UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF WASHINGTON

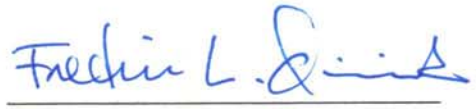
Joseph A. Pakootas, et al
v.
Teck Cominco Metals, Ltd.
Civil Action No. CV-04-0256-LRS

History of Mining, Milling, and Smelting in NE Washington

EXPERT REPORT

of

FREDRIC L. QUIVIK, PhD.



19 November 2010

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I. INTRODUCTION

A. Statement of the Problem

The area of concern for this expert report is that portion of the Columbia River Basin which is tributary to the Upper Columbia River (UCR), which in turn is that portion of the Columbia River flowing between the United States/Canadian border at the upstream (north) end and the Grand Coulee Dam at the downstream end (Fig. 1). This definition of the UCR derives from studies conducted by the U.S. Environmental Protection Agency (EPA) in response to concerns over granulated slag and other materials discharged over time by the smelter at Trail, British Columbia, which is owned and operated by Teck Metals Ltd (Teck), the defendant in this case.[1] The area of concern for this expert report includes the UCR, its tributaries (including the Pend Oreille, Spokane, Kettle, Sanpoil, and Colville rivers, and numerous smaller streams), and the lands adjacent to and drained by those rivers and streams.

Over the course of the past century and more, extractive industries in the Columbia River Basin, both in the United States and Canada, have discharged waste materials to the environment. (The historical narrative summarized here is elaborated fully in the main body of this report; full citations to sources documenting these historical facts are provided with that more detailed narrative below.) Of particular significance has been the metal mining industry, especially the mining for non-ferrous metals, predominately lead, zinc, and copper. Operations have included mines – both underground and surface mines – and facilities for treating minerals extracted from the mines. Such facilities include concentrators, which crush, grind, and physically separate metal-bearing minerals from the host rock, or from minerals without economic value (a process often called beneficiation), and include smelters, which separate metals from the other elements with which they are chemically bound, with which they comprise the mineral compounds as found in the mine. Each of these kinds of facilities in the mining industry produces one or more kinds of waste, which is disposed to the environment.

Mines produce ore, which contains metals or mineral compounds of metals in sufficient percentage and quality that the miner can realize a profit from the sale of the ore or its metals. The miner realizes a profit if the sale price is greater than the costs of extraction, treatment, and transportation to market. Mines produce ore to be sent to mineral processing facilities for treatment, but they also produce mine waste, which is rock or overburden that must be removed in order to gain access to the ore body, and they may also produce piles of low-grade material comprised of minerals in insufficient concentration to merit further treatment, for the time being at least, due to inadequate treatment methods, poor market conditions, or other factors. Mine waste and low-grade materials are typically set aside on the landscape.

[1] For a definition of the Upper Columbia River, see U.S. Environmental Protection Agency, "Upper Columbia River: Work Plan for Remedial Investigation and Feasibility Study," Vol. I, unpublished report dated December 2008, pp 1-1 & 1-2.

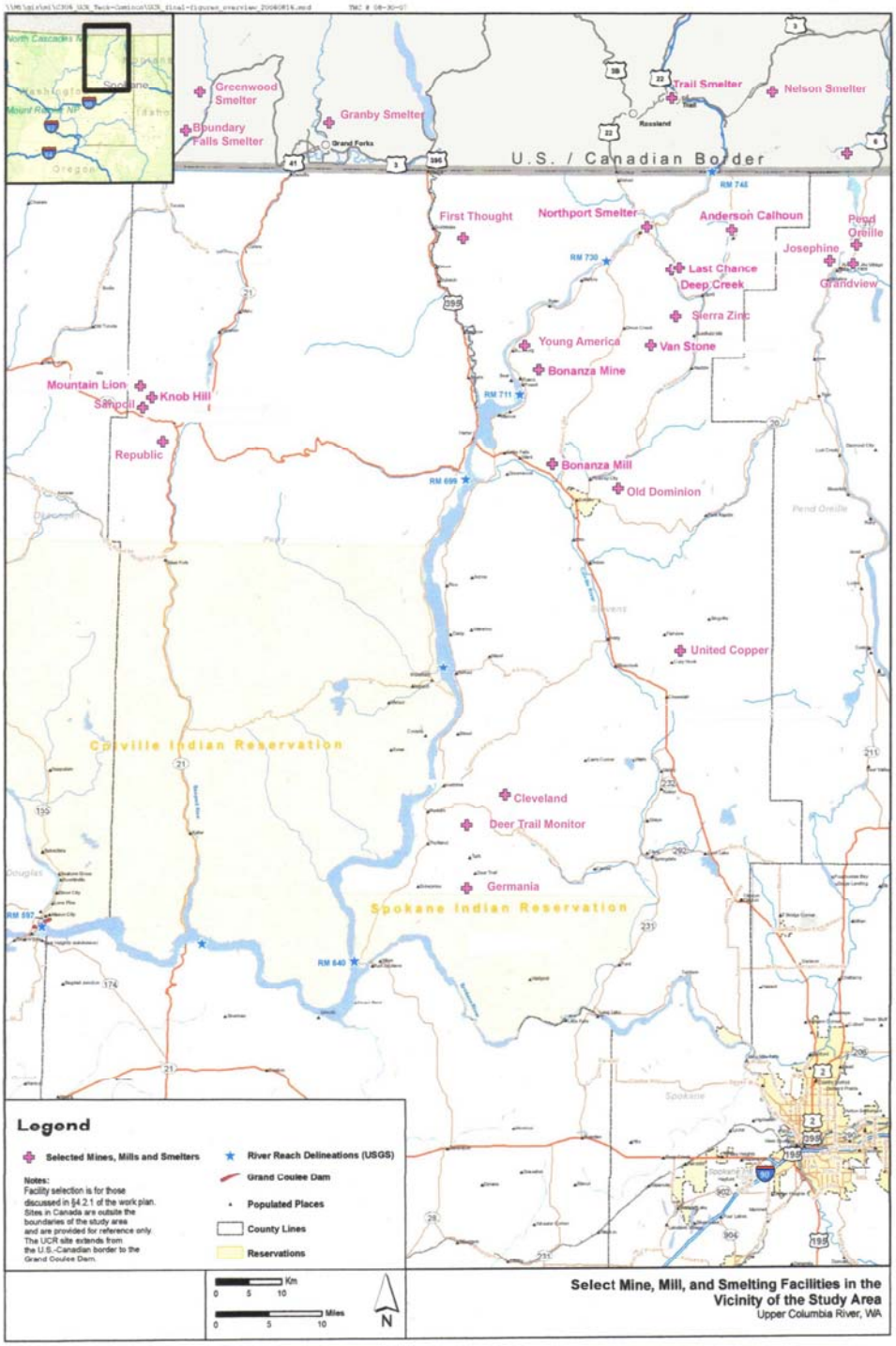


Fig. 1: Upper Columbia River Basin. Source: This map is a modified version of EPA, "Upper Columbia River: Work Plan for Remedial Investigation and Feasibility Study," Vol. I, unpublished report dated December 2008, Map 4-1 showing Mine, Mill, and Smelting Facilities in the Vicinity of the Study Area, the UCR. This version shows locations of addition mine, mill, and smelter sites not shown on the original.

Concentrators, also called mills, produce concentrates, which are processed minerals containing elevated percentages of the desired metals. Concentrates are sent to smelters or elsewhere for further treatment. Concentrates cost less to transport and to smelt than do low-grade ores. Mills or concentrators also produce tailings, the waste material of the concentrating process. Historically, some concentrators discharged their tailings directly into adjacent streams or other surface waters. Other tailings were impounded or stored on land, but before the regulatory era which gained force in the 1960s, little effort was made, typically, to prevent the tailings piles or impoundments from eroding into adjacent streams. Smelters use heat to effect chemical reactions in complex mineral compounds and to separate the metals from the other elements to which they are chemically bound. In smelting, the material is heated to the melting temperature, so that the heavier molten metal can settle to the bottom of the furnace and the lighter impurities, called slag, can float on the heavier metal. The molten layers can then be separately tapped from the furnace. Smelters produce more nearly pure metals. Smelters also produce waste streams, including slag, which is discharged to the environment. As a result of more than a century of these kinds of activities associated with the mining industry, contaminants have been discharged into the streams and onto the lands of the Upper Columbia River Basin, including the Upper Columbia River itself. These discharges have been into the subject area of this litigation.

In more recent years, regulatory agencies in the United States, most notably the U.S. Environmental Protection Agency (EPA), have issued remediation orders or otherwise caused clean-ups to occur at certain mine, mill, and smelter sites in the Columbia River Basin within the territory of the U.S. Such sites are places where the EPA has deemed that the risk to humans or the environment was sufficient to merit the removal or other treatment of hazardous materials discharged by a mining or mineral processing enterprise at the site. The EPA has not completed full investigations or analyses of all the mining or mineral processing sites in northeast Washington; other sites in the area may also be contributing contaminants to the environment.

B. My Assignment

My name is Fredric L. Quivik. I am a historian by profession. My specialty is the history of technology and industrial history. I am the author of the following expert report in the matter of the *Joseph A. Pakootas, et al, v. Teck Cominco Metals, Ltd.*

In 2008, Teck asked me to investigate the history of hardrock mining and mineral processing in northeast Washington, in areas that are tributary to the Upper Columbia River and Lake Roosevelt. Teck also has asked me to investigate and form expert opinions concerning involvement by the State of Washington in that history of mining and mineral processing in northeast Washington. I developed expert opinions pertaining to the history of the State's involvement in mining and mineral processing an expert report dated 20 September 2010. This expert report includes opinions and historical facts present in that earlier report, and it also includes opinions and historical facts pertaining to mines, mills, and smelters with which the State of Washington had no direct ownership or operational involvement.

II. SUMMARY OF OPINIONS

The purpose of this expert report is to provide documentation of the history of hardrock, non-ferrous metal mining, milling, and smelting in northeast Washington. In this section, I provide a summary of my opinions:

A. The predominant type of mining in northeast Washington was hardrock mining, through which miners and mining companies excavated minerals bearing both precious and base metals from beneath the Earth's surface using either selective underground techniques or open-pit (surface) methods. The principal metals mined in the area were lead, zinc, copper, gold, and silver.

B. Placer mining was the earliest method used to recover precious metals in the subject area of this litigation, beginning in the mid-nineteenth century, and some placer mining continued into the mid-1900s. Hardrock mining commenced in the 1880s, production increased dramatically through much of twentieth century, declined in the 1960s and 1970s, and continues to this day.

C. Mining in the Upper Columbia River Basin was accompanied by treatment of ores in mills and smelters located in the basin.

D. There is substantial documentation of the historical presence of mining, milling, and smelting operations in Pend Oreille, Stevens, and Ferry counties on lands adjacent to the Columbia River and its tributaries.

E. It is typical that mining, milling, and smelting produce waste materials and discharge them to the environment. There is ample documentation that the mines, mills, and smelters operating historically in the Upper Columbia River Basin produced waste materials and discharged them to the environment of the UCR.

III. COMPLETE STATEMENT OF OPINIONS AND THE REASONS AND BASES THEREFOR

A. Overview of Hardrock Mining in Northeast Washington

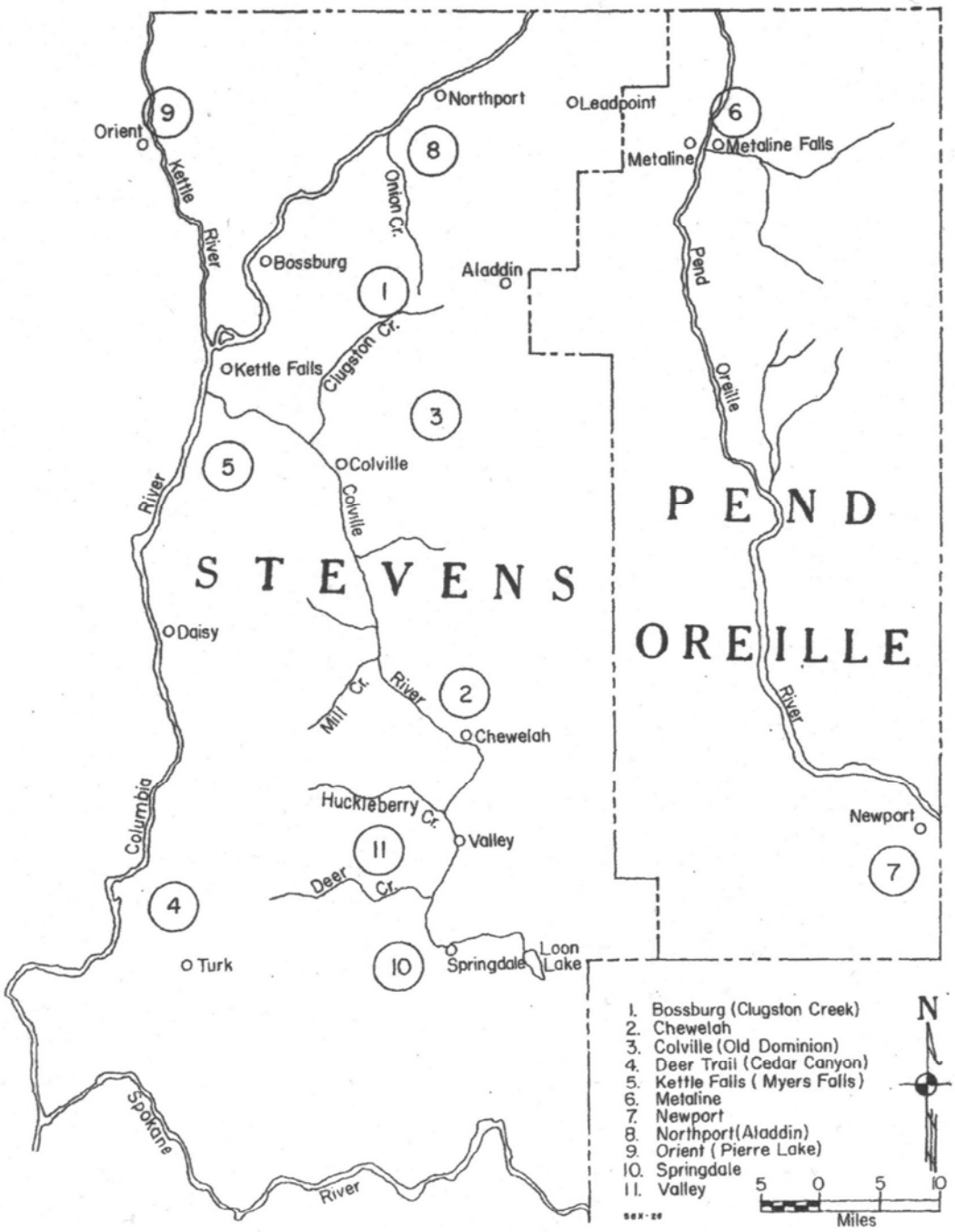
There is ample documentation, developed over recent decades, that abandoned and inactive mine sites are sources of environmental contamination. This fact is a consequence of the oxidation of mineral compounds, especially sulfide minerals, the release of dissolved metals into surface and ground waters, and the erosion of mineral solids that become sediments in water systems. These processes occur as a result of exposure of ore bodies, mine waste, and tailings at abandoned and inactive mine sites to water and oxygen.[2] I do not offer myself as an expert in the processes by which waste materials at abandoned mine sites release contaminants, or how they weather so that they threaten to release contaminants sometime in the future. My expertise is in the history of mining, milling, and smelting methods which produced wastes and by which wastes were discharged to the environment. The following sections document the ways in which mining enterprises in northeast Washington produced waste materials and discharged them to the environment of the Upper Columbia River Basin. Others have documented the contamination that sites operated by these enterprises have contributed to the environment.[3]

1. Northeast Washington's History as a Metals Producer

One of the activities that opened areas of the American West to settlement and economic development was hardrock mining for both precious and base metals. Some of the mining districts in the American West, including the Mother Lode Country in California; Virginia City, Nevada; Cripple Creek and Leadville, Colorado; Butte, Montana; the Black Hills in South Dakota; the

[2] The EPA, among other governmental agencies, has produced documents describing the potential that abandoned and inactive mine sites become sources of contamination to the environment; see for example EPA, *Managing Environmental Problems at Inactive and Abandoned Metals Mine Sites* (Cincinnati: EPA Center for Environment Research Information, October 1996); EPA, *Abandoned Mine Site Characterization and Cleanup Handbook* (Seattle: EPA Region 10, August 2000).

