH&S, with Federal retaining the right to mine ground directly under the Emma, Last Chance, and some nearby claims, and with BH&S conveying 27,000 shares of its stock, at $10.00/share, to Federal. Federal's right to mine the ground under the Last Chance group of claims would remain in force as long as Federal could do so at a profit. Six months after the mine ceased to be profitable, it, along with the Sweeney mill, would be transferred to BH&S. The Last Chance mine remained profitable for Federal until 1916, when it closed. Federal then began the process of conveying mine and mill to BH&S. Federal deeded the Sweeney mill to BH&S on 9 July 1918, at which time BH&S opened small areas of the Last Chance mine to leasers.[20]

As soon as BH&S took title to the Sweeney mill, it began a program of remodelling and conducted tests to explore the feasibility of re-treating tailings on the Sweeney mill dump. As remodelled with flotation apparatus, the mill could re-work old tailings, at a capacity of 400 tons/day, or serve as a conventional mill, with a capacity of 200 tons/day, for ore produced by leasers in the Last Chance mine. When BH&S treated leasers' ore at the Sweeney mill, BH&S did not purchase the ore, but rather assessed the leasers a royalty and milling charge, distributing the remainder of the smelter returns to the leasers. According to BH&S analysis, the Sweeney tailings dump contained about 1,200,000 tons of material with an average assay of 1.89% lead and 0.73 oz. silver per ton. BH&S estimated the dump was 70 feet at its tallest point and that it covered 20 acres. Tailings in the dump weighed 110 pounds per cubic foot. The BH&S analysis of the dump provides an excellent window into the improvement in milling technologies during the 18 years Federal had operated the Sweeney mill. BH&S could discern four distinct layers in the dump, each with progressively lower assays for both lead and silver. The bottom layer, and therefore the first layer deposited, assayed 2.35% lead and about an ounce of silver per ton. The top layer, and therefore the most recent layer deposited, assayed 1.5% lead and only 0.5 oz. silver per ton. A 1919 article on the operation of the remodelled Sweeney mill by R.S. Handy includes an illustration showing plan and sections of the Sweeney dump and showing the course of the South Fork as it flowed around the north side of the dump. The illustration even shows the portion of the dump that BH&S estimated had been eroded away by the river.[21]

The amount of material BH&S treated at the Sweeney declined in 1920, due to poor metals prices, but in 1921, when a healthy metals market returned, BH&S resumed full-capacity operations of the Sweeney mill, treating 153,820 tons of old tailings, in addition to some ores produced by leasers at the Last Chance mine.[22]

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[20]M&SP 84 (7 June 1902): 313 (FLQCA-001-0057); 100 (7 May 1910): 638 (FLQCA-001-0429); 117 (6 July 1918): 29 (FLQCA-001-0875); 118 (12 April 1919): 504 (FLQCA-001-0905); E&MJ 103 (23 June 1917): 1128 (RBUCO-001-0936); 105 (29 June 1918): 1193 (RBUCO-001-01003).

[21]R.S. Handy, "The Sweeney Mill at Kellogg, Idaho," M&SP 118 (12 April 1919): 504 (FLQCA-001-0905); Handy, "Treatment of Tailings and Ore in the Sweeney Mill," M&SP 119 (30 August 1919): 289-294 (FLQCA-001-0929-934).

[22]M&SP 122 (28 May 1921): 758 (FLQCA-001-01033); Mineral Resources of the U.S., 1921,

In 1925, BH&S began experimenting at the South mill with selective flotation on lead-zinc ores from the Sidney mine on Pine Creek. The process proved satisfactory, and the Sidney Leasing Company began construction of an three-mile aerial tramway from the mine to the Sweeney mill. Meanwhile, BH&S remodelled the Sweeney to serve as a custom mill. Ball mills and flotation apparatus were installed in the original Sweeney mill building. In 1926, the Sweeney began treating custom lead-zinc ores, mainly from the Sidney (about 20,000 tons), but also from other mines, like the Sierra Nevada. Another change made at the Sweeney mill was the demolition of the structures housing slime treating processes just west of the original mill building. These were replaced with a building housing the BH&S Tainton plant, a hydrometallurgical facility that BH&S used to treat concentrates made from old oxidized Sweeney tailings.[23]

In 1940, BH&S put a new electrolytic antimony plant in service. It may have been housed in the former Tainton plant at the Sweeney. At any rate, by 1944, the old Sweeney mill building had been demolished, and by 1951, the Tainton/antimony plant was also gone.[24]

There is no evidence in the historical record that the United States was an operator of the Sweeney mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

1899 Date

Silver King/Stewart Mill

The Silver King mill was located a little over a mile up Government Gulch on the Silver King claim, situated on the east side of the creek. During its history, it was operated by the Coeur d'Alene Development Company (which owned the Silver King mine), the Stewart Mining Company, and the Ontario Mining Company. A spur of the Oregon Railway & Navigation Company served the mill. The Silver King mill first went into operation late in 1899. It had a capacity to treat 75 tons of ore, but its limiting factor was the insufficient supply of water in

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6 (RBUCO-001-0694); R.S. Handy, "Milling Methods and Costs at the Northern Idaho Mills of the Bunker Hill and Sullivan Mining and Concentrating Co.," U.S. Bureau of Mines Information Circular No. 6314 (1930), 4 (FLQCA-001-03621).

[23]Mineral Resources of the U.S., 1925, 549 (RBUCO-001-0719); Mineral Resources of the U.S., 1926, 450, 452-453 (RBUCO-001-0726-727); Mineral Resources of the U.S., 1928, 683-684 (RBUCO-001-01735-736); R.S. Handy, "The Evolution of a Flowsheet," E&MJ 140 (August 1939): 57 (RBUCO-001-01213); "Sanborn Map for Kellogg" (1918), sheet 8 (FLQCA-001-02257-260); "Sanborn Map for Kellogg" (1928), sheet 22 (FLQCA-001-02329-332).

[24]E&MJ 141 (April 1940): 78 (RBUCO-001-01178); "Sanborn Map of Kellogg" (1928, updated to 1944), sheet 22 (FLQCA-001-02405-408); "Sanborn Map of Kellogg" (1928, updated to 1951), sheet 22 (FLQCA-001-02493-496).

Government Gulch. The Coeur d'Alene Development company continued to make improvements to the surface plant at the mine and soon installed a coal-fired steam plant at the mill to insure year-round power. The company also owned the Crown Point mine on the west side of of the gulch. A tramway linked the Crown Point to the mill. In 1904, the mill also treated ore from the Wyoming mine, hauled to the mill by wagon. The mill closed in 1905.[25]

The Silver King property then entered a litigious period involving F. Augustus Heinze, principal owner of the Stewart Mining Company and the adjoining Stewart group of claims. In 1904, before Heinze had bought it, the Stewart began producing ore, shipped over the same OR&N branch that served the Silver King. Under the management of H.F. Samuels (an owner of the Hercules), the company soon put a small jig into operation to treat some of its second-class ore. In early 1907, Heinze acquired controlling interest in the Stewart company, placing several of his Butte associates on the board of directors. Samuels remained as one of the directors. Heinze announced in spring 1907 that he would build a large concentrator, and planning began immediately. The Stewart company built its concentrator that summer on the Silver King claim and about 150 feet southeast of the Silver King mill, by now vacant. Among the mining properties Heinze thought he had rights to work were the Silver King and the Crown Point. The Stewart's new 150-ton mill ran briefly that fall, but all Stewart operations halted in October in the wake of litigation brought by the Coeur d'Alene Development Company, which then was controlled by F.W. Bradley of Bunker Hill & Sullivan. Apparently, the Stewart and Coeur d'Alene companies resolved their differences out of court.[26] Nevertheless, when the Stewart reopened its mine in 1909, it treated its ore at the Mammoth mill near Wallace, which it leased from the Federal Mining & Smelting Company (see the history of the Mammoth mill in the section of this report on Canyon Creek).

The Stewart mill on the Silver King claim did not operate for several years until December 1911, when the Ontario Mining Company leased it to treat ore from the nearby Ontario mine. The Ontario (associated with BH&S) extracted its ore through the Silver King tunnel, which had its portal very near the mill. By 1913, the Ontario company had increased the capacity of the mill to about 250 tons/day. To dispose of tailings, the Ontario extended a flume northwest toward Government Gulch. Meanwhile, the Stewart company was engaged in yet

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[25]E&MJ 68 (30 December 1899): 798 (RBUCO-001-0324); 72 (10 August 1901): 178 (RBUCO-001-0356); M&SP 79 (30 December 1899): 750 (FLQCA-001-01610); 80 (26 May 1900): 584 (FLQCA-001-0010); 88 (23 April 1904): 289 (FLQCA-001-0142); 89 (10 September 1904): 182 (FLQCA-001-0163); "Sanborn Map for Wardner" (1901), sheet 4 (FLQCA-001-03027); "Sanborn Map for Wardner" (1905), sheet 3 (FLQCA-001-03039-042).

[26]M&SP 88 (11 June 1904): 402 (FLQCA-001-0151), (18 June 1904): 418 (FLQCA-001-0155); 90 (7 January 1905): 14 (FLQCA-001-0182); 94 (2 March 1907): 262 (FLQCA-001-0265), (23 March 1907): 357 (FLQCA-001-0266), (27 April 1907): 521 (FLQCA-001-0274); 95 (6 July 1907): 6 (FLQCA-001-0295), (3 August 1907): 132 (FLQCA-001-0297), (12 October 1907): 453 (FLQCA-001-0304); 96 (11 January 1908): 58 (FLQCA-001-0317); E&MJ 84 (26 October 1907): 803 (RBUCO-001-0597); Mineral Resources of the U.S., 1907, 311 (RBUCO-001-01567); "Sanborn Map for Wardner" (1908), sheet 2 (FLQCA-001-03055).

another suit against a neighboring concern, the same Ontario Mining Company. At issue was the Stewart's extralateral rights, under apex law, to ore beneath the Ontario claim. In 1913, the Idaho Supreme Court ruled in favor of the Ontario company. The case was appealed to the U.S. Ninth Circuit Court, which upheld the Idaho Court's decision in 1915. For the duration of the litigation, the Ontario continued to operate its mine and run the mill. In 1916, however, the Ontario's output declined, and it did no business thereafter. The Stewart company operated the mill briefly in 1917, treating ore from the Stewart mine and the Crown Point mine, which the Stewart had bonded from the Coeur d'Alene Development Company. The Stewart mill is not known to have operated after 1917. In the late 1920s, Bunker Hill & Sullivan built its electrolytic zinc plant at "Silver King," likely on the Silver King claim. Construction of the zinc plant probably obliterated all traces of both the old Silver King mill and the Stewart mill.[27]

There is no evidence in the historical record that the United States was an operator of either the Stewart or Silver King mill. The United States did not own the mills, did not manage the mills, and did not own any of the materials processed at the mills. Nor did the United States inspect or in any way regulate the mills and their operations, including their generation and discharge of waste products.

Hayes Mill and nearby Tailings Mills

The Hayes Company's 75-ton flotation mill was located along the south side of the South Fork near the mouth of Pine Creek. It was managed by Arthur Hayes. According to Arthur Hayes, he put the mill in operation in late 1916. To move tailings from the impoundment to the mill, he used a clam-shell excavator, a barge, a pump, and a pipeline. He loaded impounded material onto the barge with the clam-shell. On board the barge, he had equipment for separating alluvial sand from slimes. He discarded the sand back into an area of the impoundment he had already worked, and he pumped a slurry containing slimes through the pipeline to the mill. After subjecting the slimes to flotation and separating his concentrates, he pumped his new slime tailings back into an area of the impoundment he had already worked.[28]

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[27]M&SP 106 (17 May 1913): 751 (FLQCA-001-0559); 109 (7 November 1914): 735-736 (FLQCA-001-0643-644); 110 (16 January 1915): 121 (FLQCA-001-0658), (13 March 1915): 421 (FLQCA-001-0670), (8 May 1915): 741 (FLQCA-001-0677); E&MJ 92 (9 December 1911): 1150 (RBUCO-001-0714); Mineral Resources of the U.S., 1911, 601 (RBUCO-001-01605); Mineral Resources of the U.S., 1913, 787 (RBUCO-001-01621); Mineral Resources of the U.S., 1914, 638 (RBUCO-001-01634); Mineral Resources of the U.S., 1915, 559 (RBUCO-001-01647); Mineral Resources of the U.S., 1916, 601 (RBUCO-001-01660); Mineral Resources of the U.S., 1929, 406 (RBUCO-001-01744); "Sanborn Map for Wardner" (1908), sheet 2 (FLQCA-001-03055); "Sanborn Map for Kellogg" (1915), sheet 4 (FLQCA-001-02193-196); "Sanborn Map for Kellogg" (1918), sheet 4 (FLQCA-001-02241-244).

[28]Arthur Hayes, testimony in Bunker Hill & Sullivan, et al. v. Jacob Polak, 1247-1253 (FLQCA-001-04813-814, 864-870).

Although built near the Pine Creek tailings impoundment, the mill was located on high enough ground that its operations were hardly interrupted during the winter flood of 1917-18. During most of the flood stage, the Hayes mill continued treating old tailings. The tailings worked by the mill were on average about four feet deep and assayed at 5-6% lead, 3-4% zinc, and 3-4 oz. silver per ton. Hayes shipped lead concentrates to the BH&S smelter assaying 25-30% lead and 20-24 oz. silver per ton. He also recovered zinc. The Hayes mill did not necessarily limit its feed to material from behind the Pine Creek dam. A description in 1921, by which time the mill had a capacity to treat 100 tons/day, suggests that the deposit Hayes was working was 2-3.5 ft. thick. The Pine Creek dam was taller than that. Hayes continued as a steady shipper of concentrates from old tailings through 1929, when it exhausted its supply of tailings to treat and suspended operations.[29]

In the late 1910s, Mineral Resources of the United States mentioned other companies treating tailings as well, like the Mullan Milling Company and the Thornsdon Metal Saving Company. Thorndson built a 100-ton mill opposite the mouth of Pine Creek in 1918. The dump Thorndson worked was estimated to hold 300,000 tons of silver-lead tailings. The Throndson flow sheet featured tables and flotation, but no crushing equipment. The mill apparently did not operate in 1920, but it made a small shipment of concentrates made from old tailings in 1921.[30]

Mullan Milling treated the old Ontario dump at the mouth of Government Gulch, estimated to hold 150,000 tons of tailings. Mullan obtained the right to treat the tailings by means of a lease. The operation was managed by C.L. Hewitt, who also had charge of tailings treating plants along the South Fork midway between Mullan and Wallace and along Nine-Mile Creek. The Mullan flotation mill was built in 1918, with a capacity to treat 150 tons/day. In 1920, Mullan was treating 200 tons/day of tailings and shipping about 250 tons of concentrates

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[29]"Sanborn Map for Kellogg" (1928), sheet 24 (FLQCA-001-02337-340); Arthur Hayes, testimony in Bunker Hill & Sullivan, et al, v. Jacob Polak, 282-283, 1251-1252 (FLQCA-001-04813-814, 868-869); Mineral Resources of the U.S., 1917, 491 (RBUCO-001-01671); Mineral Resources of the U.S., 1918, 495 (RBUCO-001-01679); Mineral Resources of the U.S., 1919, 483 (RBUCO-001-01686); Mineral Resources of the U.S., 1920, 258 (RBUCO-001-01690); Mineral Resources of the U.S., 1921, 5 (RBUCO-001-01694); Mineral Resources of the U.S., 1922, 243 (RBUCO-001-01698); Mineral Resources of the U.S., 1923, 403 (RBUCO-001-01705); Mineral Resources of the U.S., 1924, 284 (RBUCO-001-01712); Mineral Resources of the U.S., 1925, 549 (RBUCO-001-01719); Mineral Resources of the U.S., 1929, 410 (RBUCO-001-01746); M&SP 120 (24 April 1920): 619 (FLQCA-001-0953); 122 (2 April 1921): 470 (FLQCA-001-01022); Rice, "Flotation in the Coeur d'Alenes," E&MJ 105 (20 April 1918): 715-716 (RBUCO-001-01368-369); "Sanborn Map for Kellogg" (1928), sheet 24 (FLQCA-001-02337-340).