[3] Dan Peplow, "Environmental Impacts of Mining in Eastern Washington," fact sheet prepared for The Water Center, University of Washington, and dated January 1999; "Environmental Impacts of Hardrock Mining in Eastern Washington," fact prepared for the Center for Streamside Studies, University of Washington and dated November 2000; David K. Norman, "Washington's Inactive and Abandoned Metal Mine Inventory and Database," *Washington Geology* 28 (September 2000): 17; Mo McBroom, "Washington Undermined: The Toxic Legacy of Abandoned Metal Mines in Washington State," unpublished report prepared for the Washington Public Interest Group Foundation and dated March 2004; description (2010) of the Washington Department of Natural Resources data base and series of written reports on abandoned and inactive mines in the state at http://www.dnr.wa.gov/ResearchScience/Topics/GeologicHazardsMapping/Pages/iaml.aspx.



Mining Districts of Pend Oreille and Stevens Counties, Wash., in Relation to Towns, Rivers, and Creeks.

Fig. 2: Mining Districts in Stevens and Pend Oreille Counties. Source: Frank B. Fulkerson and Gary A. Kingston, *Mine Production of Gold, Silver, Copper, Lead, and Zinc in Pend Oreille and Stevens Counties, Wash., 1902-1956*, U.S. Bureau of Mines Information Circular 7872 (Washington, DC: U.S. Department of the Interior, 1958), p 3

Coeur d'Alenes in Idaho; and Bisbee, Jerome, and Globe, Arizona produced storied histories and monumental outputs of metals. Other areas of the West, while perhaps yielding mineral output that was smaller than the more famous districts produced, were nevertheless important in their own right, if not nationally then certainly locally and regionally. One such area was northeastern Washington, which spawned at least fourteen mining districts and yielded significant volumes of both precious and base metals, especially lead and zinc. By the mid-1950s, for example, the Metaline district in Pend Oreille County had produced more than 8,000,000 tons of ore, which yielded more than 450,000,000 pounds of zinc and 200,000,000 pounds of lead worth more than $75,000,000. [4] Deposits of metals like molybdenum and tungsten were also exploited in northeast Washington. There was also a long history of mining, milling, and smelting in areas of Canada, Idaho, and Montana that were tributary to Lake Roosevelt and the Columbia River. This report focuses on activities of the mining industry which discarded wastes in northeast Washington.

Although base metals like lead and zinc accounted for the largest volumes of ore mined and milled in northeast Washington, the quest for gold stimulated the earliest mining activities in the area. In 1956, Marshall Huntting produced a monumental review of mines and mining, mills, and smelters in Washington which outlines the trends. Huntting's volume is organized with a chapter for each metal. Each chapter provides an overview of mining for its particular metal, stating as well where Washington has ranked nationally in output and which counties were the leading producers. Regarding lead, for example, Huntting reports that in 1950 Washington was the ninth-leading producer of lead among the states. More than 99% of Washington's lead that year was produced in Pend Oreille and Stevens counties in three mining districts that are tributary to the Upper Columbia River. Pend Oreille Mines & Metals Company was the leading producer in the Metaline district in 1950, and the Metaline district ranked tenth among the nation's lead-mining districts that year. Zinc mines in Pend Oreille and Stevens counties also ranked highly. Regarding gold, Huntting reports that from 1860 through 1952, Washington ranked eleventh in the nation in gold production. The state's greatest output to that point in the twentieth century occurred in 1950, when Washington produced gold worth more than $3,000,000. Of the gold produced that year, 97% came from just three Washington mines, one of which was the Knob Hill in the Republic district of Ferry County. In 1950, the Knob Hill ranked eighteenth among the nation's gold mines.[5]

Writing for the U.S. Bureau of Mines, Frank Fulkerson and Gary Kingston produced a 1958 overview of gold, silver, copper, lead, and zinc mining in Pend Oreille and Stevens counties (Fig. 2) covering roughly the first half of the twentieth century (1902-1956). According to their summarized early history, lode mining, or underground hardrock mining, began with rushes to the Chewelah, Colville, Orient, and Deer Trail districts in the 1880s, but the high cost of transporting ores out of the area discouraged significant developments until the railroad reached northeast Washington in the 1890s. Mining in the region was further spurred with the construction of a smelters, the first of

[4] Frank B. Fulkerson and Gary A. Kingston, *Mine Production of Gold, Silver, Copper, Lead, and Zinc in Pend Oreille and Stevens Counties, Wash., 1902-1956*, U.S. Bureau of Mines Information Circular 7872 (Washington, DC: U.S. Department of the Interior, 1958), 12.

[5] Marshall T. Huntting, *Inventory of Washington Minerals*, Division of Mines and Geology Bulletin 37, Part II, Metallic Minerals, Vol. I (Olympia: State Printing Plant, 1956), 109, 205, 359.

which, located at Colville, began treating lead ores from nearby mines, like the Old Dominion, Daisy, Young America, and Bonanza, in 1888. The most important smelter in northeast Washington was built at Northport on the Columbia River in 1897, intended mainly to treat copper ores from mines in British Columbia near Rossland and Trail. The Northport furnaces were blown-in in 1898, and the facility operated as a copper smelter for about a decade. It passed through several hands and experienced a second successful run after it was purchased in 1916 by members of the Day family to treat lead ores from their mines in the Coeur d'Alene mining district of Idaho. Peak employment at the Northport smelter was more than 400. During the period it operated, the Northport smelter also accepted custom ores from nearby mines in Washington.[6] Smelters built in the Columbia River Basin in British Columbia around the turn of the twentieth century also helped to spur mining in northeast Washington.

In 1908, Stevens County led all Washington counties in value of metals production, and in 1909 it ranked second only to Ferry County. Development of lead-zinc ores in the vicinity of Metaline Falls began in the first decade of the century, and mines there went into production in the 1910s, spurred especially by wartime demand for base metals. Although the Metaline district went into decline with the market slump after World War I, it revived again in the late 1920s, with the Bella May, Grandview, and Josephine mines all contributing output. Pend Oreille Lead & Zinc Company, which operated the Josephine mine, reorganized as Pend Oreille Mines & Metals Company and was the only major metal-mining company in the area to remain in production through most of the Depression in the 1930s. World War II brought renewed demand, benefiting not only Pend Oreille Mines & Metals but numerous smaller base-metal mining operations in the area as well. Demand continued after the war, encouraging Pend Oreille Mines & Metals to build a new 2,400-ton/day mill in the early 1950s, and American Smelting & Refining Company opened the Van Stone mine with its 1,000-ton/day mill. The American Zinc, Lead, & Smelting Company (and predecessors) also operated a large mill at the Grandview mine near Metaline Falls.[7]

Fulkerson and Kingston based much of their report on a tabulation of data recorded on Permanent Individual Mine Records sheets, compiled by the USGS and the U.S. Bureau of Mines each year beginning in 1902. During the period Fulkerson and Kingston survey (1902-1956), mines in Pend Oreille County produced more than 8,000,000 tons of gold, silver, copper, lead, and zinc ore, which yielded more than 200,000 tons of zinc and 100,000 tons of lead, as well as gold, silver, and copper, all worth more than $75,000,000. Nearly all of the county's production was from the Metaline district. During the same period, mines in Stevens County produced more than 3,000,000 tons of gold, silver, copper, lead, and zinc ore worth nearly $40,000,000. Stevens County mines produced considerably more gold, silver, and copper than Pend Oreille County mines but less lead and zinc. Almost 78% of the gold, silver, copper, lead, and zinc ore mined in Stevens County was from the Northport district. The Northport district produced about 72% of Stevens County's lead output and nearly all of its zinc, but the Chewelah district was responsible for more than half of the

[6] George A. Bethune, *Mines and Minerals of Washington*, First Annual Report (Olympia, WA: O.C. White, State Printer, 1891), 25-26; Fulkerson and Kingston, *Mine Production of Gold, Silver, Copper, Lead, and Zinc in Pend Oreille and Stevens Counties, Wash., 1902-1956,* 4-5.

[7] Fulkerson and Kingston, *Mine Production of Gold, Silver, Copper, Lead, and Zinc in Pend Oreille and Stevens Counties,* 5-10.

county's silver output and copper output. The Orient district produced about 87% of Stevens County's gold across the years surveyed by Fulkerson and Kingston.[8] The following table shows the total volumes ore they show being produced between 1902 and 1956 in Pend Oreille and Stevens counties, as well as the amounts of gold, silver, lead, copper, and zinc:

Table 1: Ore and Metals Produced by Mines in Pend Oreille and Stevens Counties, 1902-1956 [9]

County	ore (tons)	gold (oz.)	silver (oz.)	lead (tons)	copper (tons)	zinc (tons)
Pend Oreille	8,285,714	255	357,904	110,691	189	229,630
Stevens	3,240,657	52,145	3,313,761	54,091	6,590	87,575

As subsequent sections of this report show, mines in Pend Oreille and Stevens counties continued to produce base metals through the 1950s, 1960s, and 1970s. A compilation from U.S. Bureau of Mines Permanent Individual Mine Records shows the following production for Ferry, Pend Oreille, and Stevens counties form the beginning of the twentieth century through 1978:

Table 2: Ore and Metals Produced by Mines in Pend Oreille and Stevens Counties, 1900-1978 [10]

County	ore (tons)	gold (oz.)	silver (oz.)	lead (tons)	copper (tons)	zinc (tons)
Pend Oreille	18,078,178	439	740,893	210,478	189	463,963
Stevens	6,057,671	47,547	2,979,735	64,213	6,517	156,548
Ferry	4,161,794	2,107,567	11,706,815	11	984	78

Mines in Ferry County were operated mainly for their gold and silver. Through 1987, precious metal mines in the county had produced about 4,400,000 tons of ore yielding 2,450,000 oz. of gold and 14,212,000 oz. of silver. Most of this output was from the Republic district, which is easily the leading gold producer in the State of Washington. Mines in Ferry County also produced some copper, lead, and zinc, but gold was responsible for 85% of the $48,300,000 the county's mines had yielded through 1970, and silver was responsible for 13% of the total wealth generated by mining of those five metals in the county.[11]

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[8] Fulkerson and Kingston, *Mine Production of Gold, Silver, Copper, Lead, and Zinc in Pend Oreille and Stevens Counties*, 11-20.

[9] Fulkerson and Kingston, *Mine Production of Gold, Silver, Copper, Lead, and Zinc in Pend Oreille and Stevens Counties*, 11, 14.

[10] HAI worked on compiling these totals from the USBOM PIMR sheets for the three counties.

[11] Wayne S. Moen, *Silver Occurrences in Washington*, Division of Geology and Earth Resources Bulletin No. 69 (Olympia: Washington Department of Natural Resources, 1976), 26; Mortimer H. Staatz and Robert C. Pearson, "The Republic Gold District, Ferry County, Washington," in *Epithermal Gold Deposits – Part I*, USGS Bulletin 1857-H (Washington, DC: GPO, 1990), pp H-14

Historical Overview of the Metals Mining Industry in Northeast Washington

In the wake of the California Gold Rush of 1849, prospectors moved into the remote reaches of the American West in search of other deposits of the precious metal. The first discoveries in what would become the State of Washington occurred in the 1850s in the Cascades along a route being explored for a transcontinental railroad, near the site that would become Colville in present-day Stevens County, and along the Similkameen River in present-day Okanogan County, but richer finds elsewhere in the West attracted most of the gold frenzy through the third quarter of the nineteenth century. Northeastern Washington remained largely unsettled by groups other than indigenous people at the time of statehood in 1889. The most significant mineral production in northeastern Washington had been placer gold taken by Chinese and other miners in the 1860s and 1870s from gravel bars along the Columbia River in the Colville Indian Reservation.[12]

No official records of mining in northeast Washington existed until the mid-1860s, and the earlier history of mining in the area is uncertain. There were reports of gold being seen in streams as early as 1852 by workers for the Hudson's Bay Company, which had established an outpost at Fort Colville near Kettle Falls in 1825. Word of the discovery was slow to get out of the region, however. A few prospectors did move into the lower Pend Oreille River, north of the Canadian border. Reports from the mid-1950s indicated only a couple dozen men engaged in placer mining activities along the gravel bars of the Pend Oreille and Columbia rivers. Even after the mid-1860s, the records are imprecise. By the 1860s, Chinese miners had moved into the area to work the placer diggings, and the numbers of miners in the area had grown to about fifty along the Pend Oreille and perhaps 150 along the Columbia downstream of Fort Colville. Chinese miners continued placer mining along the Upper Columbia River through the 1870s and into the early 1880s. The U.S. Geological Survey made an effort in the early twentieth century to estimate the value of precious metals recovered from the entire state each year in the late nineteenth century, but the tabulations do not show production for northeast Washington in particular. Although hardrock mining commenced in Stevens County in the 1880s, there are no known reliable estimates of ore produced in northeast Washington prior to 1900.[13]

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through H-20.