[30]Mineral Resources of the U.S., 1918, 495 (RBUCO-001-01679); Mineral Resources of the U.S., 1919, 483 (RBUCO-001-01686); Mineral Resources of the U.S., 1920, 258 (RBUCO-001-01690); Mineral Resources of the U.S., 1921, 5 (RBUCO-001-01694); Mineral Resources of the U.S., 1922, 243 (RBUCO-001-01698); Mineral Resources of the U.S., 1923, 403 (RBUCO-001-01705); E&MJ 106 (28 September 1918): 598 (RBUCO-001-01010).

each month. An operation known as the Mullan Leasing and Development Company operated in the same area and was likely the same concern. In 1923, Mullan leased its mill to the Idaho-American Mining Company, which used it to treat ore from the Wyoming mine, which Idaho-American was also leasing.[31]

There is no evidence in the historical record that the United States was an operator of the Hayes or other tailings mills on the lower South Fork. The United States did not own the mills, did not manage the mills, and did not own any of the materials processed at the mills. Nor did the United States inspect or in any way regulate the mills and their operations, including their generation and discharge of waste products.

Page Mill

The Federal Mining & Smelting Company began work re-opening the Page and Blackhawk mines in 1925. Located south of Smelterville on Silver and Grouse creeks, respectively, they were developed as a single mine. Late the following year, Federal opened the 250-ton Page mill on lead-zinc ores from the Page mine. Housing ball mills and flotation apparatus, the mill was built on a steep hillside along Silver Creek about a quarter mile upstream (south) of the Page mining camp. An electric trolley hauled ore 500 feet in two-ton cars between mine and mill. Average assays of the Page ore in 1927 were 6.75% lead, 2.9% zinc, and 2.2 ounces silver per ton. The mill employed no jigs for coarse concentration, as had earlier been typical in the Coeur d'Alene district. It relied exclusively on selective flotation to produce both lead and zinc concentrates. The mill recovered 87% of the silver, 88% of the lead, 83% of the zinc, and tailings discharged from the mill assayed at 0.75% lead and 0.5% zinc. A tailings flume carried waste from the mill to a discharge point along Silver Creek. Federal increased the capacity of the Page mill to 300 tons/day in 1928 and operated near full-capacity throughout the remainder of the 1920s, e.g. treating about 87,000 tons in 1928 and nearly 100,000 tons each of the next three years. Lead and silver assays of Page ore increased during those years to about 9.4% and 4.3 oz./ton, respectively, but zinc assays remained about the same. Federal shipped its lead concentrates to East Helena and its zinc concentrates to Anaconda and Great Falls. Capacity was again increased, to 500 tons/day, in 1930. With the onset of the Great Depression, though, Federal's production by the Page mine and mill declined, treating only 41,000 tons in 1931.[32]

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[31]Mineral Resources of the U.S., 1918, 495 (RBUCO-001-01679); Mineral Resources of the U.S., 1919, 483 (RBUCO-001-01686); Mineral Resources of the U.S., 1920, 258 (RBUCO-001-01690); Mineral Resources of the U.S., 1921, 5 (RBUCO-001-01694); Mineral Resources of the U.S., 1922, 243 (RBUCO-001-01698); Mineral Resources of the U.S., 1923, 403 (RBUCO-001-01705); M&SP 117 (2 November 1918): 607 (FLQCA-001-0890); 122 (2 April 1921): 470 (FLQCA-001-01022), (9 April 1921): 509 FLQCA-001-01024); E&MJ 109 (10 April 1920): 899 (RBUCO-001-01068); Rice, "Flotation in the Coeur d'Alenes," E&MJ 105 (20 April 1918): 710-711 (RBUCO-001-01363-364). The Mullan mill and the others managed by Hewitt are referred to as the Crerar-Hewitt mills in the article by Rice.

[32]H.G. Washburn, "The Federal Mining Company Page Mill," The Mining Congress Journal 13 (September 1927): 729-730 (FLQCA-001-01698); 16 (August 1930): 660 (FLQCA-001-

The Page mill operated intermittently during the 1930s. With the return of a healthy metals market at the end of the decade, Federal put its operation back on a regular basis, with the mill at its capacity of 500 tons/day in 1939. By that time, Federal had added numerous other buildings to the vicinity of the mill, including general office, machine shop, framing mill, and headframe and surface plant for a mine shaft. Federal continued operating the Page mill on Page and Blackhawk ores steadily through the 1940s and into the 1950s. ASARCO and Federal merged in 1953, with ASARCO taking over all of Federal's operations in the Coeur d'Alene district. In 1954, production was considerably lower than the previous year. From then until closing, the mill's output fluctuated, although it remained fairly large. The Page mill closed permanently in September 1969, when ore reserves at the Page mine were exhausted. Throughout its operation, the mill discharged tailings through the flume leading north from the mill toward Silver Creek.[33]

There is no evidence in the historical record that the United States was an operator of the Page mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor, prior to 1969, did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Gibbonsville Mining & Exploration Company Mill

During World War II, the Gibbonsville Mining & Exploration Company made an attempt to re-treat tailings behind the old Pine Creek dam. Both Hayes and Thornsdon had already used flotation to work those deposits around 1920, as already described. Because both the BH&S and the Sweeney mills had stacked their coarse tailings nearby, most of the material that had settled behind the Pine Creek dam between 1920 and 1940 was quite fine. It was therefore nearly completely oxidized, making it economically difficult to recover either lead or zinc. Nevertheless, the Gibbonsville company built a 250-ton flotation mill near the Pine Creek dam in

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04986); Mineral Resources of the U.S., 1926, 452 (RBUCO-001-0727); Mineral Resources of the U.S., 1928, 685 (RBUCO-001-0736); Mineral Resources of the U.S., 1931, 405 (RBUCO-001-0760); G.S. Price, "Milling Methods and Costs at the Page Concentrator of the Federal Mining and Smelting Co., Kellogg, Idaho," U.S. Bureau of Mines Information Circular No. 6590 (1932), 1-4, (FLQCA-001-016988-693); "Sanborn Map for Kellogg" (1928), sheet 24 (FLQCA-001-02337).

[33]E&MJ 139 (October 1938): 64 (RBUCO-001-01217); 140 (April 1939): 66 (RBUCO-001-01223); 141 (April 1940): 78 (FLQCA-001-01178); Mineral Yearbook, 1954, 378 (RBUCO-001-01853); Mineral Yearbook, 1969, 248 (RBUCO-001-01907); ASARCO Annual Report, 1953, 3 (RBUCO-001-05076); ASARCO Annual Report, 1969, 6 (RBUCO-001-05090); "Sanborn Map for Kellogg" (1928, up-dated to 1944), sheet 24 (FLQCA-001-02413-416); "Sanborn Map for Kellogg" (1928, up-dated to 1951), sheet 24 (FLQCA-001-02501-504); "Sanborn Map for Kellogg" (1928, up-dated to 1961), sheet 24 (FLQCA-001-02581-584).

1941. Despite the fact that very little grinding was needed, the effort did not succeed and the mill was eventually dismantled.[34]

Gibbonsville tried again in the early 1950s building a 400-ton tailings mill with the aid of a loan from the Reconstruction Finance Corporation. The mill was operated until September 1953, producing a bulk lead-zinc concentrate. Under a contract entered into by the company in 1952, the refined metal obtained from the tailings deposit by June 12, 1954 was to be purchased by DMPA at a floor price of 15.5 cents per pound for de-silverized pig lead. Despite participation in these federal programs, there is no evidence that the United States was an operator of the Gibbonsville Mining Company mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor is there evidence that the United States dictated how the Gibbonsville mill should dispose of tailings after it had retreated them.[35]

Historic Movement of Tailings and Other Solids down the South Fork

1. Free-Flowing Tailings: 1888-1901

The Stemwinder mill, located at the upper end of the stretch of the South Fork described in this section, apparently discharged it tailings directly into the river, much like other mills in the Coeur d'Alene district did. When Bunker Hill & Sullivan built its new mill on the flat below Kellogg in 1890, it deviated from the usual pattern, laundering its coarse tailings to a nearby dump instead. Although BH&S officials may have recognized that by saving those tailings the material might later be available for re-treatment if milling technologies improved, BH&S most likely chose the tailings disposal strategy it did simply because the South Fork, slow-moving through the Kellogg valley, was not capable of transporting all the coarse tailings the company was likely to produce. BH&S did rely on the South Fork to carry its fine tailings away in the early years. When the Empire State-Idaho company built the Sweeney mill on the South Fork downstream from the BH&S mills and near the mouth of Government Gulch, it was faced with the same situation, and it employed the same tailings disposal strategy: it stacked its coarse tailings on a dump near the mill and it sluiced fine tailings into the river.

BH&S and Federal (successor to Empire State-Idaho) tried to convince the courts during the early-twentieth-century tailings trials that their mills were saving nearly all their mill tailings on dumps. Their participation in the Mine Owners Association programs, however, demonstrated that the two companies demonstrated that they were full partners with the upstream mills in generating the slimes and fine solids that were depositing downstream on bottomlands along the Coeur d'Alene River. By contributing on a pro-rated basis to the programs of the Mine Owners Association, which were aimed at responding to complaints of tailings damages

[34]Zeigler, "Tailings and Mine-Dump Reclamation in the Coeur d'Alenes during World War II," 7 (FLQCA-001-03687).

[35]Minerals Yearbook 1953, 350 (RBUCO00101849).

registered by downstream property owners, BH&S and Federal demonstrated their complicity. Pro-rated contributions were calculated from tons of ore milled, not some more complicated assessment of tons of tailings actually dumped into the river system.

2. Impounded Coarse Tailings, 1901-1917

The Mine Owners Association began taking formal steps to impound tailings on the broad flat below Kellogg in 1901. One of their first steps was to acquire the land on which an impoundment could be developed. The Mine Owners Association collected $30,000 from participants to begin developing an impoundment. Following is a list of the companies that initiated the endeavor and the amount each company contributed:

Bunker Hill & Sullivan Mining & Concentrating Company	$5,400
Coeur d'Alene Development Company	1,200
Empire State-Idaho Mining & Development Company	6,570
Frisco Mining Company	2,640
Gold Hunter Mining & Smelting Company	780
Hecla Mining Company	1,020
Larson & Greenough	4,770
Mammoth Mining Company	2,880
Standard Mining Company	4,740

The land acquired for the tailings impoundment was held in trust by the Spokane and Eastern Trust Company, Spokane, Washington. The Association purchased about 2,000 acres of land for this purpose. Some of the land to be inundated was already owned by the Empire State-Idaho and the Bunker Hill & Sullivan companies.[36]

In autumn 1902, the Mine Owners Association built a wood pile-and-plank dam across the South Fork Coeur d'Alene River near the mouth of Pine Creek. It was called the Pine Creek dam. Members of the Association that helped pay the costs of construction and maintenance included the Hecla Mining Company, Gold Hunter Mining & Smelting Company, the predecessors of the Federal Mining & Smelting Company, and the Bunker Hill & Sullivan Mining & Concentrating Company. The reservoir created by the dam covered the river bottom from the dam upstream as far as Kellogg. The purpose of the dam was to impound tailings and prevent them flowing downstream, and thereby to prevent damage to bottom land along the Coeur d'Alene River from Cataldo down to the lake. In preparation for the reservoir filling with tailings, the elevation of the railroad tracks through the valley had to be raised from the dam upstream to the BH&S mill. The dam was apparently effective in settling some fine tailings but not as effective in settling all slimes. By summer 1909, tailings had accumulated to the level of the spillway and slimes were washing over the dam, according to an internal report by a Federal

[36]Agreement of Trust between Spokane & Eastern Trust Company and the Frisco Mining Company, Ltd., et al, dated 16 November 1901 (SEAWA-002-00142); Complaint, in Jacob Polak v. Bunker Hill & Sullivan, et al, 22 (FLQCA-001-04826).

company employee. Witnesses at the early twentieth-century tailings trials described the water flowing over the spillway of the dam being blue and "roily," having much the same appearance as water as it flowed out of the upstream concentrators. Tailings impounded behind the Pine Creek dam were, in general, much more fine than the coarse tailings impounded behind the Osburn dam, about eleven miles upstream.[37]

Although the area purchased by the Mine Owners Association to impound tailings behind the Pine Creek dam was some 2,000 acres, that area was bisected by the roadbed of the Oregon Railway & Navigation Company's tracks, which ran along the south side of the river. Because the river and the spillway of the dam were on the north side of the tracks, only that portion of ground behind the dam and north of the tracks filled with tailings. By 1910, it was estimated that a 25-acre area adjacent to the dam had filled with 5-6 feet of tailings and that tailings deposits had accumulated upstream to lesser depths. The tailings collected by the Pine Creek dam were almost exclusively very fine tailings.[38]

As the corporate structure of the mining industry in the Coeur d'Alene district changed. so did the list of companies participating in affairs relative to the Pine Creek dam. For example, in 1914, when H. Haff leased a 1.26 acre parcel of land in the tailings impoundment area from the Spokane & Eastern Trust Company, the following companies were explicitly released from liability for any damages their mining and milling operations might cause his property:[39]

Federal Mining & Smelting Company
Bunker Hill & Sullivan Mining & Concentrating Company
Hecla Mining Company
Hercules Mining Company
Gold Hunter Mining Company
Alice Mining Company
Green Hill-Cleveland Mining Company
(continued)

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[37]Davis R. Hoderman, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 229 (FLQCA-001-04593); James R. McCarthy, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 941-942, 1016 (FLQCA-001-04658-659, 684); Moffitt, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 1153-155 (FLQCA-001-04737-739); Miller, testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 2203 (FLQCA-001-04772); Complaint, in Jacob Polak v. Bunker Hill & Sullivan, et al, 22 (FLQCA-001-04826); Charles O. Olson, testimony in Bunker Hill & Sullivan, et al, v. Jacob Polak, 133-134 (FLQCA-001-04822-823); W.L. Berglund to W. Clayton Miller, letter dated 24 August 1909 (ASAID-082-00013).

[38]Burbidge testimony in Timothy McCarthy, et al, v. Bunker Hill & Sullivan, et al, 447-448 (FLQCA-001-06511-512).

[39]Indenture between Spokane & Eastern Trust Company and H. Haff, dated 1 August 1914 (SEAWA-002-00253-256).

Interstate-Callahan Consolidated Mining Company
Larson & Greenough
Marsh Mining Company
Ontario Mining Company
Snowstorm Mining Company
Stewart Mining Company
Tamarack & Custer Mining Company

The spillway of the Pine Creek dam washed out during the winter flood of 1917-18. The highest level of flood stage was reached on 27 December 1917. The spillway, located on the north side of the railroad tracks, went out a month later, on 30 January 1918. The mining companies did not repair the dam. As the flood eroded a channel through the spillway opening, large quantities of tailings were washed downstream. A vast store of tailings outside that channel, however, remained in place for many years to come.[40]

The Oregon Railway & Navigation Company (OR&N) built another structure during this period that affected the flow of the South Fork and of tailings through the large valley adjacent to Kellogg. It was a pile and plank sheer dam built along the south bank of the river from the railroad station at Kellogg to a point north of the BH&S mills. Its purpose was to protect the OR&N roadbed from erosion by the river, and it also served to prevent tailings originating upstream from settling on the flat on the south side of the river near Kellogg.[41]

3. Free-Flowing Fine Tailings, 1917-1968

Because the mining companies did not repair the Pine Creek dam after the spillway washed out in January 1918, there was little along the lower stretch of the South Fork to retard the movement of fine tailings after the flood.

4. Re-Working Coarse Tailings during the World War II Era

As described in other sections of this report, there was considerable activity in the Coeur d'Alene district during the World War II era aimed at recovering silver, lead, and zinc from tailings deposits, especially in Canyon Creek and along the South Fork in the vicinity of Osburn. Along the lower South Fork, however, most of the recoverable values had already been extracted by Bunker Hill & Sullivan, re-working its own dumps and those of the Sweeney mill, and by the likes of Hayes, Thorndsen, and Mullan, who reworked other tailings deposits near the Pine Creek

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[40]Arthur Hayes, testimony in Bunker Hill & Sullivan, et al, v. Jacob Polak, 282-283 (FLQCA-001-04813); W.L. Zeigler, "Mill Tailings Disposal in the Coeur d'Alene Mining District," unpublished ms dated January 1935 (ASAID-084-00097).

[41]Stanley Easton, testimony in Doty v. Bunker Hill & Sullivan, et al, 946 (FLQCA-001-06013).

dam and along Government Gulch. The most successful World War II-era tailings re-treatment program was that of BH&S in treating old tailings, yet again, to recover iron. Evidence that the tailings lying behind the deteriorated Pine Creek dam offered little more in the way of recoverable wealth can be seen in the failed effort of the Gibbonsville Mining Company mill, described briefly above.

PINE CREEK DRAINAGE

Both the east and west forks of Pine Creek rise in 4000-foot mountains near the St. Joe National Forest. They drain approximately sixty square miles. In times of high water, Pine Creek discharges approximately 280 cubic feet per second to the South Fork Coeur d'Alene River. Minimum low flows are about five cubic feet per second.[1] The stream flows north, initially through very narrow canyons. As the two forks converge with other small streams in making their way toward each other and ultimately, the South Fork Coeur d'Alene River, they course through wider valleys surrounded by steep hillsides and flanked by alluvial bottom lands as wide as 500 feet. The mills along Pine Creek were historically part of the Yreka district.

Most of the mining in the Pine Creek drainage was along the stream's east fork and its tributaries, including, in downstream order, Douglas Creek, Highland or Stewart Creek, Denver Creek, and Nabob Creek. The mines were primarily known for the high amount of zinc in their ores. Like many of the mines in the Coeur d'Alenes, the mines on Pine Creek opened and closed partially in response to the world metal markets. The initial boom on Pine Creek occurred during the 1910s. Separating the lead from the zinc in the ore proved difficult during this period, owing to the relatively primitive technology being used in the mills. Not until the shift to selective flotation in the 1920s was the problem entirely solved.

Another problem during this era was the lack of a railroad for shipping purposes. The wagon road from the mines down to the railroad siding near the mouth of Pine Creek was seasonally and frequently in poor condition. The Constitution and other companies attempted to make arrangements with the Oregon-Washington Railroad & Navigation Company (O-WR&N) to construct a spur from the mouth of Pine Creek upstream to the Constitution mine. After a decade of encouraging signals, the O-WR&N decided in 1925 not to build the line, despite the increased production from the mines in Pine Creek. Lack of rail transportation stimulated an alternative solution. With financial assistance from Bunker Hill & Sullivan, the Sidney and Constitution companies built a 3.5 mile tramway from their mines to the Bunker Hill mills near Kellogg. Loading facilities for other properties along the way were also installed. During the Great Depression (1929-1941), all mines and mills in Pine Creek closed, but then re-opened and enjoyed prosperity again during World War II.[2]

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[1]U.S. Bureau of Land Management,"Pine Creek Millsites," Section 2.2 (BLMDN999-00186).

[2]M&SP 112 (8 April 1916): 529 (FLQCA-001-0726); Earl H. Bennett, 100 Years of Lode Mining in the Coeur d'Alene District (draft chapter) (ASAID082-00632); William P. White, "The Constitution Mining & Milling Company's Mill," Mining Industry of Idaho, 1925 (RBUCO00105228); Mineral Resources of the U.S., 1918, 495 (RBUCO00101679); Mineral Resources of the U.S., 1919, 423 (RBUCO00101686); Mineral Resources of the U.S., 1923, 403 (RBUCO00101705); Mineral Resources of the U.S., 1925, no page (RBUCO00101720); The Mining Industry of Idaho for the Year 1925, 53, (RBUCO00102416).

Constitution Mill

The Constitution Mining & Milling Company built its 100-ton gravity flotation mill in 1917. The mill was located on the east side of the east fork of Pine Creek near the headwaters of the stream and about 7.5 miles south of Pinehurst. The Constitution company built the mill with the understanding that the Oregon-Washington Railroad & Navigation Company would be building a spur from the mouth of Pine Creek to the mine. The Constitution mine had been operating since at least 1915, shipping zinc ore and frequently penalized by the smelters on account of the high lead content, about 10%. The original design of the mill was ineffective, and in 1924, the company installed a new process for separating lead and zinc. Nevertheless, during the remainder of the 1920s, the Constitution continued having difficulty treating its ore. The major product, lead-zinc concentrate, was shipped to the Anaconda Company's electrolytic zinc plants at Great Falls and Anaconda, Montana. In July 1930, production was suspended because of low metal prices.[3]

The Spokane-Idaho Mining Company reopened the mine and mill in 1941. During this second period of operation, the company's method of disposing of tailings changed. By at least 1944, but probably upon re-opening in 1941, Spokane-Idaho impounded its Constitution mill tailings behind a crescent-shaped dam at the north (downstream) end of the mill. In 1941, the company treated 6,973 tons of zinc-lead ore by flotation, and in 1942, the mill treated another 20,307 tons of zinc-lead ore producing a bulk zinc-lead concentrate. In 1944, the company changed its milling practice to produce two products: a high-grade lead concentrate and a zinc-lead concentrate. That year, the 22,246 tons of zinc-lead ore yielded 3,807 tons of zinc-lead concentrates and 182 tons of high-grade lead concentrates. The mine and mill continued to be worked steadily until 1952, when a decline in prices caused a reduction in production at the mine. By this time, the Spokane-Idaho Mining Company was also operating the Douglas mine. Beginning in March 1953, Spokane-Idaho discontinued mining at the Constitution and leased the property to block lessees, who treated ore in the Constitution mill. In June 1955, the company closed the mine and also terminated its agreement with Douglas Mining Company for working the Douglas mine. A cleanup by Newell & Murphy at the Constitution mill that year produced a small tonnage of lead and zinc.[4]

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[3]A.J. Dunn, "Low Prices for Lead and Zinc Not Affecting Coeur d'Alene Output," E&MJ 100 (6 November 1915): n.p. (RBUCO-001-0857); 103 (3 February 1917): 245 (RBUCO-001-0922); 106 (13 July 1918): 88 (RBUCO00101005); 117 (12 January 1924): 67 (RBUCO00101111); 128 (28 September 1929): 521 (RBUCO00101149); Mineral Resources of the U.S., 1924, 283 (RBUCO00101711); Mineral Resources of the U.S., 1928, 685 (RBUCO00101736); Mineral Resources of the U.S., 1930, 657 (RBUCO00101755); William P. White, "The Constitution Mining & Milling Company's Mill," Mining Industry of Idaho for the Year 1925 (RBUCO00105228); The Mining Industry of Idaho for the Year 1927, 180 (RBUCO00102432); "Sanborn Map for Kellogg" 1928, sheet 27 (FLQCA-001-02349: 02350).

[4]Minerals Yearbook 1941, 356 (RBUCO00101791); Minerals Yearbook 1942, 386 (RBUCO00101795); Minerals Yearbook 1952, 305 (RBUCO00101844); Minerals Yearbook

There is no evidence in the historical record that the United States was an operator of the Constitution mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Douglas Mill

The ore of the Douglas Mining Company's property carried high values in both zinc and lead, and fair values in silver. However, the ore, as of 1911, had resisted all efforts at separation and was initially thought to be more adapted to direct smelting. The mine was worked by the Anaconda Copper Mining Company (ACM) under bond from 1916-1918. The (ACM) employed four-horse teams to haul the lead-zinc ore to the railroad and then shipped it to be milled at Anaconda. Though the mine's operation was continuous, shipping was sporadic because of impassable wagon roads. Anaconda relinquished its bond in 1918 when plans to build a railroad up Pine Creek were first abandoned. The mine was then operated by the Douglas company and ore shipped to the Timber Butte mill at Butte, Montana, until Timber Butte began to refuse it in 1927. At that point, Bunker Hill & Sullivan stepped in, purchasing a non-controlling interest in the company with an agreement that gave BH&S the rights to all of the Douglas ore for fifteen years. Douglas Mining Company continued to operate its group of fifteen claims in Pine Creek and during 1929 shipped ore to Bunker Hill's Sweeny mill.[5]

In 1943, the Small Leasing Company leased the Douglas property and completed a new 100-ton flotation mill at the Douglas mine, treating 12,789 tons of zinc-lead ore which yielded 1,727 tons of zinc-lead concentrates. The company continued to operate the mine and mill until 1947. By 1948, the Douglas Leasing Company was operating the property, but one year later, the property was idle. In 1951, the Spokane-Idaho Mining Company entered a working agreement to develop the Douglas, though it is unclear whether the mill operated at this time. For a while during 1953, ore from the Douglas was being milled at the nearby Constitution mill. In 1955, the Spokane-Idaho company terminated its agreement with the Douglas Mining Company. The mill

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1955, 365 (RBUCO00101857); "Sanborn Map for Kellogg" (1944 revision of 1928 sheet), sheet 27 (FLQCA-001-02427); "Sanborn Map for Kellogg" (1951 revision of 1928 sheet), sheet 27 (FLQCA-001-02515); "Sanborn Map for Kellogg" (1961 revision of 1928 sheet), sheet 27 (FLQCA-001-02595).

[5]M&SP 116 (8 June 1918): 804 (FLQCA-001-0868); E&MJ 102 (30 September 1916): 608 (RBUCO-001-0908); 102 (23 December 1916 (RBUCO-001-0919); 105 (1 June 1918): 1026 (RBUCO00101002); 124 (3 September 1927): 362 (RBUCO00101128); The Mining Industry of Idaho for the Year 1911, 129 (RBUCO00102337); Mineral Resources of the U.S., 1917, 492 (RBUCO00101672); Mineral Resources of the U.S., 1918, 495 (RBUCO00101679); Mineral Resources of the U.S., 1926, 452 (RBUCO00101727); Mineral Resources of the U.S., 1929, no page (RBUCO00101746).

probably closed that year, since in 1956, a clean up was done by Jim Doyle. By 1961, Sanborn maps reveal that the plant was "falling down."[6]

There is no evidence in the historical record that the United States was an operator of the Constitution mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Liberal King Mill

Liberal King Mining Company was incorporated on June 12, 1928. Other than making some improvements to the Liberal King mine in 1930, the company did little with its property for fifteen years. By 1944, Sunset Minerals, Inc., had obtained a lease on the Liberal King mine with an option to purchase. Sunset built a flotation plant around the same time and treated 7,671 tons of zinc-lead ore in 1944 and another 15,400 tons of ore in 1945. Sunset Minerals purchased the property and equipment of Liberal King in 1948, made additions to the mill, and continued to operate until 1953, when ore production began to decrease. A DMEA project was in progress at the property by 1955. Sunset Minerals operated the property through 1956 and lessees in 1957. There is no record of the mill operating again after that time, until mill cleanings from the mill were shipped in 1962.[7]

There is no evidence in the historical record that the United States was an operator of the Liberal King mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products. During the 1950s, the Sunset Minerals, Inc. Company did take advantage of a DMEA loan to explore for new ore bodies. Through that program, however, the United States did not in any way dictate operations at the Liberal King mill.[8]

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[6]Minerals Yearbook 1943, 379 (RBUCO00101800); Minerals Yearbook 1948, no page (RBUCO00101827); Minerals Yearbook 1952, 305 (RBUCO00101844); Minerals Yearbook 1953, 349 (RBUCO00101848); Minerals Yearbook 1955, 365 (RBUCO00101857); Minerals Yearbook 1956, 389 (RBUCO00101862); "Sanborn Map for Kellogg" (1961 revision of 1928 sheet), sheet 26 (FLQCA-001-02589).

[7]Mineral Resources of the U.S., 1930, 659 (RBUCO00101756); Minerals Yearbook 1944, 363 (RBUCO00101805); Minerals Yearbook 1945, 380 (RBUCO00101811); Minerals Yearbook 1946, 1448 (RBUCO00101816); Minerals Yearbook 1953, 349 (RBUCO00101848); Minerals Yearbook 1955, 365 (RBUCO00101857); Minerals Yearbook 1962, 361 (RBUCO00101883); Minerals Yearbook 1957, 382 (RBUCO00101866); The Mining Industry of Idaho for the Year 1946, 247 (RBUCO00102547); The Mining Industry of Idaho for the Year 1947, 194 (RBUCO00102724); The Mining Industry of Idaho for the Year 1949, 194 (RBUCO00102763); The Mining Industry of Idaho for the Year 1950, 229 (RBUCO00102788).

[8]Minerals Yearbook 1955, 365 (RBUCO00101857).

Amy Matchless Mill

The Amy Matchless property was located on Pine Creek, about three miles upstream (south) from its confluence with the South Fork. In 1911 and 1912, the Culver Mining Company, Ltd. operated the claims. For the next dozen years the Amy Matchless mine shipped ore and perhaps some hand-jigged concentrates. In 1923, a new company, the Amy Matchless Mining & Milling Company built a new concentration mill on the east side of the creek. By September 1924, the concentrator was operating, equipped with flotation machines and tables. In 1925, the mine worked for only a short time, but several lots of lead concentrate were made in the plant. In 1928, the Lookout Mountain Mining & Milling Company leased the Amy Matchless mill. Lookout Mountain installed a 1600-foot tramway from the mine and transported ore from the terminal of the tramway to the mill by truck. The concentrates from both processes were hauled eight miles by truck to the Bunker Hill & Sullivan's smelter. The mill was located about 300 feet from the stream, and a Sanborn map for 1928 shows a tailings flume on the north (downstream) side of the mill, indicating that the company dumped its tailings next to the creek. Apparently after that, the mill closed.[9]

The Amy Matchless mill was remodelled in 1935, but apparently saw little activity. In 1943, it treated ore from the Little Pittsburg property, which lost its own mill due to fire. In 1944, the Amy Matchless mine and mill were owned and operated by the Lynch-Pine Creek Mining Company. While the mine was inoperative, the mill processed 16,248 tons of zinc-lead ore from the Nabob mine, also operated by Lynch-Pine. The ore yielded 534 tons of lead concentrates and 1,491 tons of zinc concentrates. Sanborn maps also indicate that the mill was treating tailings. The mill was abandoned by 1951, and in 1956, Jim Doyle conducted a cleanup and sold concentrates resulting from the operations.[10]

There is no evidence in the historical record that the United States was an operator of the Amy Matchless mill. The United States did not own the mill, did not manage the mill, and did

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[9]Mineral Resources of the U.S., 1923, 403 (RBUCO00101705); Mineral Resources of the U.S., 1924, 284 (RBUCO00101712); Mineral Resources of the U.S., 1925, no page (RBUCO00101719); Mineral Resources of the U.S., 1928, 686 (RBUCO00101737); The Mining Industry of Idaho for the Year 1911, 129 (RBUCO0010102337); The Mining Industry of Idaho for the Year 1912, 179 (RBUCO00102356); The Mining Industry of Idaho for the Year 1923, 12 (RBUCO00102408); The Mining Industry of Idaho for the Year 1928, 174-175 (RBUCO001012451); "Sanborn Map for Kellogg" 1928, sheet 25 (FLQCA-001-02342).