[12] Bethune, *Mines and Minerals of Washington*, 5-10; J.T. Pardee, *Geology and Mineral Deposits of the Colville Indian Reservation, Washington*, USGS Bulletin 677 (Washington, DC: Government Printing Office, 1918), 53; Marshall T. Huntting, *Gold in Washington*, Washington Division of Mines and Geology Bulletin No. 42 (Olympia, WA: State Printing Plant, 1955), 28-29; Roy P. Full, "An Analysis of the Mineral Production from the Lands of the Confederated Tribes of the Colville Reservation," unpublished report dated November 1976, pp 8-11 (Teck0018153-156).

[13] Howland Bancroft, *Ore Deposits of Northeastern Washington*, USGS Bulletin 550 Washington, DC: Government Printing Office, 1914), 3-4; USGS, *Mineral Resources of the United States, 1913* (Washington, DC: GPO, 1914), 790; Fulkerson and Kingston, *Mine Production of Gold, Silver, Copper, Lead, and Zinc in Pend Oreille and Stevens Counties, Wash., 1902-1956*, 4-5; Full, "An Analysis of the Mineral Production from the Lands of the Confederated Tribes of the Colville Reservation," 5-24, 31 (Teck0018142).

The year of statehood in 1889 corresponded with the building of the first railroad line into northeast Washington, the Spokane Falls & Northern Railway, which was completed to Colville that year. Lack of rail transportation had made it costly to ship ores out of the region and made it costly to ship ore-treating equipment into the region, thus hampering efforts to develop mineral resources. Prior to the arrival of the railroad, the only hardrock mines of any significance operating in northeast Washington were near Colville. They included the Old Dominion, Bonanza, Daisy, and Young America mines. Quartz bearing gold and silver had been discovered near Colville in 1883, and W.H. Kearney began developing the first lode mine of consequence, the Old Dominion, in 1885. Located about six miles east of Colville, the mine had shipped about 2,500 tons of ore by 1891, according to Bethune. The ore had averaged 200 oz. of silver per ton and assayed at 30% lead. Bethune reported 3,000 tons of lower-grade material sitting on a dump at the mine averaging 30 oz. of silver per ton. Other mines in the Colville district, including the Young America and the Bonanza, had also been discovered in 1885 and began shipping a few carloads of ore to smelters after the railroad arrived. The Spokane Falls & Northern extended its line to Northport in 1891, opening new territory near the Canadian border to mineral development.[14]

The federal government opened the north half of the Colville Indian Reservation to mineral entry in 1896, and immediately prospectors moved into that territory, discovered gold and silver deposits, and established the Republic mining district. When the southern half of the Colville Reservation (the current reservation, Fig. 3) was opened to mineral location in 1898, more deposits were discovered and four additional mining districts established. Three of the districts, the Keller, Covada, and Park City (Okanogan County), are tributary to the Columbia River above the Grand Coulee Dam. The Nespelem district drains to the Columbia below the dam. The districts attracted the attention of prospectors, who filed claims, but relatively little ore was shipped. There was a small mill built on Hall Creek in the Covada district in 1913 and a small cyanide mill built and operated in 1921 and 1922 on Iron Creek in the Keller district. Little other milling of ore is known to have existed. Roy Full estimates that the Covada and Keller districts each produced about $20,000 in mineral values from hardrock metal mining.[15] (There was also a resurgence of placer mining, in the form of dredging, along stretches of the Columbia River within the Colville Indian Reservation during the 1930s and 1940s.).[16]

The Colville Indian Reservation was closed to further mineral entry in 1934. In more recent years, the Colville Confederated Tribes have contracted with geological experts to use newer

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[14] Bethune, *Mines and Minerals of Washington*, 12, 72-76; Bancroft, *Ore Deposits of Northeastern Washington*, 3-5.

[15] Bancroft, *Ore Deposits of Northeastern Washington*, 4; Pardee, *Geology and Mineral Deposits of the Colville Indian Reservation*, 53-54; Huntting, *Gold in Washington*, 30; Full, "An Analysis of the Mineral Production from the Lands of the Confederated Tribes of the Colville Reservation," unpublished report dated November 1976, pp 48-52 (Teck0018194-198).

[16] Full, "An Analysis of the Mineral Production from the Lands of the Confederated Tribes of the Colville Reservation," unpublished report dated November 1976, pp 41-42 (Teck0018187-188).

geophysical and other techniques to appraise reservation lands and ascertain their potential for

mineral development. The purpose of the studies was to see if mining could be an economic activity which would diversify the economic base of the reservation.[17]

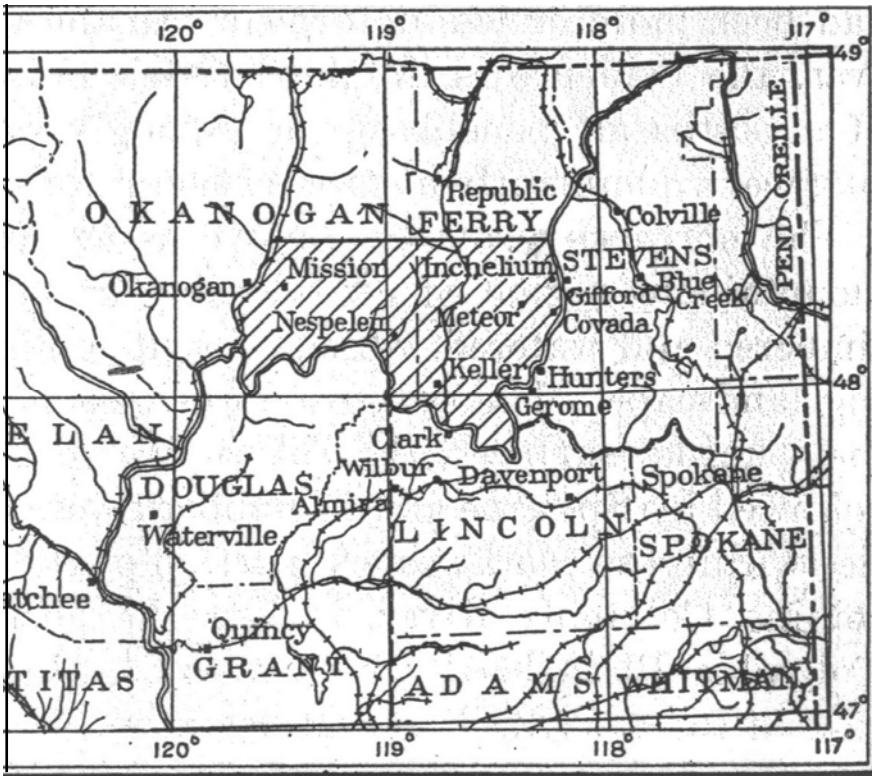

Fig. 3: Map of Northeast Washington Showing Current Boundaries of the Colville Indian Reservation. Source: J.T. Pardee, *Geology and Mineral Deposits of the Colville Indian Reservation, Washington*, USGS Bulletin 677 (Washington, DC: Government Printing Office, 1918), p 13

[17] Staff of the Colville Confederated Tribes, *Revised Geology and Mineral Potential of the Colville Indian Reservation, Washington* (Nespelem, WA: Ross Printing, 1984), 1 (Y09145721). The Tribes have also conducted environmental investigations to determine whether the earlier sites of mining and milling operations are contaminated. Analyses of soils and sediments samples taken from ten sites on the reservation in 2002 and 2003 show the presence of one or more contaminants, such as lead or arsenic, at each of the ten sites; see Terrance P. Campbell, "Study Synopsis: Initial Investigation and XRF Screening of 10 Upland Sites for Metals Contamination, Colville Indian Reservation," unpublished report prepared by TerraGraphics Environmental Engineering for the Confederated Tribes of the Colville Reservation dated March 2005 (Y09150853).

Mining

In order to expose ore and develop a mine, an operator must remove overburden or adjacent rock. This material is often set aside near the mine. Although not rich enough in desired metals to merit further treatment, such waste rock may contain mineral compounds or other elements which can become mobile in the environment, either leaching into the subsurface or eroding onto adjacent land or into adjacent surface waters. Mines that continued operating for a considerable period often used this waste material to backfill old mine workings. Miners may also extract other materials from a mine which have elevated levels of the desired metals but which nevertheless are too low in grade to be considered ore. Such materials were typically stockpiled near the mine in the hope that improvements in technology or the market would someday make it economically feasible to treat the materials as ore.[18] In the meantime, those materials, too, may release contaminants to the environment.

An example of the mineral-bearing nature of mine dumps can be seen in 1913, when a man from Spokane leased the dump at the Paragon mine in the Northport district in order to concentrate the material, hoping to make a shippable product. He set up a simple grizzly (parallel iron bars) in order to separate the coarse material from the fine. Then he ran the fine material through a riffled sluice box and a jig, hoping to recover copper minerals. At a somewhat larger scale, the Cleveland Mining & Milling Company built a 50-ton/day concentrator in 1917 near the Cleveland mine in the Springdale mining district to treat low-grade material on the mine dump bearing lead and zinc.[19] Other examples of this practice, which demonstrate that piles of mineral-bearing material were sitting near mines on the landscape of northeast Washington, are provided in the descriptions of some of the mills below.

Mills and Concentrators

Most ore is not rich enough in precious or base metals to merit shipping to a smelter or market without subjecting it to some sort of milling or concentration near the mine before shipping. Thus, mining of any magnitude did not develop in northeast Washington until mine developers could also build mills. Virtually every mine of any consequence in northeast Washington built a mill or concentrator as part of its strategy for being profitable. Smaller mines would often send their ore to a nearby mill before shipping concentrates to the smelter. Concentrators crush and grind the ore to a desired fineness in order to mechanical means to separate the metal-bearing particles from

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[18] These general observations about mining are based on my experience in researching the histories of numerous mining operations and on several standard technical texts from the historical period, including: Robert Peele, *Mining Engineers' Handbook* (New York: John Wiley & Sons, 1918); Peele, *Mining Engineers' Handbook*, Third Edition in Two Volumes (New York: John Wiley & Sons, 1941); George J. Young, *Elements of Mining*, First Edition (New York: McGraw Hill, 1916); Young, *Elements of Mining*, Fourth Edition (New York: McGraw Hill, 1946).

[19] *Mining and Scientific Press* 107 (16 August 1913): 278; Weaver, *The Mineral Resources of Stevens County*, Washington Geological Survey Bulletin No. 20 (Olympia, WA: State Printer, 1920), 209.

the non-metal-bearing particles. Concentrators thus produce two streams: concentrates, which have higher concentrations of the desired metals than the feed ore, and tailings, which are the remaining particles. Methods of concentration are not 100% effective, so concentrates contain some non-metal-bearing minerals, and tailings contain some metal-bearing particles. Depending on the methods of concentration used and the types of ore treated, tailings may have very elevated concentrations of metals, even if those concentrations are lower that the ore itself. [20]

Tailings have to be disposed in a manner that carries them away from the mill in order to make way for the on-going throughput of ore. Although mill operators occasionally tried to save their tailings in the early years, in the expectation that improved technology would make it possible to recover additional metal values from reprocessed tailings, by far the most expedient means of tailings disposal was to discharge them to a nearby stream to be carried away. This was especially true after the 1910s and 1920s with introduction of flotation methods of concentration, which offered mining companies higher recovery rates for desired metallic mineral compounds in the ores and gave the companies little reason to try to save their tailings for possible future reprocessing. Tailings disposal, of course, varied on a case-by-case basis, depending on such factors as the setting of the mill. A mill located far from a large stream did not have the luxury of using the stream to flush away its tailings. Such mills would typically stack or impound their tailings some distance from the mill on an area which afforded room for tailings to accumulate without impeding the on-going process. This sometimes necessitated elevating tailings to higher ground, as at the Knob Hill mill, described below. Since the 1950s and 1960s, regulatory agencies have required that companies impound their tailings rather than discharging them to a stream, as described below for the Josephine mills. Prior to the regulatory era, mills that happened to store or impound their tailings often made little effort to prevent the margins of their tailings dumps from eroding. [21]

The physical and mineral character of the tailings discharged into the Columbia River watershed did not remain the same throughout the eighty or ninety years during which mills made discharges into the environment. 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. Before 1880, gold and silver ores were almost exclusively the ores of choice

[20] These general observations about milling are based on my experience in researching the histories of numerous mining operations and on several standard technical texts from the historical period, including: Robert H. Richards, *Ore Dressing*, Second Edition in Four Volumes (New York: McGraw-Hill, 1908); Herbert A. Megrew *The Flotation Process* (New York: McGraw-Hill, 1916); Arthur F. Taggart, *Handbook of Ore Dressing* (New York: John Wiley & Sons, 1927); Taggart, *Handbook of Ore Dressing: Ores and Industrial Minerals* (New York: John Wiley & Sons, 1945); A.M. Gaudin, *Flotation* (New York: McGraw-Hill, 1932); Gaudin, *Principles of Mineral Dressing* (New York: McGraw-Hill, 1939). The practice of milling gold and silver ores was somewhat different from that of dressing the ores of base metals; see for example Francis L. Bosqui, *Practical Notes on the Cyanide Process*, Second Edition (New York: The Scientific Publishing Company, 1901); Henry Louis, *A Handbook of Gold Milling*, Third Edition (New York: The Macmillan Company, 1902); Alfred S. Miller, *The Cyanide Process* (New York: John Wiley & Sons, 1906).

[21] Taggart, *Handbook of Ore Dressing*, 1280-1288.

among operators of mills in northeast Washington. After 1880, prospectors identified deposits of other minerals bearing promising percentages of copper or lead. After the 1910s, metallurgical methods and changes in the market also motivated miners to seek zinc-bearing ores. In time prospectors would also discover ores of less common metals, like tungsten, molybdenum, and uranium. These various ores differed not only in the marketable metals they offered but also in their overall composition, and therefore in the content of the tailings that would be discarded after the desired metals were removed.