[10]Minerals Yearbook 1943, 379 (RBUCO00101800); Minerals Yearbook 1944, 363 (RBUCO00101805); Minerals Yearbook 1956, 388 (RBUCO00101862); The Mining Industry of Idaho for the Year 1935, 230 (RBUCO00102482); "Sanborn Map for Kellogg" (1944 revision of 1928 sheet), sheet 25 (FLQCA-001-02418); "Sanborn Map for Kellogg" (1951 revision of 1928 sheet), sheet 25 (FLQCA-001-02506).

not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Coeur d'Alene Antimony Mill

The Coeur d'Alene Antimony Mining Company's property was located downstream from the Amy Matchless, about 1.5 miles above Pine Creek's confluence with the South Fork Coeur d'Alene and on the outskirts of Pinehurst. In 1915, the new owners of the Antimony mine prepared to unwater the property and begin producing again, since ore buyers were bidding "keenly" on the output. By the end of the year, a new mill was in operation and regular shipments were being made early in 1916, with metals recovery running about 65%.[11]

In March 1916, the Mining and Scientific Press reported that Pine Creek antimony producers had decided to make no more shipments until smelters paid them a better price. Later that year, Coeur d'Alene Antimony announced that it would built its own smelter at the mouth of Pine creek, but there is no evidence that this was ever built.[12]

In 1918, the company completed a flotation unit at the mill, and while the addition resulted in a favorable recovery of metal, the market was unfavorable by 1919, and the mill closed, apparently forever.[13]

There is no evidence in the historical record that the United States was an operator of the Coeur d'Alene Antimony mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Surprise/Highland-Surprise Mill

Highland Creek flows in a southwesterly direction and joins the East Fork of Pine Creek three miles above the East Fork's confluence with the West Fork. Highland Creek is the easternmost tributary of the East Fork of Pine Fork.

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[11] M&SP 111 (11 September 1915): 413 (FLQCA-001-0695); 111 (6 November 1915): 721 (FLQCA-001-0702); 111 (18 December 1915): 941 (FLQCA-001-0711); 112 (5 February 1916): 215 (FLQCA-001-0716); 112 (6 May 1916): 684 (FLQCA-001-0730).

[12] M&SP 112 (25 March 1916): 455 (FLQCA-001-0722); 113 (9 September 1916): 399 (FLQCA-001-0760).

[13] M&SP 116 (22 June 1918): 868 (FLQCA-001-0872); 117 (19 October 1918): 540 (FLQCA-001-0889); 118 (8 February 1919): 198 (FLQCA-001-0898); E&MJ 106 (13 July 1918): 88 (RBUCO00101005).

The Surprise property, located on the south side of Highland (or Stewart) Creek, was initially financed by Senator Alfred Page of Wardner and controlled by himself and friends. The company began operating its new gravity concentrator in October 1907. It operated intermittently from its opening until about 1912, when the company merged with owners of the Highland Chief property. Located on the same ore vein, the Highland Chief's property was more thoroughly developed, but the Surprise Company had a "first-class new mill," making the merger of the two companies beneficial for both entities. In 1916 the mill was enlarged and flotation cells were added, improving metal recovery and decreasing the metal content in the tailings. The company shipped both lead-zinc concentrate and lead concentrate. Horse-drawn wagons and motor trucks hauled 4,000 tons of concentrates to the railway during 1916 (about twenty-five tons of concentrates daily). The Highland-Surprise shipped some of its product to the Anaconda zinc plant and some to eastern zinc smelters. Metal recovery was again improved that year after the installation of a ball-mill. The mill continued to produce in 1917, but the mine ceased production in 1918. Mine and mill lay idle until 1925, when the 75-ton flotation mill was completely remodeled, with Wilfley tables, ball mill, and new flotation cells, improving it to treat ore by differential flotation. The mill continued to produce lead and lead-zinc concentrates. A Dorr thickening tank was located at the southwest (downstream) end of the mill.[14]

Like the Constitution mill, output of the Highland-Surprise was to be increased upon the completion of the new Pine Creek branch of the O-WR&N. The railroad was never built, and the mill operated only sporadically from 1925 until April 1927 when it closed. In 1941, the property was reopened, and 21,000 tons of zinc-lead ore were treated in a newly-built 100-ton flotation mill. In 1942, the mine was active only from June to November, during which the mill treated a total of 14,474 tons of lead-zinc ore. In 1943, the mill treated 18,130 tons of zinc-lead ore, yielding 3576 tons of zinc-lead concentrates. Another 34,857 tons of ore were treated in 1944. The capacity of the mill itself was increased to 300 tons per day in 1948. In 1949, mine output declined, and the amount milled dropped from 72,925 tons in 1948 to 52,255 tons in 1949. Ore continued to decrease, despite an extensive exploratory project undertaken in the 1950s with DMEA assistance. The mill closed permanently on May 1, 1955, had a cleanup conducted in 1956, and was scrapped in 1962.[15]

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[14]M&SP 111 (4 December 1915): 869 (FLQCA-001-0709); E&MJ 84 (26 October 1907): 804 (RBUCO-001-0598); 102 (26 August 1916): 405 (RBUCO-001-0904); 102 (16 September 1916): 528 (RBUCO-001-0906); Mineral Resources of the U.S., 1916, 601 (RBUCO00101660);Mineral Resources of the U.S., 1917, 492 (RBUCO00101672); Mineral Resources of the U.S., 1918, 495 (RBUCO00101679); Mineral Resources of the U.S., 1925, page? (RBUCO00101719); Mineral Resources of the U.S., 1926, 453 (RBUCO00101727); The Mining Industry of Idaho for the Year 1911, 127 (RBUCO00102336); The Mining Industry of Idaho for the Year 1912, 176 (RBUCO00102355). "Sanborn Map for Kellogg" 1928, sheet 25 (FLQCA-001-02343).

[15]Idaho, Shoshone County Yreka Mining District Highland Surprise Mine, Wallace, Idaho (9 January 1950) (ASANJ021-00008); E&MJ 106 (13 July 1918): 88 (RBUCO00101005); Minerals Yearbook 1941, 356 (RBUCO00101791); Minerals Yearbook 1942, 386 (RBUCO00101795); Minerals Yearbook 1943, 379 (RBUCO00101800); Minerals Yearbook 1944, 363

There is no evidence in the historical record that the United States was an operator of the Highland-Surprise mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products. Despite taking advantage of a DMEA loan in the 1950s to explore for new ore bodies, that program did not directly involve the United States in any of the operations at the Highland-Surprise mill.[16]

Sidney Mill

The Sidney mine was located above the Little Pittsburg mine on Denver Creek. Sidney Leasing Company operated the Sidney mine from May until October 1921 and shipped many hundred tons of lead carbonate ore. In 1925, the lead-zinc ore, which was said to be amenable to differential flotation, was being shipped to Bunker Hill & Sullivan's Star mill. An aerial tramway was constructed in early 1926 from Pine Creek to Kellogg, and began operating late in that year, tramming ore from the Sidney mine to Bunker Hill & Sullivan's Sweeny mill. BH&S assistance to the Sidney operation helped it to operate at a "substantial profit" in the 1920s, despite low metal prices. The Sidney company continued through 1931 to tram its lead-zinc ore to the Government Gulch spur of the Oregon-Washington Railroad & Navigation Company, from where it was taken to the Sweeny mill and separated by flotation into lead concentrates and zinc concentrates.[17]

Soon after 1931, Sidney closed for several years on account of the low price of zinc. In 1935, the property opened briefly but was not operated continuously again until 1944, when the Sidney Mining Company began treating its own ore by flotation. The Sidney initially operated a 50-ton pilot flotation mill, which may have been located in an existing building near the mine portal on Denver Creek. At the same time, the Sidney was developing a new portal, which opened on Red Cloud Creek, a tributary of Highland Creek. In 1945, the company began erecting a new 250-ton selective flotation plant near the new portal on Red Cloud Creek to replace its pilot plant. The new mill continued operating until 1949, when it closed from August 20 to November 20, due primarily to a decrease in ore from the mine. It operated continuously

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(RBUCO00101805); Minerals Yearbook 1948, no page (RBUCO00101826); Minerals Yearbook 1949, 1482 (RBUCO00101832); Minerals Yearbook 1950, 1500 (RBUCO00101836); Minerals Yearbook 1953, 349 (RBUCO00101848); Minerals Yearbook 1955, 365 (RBUCO00101857); Minerals Yearbook 1956, 388 (RBUCO00101862); Minerals Yearbook 1962, 361 (RBUCO00101883).

[16]Minerals Yearbook 1953, 349 (RBUCO00101848).

[17]Mineral Resources of the U.S., 1921, 5 (RBUCO00101694); Mineral Resources of the U.S., 1925, no page (RBUCO00101719); Mineral Resources of the U.S., 1928, 686 (RBUC00101737); The Mining Industry of Idaho for the Year 1927, 180 (RBUCO00102432).

again throughout 1950 when ore output increased. The Sidney company began exploring deeper levels of its own and adjoining properties in 1954 under a DMEA contract. Despite a cleanup operation at the Sidney mill in 1956, suggesting that the mill had closed by then, the U.S. Bureau of Mines reported in 1957 that the mill was operative. Finally, in 1958, the Sidney Mining Company removed mining equipment below a certain level and allowed water to flood workings. Although its own ore reserve was nearing exhaustion, Sidney entered into a profit-sharing agreement with Nabob Silver-Lead Company to develop and mine the Nabob property. The agreement lasted until March 1960. By 1961, the mill was no longer in operation, and mill cleanings were shipped from the Sidney in 1962.[18]

There is no evidence in the historical record that the United States was an operator of the Sidney mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products. Although the Sidney Mining Company took advantage of a DMEA loan in the 1950s to explore for new ore bodies, the program did not involve the United States in any direct way with operations at the Sidney mill.[19]

Little Pittsburg

By December 1915, the newly-organized Colonial Mining & Milling Company had bonded and was operating the Little Pittsburg mine, located on Denver Creek downstream from the Sidney mine. The new company began erecting a 250-ton concentrator that year completing it in 1916. Colonial also built a 5178-foot long tramway to convey ore from the mine to the mill. A sorting-plant was erected to separate the high-grade ore from the milling ore. There is no record of Colonial's mill begin completed or ever operating.

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[18]Earl H. Bennett, Draft Chapter, "100 Years of Mining in the Coeur d'Alene District," (ASAID082-00636); E&MJ 136 (October 1935 (RBUCO00101195); Minerals Yearbook 1944, 363 (RBUCO00101805); Minerals Yearbook 1945, 380 (RBUCO00101811); Minerals Yearbook 1946, 1448 (RBUCO00101816); Minerals Yearbook 1949, 1481 (RBUCO00101831); Minerals Yearbook 1950, 1499 (RBUCO00101835); Minerals Yearbook 1954, 377 (RBUCO00101852); Minerals Yearbook 1955, 365 (RBUCO00101857); Minerals Yearbook 1956, 388 (RBUCO00101862); Minerals Yearbook 1957, 382 (RBUCO00101866); Minerals Yearbook 1958, 312 (RBUCO00101870); Minerals Yearbook 1959, 330 (RBUCO00101874); Minerals Yearbook 1960, 343 (RBUCO00101877); Minerals Yearbook 1960, 361 (RBUCO00101833); The Mining Industry of Idaho for the Year 1945, 219 (RBUCO00102986); The Mining Industry of Idaho for the Year 1946, 217 (RBUCO00102710); The Mining Industry of Idaho for the Year 1947, 200 (RBUCO00102727); (Photograph of mill in The Mining Industry of Idaho for the Year 1951, 95 (RBUCO00102806)); "Sanborn Map for Kellogg" (1961 revision of 1928 sheet), sheet 26 (FLQCA-001-02591).

[19]Minerals Yearbook 1955, 365 (RBUCO00101857).

In 1926, the Little Pittsburg mine sent lead-zinc ore to a custom mill for testing. In 1929, the property was taken over by the newly incorporated Pine Creek Lead-Zinc Company, which began constructing a 250-ton fine-grinding flotation concentrator. The new mill was completed in 1930. It did not treat any ore in 1930, nor in the next decade, for that matter, due to low metal prices.[20]

Some production occurred in 1941, but it was unprofitable. Subsequently, the property was leased to the Denver Development Company in 1942. The mill treated 11,656 tons of ore containing an average of 1.50 ounces of silver to the ton, 3.31% lead, and 8.32% zinc. Operations were suspended in 1943, when an explosion caused a fire that completely destroyed the buildings. By the end of the year, the reconstruction was complete, and the Denver Development Company resumed operations, milling some ore in the newly constructed 100-ton flotation mill. While re-construction was underway, Denver Development treated some of its ore in the Amy Matchless mill. The Denver company's lease continued until 1949, when the ore reserves declined and low metal prices ensued. By 1952, a different company, Mascot Mines, Inc., was operating the mine, and decreasing ore from the mine continued to be reported until 1955. Finally, Mascot and Pine Creek Lead-Zinc merged in 1960, but the Little Pittsburg mill apparently did not operate after 1952.[21]

There is no evidence in the historical record that the United States was an operator of the Little Pittsburg mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Nabob Mill

The Nabob mine, located on Denver Creek, was developed during the early part of the 1910s. Hand-picked and sorted ore was hauled by team from the Nabob mine about eight miles to Pine Creek Spur before the mill was built. When a good grade of lead-zinc ore was discovered at the 900-foot level in 1918, the Nabob Consolidated Mining Company began planning a 150-ton mill on the lower stretches of Nabob creek just above its confluence with Pine Creek. Machinery for the 1919 construction of the mill came from the old Stewart mill. After being shut

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[20]M&SP 111 (4 December 1915): 869 (RBUCO-001-0709); E&MJ 101 (22 January 1916): 202 (RBUCO-001-0877); Mineral Resources of the U.S., 1926, 453 (RBUCO00101727); Mineral Resources of the U.S., 1929, no page (RBUCO00101746): Mineral Resources of the U.S., 1930, 659 (RBUCO00101756); The Mining Industry of Idaho for the Year 1930, 203 (RBUCO001012462); The Mining Industry of Idaho for the Year 1931, 241 (PHRCA019-00921).

[21]Earl H. Bennett, Draft Chapter, "100 Years of Lode Mining in the Coeur d'Alene District," (ASAID082-00645: 00646); Minerals Yearbook 1942, 386 (RBUCO00101795); Minerals Yearbook 1943, 379 (RBUCO00101800); Minerals Yearbook 1948, no page (RBUCO00101827); Minerals Yearbook 1949, 1482 (RBUCO00101832).

down for a time late in 1919 because of financial difficulties, the mill resumed operations in 1920, adding equipment for the recovery of zinc, a metal previously disposed of in the creek. The property ceased operations for a period, but then resumed in 1923, remodeling the mill in order to better separate lead and zinc products. The Nabob Silver-Lead Company incorporated in 1923 and apparently took ownership of the Nabob property. In 1924, the Nabob Silver-Lead Company treated considerable ore and shipped several thousand tons of lead concentrate and lead-zinc concentrate before July 14, 1924 when the entire surface plant was destroyed by a forest fire. The surface plant of the mine was rebuilt in 1925, but ore mined thereafter was shipped to the Timber Butte mill in Montana. In 1926, the Nabob continued development but shipped no ore, and it appears that the mine ceased to be an important producer again until 1944.[22]

In 1944, the Nabob mine was under lease to the Lynch-Pine Creek Mining Company which hauled 16,248 tons of zinc-lead ore to the Amy Matchless flotation mill on Pine Creek, where the ore was dressed to 534 tons of lead concentrates and 1,491 tons of zinc concentrates. In June 1945, Lynch-Pine relinquished its lease on the mine, and Nabob Silver-Lead Company began erecting a new 250-ton flotation mill in September. By 1946, the mill was complete, and 8000 tons of zinc-lead ore were treated that year. The mine, and presumably the mill, continued to operate until low lead-zinc prices led the company to suspend production (though it continued development) in 1953. In 1956, the Nabob Silver-Lead Company produced concentrates from development ore extracted during winze-sinking operations at the mine. Mine exploration and development work were done under a DMEA contract. Although a new ore shoot was discovered, the Nabob mine closed again in 1957 because of low metal prices. Development continued for a year between 1959-1960 under an agreement with Sidney Mining Company to develop the Nabob mine on a profit-sharing basis. However, the ore was most likely treated at the Sidney mill, as there is no record of the Nabob mill operating again after 1957. Ore produced from the mine by lessees in 1964 was shipped to the Bunker Hill mill. In 1975, Intermountain rehabilitated the mill, replacing the roofs and fixing the flotation cells and machinery.[23]

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[22]Earl H. Bennett, 100 Years of Lode Mining in the Coeur d'Alene District (draft chapter) (ASAID082-00652); W.J. Berglund to W. Clayton Miller, 15 October 1907 (ASAID082-00014-00015); M&SP 108 (7 February 1914): 271 (FLQCA-001-0605); E&MJ 103 (16 June 1917): 1087 (RBUCO-001-0935); 104 (25 August 1917): RBUCO001-0944); 108 (13 September 1919): 488 (RBUCO00101055); 108 (11 October 1919): 631 (RBUCO00101057); 109 (22 May 1920): no page (RBUCO00101073); Mineral Resources of the U.S., 1918, 495 (RBUCO00101679); Mineral Resources of the U.S., 1919, 483 (RBUCO00101686); Mineral Resources of the U.S., 1923, 403 (RBUCO00101705); Mineral Resources of the U.S., 1924, 283 (RBUCO00101711); Mineral Resources of the U.S., 1925, no page (RBUCO00101719); Mineral Resources of the U.S., 1926, 452 (RBUCO00101727); The Mining Industry of Idaho for the Year 1911, 129 (RBUCO00102337); The Mining Industry of Idaho for the Year 1924, 152 (RBUCO00102414).

[23]Wallace Miner, June 2, 1988 (NABSI-012-00713); Minerals Yearbook 1944, 363 (RBUCO00101805); Minerals Yearbook 1946, 1448 (RBUCO00101816); Minerals Yearbook 1953, 349 (RBUCO00101848); Minerals Yearbook 1956, 388 (RBUCO00101862); Minerals Yearbook 1959, 330 (RBUCO00101874); Minerals Yearbook 1964, 343 (RBUCO00101890).

There is no evidence in the historical record that the United States was an operator of the Nabob mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products. Although the Nabob Silver-Lead Company did take advantage of a DMEA loan during the 1950s to explore for new ore bodies that program did not involve the United States in any of the operations at the Nabob mill.[24]

Historic Movement of Tailings and Other Solids down Pine Creek

During the early operation of Pine Creek mills, tailings were disposed of directly in the creeks. The earliest mill erected in the Pine Creek region was the Surprise (later the Highland-Surprise) mill, located on Highland Creek. Erected in 1907, the mill was a gravity concentrator. Coarse tailings were most likely disposed of directly into or next to the creek, as historic records do not show any impoundment facilities in the area. In 1916, flotation cells were added to the Surprise mill, and most mills constructed after that time began with some type of flotation process. Even with flotation, however, early metal recovery was often low -- only about 65% for the Coeur d'Alene Antimony mill in 1916.

Recovery rates rose as milling processes improved. By 1940, when many of the mines and mills re-opened after having been closed during the Depression, mills had installed selective flotation. Highland-Surprise processed ore at ratio of about 5:1 during WWII years. Selective flotation yielded better metals recovery, and therefore cleaner tailings. At least one company, the Spokane-Idaho Mining Company which operated the Constitution mill, was impounding its tailings behind a dam during this period.

There is little record of tailings from the banks and bed of Pine Creek being re-treated. On the other hand, most, if not all, of the companies operating mills on Pine Creek contributed to the costs of operating the Cataldo dredge, suggesting that the Pine Creek companies counted on much of their tailings discharge flowing down to the South Fork and thence downstream to the dredge site.[25]

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[24]Minerals Yearbook 1956, 388 (RBUCO00101862).

[25]"Dredge Fund," annual account summaries, 1947-1968 (ASAID-091-00106).

NORTH FORK COEUR D'ALENE RIVER

The watershed for the North Fork Coeur d'Alene River lies directly north of that for the South Fork. Although virtually all the large ore producing mine were located in the South Fork watershed, there were several small mines in the North Fork, and indeed the first discovery of gold in the Coeur d'Alene district took place in the North Fork. Mining activity in the North Fork took place along tributaries like Pritchard Creek, Eagle Creek, and Beaver Creek, located primarily in the southern portions of the watershed, adjacent to and directly over the divide from the South Fork. The processing of minerals in the North Fork can be divided into three categories: 1) stamp milling, which largely took place during the first twenty years of mining in the district and which was aimed almost exclusively on recovering gold; 2) hydraulic mining, which mainly took place during the first forty years of mining in the district and which was also aimed almost exclusively on recovering gold; and 3) concentration, which used several stages of mineral processing to separate minerals bearing precious, base, and/or rare metals from the host rock. Although these three kinds of metallurgical activity, in aggregate, did dislodge vast amounts of solid material from its native setting and discharge that material into the hydraulic system of the North Fork and therefore the Coeur d'Alene River system as a whole, the mining activities on the North Fork contributed relatively little to the accumulations of contaminants below the confluence with the South Fork.

Stamp Milling

The first discovery of gold in the Coeur d'Alene district is attributed to Andrew Pritchard, who supposedly found colors in the gravels of the South Fork drainage near the mouth of Big Creek in 1878. He extended his search into the North Fork country, and in 1882 he found more promising evidence of placer gold along Pritchard Creek. He staked a claim about two miles east of the confluence of Eagle and Pritchard creeks in March 1883. Several other prospectors filed both placer and lode claims, and a small boom ensued. Some of those who filed lode claims were able to assemble the capital necessary to build small stamp mills.

It was standard practice in nineteenth-century stamp mills to use the propensity of quicksilver (mercury) to form an amalgam, when it comes in contact with gold, as a means of recovering gold from finely stamped pulp. The amalgam was periodically collected and sent to retort, where it was heated to a temperature sufficient to separate the gold and quicksilver. Molten gold was poured into molds for form bullion bars, and the mercury evaporated. The retort captured the mercury gas, cooled it, condensing the quicksilver so that it could be used again.

I have scanned the numerous reports in Engineering & Mining Journal and Mining & Scientific Press describing the numerous small stamp mills operating in the Murray vicinity during the 1880s, 1890s, and early 1900s. There is almost no mention of the mills using

amalgamation to recovery. On the other hand, Sanborn maps for Murray show that the mills housed vanners.[1] It may be that, instead of amalgamation, the gold stamp mills in the North Fork country used vanners to produce a product of nearly pure gold dust.

The best description of a stamp mill in the Coeur d'Alene district may be that provided in a 1906 issue of Mining & Scientific Press describing the Golden Reward, a 20-stamp mill near Murray. A nicely detailed drawing, a section through the mill, shows a conventional array of stamps below the ore bin, an amalgamating table downstream of the stamp battery, and an amalgam tramp at the downstream end of the table. The mill was also equipped with a Wilfley table, rather than a vanner.[2]

Regardless of whether mills in the North Fork country used amalgamation, it is clear that they did not use a salt-roast, such as was historically used in some silver mills, or other methods that chemically altered the ore. The North Fork stamp mills merely crushed the ore finely so that they could recover gold, discharging the pulp into the nearby creeks. Unlike the silver-lead concentrators on the South Fork, which shipped some real fraction of concentrates to smelters (perhaps 12-15% by weight) and therefore only discarded the remainder as tailings (perhaps 75-88% by weight), the stamp mills on the North Fork discarded essentially all the material they crushed as tailings, because they were recovering only ounce per ton. It they did use amalgamation, then they almost certainly lost some mercury to the environment. Early in the twentieth century, there were reports of plans to use cyanide to retreat old stamp-mill tailings in the North Fork country, but there is little evidence that the practice was wide-spread.[3]

There is no evidence in the historical record that the United States was an operator of any of the early stamp mills in the North Fork country. The United States did not own any of the mills, did not manage the mills, and did not own any of the materials processed at the mills. Nor did the United States inspect or in any way regulate the mills and their operations, including their generation and discharge of waste products.

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[1]"Sanborn Map for Murray" (1896), (FLQCA-001-02731-734); "Sanborn Map for Murray" (1908), (FLQCA-001-02735-738). One rare early mention of amalgamation is a report in an 1888 issue of Mining & Scientific Press, describing a centrifugal amalgamator that would be tested on Golden Chest tailings; see M&SP 56 (26 May 1888): 333 (FLQCA-001-01075).

[2]"A Modern Stamp-Mill," M&SP 92 (24 March 1906): 200-201 (FLQCA-001-0244-0245).

[3]For example, between 1900 and 1903, there were several reports in Mining & Scientific Press of various individuals laying plans to treat Golden Chest tailings with cyanide, but there is not a single report that I've seen of anyone actually putting a cyanide plant in use at the Golden Chest.

Placer Mining

During the late nineteenth century, several groups of miners used hydraulic methods to mine the North Fork country for gold. The operations used water under pressure, sprayed through giant nozzles, to erode large volumes of sand and gravel and wash the material through sluice boxes to recover gold.[4] In the early twentieth century, other companies began dredging stretches of Pritchard Creek, Eagle Creek, and other streams in the vicinity of Delta. The Coeur d'Alene Mining Company consolidated many of the placer claims around Delta in 1900 and shortly thereafter.[5]

Although these various forms of placer mining dislodged tremendous volumes of alluvial material along the banks and beds of the streams tributary to the North Fork, the operations did not change the size or the chemistry of the material. They simply washed it through sluices and other devices designed to recovery gold resident in the sands and gravels.

There is no evidence in the historical record that the United States was an operator of any of the placer mining operations in the North Fork country. The United States did not own the operations, did not manage the operations, and did not own any of the materials processed. Nor did the United States inspect or in any way regulate the operations, including their generation and discharges of waste products.

Concentrators on the North Fork

Early in the twentieth century, several companies began concentrating ores mined in the North Fork country, seeking to profit from metals other than gold. None of these mills operated at a scale or for a duration to rival the major concentrators on the South Fork and its tributaries, which generated the vast majority of the tailings flowing into the Coeur d'Alene River. Nevertheless, a few of the mills are worth noting briefly.

Bear Top Mill

One of the first concentrators in the Murray area was the Bear Top, located about five miles east of Murray. In 1904, the Bear Top Mining Company purchased the equipment from the Black Bear mill, which had operated briefly in Canyon Creek. The Bear Top also built a half-

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[4]Photos of these operations may be seen in Patricia Hart and Ivar Nelson, Mining Town: The Photographic Record of T.N. Barnard and Nellie Stockbridge from the Coeur d'Alenes (Seattle: University of Washington Press, 1984), 22-25.

[5]M&SP 80 (30 June 1900): 738 (FLQCA-001-00019); 81 (27 October 1900): 499 (FLQCA-001-04264); 88 (16 January 1904): 49 (FLQCA-001-0129); 97 (7 November 1908): 618 (FLQCA-001-0370).

mile tramway to haul ore from mine to mill. When the relocated mill went into operation in 1906, the company began shipping lead-silver concentrates. Because of its remote location, the company had to ship its concentrates several miles to the railroad by horse-drawn wagon. In 1909, the Bear Top modified its mill to be able to produce zinc concentrates. The company produced little product after that however.[6]

There is no evidence in the historical record that the United States was an operator of the Bear Top mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Golden Chest

The Golden Chest mill is significant as the first in the Coeur d'Alene district to produce tungsten. It started operating in 1894 as a simply 10-stamp gold mill equipped with vanners. After more than a decade of intermittent operations, during which the mill was enlarged to 20 stamps, the Gold Chest Mining Company began hand-jigging some of its ore to try to recover scheelite, a tungsten mineral. During the 1910s, the Golden Chest mill shipped tungsten concentrates from time to time, treating ores from nearby mines as well as from the Golden Chest mine. The operation was not commercially successful, and the mill apparently did not operate after about 1916.[7]

There is no evidence in the historical record that the United States was an operator of the Golden Chest mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

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[6]M&SP 89 (10 December 1904): 400 (FLQCA-001-0177); 90 (18 March 1905): 175 (FLQCA-001-0192); 93 (4 August 1906): 132 (FLQCA-001-0252); 97 (17 October 1908): 514 (FLQCA-001-0363); 99 (28 August 1909): 278 (FLQCA-001-0412).

[7]M&SP 68 (28 April 1894): 270 (FLQCA-001-01292); 98 (9 January 1909): 71 (FLQCA-001-0385); 112 (5 February 1916): 215 (FLQCA-001-0716); Robert Rhea Goodrich and Norman E. Holden, "Experiments in the Recovery of Tungsten and Gold in the Murray District, Idaho," Trans. AIME 58 (1918): 224-231 (FLQCA-001-03424-427); "Sanborn Map for Murray" (1896), (FLQCA-001-02731-734); "Sanborn Map for Murray" (1908), (FLQCA-001-02735-738); "Sanborn Map for Murray" (1921), sheet 2 (FLQCA-001-02743-746); "Sanborn Map for Murray" (1921, up-dated to 1927), sheet 2 (FLQCA-001-02751-754).

Ray-Jefferson Mill

The Day interests began construction of the Ray Jefferson Mill in 1916. The mill was operating by early 1917 In 1944, the mill, now known as the Carlisle mill began operating, treating ore from the Monitor and nearby groups. It closed in 1952.[8]

There is no evidence in the historical record that the United States was an operator of the Ray-Jefferson mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Jack Waite Mill

The Jack Waite underground mine workings actually extended from the headwaters of the Eagle Creek drainage eastward into Montana. The mine began producing as early as 1911. Ore had to be hauled by wagon twelve miles to a railroad shipping point. In 1926, the Jack Waite Leasing Company built a 125-ton mill. It was enlarged in 1929 to a capacity of 150 tons/day. ASARCO acquired the Jack Waite in 1934, but it continued to operate only intermittently.[9]

There is no evidence in the historical record that the United States was an operator of the Jack Waite mill. The United States did not own the mill, did not manage the mill, and did not own any of the materials processed at the mill. Nor did the United States inspect or in any way regulate the mill and its operations, including its generation and discharge of waste products.

Historic Movement of Tailings and Other Solids down Pritchard Creek

Testifying at a early twentieth-century tailings trial, the manager of the Federal Mining & Smelting Company, W. Clayton Miller, stated that during periods of high water, the North Fork Coeur d'Alene River often appeared to carry even more solids that the South Fork did. He attributed this to the work of the placer miners, who did nothing to impound the debris they send downstream from their mining operations. On the other hand, during periods of low flow, the

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[8]E&MJ 101 (27 May 1916): 963 (RBUCO-001-0892); 103 (17 February 1917): 325 (RBUCO-001-0923); M&SP 117 (31 August 1918): 295 (FLQCA-001-0885); Minerals Yearbook, 1944, 357 (RBUCO-001-01802); Minerals Yearbook, 1952, 302 (RBUCO-001-01843); "Ray Jefferson Mill, Later Named the Carlisle," photo, n.d. (FLQCA-001-03343).

[9]M&SP 103 (28 October 1911): 567 (FLQCA-001-0489); Mining Industry in Idaho for the Year 1926, 44 (RBUCO-001-02424); Mining Industry in Idaho for the Year 1929, 197 (RBUCO-001-02456); John R. Turner, "The Jack Waite Mine," Mining Congress Journal 17 (December 1931): 671-673 (RBUCO-001-05356); "The Jack Waite Mill, Duthie, Idaho - July 1934," photo (FLQCA-001-03299); "The Jack Waite Mill," photo, n.d. (FLQCA-001-03300).