By the end of the first decade of the twentieth century, rail lines from three different railroads extended more extensively into northeast Washington. In addition to the Spokane Falls & Northern (part of the Great Northern Railway system), one line extended from northern Idaho along the Clark Fork (Pend Oreille) River to Metaline Falls, and another line extended along the Kettle River through the border region of British Columbia and into the Republic mining district of Ferry County. These rail lines brought lower-cost overland transportation closer to many of the mines (although miners typically had to haul their ores several miles by horse-drawn wagon or motor truck to railroad shipping points) and it made construction of mills and smelters more affordable.[22]

Entrepreneurs tried developing mills and concentrators to treat ores from northeast Washington in the 1890s and the first two decades of the twentieth century, but results were disappointing. Current concentrators are often able to operate at levels of very high effectiveness, typically recovering well in excess of 90% of the target minerals. Mills and concentrators at the turn of the twentieth century were not nearly so effective. On particularly troublesome ores, they sometimes recovered less than 60% of the desired minerals. Such poor performance meant that the unrecovered minerals were discharged onto the floodplain or into the creek or river as solid particles ranging in size from small gravels to extremely fine powder. The transition from relatively poor recovery rates to high recovery rates was gradual. Therefore, early companies and their mills discharged to the Upper Columbia watershed thousands of tons of tailings bearing the copper, lead, silver, zinc, or other metals that they were not able to recover.[23]

Gravity concentration worked poorly enough on the low-grade ores of northeast Washington that by the early 1910s, when Bancroft surveyed the area, there was only one mill operating, at Germania (described later in this report). He described mills that were under construction at the time and others which had failed, notably in the Republic district. Technical difficulties in matching available milling methods to the area's intractable ores had frustrated mine and mill developers.[24]

When ore is crushed and ground, a certain amount of fine dust and sand will be

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[22] Bancroft, *Ore Deposits of Northeastern Washington*, 5-8, 39.

[23] For further descriptions of these discharges, see descriptions below for such facilities as the Republic mills in Ferry County and the Josephine mills in Stevens County.

[24] Bancroft, *Ore Deposits of Northeastern Washington*, 6-7.

generated, even if the intent is to reduce the material only to pebble-size. Early mill builders and operators knew from experience that concentrating machines called jigs were relatively effective at separating metal-bearing particles 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 metals-bearing minerals from gangue in the fine particle range. Even with efforts to improve recoveries from fines, mills nevertheless often 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 northeast Washington discharged two kinds of tailings: 1) coarse tailings, with relatively low assay values in lead, zinc, or copper, and 2) fine tailings, with relatively high assay values in those and other metals. 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, if tailings were discharged to a stream. If tailings were stored on land, fine tailings could relatively easily flow away with drainage, seepage, or erosion from the tailings dump.

The development of a process called flotation in the early twentieth century offered a greatly improved means of recovering values from fine tailings before they were discarded. 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 Columbia River basin 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 Columbia watershed were of a fineness such that, if they reached flowing water, they were readily carried downstream.

Flotation had another consequence for mining in northeast Washington: many of the base-metal mineral deposits known to exist had grades too low to merit shipping to smelters and even too low to merit concentrating by gravity methods. Flotation, however, made it possible to mine and treat large volumes of relatively low-grade lead and zinc ores to produce concentrates rich enough to ship to smelters. Thus, flotation made possible the exploitation of mineral deposits in northeast Washington which may otherwise have been left undeveloped. Some of the improved mills of the second half of the twentieth century were very large-scale operations, as described below.

Smelters

Entrepreneurs tried to develop smelters in Washington early in this history. By the time George Bethune produced the first annual report for the Washington State Geologist in 1891,

there were three smelters in the state, one at Tacoma, one at Colville in northeast Washington, and one at Spokane. The Colville smelter, built in 1888 and operated just a few years, treated lead-silver ores from several of the early mines in its vicinity, like the Old Dominion, Daisy, Bonanza, and Young America. The Spokane smelter was never blown-in. The Tacoma smelter, on the other hand had a long life. It eventually became part of the American Smelting and Refining Company (Asarco) enterprise and served for many decades as a custom smelter for ores not only from northeast Washington but the entire western U.S. By the time Howland Bancroft wrote his USGS report on *Ore Deposits of Northeastern Washington*, there were three smelters in Washington: Tacoma, Everett, and Northport. Several northeast Washington mines shipped lead ores to the Everett smelter, as described below. The Northport smelter, described in greater detail below, began in the 1890s as a copper smelter, closed for a few years around 1910, and then reopened during World War I as a lead smelter.[25]

There were also some important mines, mills, smelters in nearby British Columbia, and the smelters often received ore from the mines in northeast Washington. The first British Columbia smelter was a copper smelter developed at Trail by an American entrepreneur in 1896. The Canadian Pacific Railway bought the smelter in 1898 and modified it to be able to smelt lead ores as well. The Trail facility eventually ceased smelting copper and developed the capacity to treat zinc materials in addition to lead. Many mines in northeast Washington sent zinc and lead materials to Trail, and that smelter is now owned by the defendant in this case. Two other Canadian smelters, at Grand Forks and Greenwood, were also important in the period around the turn of the twentieth century. The Granby Consolidated Mining, Smelting, and Power Company put its copper smelter at Grand Forks into operation in 1900, and the British Columbia Copper Company's smelter at Greenwood went into service in 1901. The Granby smelter was located west of Trail along the banks of the North Fork Kettle River, a tributary of the Columbia River. The Greenwood smelter was located northwest of Grand Forks at the confluence of Copper and Boundary creeks.[26] After the Bunker Hill and Sullivan Mining Company built its lead smelter at Kellogg, Idaho, in 1915, it became an important destination for lead ores and concentrates from northeast Washington. The associated zinc works near Kellogg also took zinc materials from northeast Washington. Mines in the area also sent lead and zinc ores and concentrates to Asarco works in Montana and elsewhere and to Anaconda Copper Mining Company works in Montana.

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[25] George A. Bethune, *Mines and Minerals of Washington* (Olympia, WA: State Printer, 1891), 23-28; Howland Bancroft, *The Ore Deposits of Northeastern Washington*, USGS Bulletin 550 (Washington, DC: GPO, 1914), 6.

[26] Alfred W.G. Wilson, *The Copper Smelting Industries of Canada* (Ottawa: Government Printing Bureau, 1913), 95-97, 120-121; Bancroft, *The Ore Deposits of Northeastern Washington*, 6; Jeremy Mouat, "'The Assistance of Science and Capital': The Role of Technology in Establishing B.C.'s Hard Rock Mining Industry, 1876-1906," *Scientia Canadensis: Canadian Journal of the History of Science, Technology and Medicine* 16 (1982): 174-176.

B. Histories of Mining, Milling, and Smelting Operations in Northeast Washington

State and federal agencies have documented the presence and operations of mines and mills in the subject area of this litigation for more than a century. Based on those government records, it is fair to say that well over 900 mines have existed on lands that drain to the Upper Columbia River. Each of the mines is a property which possessed enough mineralization that some prospector considered it worth while to stake a mining claim and, further, at least to begin excavating mineralized material in an effort to develop a producing mine. While the only physical evidence for some of the mines may be just a small area of disturbed ground, some of the mines developed into large producers, which operated for many years, yielding hundreds of thousands of tons of ore each year and resulting in the setting aside a considerable volumes of mineralized material that did not qualify as ore. There have also been about 130 mills or concentrators built in the area that drains to Lake Roosevelt and the Upper Columbia River. Some of the mills never operated; some operated only briefly, discharging relatively small volumes of tailings to the environment; some operated many years and discharged hundreds of thousands of tons of tailings.[27] My report only describes the mills which operated for durations sufficient to produce relatively large volumes of tailings and did so in close proximity to one of the streams tributary to the Upper Columbia.

There are several ways in which historical information about mining and ore treatment in northeast Washington may be organized: by method, by geography, and chronologically. I describe the Northport smelter first, because it was a distinct kind of metallurgical operation, and its waste discharges were quite different from those of the mills. I then describe the major mills which operated in the area. I have broadly organized these facilities geographically, by mining district, and then within each mining district by mill. The mining districts are arranged in this report roughly by their productivity, beginning with the Metaline district in Pend Oreille County, which produced and milled the most ore of any district in northeast Washington. The information within each mill description is organized chronologically.

1. Northport Smelter

The Northport smelter, also known as the LeRoi smelter, was located on the east bank of the Columbia River adjacent to the town of Northport, Washington, just upstream of the south abutment and approach of the present-day bridge across the river (section 33, T40N, R40E). The facility operated around the turn of the twentieth century as a copper smelter, and then after a brief hiatus, it was remodeled to serve as a lead smelter. The Northport smelter treated lead ores during the World

[27] The numbers of mines and mills reported here are based on tabulations performed by HAI. The number of mines on lands that drain to the UCR is derived from Huntting, *Inventory of Washington Minerals*, specifically his lists of mines for the various metals that have existed in Ferry, Pend Oreille, Spokane, and Stevens counties. The number of mills is derived from Huntting (mills are listed as "improvements" for the mines that had them) as well as other historical documents which have described mills.

War I era. Because of contaminants discharged from the smelter during both periods of operation, the smelter has continued to be a subject of investigation. In the last two decades, it was studied by both the Washington Department of Ecology and the U.S. Environmental Protection Agency (EPA). In 2004, after considerable study, the EPA, under its CERCLA (Superfund) authority, conducted removal and containment actions at the smelter site and at 29 residential properties in Northport. The EPA established a containment area at the smelter site where it could place hazardous materials removed from other parts of the smelter site and from the residential properties. The BNSF Railroad also conducted a removal action from its property near the smelter site and placed removed materials in the containment area established by the EPA.[28] This section of my report describes the history of the smelter's discharges of waste products into the environment, including materials no longer present at the smelter site.

In 1897, the LeRoi Mining Company built a smelter at Northport, Washington, to treat its gold-bearing copper-sulfide ores from the LeRoi mine near Rossland, British Columbia. The company had been sending its ores to F. Augustus Heinze's copper smelter at Trail, British Columbia, but when Daniel Corbin completed a railroad from Rossland to Northport in 1896, the company decided to build its own smelter at Northport. The LeRoi company's contract to send its ores to Heinze's Trail smelter expired at the end of 1897, and the Northport smelter began smelting LeRoi ores in January 1898. Later in 1898, the LeRoi company transferred title and operation of its smelter to a newly formed affiliate incorporated in the state of Washington that year, the Northport Mining and Smelting Company. In 1901, the Northport company reorganized as the Northport Smelting and Refining Company, incorporated in the State of Idaho. The smelter began operating in 1898 with two blast furnaces. The smelter increased its capacity over the next several years by building four additional blast furnaces, with last one being completed by June 1902.[29]

The LeRoi ore was rich in sulfur, and before being smelted it was roasted in open heaps adjacent to the smelter for thirty to forty days in order to drive off more than half of the sulfur. The smelter at Northport continued to utilize heap-roasting as late as 1903. Roasted ore was charged to the blast furnaces and smelted twice. The first treatment produced a matte of 25-30% copper, which was cooled and broken before charging to a second blast furnace. The second treatment produced a

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[28] Weston Solutions, Inc., "LeRoi Smelter Removal Action Report, Northport, Stevens County, Washington," unpublished report prepared for the U.S. Environmental Protection Agency and dated April 2005.

[29] *Engineering and Mining Journal* (hereafter *E&MJ*) 65 (15 January 1898): 84 and (5 February 1898): 174; *E&MJ* 71 (16 February 1901): 208-209 and (20 April 1901): 522; "LeRoi Mining Company," *E&MJ* 75 (4 April 1903): 527; *Annual Report of the Minister of Mines for the Year Ending 31st December 1902 in the Province of British Columbia* (Victoria, BC: Printer to the King's Most Excellent Majesty, 1903), 169; Jeremy Mouat, "'The Assistance of Science and Capital': The Role of Technology in Establishing B.C.'s Hard Rock Mining Industry, 1876-1906," *Scientia Canadensis: Canadian Journal of the History of Science, Technology and Medicine* 16 (1982): 174; "Northport Smelting and Refining Company," introductory to the inventory of the Records of the Northport Smelting and Refining Company, Manuscript Group 234, Special Collections, Library of the University of Idaho, Moscow.

matte of about 40% copper, which was suitable to be shipped to a refinery elsewhere.

Maps of the smelter show three calcining furnaces by the early twentieth century, but these were installed to calcine matte and not to roast ore. They were apparently never used for their intended purpose, because the second treatment in a blast furnace produced an acceptable matte. [30]

Typical of smelters treating sulfide ores, the Northport smelter produced two classes of waste products: smoke, which was rich in sulfur dioxide and dust, and slag. The smelter was equipped with a dust chamber for recovering flue dust, which could then be resmelted. The company reportedly recovered about 15 tons of flue dust each day in 1901. Lime was added to the dust, and the mixture was formed into briquettes, which were recharged to the blast furnaces. Around the turn of the twentieth century, control of the LeRoi company's board of directors changed, and the new group hired R.J. Frecheville to report on the LeRoi property and its operations. In addition to examining the mining operation, he also examined the smelter at Northport, reporting that it had been poorly managed. One of the problems he identified was that the earlier manager had used too much coke and a blast that was too strong to fire the furnaces. As a consequence, fuel costs and losses in the form of flue dust were excessive. A new smelter manager modified operations leading, among other things, to a reduction in flue dust losses.[31]

On the other hand, the discharge of slag went largely unnoticed. The blast furnaces discharged their slag into launders flowing with water. Upon hitting the cool water in the launders, the slag quickly cooled and fractured into granules the size of sand. The flowing water in the launders conveyed the granulated slag to the nearby Columbia River, which carried the slag downstream to locations unknown. The LeRoi company shipped only its first-class ore (ore rich enough in copper, gold, and silver values to bear the costs of shipping and smelting before first being concentrated) to the smelter at Northport. The company accumulated its second-class ore (ore that would require concentrating prior to shipping and smelting) on a dump near its mine at Rossland. Therefore, there was not a concentrator at the Northport smelter, and the facility discharged no tailings during its copper period.[32]

The Canadian Pacific Railway (CPR) purchased Heinze's Trail smelter in 1898, along with the rail line linking the smelter to Rossland. In 1905, the CPR reached an agreement with the LeRoi Mining Company whereby the latter would begin sending it ores to Trail again. With the loss of its principal supplier of ore, the Northport smelter continued operating for a few years at a reduced rate, but it closed in early May 1909. During the decade the Northport smelter treated the LeRoi Mining

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[30] William S. Thyng, "The Northport Smelter," in Washington Geological Survey, *Annual Report for 1901*, Vol. I (Olympia, WA: State Printer, 1902), 143-146; *E&MJ* 75 (25 April 1903): 648.