North Fork was virtually clear at the confluence with the South Fork, which was cloudy, or opaque, on a year-round basis due to the continual loading of the stream with slimes from the concentrators upstream. Witnesses for the farmers corroborated Miller's account of the seasonal differences in character between the waters of the North Fork and the South Fork. Wallace Morphy, for example, testified that during most months of the year a line of demarcation was evident distinguishing the waters of the North Fork from the waters of the South Fork for a considerable distance below the confluence, the former being clear and the latter being very cloudy.[10]

[10]W. Clayton Miller, testimony in McCarthy v. BH&S, 2224, 2227 (FLQCA-001-04780, 783); Davis Holderman, McCarthy v. BH&S, 230 (FLQCA-001-04594); Wallace M. Morphy, testimony in Doty v. BH&S, 27-28 (FLQCA-001-6932-933).

COEUR D'ALENE RIVER
(from the confluence of the North and South Forks downstream)

The North Fork Coeur d'Alene River and the South Fork Coeur d'Alene River join a couple miles below the mouth of Pine Creek and form the Coeur d'Alene River itself. A short distance below the confluence, downstream of the Cataldo Mission, the river valley broadens and the river is flanked by expansive bottom lands on either side. The river makes a gradual transition into becoming an arm of Coeur d'Alene Lake, with the line of transition fluctuating with the elevation of the lake. It was into this arm of the lake and onto these bottom lands that fine solids discharged as tailings from the upstream concentrators settled. When the river's flow reached the still waters of the lake, even the finest of the water-borne slimes were able to fall out of suspension.

There were no mills operating along this stretch of the river. Nevertheless, it played an important role in the early metallurgical history of the Coeur d'Alene mining district. Before it was possible to load ore or concentrates onto railroad cars at mines or mills within the district and transport those cars to smelters without unloading and reloading onto other conveyances, the lake served as an important link in the transportation system. Before the narrow-gauge railroad between and the mining district went into service in 1887, ore was hauled by horsedrawn wagon to the docks, loaded onto a steamboat, and shipped to a railroad terminal at Coeur d'Alene City. When the Coeur d'Alene Railway & Navigation Company's narrow-gauge line started running, the railroad built a special dock at Mission to off-load ore from cars and onto the boat. Even after the other rail lines were constructed into the district from Montana to the east and around the southern end of the lake, the steamboat link across the lake continued as an important route out of the district for several years. I have found no historical accounts to date of how extensive spillage of ore and concentrates may have been at Mission or Coeur d'Alene.

Historic Movement of Tailings and Other Solids down the Coeur d'Alene River

1. Free-Flowing Tailings: 1888-1901

In the 1880s, before tailings made their way below the confluence of the South Fork and the North Fork, observers of the Coeur d'Alene River reported that it was a beautifully clear mountain stream. Some time prior to 1900, however, the Coeur d'Alene River became a cloudy stream, as the waters of the South Fork grew to be ever more heavily-laden with slimes from the upstream milling operations. Patrick Whalen, who had owned a farm along the river near

Cataldo since about 1880, stated that he first noticed tailings deposits on his land after high water in 1901.[1]

2. Impounded Coarse Tailings, 1901-1917

One of the responses mining companies in the Coeur d'Alene district made to the early twentieth-century tailings litigation was to acquire easements from owners of property along the Coeur d'Alene River. At a meeting in August 1910, five companies agreed to pool their resources to acquire such easements. The proportions the companies agreed to pay were based on the volumes of ore each company concentrated between January 1905 and June 1910. The proportions were as follows:

Federal Mining & Smelting Company	57.92%
Bunker Hill & Sullivan Mining & Concentrating Company	25.77
Hecla Mining Company	7.03
Hercules Mining Company	5.20
Gold Hunter Mining Company	4.07

The companies also used some of the money they collected from each other to pay legal settlements to individuals who had brought suits against the companies, to purchase land in the vicinity of the Pine Creek dam, to pay costs associated with the wing dam along the south bank of the South Fork in the vicinity of Kellogg, to pay legal fees, and to pay an agent to conduct negotiations with property owners.[2]

In 1913, the original five companies enlisted the participation of several other companies in the district, some of which had been active for nearly a decade, and some of which had recently commenced operations as part of the new wave of zinc mining in the district. Following is a list of the new participants:

Alice Mining Company
Green Hill-Cleveland Mining Company
Interstate-Callahan Consolidated Mining Company
Marsh Mining Company
Ontario Mining Company
Snowstorm Mining Company
Stewart Mining Company
Tamarack & Custer Mining Company

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[1]Wallace M. Morphy, testimony in Doty v. Bunker Hill & Sullivan, et al, 28-31 (FLQCA-001-06929-932); Patrick J. Whalen, testimony in Doty v. Bunker Hill & Sullivan, et al, 144, 147 (FLQCA-001-06813, 816).

[2]"Coeur d'Alene River Valley Easements," financial records of the companies cooperating in the endeavor, 26 September 1910 through 11 July 1913 (ASAID-084-00002-012).

With a new set of members, the group changed its assessment formula. The old fixed proportions were abandoned, and the group asked its members to contribute towards the easement fund monthly at the rate of two cents per ton of ore milled. Green Hill-Cleveland and the Stewart were the two companies that entered the group with larger monthly contributions than the smallest of the original members, the Gold Hunter. During the year for which records are available, it is evident that the larger companies made regular contributions, but that some of the smaller companies, especially the Alice, Marsh, and Ontario, made initial contributions and then dropped out. The group continued acquiring easements at least through 1919.[3]

The U.S. Army Corps of Engineers conducted a study of the Coeur d'Alene River in April 1914. The field investigation was conducted under the Corps' authority for navigable rivers within the country. The Coeur d'Alene River was considered navigable from the lake up to the confluence of the North Fork and the South Fork. The Corps' report described the waters of the South Fork and the Coeur d'Alene River itself being impregnated on a year-round basis with slimes from the concentrators operating in the drainage. The report described how flood stages of the river, in conjunction with rising levels in the lake during those periods, functioned to spread deposits of slimes on low-lying fields and meadows along the river. The Corps also mentioned farmers' allegations that the slimes made hay poisonous to livestock, but the Corps did not take a position on the farmers allegations. The Corps was more interested in the physical consequences of tailings in the river. The 1914 report described shoaling along the entire length of the Coeur d'Alene River and attributed that shoaling to tailings. According to the Corps, however, shoaling was not interfering with navigation, and the agency saw no need to interfere with mining or take steps to improve existing conditions in the river.[4]

According to Jacob Polak's complaint in his suit against the major mining companies in the Coeur d'Alene district, their tailings impoundments at Osburn and Pine Creek had filled by 1912. Thereafter, he claimed, the amount of tailings flowing over the dams increased. Those tailings flowed downstream to his property, just west of Cataldo. He complained that, rather than increasing the height of the dams further, the companies built pile and plank barriers along the river in an effort to prevent tailings from overflowing onto adjacent lowlands. One such barrier was built along the river near Polak's property. According to Polak's complaint, the barriers did not serve their purpose from the beginning; the river's current readily undermined them. By the time of the 1917 flood, the barriers had deteriorated and were completely ineffective.[5]

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[3]"Coeur d'Alene River Valley Easements," financial records of the companies cooperating in the endeavor, 18 August 1913 through 27 January 1915 (ASAID-084-00013-028); list of deeds and easements (ASAID-137-00019-034).

[4]District Engineer, "Preliminary Examination of Coeur d'Alene River, Idaho," unpublished report dated 30 June 1914 (COENA-009-00002-007).

[5]Complaint, in Jacob Polak v. Bunker Hill & Sullivan, et al, 24-26 (FLQCA-001-04828-830).

Law suits against the mining companies continued. One such suit was filed during the 1920s by Christ Lauma against the Bunker Hill & Sullivan Mining & Concentrating Company, the Federal Mining & Smelting Company, and the Hecla Mining Company. Lauma had purchased land along the Coeur d'Alene River from a Mr. Brown, who years earlier had sold a tailings easement to the mining companies. Despite those easements on some 225 farms, releasing the mining companies from further damage claims, more than a dozen individuals had subsequently filed suits against the companies. On 16 June 1930, the Ninth Circuit Court in San Francisco upheld a U.S. District Court ruling that Lauma could not recover damages.[6]

3. Free-Flowing Fine Tailings, 1917-1968

The complaint in Polak v. Bunker Hill & Sullivan, et al, stated that the Pine Creek dam had filled by 1912 and that thereafter fine tailings steadily flowed over the spillway. Whether or not that was true, after the Pine Creek dam went out in the 1917-18 flood (see section on Lower South Fork), there would have been little to retard the flow of fine tailings in the South Fork or prevent them from moving down into the Coeur d'Alene River. In the Polak case, tried shortly after the 1917-18 flood, a surveyor named Shonts testified that there were deposits of aluminum along the banks of the Coeur d'Alene River that made the ground adjacent to the river higher in elevation that the bottom farther back from the river.[7]

In 1931, the U.S. Bureau of Mines prepared a study on the history and behavior of tailings flowing into and through the Coeur d'Alene River. The Bureau's report, presented in 1932, summarized the effects of the flood and subsequent tailings movement as follows:

> [In 1917,] an unusual flood scattered fine tailings over much larger areas than had previously been affected. The damage was due in a large measure to the failure of the two impounding dams [Pine Creek and Osburn] which by this time had accumulated large amount of tailings. This was undoubtedly augmented by the action of the flood in carrying farther down stream some of the tailings that had been deposited in the river channel during normal years.[8]

The Bureau's report also verified the observation that tailings tended to accumulate in greater amounts near the banks of the river. The Bureau's assays of the alluvial materials deposited along the banks of the river in the areas below Cataldo verified that the materials were indeed tailings, exhibiting an appearance of tailings and showing lead assays comparable to tailings.[9]

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[6]Mining Congress Journal 16 (July 1930): 620 (FLQCA-001-04985).

[7]Complaint, in Jacob Polak v. Bunker Hill & Sullivan, et al, 24 (FLQCA-001-04828); Shonts, testimony in Bunker Hill & Sullivan v. Polak, 1090 (FLQCA-001-04860).

[8]U.S. Bureau of Mines, "Pollution of Coeur d'Alene River and Lake by Mill Tailings" (unpublished report dated December 1932), 6 (ASADC-008-00555).

[9]U.S. Bureau of Mines, "Pollution of Coeur d'Alene River and Lake by Mill Tailings," 8, 12

Little was done by the mining industry during the 1920s, intentionally, to regulate the movement of tailings down the South Fork and into the Coeur d'Alene River, although it should be noted that Bunker Hill & Sullivan continued to stack its tailings on the flat near Kellogg. As described in the individual mill descriptions throughout this report, however, the mining industry was going through a very significant change that had an inadvertent effect on the movement of tailings through the system. Beginning in the 1910s and continuing through the 1920s, concentrators in the Coeur d'Alene district evolved to rely increasingly on the flotation process to recover lead, zinc, and other metals from ores. Flotation required that the material be ground very finely before it was sent to the flotation cells. As a consequence mills in the Coeur d'Alene district arrived at the point where they discharged only fine tailings into the environment. By the 1930s, Bunker Hill & Sullivan may have been the only company that still used jigs as a first step in concentration, but even at the West mill, BH&S ground finely all the tailings from the jigging plant and sent them through the flotation plant before discharging any material as waste. Eventually, some companies also began using tailings to backfill stopes. They selected only the coarsest of their flotation tailings, however. Slimes did not readily settle and therefore continued to be discharged into nearby streams. Reviewing the situation in 1934, W.L. Zeigler of the Hecla Mining Company said that, as a consequence of the switch to flotation, "Naturally fine material is carried farther down stream by water currents."[10]

The 1932 Bureau of Mines report noted that the near universal use of flotation in the district had two contrary effects on the character and behavior of tailings in the river:

> Flotation has, however, resulted in an increased production of fine size tailings so that from the viewpoint of contamination of waters, the lead content of the tailings has been reduced, but on the other hand the amount of very fine material which is difficult to remove from the water has been increased.[11]

The 1932 Bureau of Mines report also noted that the lead content of tailings deposits in the Coeur d'Alene River and in the lake was higher than the lead content of tailings being discharged at the time by the flotation mills in the district. One explanation the Bureau offered for this observation was that the tailings being assayed in the river and the lake were from earlier milling operations, when methods were not as effective at recovering lead.[12]

(ASADC-008-00558, 564).

[10]Zeigler, "Mill Tailings Disposal in the Coeur d'Alene Mining District," (unpublished ms. dated 1934 and presented at an AIME meeting in January 1935), 1 (ASAID-084-00097); L.A. Grant to H.C. Clare, letter dated 12 June 1952 (ASAID-024-00555-556).

[11]U.S. Bureau of Mines, "Pollution of Coeur d'Alene River and Lake by Mill Tailings," 2 (ASADC-008-00549).

[12]U.S. Bureau of Mines, "Pollution of Coeur d'Alene River and Lake by Mill Tailings," 35 (ASADC-008-00588).

Zeigler went on to say that the large volume of fine tailings washing down to Mission Flats aroused concern by folks living along Coeur d'Alene Lake that the metallurgical wastes were polluting the waters of the lake, perhaps making the lake dangerous to human health. Voicing of public concern led to two sets of actions: 1) several government agencies at both state and federal levels conducted extensive scientific analyses of the effects of tailings on water quality in the lake, and 2) the mining industry conducted its own studies, out of which developed a plan to prevent tailings from entering the lake or polluting its waters. Zeigler was one of the individuals who prepared the plan, under which cooperating companies would install a dredge below Cataldo Mission and pump settled material from the river bottom onto adjacent land.[13]

The mining companies had already acquired much of the land along the river in that vicinity as a means of forestalling damage claims. The companies bought additional land, to gain sufficient dumping ground, and built a suction dredge, similar to the type often used to deepen shipping channels in harbors. The land was held in trust by the Old National Bank & Union Trust Company of Spokane and the First National Bank of Wallace. Apparently, Bunker Hill & Sullivan, Federal, and Hecla were the only three companies contributing to the costs associated with the dredging operation at the outset, although others would contribute later. The dredge went into operation in July 1932. It piped water and fine tailings to an area north of the river. The pipeline, elevated on pile bents, had four-inch holes along the bottom, spaced at ten-foot intervals. The holes allow coarser material to drop out of the pipe first and finer material to be carried farther from the river. As water drained away from the dump area, it flowed through swamps for about two miles before returning to the river downstream. Zeigler reported that by the time water returned to the river, it was "perfectly clear."[14]

In December 1933, the Coeur d'Alene Basin experienced its worst flood on record. The flood followed two seasons of work by the dredge, during which a sizeable "artificial lake" had been created. In 1932, the dredge had been able to excavate the river channel for about 1,000 feet. Considerable fine material settled back into the channel, so the dredge re-worked it to close out the season before freezing weather arrived. The dredge removed about 750,000 tons of tailings and other debris in 1932. By the beginning of the 1933 season, the channel had again completely filled with tailings. After removing that material to the dump, the dredge then began expanding the size of the cleared area, creating the so-called artificial lake. The dredge removed about 1,250,000 tons of tailings and other debris in 1933.[15]

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[13]Zeigler, "Mill Tailings Disposal in the Coeur d'Alene Mining District," 2-4 (ASAID-084-00098-100).

[14]Zeigler, "Mill Tailings Disposal in the Coeur d'Alene Mining District," 2-4 (ASAID-084-00098-100); Agreement between the Old National Bank & Union Trust Company and Bunker Hill & Sullivan, Federal, and Hecla (undated), and Agreement between the First National Bank, Wallace, and Bunker Hill & Sullivan, Federal, and Hecla, document dated 31 May 1946 (ASAID-084-00050-064).