[31] "The LeRoi Mine," *E&*MJ 73 (18 January 1902): 99.

[32] Thyng, "The Northport Smelter," 146; Edward Dyer Peters, Jr., *Modern Copper Smelting* (New York: The Scientific Publishing Company, 1901), 317-319; Sanborn Fire Insurance Map for Northport, WA, 1901, sheet 5; Sanborn Fire Insurance Map for Northport, WA, 1908, sheet 5; "LeRoi Mining Company," *E&MJ* 75 (4 April 1903): 526.

Company's ores, it smelted more than 100,000 tons of material per year. During the

last couple years of operation, after it lost its LeRoi source of copper ores, the volume of ore it treated decreased considerably. [33]

The Northport smelter sat idle for several years until the mid-1910s, when it was converted to a lead smelter by the Day interests. Members of the Day family owned several prominent mining properties in Idaho's Coeur d'Alene mining district, including the Hercules Mining Company and the Tamarack & Custer Consolidated Mining Company, both of which were important producers of lead ores and concentrates. Dissatisfied with the smelting rates to which they were subjected by the American Smelting and Refining Company, the Days decided to purchase the Northport Smelting and Refining Company so they could go into the smelting business themselves. The Days remodeled the Northport smelter in 1915 with the installation of blast furnaces and other equipment necessary for smelting lead-sulfide ores and concentrates from their mines in the Coeur d'Alene district. Two furnaces, each with a capacity to treat about 250 tons of materials, were blown in early in 1916. A third was installed in late 1916, but it was never operated. The company also installed four Dwight-Lloyd sintering machines (and shortly thereafter added two more, for a total of six), the purpose of which was to roast the material and sinter it, or fuse it into larger chunks. This was necessary because, whereas the old copper smelter had treated coarse first-class ore, much of the material shipped to the smelter from the Day's lead mines in the Coeur d'Alenes was very fine concentrate from flotation mills. Such fine material, called slimes, could not be charged directly to blast furnaces and had to be fused into larger solids first. The remodeled smelter began operating late in March 1916 and operated continuously through the end of 1918. The smelter operated only about half of 1919, nearly continuously during 1920, and then for about three months in 1921, before the Days closed it.[34]

As was the case when the smelter treated copper ores, it produced considerable tonnages of slag when it served as a lead smelter during the years 1916-1921. For example, in 1917, the peak year of operation, the Northport smelter treated about 158,000 tons of lead ores and concentrates, charging a total of about 209,000 tons of material to the furnaces, including siliceous ores from the Republic mining district and other flux materials. The smelter produced about 45,000 tons of lead bullion, 25,000 tons of lead-copper matte, and 111,000 tons of slag. Assays of the slag showed that it averaged about 1.045% lead and 0.065% copper.[35] As with the period when Northport served as a

[33] "J.J. Hill is a Bull, with Reservations," *New York Times* (8 September 1905); U.S. Dept. of Commerce and Labor, Census of Manufactures General Schedule for the Northport smelter for the year 1909 (UI6780); Northport Smelting & Refining Company to Director of the Census, letter dated 29 July 1910 (UI6784); Barke to Ledyard, 18 March 1918 (UOI0001617); Weeks to Ledyard, 12 November 1918 (UOI0001718); Affidavit of Jerome J. Day dated 4 May 1937, p 2 (UOI0000711); Mouat, "The Assistance of Science and Capital," 175.

[34] *Mining and Scientific Press* 112 (26 February 1916): 324-325; R.W. Marston to Jerome Day, letter dated 15 January 1917 (UOI0000863-864); Affidavit of Jerome J. Day, pp 1-6 (UOI0000710-715); Paul B. Jessup, "Report on Northport Smelting and Refining Company Liquidation," undated, unpublished report, p 1 (UOI0000694).

[35] "Report of the Northport Smelting and Refining Company for the Year 1917," undated, unpublished report, p 1-2 (UOI0007818-819).

copper smelter, the lead smelter continued to discharge its granulated slag directly to the bank of the Columbia River. Fourteen years later, an observer studying granulated slag in the Columbia River noted remnants of the old slag pile along the river, which could continue to be eroded downstream.[36]

The Northport company sold its smelter and its equipment to Asarco in 1922. Asarco dismantled the smelter in 1923. The Northport company also had owned a number of mining claims and other property in the vicinity, which it sold to Asarco in 1927. After the final winding down of its affairs and disposal of its assets and liabilities, the Northport Smelting and Refining Company was dissolved as a corporate entity in 1936.[37]

In addition to slag discharged from the Northport smelter into the Columbia River, the Northport Smelting & Refining Company discharged other waste materials which may have released contaminants to the environment, resulting in either a release or a threatened release of hazardous substances, such as copper or lead.

2. Pend Oreille County

The eastern half of Stevens County was split off to become Pend Oreille County in 1911. Its county seat was established at Newport, where there was a small mining district, but the new county's most promising mining area was in the vicinity of Metaline Falls, located along the Pend Oreille (Clark Fork) River just south of the Canadian border. The Metaline mining district would develop some of the most productive zinc and lead mines in the State of Washington.

a. Metaline Mining District

Prior to 1910, when the Idaho & Washington Northern Railroad reached Metaline Falls along the east banks of the Pend Oreille River, the Metaline mining district had been one of the most remote areas in the northeast corner of Washington. This, coupled with the low grade of the base ores, had delayed mineral development in the district. When Bancroft visited the area in preparation of his 1914 USGS bulletin, he noted that galena (lead sulfide) and sphalerite (zinc sulfide) were so sparsely disseminated in the host rock or the known ore bodies that a mill would have to be able to achieve a concentration ratio of as much as 30:1, which he proposed was not a promising prospect. His visit occurred during the era of gravity concentration and before flotation methods had been proven effective in the U.S., so his skepticism was well founded. Nevertheless, miners were trying

[36] S.W. Griffin and E.F. Potter, "Undissolved Mineral Matter, Natural and Extraneous, in the Columbia River in Northern Stevens County, Washington: Slag Pollution," unpublished report by the Bureau of Chemistry and Soils, Department of Agriculture, dated February 1936, 73 (BCA0000287).

[37] Jessup, "Report on Northport Smelting and Refining Company Liquidation," p 1-2 (UOI0000694-695); Frederick C. Robertson to Jerome Day, letter dated 24 March 1923 (UOI0000691).

to develop several groups of claims, and he observed the most excavation having occurred on the surface of Josephine claim in the Clark group of claims along Flume Creek.[38] With the advent of flotation and the introduction of lower-cost methods of underground mining, the Josephine and other claims in the district would prove very productive during the middle third of the twentieth century, as described below.

Mills of the Pend Oreille Mines & Metals Corporation

Pend Oreille Mines & Metals Corporation (and its predecessors) built and operated three mills near Metaline Falls. The earlier two mills stood on the west side of the Pend Oreille River and were often called the Josephine mills. The third mill, often called the Pend Oreille mill, stands on the east side of the river. They are described here in turn.

Josephine Mills

The Josephine group of mining claims is located near Metaline Falls, along the west side of the Pend Oreille River. It produced zinc-lead ores. Over time, the owners of the Josephine group of claims developed and produced from adjoining groups of claims, including the Clark, Oriole, Yellowhead, and Sullivan groups, and they also mined ores from leased lands, owned by the State of Washington, both uplands and land beneath the Pend Oreille River. The oldest of the mill sites is often named in recent environmental investigations the Old Josephine Mill Site or the Josephine Mill Site #1. The second of the mill sites is often named the New Josephine Mill Site or the Josephine Mill Site #2.[39]

Developed by Lewis P. Larsen, the property saw its most productive years during the tenure of the Pend Oreille Mines & Metals Company, a company he helped to organize. Prior to that company's successful run, Larson operated the property through two earlier enterprises, the Lead & Zinc Company and Pend Oreille Lead & Zinc Company. The Lead & Zinc Company built the first mill in the World War I era near the Josephine shaft. It was a gravity concentrator, located about a half-mile up Flume Creek from the Pend Oreille River. It ceased operating at the end of the war, and the equipment was sold. The building was remodeled to operate as flotation mill in the late 1920s by Pend Oreille Lead & Zinc Company. It had a peak capacity of about 300 tons/day and operated intermittently until 1934. Pend Oreille Lead & Zinc Company was reorganized in 1929 as the Pend Oreille Mines & Metals Company, which built the second west-side mill in the early 1930s. It is the

[38] Bancroft, *Ore Deposits of Northeastern Washington*, 40-41.

[39] U.S. Bureau of Mines, Permanent Individual Mine Records for Pend Oreille County (Plaintiff-00043819-922 and unnumbered forms for Pend Oreille and Josephine Mines); Region 10 Superfund Technical Assessment and Response Team, "Grandview, Josephine, and Pend Oreille Mines/Mills Trip Report," unpublished report dated September 2002; Region 10 Superfund Technical Assessment and Response Team, "Grandview and Josephine Mines Removal Assessment Report," unpublished report dated November 2003; LFR, Inc., "Final Site Investigation Report Josephine Mill #1," unpublished report dated January 2010.

one now known as the New Josephine Mill or Josephine Mill #2. Located on Flume Creek near the Cascade adit, about 500 feet from the Pend Oreille River, the second mill operated from 1936 until 1952. It reached a peak capacity of 800 tons/day. Pend Oreille Mines & Metals built the third mill, the east-side mill, in the early 1950s. It consisted of three units, each with a capacity of 800 tons/day. The first unit began operating in December 1950, the second in mid-1952, and the third in mid-1954. The east-side mill, described in the next sub-section, ceased operating at the end of May 1977.[40]

Larsen had begun trying to develop some of the claims in the Josephine group in 1907, but it was not until the World War I era that he built a gravity concentrator to process his ore. His first mine was an open-pit or glory-hole operation, and horse-drawn wagons hauled ore from the mine to the mill, which went into operation in 1915. The original concentrator was quite small, but once production got underway, its capacity was increased to 100 tons/day in late 1915. The Lead & Zinc Company shipped both zinc concentrates and zinc ore. The company stored its tailings and had plans to install a flotation circuit with which to retreat the tailings. By 1916, capacity of the mill had increased to 125 tons/day. In 1917, six mines in the Metaline district produced 15,093 tons of ore, and *Mineral Resource of the U.S* attributed nearly all of it to the Lead-Zinc Company. By the end of the year, the mill reportedly had a flotation circuit and had a capacity of 175 tons/day. The Josephine mine closed in January 1918, however, and shortly thereafter the company sold the milling equipment.[41]

With the drop in metals prices following the war, production at the mine and mill remained dormant until the 1920s, when Larsen renewed activity at his property, shipping some smelting ore from the Josephine mine in 1925 and 1926. Under the organization of his new company, Pend Oreille Lead & Zinc Company, he installed flotation equipment in the mill building which had housed the old gravity concentrator. The flotation mill had a capacity to treat 100 tons/day of ore in 1927. The following year, Pend Oreille Lead & Zinc treated both ore and tailings in its mill, now expanded to 200 tons/day, and it began a program of diamond drilling to explore the sub-surface for more ore. The tailings treated at the mill may well have been those set aside by the old gravity concentrator during World War I. In 1929, the company was reorganized as the Pend Oreille Mines & Metals Corporation, and it controlled the Hortense, Oriole, Sullivan, and Yellow Head groups of

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[40] USBOM, *Minerals Yearbook, 1937* (Washington, DC: Government Printing Office, 1937), 552; *Minerals Yearbook, 1951* (Washington, DC: GPO, 195X), 479; J.C. Crampton, "Pend Oreille Mines & Metals Co. Latest Mill Reflects Changes Over Four Decades of Mining," *Mining Engineering* 7 (September 1955): 846; L.M. Kinney, "Pend Oreille History," unpublished report dated c1977, pp 57, 74-77 (TS001844-946).

[41] Robert M. Brimsmade, "Two Washington Mining Districts," *Mining & Scientific Press* 113 (18 November 1916): 743-745; USGS, *Mineral Resources of the United States, 1915* (Washington, DC: GPO, 1917), 572; *Mineral Resources of the United States, 1916* (Washington, DC: GPO, 1919), 613; USGS, *Mineral Resources of the United States, 1917* (Washington, DC: GPO, 1921), 503; *Mineral Resources of the United States, 1918* (Washington, DC: GPO, 1921), 507; Olaf P. Jenkins, *Lead Deposits of Pend Oreille and Stevens Counties Washington*, Division of Geology Bulletin No. 31 (Olympia: State of Washington, 1924), 56 (HAI0007495-577).

claims, in addition to the Josephine group. Larsen's enterprise did not produce or treat any new ore, shipping only two carloads of zinc concentrates remaining in the old mill. Meanwhile, the company made plans for a new mill and began work on a new access tunnel to the Josephine workings. Although diamond drilling and development work in the mine workings continued in 1930, construction of the new mill was suspended because of low metals prices, so Pend Oreille Mines & Metals reactivated its old mill late in the year, treating ore from the Sullivan workings. The mill treated 6,000 tons of ore and shipped lead concentrates but held its zinc concentrates until 1931. The enterprise was back in full operation in 1931, treating 80,968 tons of ore and producing 10,850 tons of lead and zinc concentrates at its 300 tons/day mill. Pend Oreille Mine & Metals closed its mill in early May 1932 because of continuing low metals prices.[42]

The mine and mill resumed operations in June 1933, treating 48,479 tons of ore through the remainder of the year. The mill treated another 28,322 tons before April 1934, when it closed so Pend Oreille Mines & Metals could make the transition to its new mill. The company developed the mine during 1935 but neither produced nor milled any ore that year. The new mill began operating at the beginning of 1936 with a capacity of 300 tons/day and treated 76,060 tons that year. The company increased the mill's capacity to 600 tons/day in 1937. Operating continuously throughout 1938, the mill treated more than 200,000 tons of ore that year. Its throughput remained above that level through 1942, during which time its capacity increased slightly to 700 tons/day. Output at the mine, and therefore throughput at the mill, decreased about 13% from 1942 to 1943, due to war-induced labor shortage and also a brief shortage of electricity in the spring. Labor shortages continued to hamper production through the remainder of the war; and output continued to hover at between 100,000 and 150,000 tons through most of the late 1940s, finally jumping to more than 180,000 per year in 1949 and 1950. Pend Oreille Mines & Metals began construction of its new east-side mill in 1950, putting the first 800-ton/day unit into service in December.[43]

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[42] USBOM, *Mineral Resources of the United States, 1925* (Washington, DC: GPO, 1928), 559; *Mineral Resources of the United States, 1926* (Washington, DC: GPO, 1929), 468; *Mineral Resources of the United States, 1927* (Washington, DC: GPO, 1930), 591; *Mineral Resources of the United States, 1928* (Washington, DC: GPO, 1931), 700-701; *Mineral Resources of the United States, 1929* (Washington, DC: GPO, 1932), 427; *Mineral Resources of the United States, 1930* (Washington, DC: GPO, 1933), 673-674; *Mineral Resources of the United States, 1931* (Washington, DC: GPO, 1934), 673-674; *Minerals Yearbook, 1932-1933* (Washington, DC: GPO, 1933), 118-119.