[15]"Remove Much Mines Debris," Coeur d'Alene Press (14 October 1933): n.p. (ASAID-137-00011); Zeigler, "Mill Tailings Disposal in the Coeur d'Alene Mining District," 4-5 (ASAID-

The flood refilled the excavated area with tailings and other debris. Zeigler was pleased with the stability of the tailings dump his operation was creating. Flood waters rose high enough to inundate the ground on which the dump was building, but the river bottom is so wide there that flood waters generated no perceptible current and therefore did not erode any of the dump away. Moreover, Zeigler observed, the flood waters caused additional fine solids to settle over the dump area. He concluded that the 1933 flood demonstrated it would be impractical to try to impound fine tailings at points along the South Fork. The location of the Cataldo dredge, Zeigler believed, was the first place below all of the mills were tailings could be impounded and be safe from floods.[16]

Over the course of the next twenty years, the mining companies removed an estimated 17,000,000 tons of material from the bed of the Coeur d'Alene River at the Cataldo dredge site. Every season, the dredge pumped tailings and other debris to a depth of 22 feet in a crescent-shaped pond 2,800 feet long and 600 feet wide. The mining companies also took annual soundings of the river bed, testing twelve locations between the dredge and the lake. Their data showed that no new material had accumulated in the river channel since 1930.[17]

In the early 1950s, the U.S. Public Health Service, the Idaho Department of Public Health, and the Washington Pollution Control Commission cooperated to produce a study titled, "Report on Water Pollution Control: Spokane River Basin."[18] The report drew some conclusions, to which the mining industry objected, about the effects of tailings on fish in the Coeur d'Alene River, the quality of drinking water at Harrison, and the potential deterioration of water quality for the City of Coeur d'Alene's water system. One such objection came in the form of a letter from J.B. Haffner, vice president and general manager of Bunker Hill & Sullivan. He noted that BH&S impounded all its tailings on the flat near Kellogg. His company was able to do so because of the location of its mill. He sought to defend the disposal methods of the other companies on Pine Creek and further up the South Fork drainage, who discharged their tailings directly into streams, pointing out that local topography precluded those companies from storing their tailings. Haffner then went on to describe the Cataldo dredge, asserting that "it should properly be classified as a treatment facility as far as industrial waste is concerned," and claiming that the Coeur d'Alene River below the dredge was "perfectly clear and free from all contamination from the concentrating operations." The state/federal report demonstrated that there was significant public concern in the 1950s about pollution of the Coeur d'Alene River and

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084-00100-101).

[16]Zeigler, "Mill Tailings Disposal in the Coeur d'Alene Mining District," 4-5 (ASAID-084-00100-101).

[17]Lewis A. Grant, "A History of the Cataldo Dredge," (unpublished ms. of an address made to the Fourth Pacific Northwest Industrial Waste Conference, March 1952), 4 (ASAID-084-00070).

[18]Pacific Northwest Drainage Basins Office, "Report on Water Pollution Control: Spokane River Basin, 1952" (ASAID-024-00018-178).

Coeur d'Alene Lake. Haffner's response demonstrates that the mining industry considered the Cataldo dredge to be an adequate response.[19]

An episode in 1955 demonstrates the extent to which the mining companies considered the dredge an effective pollution abatement method. ASARCO's tailings impoundment for the Page mill was nearly full. Among the alternatives ASARCO considered for addressing the situation was the discontinuation of its practice of impounding tailings at the Page. Instead, ASARCO would discharge its Page mill tailings into the South Fork and let the Cataldo dredge handle the problem. An ASARCO manager asked L.A. Grant, who had charge of the dredge, what impact he thought such an action by ASARCO would have on the dredging operation. Grant responded that he did not think it would present a problem. He noted that the volume of tailings being discharged by the Morning had declined recently, as had tailings from the Pine Creek mills, so the dredge could readily handle any additional tailings the Page mill discharged into the system. Grant even stated his belief that the dredge could handle all of the BH&S tailings without an increase in operating costs. He also asserted that the addition of Page tailings to the river would not affect pollution in the river or lake below the dredge operation. In the end, ASARCO decided to increase it storage capacity for Page tailings, mainly as a good-will gesture to BH&S, which wanted the two companies (BH&S and ASARCO) to abide by their long-standing informal agreement that they would impound all their tailings from the Kellogg-area mills.[20]

During its operation, most, if not all, of the companies operating concentrators in the Coeur d'Alene district contributed to the "dredge fund," collected by annual assessments. In addition to Bunker Hill & Sullivan, ASARCO (Federal), and Hecla, companies contributing to the fund included Sunshine, Day Mines, Coeur d'Alene Mines, and the several Pine Creek operators. Golconda contributed on the basis of its custom mill, and Hecla contributed on the basis of its operation Osburn tailings. The mining companies continued to operate the Cataldo dredge until the mining industry in the Coeur d'Alene district collectively began in 1968 to impound all tailings at or near the mills. The dredge operated in 1968. I have not yet found documentation of when the dredge permanently ceased operating.[21]

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[19]J.B. Haffner to H.C. Clare, letter dated 5 December 1951 (HECBO-045-00001-002).

[20]ASARCO correspondence concerning the Page mill tailings, April-June 1955 (ASAID-118-00096-118).

[21]"Dredge Fund," annual account summaries, 1947-1968 (ASAID-091-00106); "Mines Are Cooperating in Stream Cleanup," Kellogg-Wardner News (22 January 1965): n.p. (ASAID-191-00472); Statement by J.G. Craig, Manager of Mills, Hecla Mining Company, dated March 1967 (ASAID-175-00314).

12.8.1
5-28-99

FILE

Quivik Consulting Historian, Inc.
May 28, 1999

2830 Pearl Harbor Road
Alameda, CA 94501

office phone and fax: 510-769-7855
home phone: 510-337-0339
e-mail: fquivik@lmi.net

Serene Charles
Aspen Systems
EES/U.S. Dept. of Justice
P.O. Box 7611
Washington, DC 20044

Dear Serene:

It was a pleasure meeting you the other day. Thanks for showing me through the maps and other data in the Bunker Hill case. Thanks for handing me the documents I had requested earlier from Anne Phelps. And thanks also for helping me by phone in Denver to find my way through the computerized data base. I look forward to working with you as I continue my way through all those documents.

Here's a request for hard copies of some documents I found in the data base during my recent stay in Denver that will be useful to me in my work. I list them below by Bates numbers:

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You may send these documents to the address at the head of this letter. I need these as soon as possible, so please send them either Priority U.S. Mail or FedEx. Thanks.

Sincerely,

Fredric L. Quivik

Fredric L. Quivik

cc: David Askman (DOJ)

FILE

Fredric L. Quivik PhD
July 30, 1999

2830 Pearl Harbor Road
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Serene Charles
c/o EES/ENRD
U.S. Dept. of Justice
P.O. Box 7611
Washington, DC 20044

Dear Serene:

Following is a list of Bates numbers for documents I'd like you to copy from the data base and send me. The list was compiled by Jennifer Stevens while she was in Denver this past week using a computer at the DOJ office.

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Jennifer found all of these items while searching the data base on topics related to the EDS side of the case. I mention this in case you keep track of the time you spend responding to document requests for EES and EDS.

Sincerely,

FRED

Fredric L. Quivik

FILE

Fredric L. Quivik PhD
August 5, 1999

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Serene Charles
c/o EES/ENRD
U.S. Dept. of Justice
P.O. Box 7611
Washington, DC 20044

SENT VIA FAX
3 pages

Dear Serene:

Following is another list of Bates numbers for documents I'd like you to copy from the data base and send me. The list was alos compiled by Jennifer Stevens while she was in Denver last week using a computer at the DOJ office.

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Sincerely,

FRED

Fredric L. Quivik

Fredric L. Quivik, PhD.
August 1999

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RESUME

SUMMARY OF EXPERIENCE

Since 1976, Dr. Quivik has been professionally active in the fields of history of technology, industrial archeology, and cultural resource management. In 1982, he founded Renewable Technologies, Inc. (RTI), an historic preservation consulting firm in Butte, Montana, which is still a thriving business. In 1990, Dr. Quivik left RTI to attend the University of Pennsylvania, were he was a William Penn Fellow. He received the PhD in History and Sociology of Science from Penn in 1998. The title of his dissertation is "Smoke & Tailings: An Environmental History of Copper Smelting Technologies in Montana, 1880-1930." While writing his dissertation, he continued to work as a consultant. In 1998, he established Quivik Consulting Historian, Inc. His principal client has been the U.S. Department of Justice, for which he has served as an expert witness (historian of technology) in the Clark Fork (MT) Superfund litigation. He also serves as an expert witness in other Superfund cases.

As an expert witness for the U.S. Dept. of Justice, providing litigation support in the Clark Fork Superfund case (U.S. v. ARCO), Dr. Quivik's specialty has been the history of the metallurgical technologies used at Butte and Anaconda, with special attention to the discharge of byproducts. He has extensive knowledge of the role of industrialization in the development of the American West. At RTI, he completed surveys and HAER documentation of dams and hydroelectric generating plants of the Montana Power Company, of the Corps of Engineers' Fort Peck Dam, and of Bureau of Reclamation dams and irrigation infrastructure in Idaho, New Mexico, Oregon, and Wyoming. He conducted statewide historic bridge inventories in Minnesota, Montana, Nebraska, and North and South Dakota. He has also prepared a business and technological history of the Connellsville Coke Region in southwestern Pennsylvania for the Historic American Engineering Record/America's Industrial Heritage Project.

Dr. Quivik's experience in cultural resource management includes conducting surveys of rural, urban, and industrial historic sites and districts, preparing National Register nominations, performing determinations of eligibility and impact assessments according to federal guidelines, preparing photo-documentation and measured drawings of historic sites, and developing planning documents for the preservation of historic districts. Dr. Quivik is particularly skilled at researching and developing historical contexts within which to assess the significance of cultural resources. He is also skilled at large-format (4 x 5) photographic documentation of buildings and structures meeting HABS/HAER standards. He served for ten years on the Montana State Historic Preservation Review Board.

Dr. Quivik has taught several courses at the college and university level: historic preservation and engineering graphics at Montana Tech and historic preservation and architectural history at Montana State University. As a research assistant at Penn, he examined the history of large-scale technological systems in the post-World War II period for Prof. Thomas Parke Hughes. He is now a lecturer in the history of science and engineering in the Interdisciplinary Studies Program, College of Engineering, University of California at Berkeley.

EDUCATION

PhD, History and Sociology of Science, University of Pennsylvania, Philadelphia, 1998. Dissertation title: "Smoke and Tailings: An Environmental History of Copper Smelting Technologies in Montana, 1880-1930." M.A., 1992.

Master of Science in Historic Preservation, Graduate School of Architecture and Planning, Columbia University, New York City, 1977.

Bachelor of Environmental Design, School of Architecture, University of Minnesota, Minneapolis, MN, 1975.

Bachelor of Arts in Art, St. Olaf College, Northfield, MN, 1971.

EMPLOYMENT HISTORY

Consulting Historian of Technology, principally working in litigation support as an expert witness under contract to the U.S. Dept. of Justice, March 1994 to present.

Lecturer, history of science and engineering, Interdisciplinary Studies Program, College of Engineering, University of California at Berkeley, January 1999 to present.

Research Assistant for Thomas Parke Hughes, Mellon Professor of the History and Sociology of Science, University of Pennsylvania, Philadelphia, September 1992 to May 1993.

Historian, Historic American Engineering Record, U.S. Dept. of the Interior, Jeannette, PA, June to August 1991, June to September 1992.

Architectural Historian (and founder), Renewable Technologies, Inc., Butte, MT, May 1982 to August 1990.

Adjunct Assistant Professor, School of Architecture, Montana State University, Bozeman, MT, winter quarter 1983.

Instructor, Historic Preservation, Montana State Univ., Bozeman, winter quarter 1982); Montana College of Mineral Science & Technology, Butte, MT, fall semester 1979.

Building Recycling Spec., Nat'l. Center for Appropriate Technology, Butte, MT, April 1977 to September 1981.

Instructor, Engineering Graphics, Montana College of Mineral Science and Technology, Butte, MT, 1/81-5/81 (spring semester).

Historian, Historic American Engineering Record, U.S. Dept. of Interior, Butte, October 1979 to April 1981.

PROFESSIONAL AFFILIATIONS

Society for Industrial Archeology: past-president 6/98 to present; president 6/96 to 6/98; vice president 6/94-6/96; national Board of Directors 6/90-6/93.
Capitol Advisory Council (Montana), appointed by Gov. Racicot 1/96 to 8/98.
Klepetko (Montana) Chapter, Society for Industrial Archeology, president 9/87-8/90.
Committee on Historic and Archeological Preservation in Transportation, Transportation Research Board of the Nat'l Research Council, 1/91 to 6/93.
Board of Directors, Butte-Anaconda Historical Park and Railroad Corporation, 1986-1990.
Montana Historic Preservation Review Board, 1981-1990: appointed by Governor Schwinden, 10/81; reappointed 10/85; elected chairperson, 12/87.
Montana State Capitol Restoration Advisory Panel, appointed by House Speaker John Vincent, 5/85-4/89.
Board of Directors, Butte-Silver Bow Public Archives, 1979-1986.
Society of Architectural Historians.
Society for the History of Technology.
American Society for Environmental History
History of Science Society
Western History Association
Organization of American Historians
Norwegian-American Historical Association

SCHOLARLY PUBLICATIONS and PRESENTATIONS

Review of Managing the Industrial Heritage, edited by Marilyn Palmer and Peter Neaverson, in IA: The Journal of the Society for Industrial Archeology 24 (no. 2, 1998): 53-54.

"Landscapes as Industrial Artifacts: Lessons from Environmental History," paper presented at Whither Industrial Archeology, a symposium sponsored by the Society for Industrial Archeology at Lowell National Historic Park, MA, November 1998.

"Government Intervention v. Economic Efficiency in the Abatement of Smelter Smoke Pollution: The Case of the Anaconda Smelter in the 1910s, paper given at the annual meeting of the Society for the History of Technology, Baltimore, MD, October 1998.

Review of The Search for the Ultimate Sink: Urban Pollution in Historical Perspective, by Joel Tarr, in Historical Geography 26 (1988): 228-230.

"The Historic Industrial Landscape of Butte and Anaconda," in Images of an American Land: Vernacular Architecture Studies in the Western United States, Thomas Carter, ed. (Albuquerque: University of New Mexico Press, 1997).

Review of Race and Labor in Western Copper, by Philip J. Mellinger, in Montana: The Magazine of Western History 47 (Autumn 1997): 84-85.

"On the Nature of Tailings: An Overview of Early Attitudes Towards Tailings Disposal in the Montana Copper Industry," Montana State History Conference, Butte, MT, October 1996. "Smoke and Tailings: An Environmental History of Copper Smelting Technologies in Montana, 1880-1920," public presentations based on PhD dissertation and illustrated with slides, given at the Parker Lecture Series, Lowell, MA, November 1998; Chemical Heritage Foundation, Philadelphia, October 1998; Froid Lutheran Church, July 1998; Center for the Rocky Mountain West, Missoula, MT, March 1996.

"Captain Couch of the Boston & Montana: A Self-Trained Mining Engineer and the Industrialization of Butte's Copper Mining District," paper presented at the annual meeting of the Western History Association, Denver, CO, October 1995.

Review of Environmental History Review, Spring 1994, special issue on "Technology, Pollution, and the Environment," Joel A. Tarr and Jeffrey K. Stine, eds., and Journal of Urban History, May 1994, special issue on "The City and the Environment," Joel A. Tarr and Christine M. Rosen, eds., in Technology & Culture 36 (October 1995): 1038-1041.

"Conflict in the Science of Environmental Impact: The Anaconda Smelter Smoke Cases, 1902-1911," paper presented at the biennial meeting of the American Society for Environmental History, Las Vegas, NV, March 1995.

"Architects as Designers of Pre-World War II, Large-Scale Technological Systems: Edward W. Tanner and the Design of the Fort Peck Townsite," paper presented at session titled "Topics at the Intersection of Architectural History and the History of Technology" at the Annual Meeting of the Society of Architectural Historians, Seattle, WA, April 1995.