[43] *Minerals Yearbook, 1934* (Washington, DC: GPO, 1934), 297; *Minerals Yearbook, 1935* (Washington, DC: GPO, 1935), 354; *Minerals Yearbook, 1936* (Washington, DC: GPO, 1936), 217; *Minerals Yearbook, 1937* (Washington, DC: GPO, 1937), 552; *Minerals Yearbook, 1938* (Washington, DC: GPO, 1938), 459; *Minerals Yearbook, 1939* (Washington, DC: GPO, 1939), 491; *Minerals Yearbook, 1940* (Washington, DC: GPO, 1940), 479; *Minerals Yearbook Review of 1940* (Washington, DC: GPO, 1941), 474; *Minerals Yearbook, 1941* (Washington, DC: GPO, 1943), 486; *Minerals Yearbook, 1942* (Washington, DC: GPO, 1943), 514; *Minerals Yearbook, 1943* (Washington, DC: GPO, 1945), 493; *Minerals Yearbook, 1944* (Washington, DC: GPO, 1946), 472; *Minerals Yearbook, 1945* (Washington, DC: GPO, 1947), 486; *Minerals Yearbook, 1946* (Washington, DC: GPO, 1948), 1568; *Minerals Yearbook, 1947* (Washington, DC: GPO, 1949), 1534; *Minerals Yearbook, 1948* (Washington, DC: GPO, 1950), 1625; *Minerals Yearbook, 1949*

There are two important historical facts about the conduct of the Pend Oreille Mines & Metals operation at the Josephine mills that are germane to this case. The first is that for most of its history the company discharged its tailings directly into the river system. There may have been a brief period during World War I when the Old Josephine mill used gravity concentration and it stored some of its tailings so that they could be retreated later using flotation, but with the installation of flotation equipment, and its more effective recovery of metal values, the company started discharging its tailings into Flume Creek a relatively short distance from its mouth on the Pend Oreille River. A 2003 report by the Superfund Technical Assessment and Response Team noted that at the Old Josephine mill site, 2.5 acres of tailings piles remained, extending into Flume Creek. The Josephine mills discharged hundreds of thousands of tons of tailings into tributaries of the Columbia River prior to closing. The new east-side mill continued the practice of discharging tailings directly to the Pend Oreille River, as described below.[44]

The second important historical fact about the conduct of the Pend Oreille Mines & Metals operation that is germane to this case concerns mining which the company undertook on lands leased from the State of Washington, and for which the company paid royalties to the State of Washington. The mining took place in the 1940s on lands covered by two mining contracts between Pend Oreille Mines & Metals and the State of Washington: contract 240 covered state lands located in section 16, T39N, R43E; contract 292 covered lands beneath the bed and shores of the Pend Oreille River in sections 15 and 16, T39N, R43E. According to a 1967 tabulation compiled by a geologist in the Lands Division of the Washington Department of Natural Resources, Pend Oreille Mines & Metals mined and milled 395,700 tons of ore from upland areas of section 16, paying royalties of $43,465.45, and it mined and milled 160,401 tons of ore from beneath the bed and shores of the river, paying royalties of $13,995.50. After 1949, by which time the company had extracted all the ore it could from those lands, it kept its contracts with the State current (with some delinquencies for late filing), paid fees, and reported drilling and maintenance work it conducted on state lands, work for which it was not required to pay royalties.[45] The ores Pend Oreille Mines &

(Washington, DC: GPO, 1951), 1598; *Minerals Yearbook, 1950* (Washington, DC: GPO, 1953), 1612.

[44] Gerald T. Orlob and Walter W. Saxton, "A Preliminary Survey of the Sources of Mining and Mill Waste Pollution in the Upper Columbia River Basin and Lake Roosevelt," unpublished report prepared for the Washington Pollution Control Commission and dated c 1950, p 9 (INT0056688-708); D.L. Hansen to files, memorandum dated c28 April 1950 (WAARCH0003536); Region 10 Superfund Technical Assessment and Response Team, "Grandview and Josephine Mines Removal Assessment Report," unpublished report dated November 2003.

[45] M.D. Corbin to Donald M. Ford, letter dated 29 September 1959 (DNR2-045403); Ford to Paul McCann, letter dated 15 February 1967 (DNR2-045398-399). Documents available in this case include a compilation (DNR2-045398-599) of Proof of Labor forms, smelter settlements, correspondence, and other documents related to the royalties Pend Oreille Mines & Metals paid the State of Washington in the 1940s and the work it did in the 1950s to keep its lease contracts with the State of Washington valid.

Metals extracted from lands leased from the State of Washington in the 1940s were treated at the company's Josephine mill #2. Pend Oreille Mines & Metals discharged tailings from that mill into Flume Creek, which carried the tailings into the Pend Oreille River.

In addition to tailings discharged from the Josephine mills into tributaries of the Columbia River, Pend Oreille Mines & Metals (and its predecessors) extracted waste rock and low-grade materials which were piled near the mine and which may have released contaminants to the environment, resulting in either a release or a threatened release of hazardous substances, such as zinc or lead.

Pend Oreille Mill

With the first unit of the new east-side mill operating in 1951, Pend Oreille Mines & Metals production jumped, and 273,580 tons of ore were treated in the Josephine mill and the first unit of the east-side mill. This increase was accomplished in spite of reports that labor shortages still curtailed mining and development by Pend Oreille Mines & Metals. The Josephine mill also treated ore delivered by the Sullivan Mining Company from the Metaline Contact mine in 1951. The west-side mill operated only briefly in 1952 before closing permanently. Meanwhile, the second unit of the east-side mill went into operation in August 1952, the volume of ore treated increased to more than 300,000 tons that year, and it reached 500,000 tons for 1953. Increased production from the mine was facilitated in part by construction of a conveyor in an inclined shaft to the mine workings and the installation of a trackless mining system underground. Production remained high throughout the rest of 1950s, exceeding 700,000 tons in 1957 and 1960.[46]

Pend Oreille Mines & Metals continued its customary large output in the 1960s, milling 742,934 tons in 1961, and then dropping below 700,000 tons for the next several years, in part due to labor shortages again. A strike in 1967 caused production to drop to 292,628 tons. Pend Oreille Mines & Metals continued producing and milling ore until May 1977, when a strike halted production, but the mine's output never again achieved the levels 1950s and early 1960s. In March 1974, the shareholders of Pend Oreille Mines & Metals had agreed to merge with the Bunker Hill Company. Bunker Hill had first gained an interest in Pend Orielle Mines & Metals in 1948 by means of the purchase of 700,000 shares of Pend Oreille stock by the Sullivan Mining Company. Sullivan was owned jointly by Bunker Hill & Sullivan Mining & Concentrating Company and the

[46] *Minerals Yearbook, 1951* (Washington, DC: GPO, 1954), 1615-1616; *Minerals Yearbook, 1952* (Washington, DC: GPO, 1955), 963-964; *Minerals Yearbook, 1953* (Washington, DC: GPO, 1956), 1076-1077; *Minerals Yearbook, 1954* (Washington, DC: GPO, 1957), 1125; *Minerals Yearbook, 1955* (Washington, DC: GPO, 1958), 1159-1160; *Minerals Yearbook, 1956* (Washington, DC: GPO, 1958), 1225-1226; *Minerals Yearbook, 1957* (Washington, DC: GPO, 1959), 1181; *Minerals Yearbook, 1958* (Washington, DC: GPO, 1959), 1008; *Minerals Yearbook, 1959* (Washington, DC GPO, 1960), 1072; *Minerals Yearbook, 1960* (Washington, DC: GPO, 1961), 1099; N.H. Rayner, "Pend Oreille's Incline Conveyor Reduces Ore Hoisting Costs," *Engineering & Mining Journal* 153 (July 1952): 90-93; L.M. Kinney, "Trackless Mining at Pend Oreille," *Mining Congress Journal* 39 (November 1953): 28-29, 105; R.M. Gilbert and A.A. Bulen, "Ore Conveyors at the Pend Oreille Mines & Metals Co.," *Mining Congress Journal* 42 (October 1956): 34-36.

Hecla Mining Company. By the time of the merger in 1974, Bunker Hill was a wholly-owned subsidiary of Gulf Resources. Bunker Hill reopened the mine briefly in 1977 after reaching an agreement with striking workers, but in the light of depressed metals prices, Bunker Hill closed the Pend Oreille operation again later in the year.[47]

When the new east-side mill went into service in the early 1950s, tailings were discharged directly into the river. The Washington Pollution Control Commission began negotiations with Pend Oreille Mines & Metals as early as 1956 to have the company impound its tailings, but that did not happen until 1968. During the intervening years, officials with the State of Washington tried to help the company find the most economical alternative to disposing of tailings into the river, and officials with the company insisted that the alternatives, whether impounding the solids or using the solids for back-fill in the mine, were not practicable given the nature of the stopes in the mine and the costs of conveying tailings to potential impoundment areas.[48] In the early 1960s, the Pollution Control Commission issued Pend Oreille Mines & Metals temporary permits for discharging tailings into the Pend Oreille River, and in 1963 the company's manager requested that the state make the permit permanent for five years, asserting that discharging tailings into the river was "the only method compatible with continued mining." [49] The Pollution Control Commission continued to issue the company temporary permits.[50]

In the wake of the Federal Water Quality Act of 1965, the State of Washington took steps to

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[47] *Minerals Yearbook, 1961* (Washington, DC: GPO, 1962), 1108; *Minerals Yearbook, 1962* (Washington, DC: GPO, 1963), 1136; *Minerals Yearbook, 1963* (Washington, DC: GPO, 1964), 1161; *Minerals Yearbook, 1964* (Washington, DC: GPO, 1965), 1079; *Minerals Yearbook, 1965* (Washington, DC: GPO, 1967), 868; *Minerals Yearbook, 1966* (Washington, DC: GPO, 1967), 833; *Minerals Yearbook, 1967* (Washington, DC: GPO, 1968), 841; *Minerals Yearbook, 1973* (Washington, DC: GPO, 1976), 746; *Minerals Yearbook, 1974* (Washington, DC: GPO, 1977), 755; *Minerals Yearbook, 1977* (Washington, DC: GPO, 1981), 629; Kinney, "Pend Oreille History," 35, 39, 79.

[48] John E. Hogan to Alfred T. Neale and George H. Hansen, memorandum dated 15 May 1956 (WAARCH 0003350-531; E.W. Asselstine to L.M. Kinney, letter dated 15 August 1962 (WAARCH3507-508); Alfred T. Neale to Marshall T. Huntting, letter dated 19 July 1962 (WAARCH0003512); excerpt from Pend Oreille Mines & Metals Company, "Measures Available for Waste Treatment and Evaluation of Their Use, Feasibility, and Economics," unpublished report dated 17 July 1962 (WAARCH0003515-516); Pend Oreille Mines & Metals Company to Roy M. Harris, letter dated 20 January 1965 (WAARCH0003483).

[49] L.M. Kinney to Wallace W. Bergerson, letter dated 19 April 1963 (WAARCH0003497). See also State of Washington Pollution Control Commission Permit T 424 issued to Pend Oreille Mines & Metals Company dated 14 August 1961.

[50] State of Washington Pollution Control Commission Permit T 493 issued to Pend Oreille Mines & Metals Company dated 9 March 1965; Tom Haggarty to files, memorandum dated 13 November 1967; Harris to Pend Oreille Mines & Metals Company, letter dated 19 March 1968. These documents are from a large group, WAARCH-10-09-09-000395-645.

end Pend Oreille Mines & Metals' discharge of tailings to the river. In late 1966, the Pollution Control Commission instructed the company to submit a proposal for a tailings treatment method which would meet the new requirements. The company's new president pleaded that the slim margins of Pend Oreilles' low-grade mining operation could not sustain the added costs of keeping tailings from the river, but the company complied rather than shutting down. It proposed to develop a tailings impoundment about 2200 feet northeast of the mill. The bench where the impoundment was to be located was at an elevation about 110 feet higher than the tailrace of the mill, so tailings would be pumped there by means of an eight-inch pipe. In anticipation that the company would build its tailings-disposal system, the Pollution Control Commission issued another temporary permit, due to expire in October 1968, to discharge tailings to the river. The company started pumping tailings to its new tailings impoundment on October 8th. During the first year of tailings impoundment, Pend Oreille Mines & Metals had problems with its new system: the impoundment berm sometimes leaked or was breached, and the effluent flowing from the impoundment to the river was sometimes not clear enough to meet State requirements. In 1974, the company abandoned its original tailings impoundment area and established a new one about 1500 feet farther to the northeast. This second impoundment also experienced problems and suffered a breach in February 1975. Pend Oreille Mines & Metals then constructed a third tailings impoundment in a natural basin covering 120 acres; this impoundment lasted until the mill's closure in 1977.[51]

In addition to tailings discharged into tributaries of the Columbia River, Pend Oreille Mines & Metals extracted waste rock and low-grade materials which were piled near the mine and which may have released contaminants to the environment, resulting in either a release or a threatened release of hazardous substances, such as zinc or lead.

Grandview Mill

The Grandview mine is located on the east side of the Pend Oreille River near Metaline Falls. It produced small amounts of ore in the 1920s, being operated in succession by J. McGinn, Grandview Mining Company, Grandview Lead Company, and Grandview Mines, Inc. The mine closed, however, during the Great Depression of the 1930s and did not achieve sustained production until it was leased and put into production by American Zinc, Lead, and Smelting Company in about 1940. The narrative below describes each of the Grandview's periods of operation in turn.

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[51] State of Washington Pollution Control Commission Permit T 2929 issued to Pend Oreille Mines & Metals Company dated 19 Febraury 1968; Tom Haggarty to files, memoranda dated 13 November 1967 and 26 September 1968; Wray D. Farmin to Haggarty, letters dated 28 December 1967 and 16 January 1968; Haggarty to Gene Asselstine, memorandum dated 1 February 1968; Harris to Pend Oreille Mines & Metals Company, letters dated 19 Feburary 1968 and 19 March 1968; Farmin to Harris, letter dated 30 April 1968; Howard Bunten to files, memoranda dated 15 July, 30 October, and 12 November 1969, and 16 January and 15 May 1970, and 29 March 1972; Robert Townsend to Rhys Sterling, letter dated 3 June 1974; "Existing Outfall Discharge," map dated 25 June 1971 and revised 31 May 1974. These documents are from a large group, WAARCH-10-09-09-000395-645. See also: L.M. Kinney, "Pend Oreille History," unpublished report dated c1977, p 76 (Teck0060883); Hallam Knight Piesold Ltd, "Environmental and Permitting Evaluation of the Pend Oreille Property," unpublished report dated July 1992, pp 16-17 (TS001314).

The Grandview mine near Metaline Falls began producing in 1924, when J. McGinn shipped about 217 tons of lead ore directly to the Bunker Hill & Sullivan smelter in Idaho. The following year, the Grandview, now being operated by the Grandview Mining Company, was the largest producer in the Metaline mining district, shipping 547 tons of ore. Grandview Mining Company built a concentrator at the mine in 1925. With a capacity to treat 50 tons of ore daily, the new mill saw limited operation in 1925 and 1926, when it produced but one carload of concentrates. Grandview Mines, Inc., acquired the Z-Canyon Lead-Zinc Company in 1928, the same year it built a new flotation mill with capacity of 200 tons/day. The mill went into operation in March 1929 and that year treated about 50,000 tons of ore, yielding mostly zinc. The concentrates were shipped to the Bunker Hill smelter in Idaho. Grandview Mines closed its mine and mill in January 1930. American Zinc, Lead, & Smelting Company acquired of the operations and property of Grandview Mines, Inc., in 1936. American Zinc would operate the Grandview operations under a profit-sharing arrangement. In 1937, American Zinc acquired a 51% interest in Metaline Mining & Leasing Company, which also owned mining property in the vicinity of Metaline Falls.[52]

The Grandview flotation mill resumed operations again in October 1937, when Metaline Mining & Leasing reconditioned it. The new capacity was 300 tons/day. Metaline Mining & Leasing treated about 7,500 tons of zinc-lead ore at the Grandview mill in 1937 and about 35,000 tons in 1938. After milling nearly 18,000 tons of ore in early 1939, Metaline Mining & Leasing suspended operations in March. American Zinc resumed operations of the Grandview mill in August 1940, treating ore from Metaline Mining & Leasing's property. Then in September 1940, the Grandview mine resumed operations, sending its ore as well to the Grandview mill. By that time, the Grandview concentrator had been enlarged to a capacity of 500 tons/day. American Zinc again increased the mill's capacity (to 600 tons/day) in 1942. In 1943, the Grandview mill treated nearly 82,000 tons of ore from the Grandview mine and about 46,000 tons of ore from the Metaline Mining & Leasing property, producing nearly 12,000 tons of zinc and lead concentrates. Output from both mines increased again in 1944, as did the volume of zinc and lead concentrates produced by the mill. At the end of 1944, American Zinc relinquished all of its interest in the Metaline Mining & Leasing Company, but American Zinc continued thereafter to treat Metaline Mining &

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[52] USBOM, *Mineral Resources of the United States, 1924* (Washington, DC: GPO, 1927), 293; *Mineral Resources of the United States, 1925* (Washington, DC: GPO, 1928), 559; *Mineral Resources of the United States, 1926* (Washington, DC: GPO, 1929), 468; *Mineral Resources of the United States, 1927* (Washington, DC: GPO, 1930), 591; *Mineral Resources of the United States, 1928* (Washington, DC: GPO, 1931), 700; *Mineral Resources of the United States, 1929* (Washington, DC: GPO, 1932), 426-427; *Mineral Resources of the United States, 1930* (Washington, DC: GPO, 1933), 673; USBOM, Permanent Individual Mine Record forms for the Grandview mine (Plaintiff-00043832); H.L. Gage, "Some Foreign and Domestic Zinc-Lead Mines That Could Supply Zinc Concentrates to a Pacific Northwest Electrolytic Zinc Industry," preliminary report of the Market Development Section, Bonneville Power Administration, dated December 1941, 21, 25-26, 32; Frank B. Fulkerson and Gary A. Kingston, *Mine Production of Gold, Silver, Copper, Lead, and Zinc in Pend Oreille and Stevens Counties, Wash., 1902-1956*, U.S. Bureau of Mines Information Circular 7872 (Washington, DC: U.S. Department of the Interior, 1958), 8-9, 21.

Leasing ores at its Grandview mill. Output from the American Zinc's Grandview mine declined slightly in 1945 to about 93,000 tons, and output from Metaline Mining & Leasing's mine decreased to about 36,000. Ores from both mines continued to be concentrated at the Grandview mill.[53]

Despite the end of World War II, production of the Grandview mine continue strong in 1946, dropping about six percent because of a two-month labor strike during the summer. The same strike reduced Metaline Mining & Leasing's output in 1946 by about eight percent compared to 1945. Production at the Grandview mine jumped by 68% in 1947. Meanwhile, Metaline Mining & Leasing conducted only development work in 1947 and 1948, so its ore production dropped considerably from 1946. American Zinc operated the Grandview mine for only the first half of 1948 due to another strike, and output dropped accordingly. The strike was not settled until the end of September 1949. Production for the remainder of the year was about 52,000 tons. Metaline Mining & Leasing also resumed production then, producing about 5,000 tons of ore before the end of the year. The Grandview mill treated ores from both operations. The mill, now with a capacity of 700 tons/day, treated 230,000 tons of ore from the Grandview mine in 1950, but Metaline Mining & Leasing had no output.[54]

Output from the Grandview mine and mill continued strong into the 1950s. The mill's capacity was 750 tons/day in 1951, when it and the Grandview mine operated at full capacity throughout the year, except for a brief period when a strike suspended operations. That same year, American Zinc began to develop an open-pit mine at its Lead Hill property and shipped a small volume of ore fifteen miles by truck to the Grandview mill. American Zinc continued to operate the Grandview mine and mill at capacity until September 1953, when production was curtailed to permit the development of a new inclined shaft. Nevertheless, output from the Grandview mine for 1953 (234,250 tons) was nearly identical to what it had been in 1950, 1951, and 1952. A strike in the second half of 1954 limited production that year to about half of what it had been the previous four years. Output from the Grandview mine in 1955 and 1956 returned to near pre-strike levels, about 200,000 tons each year. Despite a deteriorating market for zinc and lead, American Zinc continued to operate the Grandview property at capacity in 1957, the year American Zinc negotiated an agreement to purchase the property from Grandview Mines, Inc. Production from the Grandview mine in 1957, 1958, and 1959 was about 230,000 tons/year. In 1960, production of ore from the Grandview mine continued, but American Zinc began extracting ore as well from an adjoining

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[53] *Minerals Yearbook, 1938* (Washington, DC: GPO, 1938), 459; *Minerals Yearbook, 1939* (Washington, DC: GPO, 1939), 491; *Minerals Yearbook, 1940* (Washington, DC: GPO, 1940), 479; *Minerals Yearbook Review of 1940* (Washington, DC: GPO, 1941), 474; *Minerals Yearbook, 1941* (Washington, DC: GPO, 1943), 486-487; *Minerals Yearbook, 1942* (Washington, DC: GPO, 1943), 514; *Minerals Yearbook, 1943* (Washington, DC: GPO, 1945), 493-494; *Minerals Yearbook, 1944* (Washington, DC: GPO, 1946), 472-473; *Minerals Yearbook, 1945* (Washington, DC: GPO, 1947), 488; Gage, "Some Foreign and Domestic Zinc-Lead Mines," 28.

[54] *Minerals Yearbook, 1946* (Washington, DC: GPO, 1948), 1558; *Minerals Yearbook, 1947* (Washington, DC: GPO, 1949), 1533-534; *Minerals Yearbook, 1948* (Washington, DC: GPO, 1950), 1625; *Minerals Yearbook, 1949* (Washington, DC: GPO, 1951), 1598; *Minerals Yearbook, 1950* (Washington, DC: GPO, 1953), 1612.

property called the Mineral Right.[55]

In the early 1960s, the State of Washington was issuing one-year permits for the Grandview mill's tailings discharges while at the same time urging American Zinc to build a settling pond to remove fine solids before waste water discharged to the river. American Zinc's resident manager, in turn, asked for a five-year permit, suggesting that the cost incurred by impounding the tailings could threaten the jobs at the mill and that the present method of disposal did little more than aesthetic harm to the river.[56]

American Zinc produced ore from the Mineral Right property through 1964, achieving peak output in 1962 of about 149,000 tons. Production from the Grandview mine also declined across the same period, dropping to 162,000 in 1961, 60,000 tons in 1962, 57,000 tons in 1963, and 50,000 tons in 1964. In 1963, American Zinc reported to its stockholders that both production and reserves at the Grandview operation were in decline, as the property neared being worked out. The company therefore took an option on the Anderson mine, owned by Goldfield Consolidated Mining Company, in neighboring Stevens County. America Zinc put that property into production in the mid-1960s. It is described elsewhere. Meanwhile, American Zinc became a subsidiary of Consolidated Gold Field of South Africa, Ltd., in 1963. The Grandview mine and mill ceased operating in 1964. When the mill closed, the company was still receiving one-year permits to discharge tailings to the river and was still requesting a five-year permit.[57]

Two sources described the Grandview mill's tailings disposal practice in about 1950. Orlob and Saxton wrote that the mill used a flume to convey tailings to the Pend Oreille River, and the solids assayed at about 0.3% zinc and 0.1% lead. Hansen's description was about the

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[55] *Minerals Yearbook, 1951* (Washington, DC: GPO, 1954), 1615; *Minerals Yearbook, 1952* (Washington, DC: GPO, 1955), 964; *Minerals Yearbook, 1953* (Washington, DC: GPO, 1956), 1077; *Minerals Yearbook, 1954* (Washington, DC: GPO, 1957), 1125; *Minerals Yearbook, 1955* (Washington, DC: GPO, 1958), 1160; *Minerals Yearbook, 1956* (Washington, DC: GPO, 1958), 1225; *Minerals Yearbook, 1957* (Washington, DC: GPO, 1959), 1181; *Minerals Yearbook, 1958* (Washington, DC: GPO, 1959), 1008; *Minerals Yearbook, 1959* (Washington, DC GPO, 1960), 1072; *Minerals Yearbook, 1960* (Washington, DC: GPO, 1961), 1099; USBOM, Permanent Individual Mine Record forms for the Grandview mine (Plaintiff-00043822, 43824); Fulkerson and Kingston, *Mine Production of Gold, Silver, Copper, Lead, and Zinc in Pend Oreille and Stevens Counties, Wash., 1902-1956*, 22.

[56] Washington Pollution Control Commission, Waste Discharge Permit issued to American Zinc and dated 9 August 1961 (WAARC0000573); E.W. Asselstine to John W. Currie, letter dated 15 August 1962 (WAARC0003310); Currie to Alfred T. Neale, letter dated 6 December 1962 (WAARC0000582).

[57] *Minerals Yearbook, 1962* (Washington, DC: GPO, 1963), 1136; *Minerals Yearbook, 1963* (Washington, DC: GPO, 1964), 1162; USBOM, Permanent Individual Mine Record forms for the Grandview and Mineral Right mines (Plaintiff-00043822, 43894); W.M. Calhoun to Asselstine, letter dated 17 June 1964 (WAARC0000566).

same. Both reports noted that there was a small flat area between mill and river, but neither indicated that the area was being used to store tailings. A 2003 START report indicated that mill tailings "were discharged to a drainage ditch that discharges to a canyon south of the upper mine/mill area." The report further noted that "the size of the tailings deposit remaining at the site is inconsistent with the reported amount of ore produced at the mine. Therefore it is believed that much of the tailings generated at the mine over the course of its operation were washed over Riverside Bluff into the Pend Oreille River."[58]

In addition to tailings discharged from the Grandview mill into tributaries of the Columbia River, American Zinc extracted waste rock and low-grade materials which were piled near the mine and which may have released contaminants to the environment, resulting in either a release or a threatened release of hazardous substances, such as zinc or lead.

b. Newport Mining District

The Newport mining district was a relatively small producer in Pend Oreille County. One of the mines in the district was the Eagle (Ries) mine. The owner produced some ore from land leased from the State of Washington. His operation is therefore described in my September 2010 expert report. He did not operate a mill at the mine.

2. Stevens County

Stevens County was one of the state's leading mineral producers in the twentieth century. The county had several mining districts, some of which were quite productive, especially the Northport district.

a. Northport (Aladdin) Mining District

The Northport mining district was by far the most productive district in Stevens County. In addition, it was the only district in northeast Washington where a smelter (Northport, described above) succeeded in operating more than briefly. Thus, the Northport district is the one district covered in this report which directly produced significant volumes of slag discharges to the environment, in addition to the other mining and metallurgical wastes discharged to the environment. Sections below describe the Northport major mills: Sierra Zinc, Last Chance, Admiral Consolidated, Anderson-Calhoun, and Van Stone mills.

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[58] Gerald T. Orlob and Walter W. Saxton, "A Preliminary Survey of the Sources of Mining and Mill Waste Pollution in the Upper Columbia River Basin and Lake Roosevelt," unpublished report prepared for the Washington Pollution Control Commission and dated c 1950, pp 9-10 (TECK0025234-235); D.L. Hansen to files, memorandum dated 28 August 1950 (WAARCH0003340); Region 10 START-2, "Grandview Mine Preliminary Assessment/Site Inspection Metaline Falls, Washington" unpublished report dated June 2001, pp 1-2 (1173351; CTRL082335).

Sierra Zinc Mill

The Sierra Zinc mill is located near the intersection of sections 19, 20, 29, and 30, T38N, R41E near Deep Creek in Stevens County. A large tailings deposit is located to the north of the concentrator. The concentrator went by several names over the years, including the Goldfield Consolidated mill, the Blue Ridge mill, and the Deep Creek mill.