Review of Water Towers and Gas Tanks, by Bernd and Hilla Becher, in Design Book Review 35/36 (Winter/Spring 1995): 56-59.

Review of The Texture of Industry: An Archaeological View of the Industrialization of North America by Robert B. Gordon and Patrick M. Malone, in Environmental History Review 18 (Winter 1994): 102-104.

"The Concept of Industrial Waste: Smoke 'Nuisance' Cases in the Montana Copper Industry at the Turn of the Twentieth Century," paper presented at the annual meeting of the Society for the History of Technology, Lowell, MA, October 1994.

Review of Bisbee: Urban Outpost on the Frontier, Carlos A. Schwantes, ed., in Technology and Culture 35 (April 1994): 435-436.

"Retarded Mechanization in the Connellsville Beehive Coke Industry," paper presented at the annual meeting of the Society for Industrial Archeology, Pittsburgh, PA, June 1993.

"EPA's Superfund in the Context of Other American Large-Scale Technological Systems," paper presented at the fifteenth annual meeting of the National Council on Public History, Valley Forge, PA, May 1993.

"Imposing an Industrial Order on the Northern Plains: Patterns of Truss Bridge Construction, 1880-1920," paper presented at the annual symposium of the Center for Great Plains Studies, Lincoln, NE, April 1993.

Review of In the Servitude of Power: Energy and Civilization through the Ages by Jean-Claude Debeir, Jean-Paul Deleage, and Daniel Hemery, in Environmental History Review 17 (Summer 1993): 97-98.

"Industrial Pollution on the Southwestern Pennsylvania Countryside: The Connellsville Beehive Coke Industry, 1880-1920," paper presented at the biennial meeting of the American Society for Environmental History, Pittsburgh, PA, March 1993. A longer version of this paper won the 1994 Newcomen Prize at the University of Pennsylvania.

"EPA Superfund: After a Decade, Why Is It Not an Effective Technological System?" paper presented at the annual meeting of the Society for the History of Technology, Madison, Wisconsin, October 1991.

"A Comparison of the U.S. Bureau of Reclamation's Cylinder-Gate and Ring-Gate Designs for Spillway Controls," paper presented at the 20th Annual Meeting of the Society for Industrial Archeology, Chicago, June 1991.

Review of The Colossus of 1812: An American Engineering Superlative by Lee H. Nelson, in IA: The Journal of the Society for Industrial Archeology, 16 (1990), No. 1.

Butte & Anaconda Revisited: An Overview of Early-Day Mining and Smelting in Montana, with Brian Shovers, Dale Martin, and Mark Fiege, Special Publication 99 (Butte: Montana Bureau of Mines, 1991). This is a reprint of "Guidebook to Historic Industrial Resources of Butte and Anaconda," October 1989, prepared by the same authors for the Annual Fall Tour of the Society for Industrial Archeology.

"Steel Transmission Towers & Energy for Montana's Copper Industry," Historic Landscapes feature in Montana: The Magazine of Western History, 38 (Fall 1988): 67-69.

"Contribution of Railroads to Montana's Historic Bridge Landscape," presentation at the Montana History Conference, Livingston, MT, October 1988.

"Power for the Copper Industry: Hydroelectric Developments Along the Great Falls of the Missouri River, 1890-1957," paper given at the 17th Annual Meeting of the Society for Industrial Archeology, Wheeling, WV, May 198.

Review of Song of the Hammer & Steel by Duane Smith, in IA: The Journal of the Society for Industrial Archeology, 14 (1988), No. 1.

"Historical Differences Between Hardrock Mining and Underground Coal Mining," presentation at the Montana History Conference, Helena, MT, October 1987.

"Industrial Urbanism on the Wheat Frontier: Minot, North Dakota, 1886-1929," paper given at the 15th Annual Meeting of the Society of Industrial Archeology, Cleveland, OH, June 1986.

"The Western Clay Manufacturing Co.," paper given at the 14th Annual Meeting of the Society for Industrial Archeology, Newark, NJ, May 1985.

"Superinsulation Retrofit: An Effective Integration of Community Economic Development and Community Energy Management," with James Masker and Ralph Wittcoff, presented at the Nebraska Energy Office National Colloquium on Community Energy Management as a Community Economic Development Strategy, Lincoln, NE, October 1984.

"Appropriate Technologies and Historic Preservation," paper given at the International Conference on the Conservation of Industrial Heritage (TICCIH), Lowell, MA, June 1984.

"The Anaconda Company Smelters at Great Falls and Anaconda," in The Speculator: The Journal of Butte and Southwest Montana History, 1 (Summer 1984), based on a paper given at the Annual Meeting of the Society for Industrial Archeology, St. Paul, MN, May 1983.

"Montana's Minneapolis Bridge Buildings," in IA: The Journal of the Society for Industrial Archeology, 10 (1984), no. 1, based on a paper given at the Annual Meeting of the Society for Industrial Archeology, St. Paul, MN, May 1983.

"Maintenance and Stabilization of Historic Bridges," paper given at the Annual Meeting of the Association for Preservation Technology, Banff, Alberta, October 1982.

"The Great Falls Smelter: Some Reflections on Its Significance," paper given at the Montana State History Conference, Great Falls, MT, October 1982.

"Superinsulation vs. Passive Solar Energy in Historic Buildings," paper given at the Annual Meeting of the Association for Preservation Technology, Washington, D.C., October 1981.

"A Comparison Between Passive Solar and Superinsulated Retrofits," paper given at the Sixth National Passive Solar Conference, Portland, OR, September 1981. Published in the Conference Proceedings, AS/ISES, 1981.

"Retrofitting with Passive Solar," paper published in New Energy From Old Buildings (Washington, D.C: The Preservation Press, 1981), and presented at the Smithsonian Institution, Washington, D.C., during National Historic Preservation Week, May 1980.

"Passive Solar Retrofit of Historic Structures," paper given at the Annual Meeting of the Association for Preservation Technology, Denver, CO, September 1979.

SCHOLARLY and RELATED EVENTS and PROJECTS

Chair of the Program Committee, "Whither Industrial Archeology," a three-day symposium featuring twenty-four speakers and co-sponsored by the Society for Industrial Archeology, Historic American Engineering Record, and Lowell National Historic Park. Held at Lowell, MA, November 1998.

Organizer, industrial archeology tour of NE Montana, organized for the Klepetko (Montana) Chapter of the Society for Industrial Archeology, September 1995.
Panel organizer, "Topics at the Intersection of Architectural History and the History of Technology," a two-session panel featuring seven papers and a comment, presented at the Annual Meeting of the Society of Architectural Historians, Seattle, WA, April 1995.

Organizer, Coal and Coke Tour, organized for the Annual Meeting of the Society for Industrial Archeology, Pittsburgh, PA, June 1993.

Co-organizer with Brian Shovers, Fall Tour of Butte and Anaconda, Montana, organized by the Klepetko (Montana) Chapter for the Society for Industrial Archeology, October 1989.

Co-organizer with Brian Shovers, "Butte: The Urban Frontier," three-day history conference featuring twenty-six speakers and sponsored by the Butte Historical Society with major funding by the Montana Committee for the Humanities, Butte, MT, September 1982.

Project Director, Historic and Architectural Survey of over 3,000 structures in the Butte National Historic Landmark District, sponsored by the Butte Historical Society with major funding from the Montana State Historic Preservation Office and the Butte-Silver Bow Community Development Office, 1981-1985.

SELECT CONTRACT PUBLICATIONS AND PRESENTATIONS

"Expert Report," prepared for the Environmental Enforcement Section, U.S. Department of Justice, August 1997. The report includes technological histories of the silver mills, copper smelters, zinc concentrators, and manganese plant at Butte and Anaconda, Montana, as well as histories of the Anaconda Smelter Smoke Commission and a series of land exchanges effected by the Anaconda Copper Mining Company and the U.S. Forest Service.

"The Anaconda Smelter Smoke Commission: A Technological History," expert report prepared for the Environmental Defense Section, U.S. Department of Justice, May 1997. In addition to a history of the Smoke Commission, the report includes a technological and pollution history of the Anaconda Copper Mining Company's Washoe smelter at Anaconda.

"Sheridan Electric Co-op: A History of Its Organizing," a history written to commemorate Sheridan Electric's 50th annual membership meeting, October 1997. The project is accompanied by the recording of about a dozen oral histories of early co-op members recalling the impacts of rural electrification on farm life in northeast Montana.

"Connellsville Coal and Coke Study," a business and technological overview of the Connellsville Coke Region for the America's Industrial Heritage Project, Historic American Engineering Record, National Park Service, September 1992. Transmitted to the Library of Congress as historical narrative accompanying Historic American Engineering Record measured drawings of beehive coke ovens in the region as "Connellsville Coal & Coke Region, HAER No. PA-283," 1995.

"Selby Avenue Bridge, HAER No. MN-61," Historic American Engineering Record narrative and large format photographs, sub-contract to Robert M. Frame III for the Department of Public Works, St. Paul, MN, September 1992.

"Historic Bridges in North Dakota," statewide survey and determination of eligibility, with Lon Johnson, Mark Hufstetler, and Charlene Roise, contract to North Dakota State Department of Transportation, May 1992.

"Deer Flat Embankments, HAER No. ID-17-B," with Amy Slaton (RTI), Historic American Engineering Record narrative history, contract to Pacific Northwest Region, U.S. Bureau of Reclamation, December 1991.

"Owyhee Dam, HAER No. OR-17," with Amy Slaton (RTI), Historic American Engineering Record narrative history, contract to Pacific Northwest Region, U.S. Bureau of Reclamation, September 1991.

"Determination of Eligibility for Historic Resources at Camp Grafton, North Dakota," contract to Omaha District U.S. Army Corps of Engineers for the North Dakota National Guard, March 1991.

"Boise Project Office, HAER No. ID-17-C," (RTI) Historic American Engineering Record narrative history, contract to Pacific Northwest Region, U.S. Bureau of Reclamation, September 1990.

"Dams of the Upper Souris National Wildlife Refuge, HAER No. ND-3" and "Dams of the J. Clark Salyer National Wildlife Refuge, HAER No. ND-4," with Mary McCormick (RTI), Historic American Engineering Record narrative history and large-format photography, contract to St. Paul District U.S. Army Corps of Engineers for U.S. Fish and Wildlife Service, August 1990.

"Historic Bridges in South Dakota," statewide survey & determination of eligibility, with Lon Johnson, contract to South Dakota Department of Transportation, October 1990.

"Determination of Eligibility for Seven Bureau of Reclamation Dams in Oregon, Idaho, and Wyoming," with Jeffrey A. Hess, contract to Pacific Northwest Region, Bureau of Reclamation, October 1989.

"Blaine Spring Creek Bridge, HAER No. MT-63" and "Upper Madison Bridge, HAER No. MT-64," with Lon Johnson, Historic American Engineering Record narrative history and large format photographic documentation, sub-contract to Ethos Consulting for Montana Highway Department, June 1989.

"Crow Agency Historic Complex, HABS N. MT-79," with Mary McCormick, Historic American Buildings Survey narrative history and large format archival photographic documentation of five buildings at Crow Agency, contract to the Bureau of Indian Affairs, June 1989.

"Rocky Boy's Agency Flour Mill, HABS N. MT-76," Historic American Building Survey narrative history & photographic documentation, contract to Billings Area Office, Bureau of Indian Affairs, October 1988.

"Reconnaissance Surveys of Crosby and Velva, North Dakota," with Dale Martin, contract to State Historical Society of North Dakota, September 1988.

"Determination of Eligibility of Five C&NW Bridges and a Freight Depot at Sioux Falls, South Dakota," contract to Chicago and Northwestern Railroad, June 1988.

"Historic Iron and Steel Bridges in Minnesota, 1873-1940," statewide survey and preparation of historical context for the Minnesota Historical Society, with Dale Martin, subcontract to Jeffrey A. Hess, June 1988.

"Determination of Eligibility of Four Montana Power Company Hydroelectric Generating Facilities Near Great Falls, Montana," with Mary McCormick, contract to the Montana Power Company, May 1988.

"Hardin City Water Works, HABS No. MT-71," Historic American Buildings Survey Narrative Architectural History, contract to City of Hardin, Montana, September 1987.

"Determination of Eligibility of Buildings at Six BIA Agencies in Montana," with Mark Fiege, contract to Billings Area Office, Bureau of Indian Affairs, September 1987.

"Fort Peck Townsite, HABS No. MT-70," Historic American Buildings Survey Narrative Architectural History, contract to Omaha District U.S. Army Corps of Engineers, May 1987.

"Determination of Eligibility of the Madison River Dam and Power Plant," with Mark Fiege, contract to Montana Power Company, April 1987.

"Historic Resources of North Side Fargo: Inventory and Assessment," with Mark Fiege and Jack Crowley, contract to the Fargo Historical Society, August 1986.

"Final Report on the Intensive and Reconnaissance Surveys for Minot, North Dakota," with Mary McCormick, contract to the State History Society of North Dakota, December 1985.

"Flint Creek Powerhouse and Dam: A Determination of Eligibility for the National Register of Historic Places," with Mark Fiege, contract to the Montana Power Company, December 1985.

"Preservation of a Neighborhood: A Neighborhood Preservation Plan for Central Butte," with Bruce von Alten & Jim E. Richard, contract to Butte Community Union, November 1985.

"Industrial Heritage of Butte and Anaconda: An Analysis of the Historical Significance of the Surviving Physical Features of the Anaconda Copper Mining Company," with Mark Fiege and Brian Shovers, contract to the Butte Historical Society, September 1985.

"Butte-Anaconda Historical Park System Master Plan," with Dennis Glick and Mark Fiege, contract to the Butte Historical Society, September 1985.

"The Western Clay Manufacturing Co.: An Historical Analysis of Its Plant and Its Development," contract to the Archie Bray Foundation, February 1985.

"Milltown Dam: A Determination of Eligibility for the National Register of Historic Places," contract to the Montana Power Company, December 1984.

"Development of the Built Environment in the Original Townsite of Hardin, Montana," contract to the Big Horn County Historical Museum, September 1984.

Historic Bridges in Montana, (Washington, DC: U.S. Department of the Interior, National Park Service, Historic American Engineering Record, 1982).

"Cultural Resource Inventory and Evaluation Project, Homestake Mining Company Properties, Jardine, Montana," with Peter Steere and Paul Anderson, contract to Homestake Mining Company, April 1982.

NATIONAL REGISTER NOMINATIONS

"Historic Bridges of South Dakota," with Lon Johnson and Mary McCormick, 10/90.

"Boise Project Office," Boise, ID, 9/90.

"Owyhee Dam," near Adrian, OR, 2/88.

"McKay Dam," near Pendleton, OR, 2/88.

"Deadwood Dam," near Cascade, ID, 2/88.

"Historic Metal Bridges in Minnesota," with Dale Martin, 6/88.

"Antler State Bank," Antler, North Dakota, 10/87.

"Historic Resources of Minot, North Dakota," with Mary McCormick and Mark Fiege, 1986.

"Headframes and Mineyards of Butte," with Mark Fiege and Brian Shovers, 1985.

"The Butte, Anaconda and Pacific Railway Historic District," with Mark Fiege, 1985.

"The Foundry Department of the Anaconda Copper Mining Company Historic District," with Mark Fiege, 1985.

"Old Works Smelter Historic District," 1985.

"Western Clay Manufacturing Company Historic District," 1985.

"Historic Resources of Hardin, Montana," 1984.

"Silver Bow Brewery Malt House," 1982.

"Silver Bow County Poor Farm," 1979.

And numerous others during the summer of 1976 while employed by the Montana State Historic Preservation Office, incl. ding:

"Paris Gibson High School," Great Falls.
"The Castle," White Sulphur Springs.
"Charles Clark House," Butte.
"Missoula County Courthouse," Missoula.
"Kleffner Ranch," East Helena.
"Orr Mansion," Dillon.