The Sierra Zinc Company built the concentrator in 1941 as a flotation mill with a capacity to treat 50 tons of ore daily. The company started producing ore from its Blue Ridge mine late in the same year, sending about 2,000 tons of ore to the mill. The following year, the company acquired some adjoining land in order to install a tailings pond. The mill operated most of 1942, being closed for only short periods in winter months, and treated about 12,000 tons of zinc-lead ore from the Blue Ridge mine. In 1943, Sierra Zinc sent about 19,000 tons of ore from the Blue Ridge mine to the mill, capacity of which had been increased to 90 tons/day. Sierra Zinc's mill treated about 23,000 tons of ore from the Blue Ridge mine in 1944 and another 8,000 tons of zinc ore from the Deep Creek mine, owned by the Jamison-Higginbotham Mining Company. This was the last year of production from the Blue Ridge mine. In 1945, Sierra Zinc's mill (now called the Blue Ridge mill in *Minerals Yearbook*) treated about 29,000 tons of ore from the Deep Creek mine.[59]

Sierra Zinc's Blue Ridge mill continued operating after World War II, treating nearly 40,000 tons of Jamison-Higginbotham ore from the Deep Creek mine in 1946. Goldfield Consolidated Mines Company acquired the Deep Creek mine from Jamison-Higginbotham in 1947. Total production from the mine that year was about 49,000 tons, treated again at the Sierra Zinc mill. In 1948, Goldfield Consolidated produced about 50,000 tons of lead-zinc ore from the Deep Creek mine and treated it at a concentrator the *Minerals Yearbook* called the Deep Creek flotation mill of Goldfield Consolidated. The mill was now said to have a capacity of 260 tons/day. The following year, the Deep Creek mill treated 45,000 tons of ore from Goldfield Consolidated's Deep Creek mine. And in 1950, the mill treated about 47,000 tons of ore from Goldfield Consolidated's mines, which now included both the Deep Creek and the Anderson mines.[60]

According to the *Minerals Yearbook*, Goldfield Consolidated's 1951 output from its Deep Creek mine increased four-fold over 1950, while Goldfield Consolidated's overall production increased to about 104,000 tons, all of it treated at the Sierra Zinc mill. The mill now had a capacity

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[59] USBOM, *Minerals Yearbook, 1941* (Washington, DC: GPO, 1943), 487; *Minerals Yearbook, 1942* (Washington, DC: GPO, 1943), 515; *Minerals Yearbook, 1943* (Washington, DC: GPO, 1945), 494; *Minerals Yearbook, 1944* (Washington, DC: GPO, 1946), 473-474; *Minerals Yearbook, 1945* (Washington, DC: GPO, 1947), 489; USBOM, Permanent Individual Mine Record forms for the Blue Ridge and Deep Creek mines (Plaintiff-00043988, 44072).

[60] *Minerals Yearbook, 1946* (Washington, DC: GPO, 1948), 1558; *Minerals Yearbook, 1947* (Washington, DC: GPO, 1949), 1534; *Minerals Yearbook, 1948* (Washington, DC: GPO, 1950), 1625; *Minerals Yearbook, 1949* (Washington, DC: GPO, 1951), 1598; *Minerals Yearbook, 1950* (Washington, DC: GPO, 1953), 1613; USBOM, Permanent Individual Mine Record forms for the Deep Creek mine (Plaintiff-00044072).

of 300 tons/day. Goldfield Consolidated continued operating the Deep Creek mine and mill in 1952 and 1953, closing the operation in mid-October 1953. The company reopened the mine and mill at reduced rates of production in May 1954, after lead and zinc prices had improved. Operations in the Deep Creek mine were intermittent in 1955, due in part to a September fire in the inclined shaft. In 1955, *Minerals Yearbook* was once again stating the mill that was treating Deep Creek ore was owned by the Sierra Zinc Company. Goldfield Consolidated closed its operation in 1956 due to the poor market for zinc.[61]

Other than the mention of the land acquired in 1942 for tailings disposal, there is little mention in the historical record of tailings at the Sierra Zinc mill. A photograph of the tailings deposit appeared in a November 1950 Spokane newspaper. Although the newspaper photo is grainy, the tailings in the photo appear much as they do at present. About a decade after the mill closed, an official from the Washington Pollution Control Commission visited the site and noted in a memorandum that that the dikes surrounding the tailings dump appeared to be satisfactory to contain them. In 2002, the Superfund Technical Assessment and Response Team (START) examined the tailings pile and noted that drainage from the tailings pile flowed into a drainage ditch. This ditch flowed a short distance to the South Fork of Deep Creek, which then joined the main branch of the creek a few miles downstream.[62]

Although the Sierra Zinc mill was rehabilitated in 1974 with the intent to treat ore from the nearby Schumaker mine, it appears that the mill never actually operated again after 1956.[63]

In addition to tailings discharged from the Sierra mill into the watershed of the Columbia River, Goldfield Consolidated extracted waste rock and low-grade materials which were piled near the mine and which may have released contaminants to the environment, resulting in either a release

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[61] *Minerals Yearbook, 1951* (Washington, DC: GPO, 1954), 1616; *Minerals Yearbook, 1952* (Washington, DC: GPO, 1955), 966-967; *Minerals Yearbook, 1953* (Washington, DC: GPO, 1956), 1081; *Minerals Yearbook, 1954* (Washington, DC: GPO, 1957), 1129; *Minerals Yearbook, 1955* (Washington, DC: GPO, 1958), 1165; *Minerals Yearbook, 1956* (Washington, DC: GPO, 1958), 1230; Frank B. Fulkerson and Gary A. Kingston, *Mine Production of Gold, Silver, Copper, Lead, and Zinc*, USBOM Information Circular No. 7872 (Washington, DC: Government Printing Office, 1958), 36; USBOM, Permanent Individual Mine Record forms for the Deep Creek mine (Plaintiff-00044070).

[62] "Tailings Pond," photo in *Spokane Daily Chronicle*, (22 November 1950): 15; Asselstine to file, memorandum dated 20 April 1965 (WAECY-HQ-10-07-09-000995); Region 10 Superfund Technical Assessment and Response Team 2, "Preliminary Assessments and Site Inspections Report Upper Columbia River Mines and Mills" (October 2002), 7-15 (CCT1-011479); Wolff, McKay, and Norman, "Inactive and Abandoned Mine Lands – Sierra Zinc Mine, Chewelah Mining District, Stevens County, Washington," Washington Division of Geology and Earth Resources (October 2003), 4 (Plaintiff-00053049). The comment on the appearance of the tailings is based on my visit to the site during the summer of 2010.

[63] *Minerals Yearbook, 1974* (Washington, DC: GPO, 1977), 755.

or a threatened release of hazardous substances, such as zinc or lead.

Last Chance Mill

The Last Chance mine is located in sections 24 and 25, T39N, R40E, of the Northport mining district in Stevens County, Washington. The mine is on a steep west-facing slope overlooking Deep Creek, about 5 miles southeast of Northport. The Last Chance mill was located near the base of the hill, west of the mine along a small drainage flowing down into Deep Creek, a tributary of the Columbia River.[64]

When the Last Chance mine went into production in 1903, it was operated by C.C. Knudsen. He was able to sell about 800 tons of lead ore. He sold the mine to the Picher Lead Company of Joplin, Missouri, which in 1904 had it operated by the Jupiter Lead Company of Spokane, Washington. For the next several years, through 1911, Jupiter shipped a few hundred tons of its lead ore to the Picher lead works in Joplin each year. There was no production during the period 1912-1916. With the reopening of the Northport smelter as a lead smelter in 1917, Jupiter and others continued to operate the Last Chance mine intermittently, sending very small lots of ore to the Northport smelter and later the Bunker Hill smelter in Kellogg, Idaho. After a shipment of fifteen tons of lead ore to the Bunker Hill smelter in 1926 (by which time Jupiter Lead Company owned the mine), the Last Chance sat idle until 1938. In 1938 and 1939, the mine sent less than fifty tons of lead ore total to the Bunker Hill smelter. The mine then sat idle through the end of World War II.[65]

In 1940, sources report that the Jupiter Lead Company built a 25-ton flotation mill near the Last Chance mine and operating it on a 24-hour basis. If that was the case, the U.S. Bureau of Mines was unaware of the production; the activity was not reported on the PIMR forms for the Last Chance mine, nor was it reported in *Minerals Yearbook* for that year. The *Minerals Yearbook* and the PIMR forms do, however, show milling commencing in 1947. The Last Chance Consolidated Mines, Inc., built a gravity concentrator that year and planned to add a flotation circuit in 1948. The company treated about 800 tons of zinc-lead ore in its flotation mill in 1948 and about 850 tons in 1949, but it was never able to become a significant producer. The Last Chance company milled about 80 tons of zinc-lead or in 1950 and about 50 tons in 1954.[66]

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[64] Bishop Mines Ltd, Map of Last Chance Property dated September 1980 (WADNR-HQ-10-08-09-014885).

[65] USBOM, Permanent Individual Mine Record forms for the Last Chance mine (Plaintiff-00044225-228).

[66] H.L. Gage, "Some Foreign and Domestic Zinc-Lead Mines That Could Supply Zinc Concentrates to a Pacific Northwest Electrolytic Zinc Industry," unpublished report prepared by the Bonneville Power Administration and dated December 1941, pp 88-90 (HAI0007215-217); *Minerals Yearbook Review of 1940* (Washington, DC: GPO, 1941): 475; *Minerals Yearbook 1947* (Washington, DC: GPO, 1949): 1534; *Minerals Yearbook 1948* (Washington, DC: GPO, 1950): 1626; *Minerals Yearbook 1949* (Washington, DC: GPO, 1951): 1599; *Minerals Yearbook 1950* (Washington, DC: GPO, 1953): 1613; *Minerals Yearbook 1954* (Washington, DC: GPO, 1957): 1130; USBOM, Permanent Individual Mine Record forms for the Last Chance mine (Plaintiff-

A 1950 environmental survey reported that drainage for the Last Chance mill was "to the Columbia river." A 2000 START report noted that evidence existed that tailings and waste rock were disposed of in or near an unnamed creek approximately ten yards from the mill. Additionally, remnants of tailings still existed at the site. [67]

In addition to tailings discharged from the Last Chance mill into the Columbia River watershed, operators of the Last Chance mine extracted waste rock and low-grade materials which were piled near the mine and which may have released contaminants to the environment, resulting in either a release or a threatened release of hazardous substances, such as zinc or lead.

Van Stone Mill

The Van Stone mine, which was an open-pit operation, is located in sections 28 and 33, T38N, R40E, of Stevens County, Washington, at the head of Onion Creek, which flows north into the Columbia River near Northport. The Van Stone mine and mill were developed by American Smelting & Refining Company (Asarco) into a large operation, but the property was operated only intermittently.

After acquiring the property in 1950, Asarco began production at the Van Stone mine in 1952. To expose the ore body, Asarco excavated 750,000 tons of mine waste and overburden. The new flotation mill had a capacity to treat 1,000 tons of ore daily, and the mill was operating at capacity by the end of 1952. Output from the mine reached 30,000 tons per month in March 1953. Asarco maintained that level of production during the years 1954-56. For 1954, *Minerals Yearbook* reported that the Van Stone mining operation entailed setting aside about 30,000 tons of mine waste and overburden each month, in addition to the excavation of that volume of ore each month. For 1956, *Minerals Yearbook* reported that the Van Stone mining operation was handing about 2,000 tons of waste daily, in addition to the ore it was mining. These figures are good indications of the volume of material which the mining operation was conveying from the mine to the surrounding

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00044223-226).

[67] Gerald T. Orlob and Walter W. Saxton, "A Preliminary Survey of the Sources of Mining and Mill Waste Pollution in the Upper Columbia River Basin and Lake Roosevelt," Washington Pollution Control Commission (1950), 9 (TECK 0025219); Region 10 Superfund Technical Assessment and Response Team-2, "Last Chance Mine Preliminary Assessment Report, Stevens County, Washington" unpublished report dated July 2000, pp2-1 to 2-3 (Plaintiff-00008467); Region 10 START-2, "Preliminary Assessments and Site Inspections Report, Upper Columbia River Mines and Mills, Stevens County, Washington" unpublished report dated October 2002, pp 6-101 to 6-103, 6-163 (CCT1-011479).

environment in addition to the ore it was mining and milling. Asarco suspended operations at the Van Stone mine and mill in 1957 due to the condition of the metals market.[68]

Asarco had developed a series of tailings impoundments some distance from the mill. The upper pond was about ¾ mile from the mill. Despite being a relatively modern operation, the tailings disposal system for the Van Stone mill encountered problems during its first decade. Shortly after the mill went into operation, there was a fish kill in Onion Creek downstream of the tailings, apparently caused by a release from the mill. Then in April 1961, the tailings impoundment failed, sending a large volume of slurry down Onion Creek causing damage both to the stream itself and to built structures along it. After the failure, Asarco discontinued use of the upper pond and sent its tailings to an 80-acre impoundment about two miles from the mill. Despite this closure, the upper tailings disposal area has continued to cause problems, including erosion of tailings during spring run-off and complaints of contamination of Onion Creek below the tailings. Since 2000, the State of Washington has continued to issue notices to the owner of the site to make corrections.[69]

Asarco reopened the Van Stone mine and mill in 1964. The mill treated about 187,000 tons of ore in 1964, and nearly 400,000 tons in both 1965 and 1966. Operations were again suspended on May 1, 1967. Asarco milled about 142,000 tons of ore that year. Asarco shipped its lead concentrates to its East Helena lead smelter and the zinc concentrates to The Anaconda Company's zinc works in Great Falls. Asarco had one other brief period of production at the Van Stone mine, milling 261,000 tons in 1969 and 363,000 tons in 1970, before closing mine and mill in December. Callahan Mining Company bought the Van Stone mine in 1971 and conducted some development work, but the mine did not reopen.[70]

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[68] "American Smelting Rushes Work on Van Stone Mine," *Spokesman-Review* (October 1951, WAECY-HQ-10-07-09-001121); USBOM, *Minerals Yearbook, 1952* (Washington, DC: GPO, 1955), 967; *Minerals Yearbook, 1953* (Washington, DC: GPO, 1956), 1081; *Minerals Yearbook, 1954* (Washington, DC: GPO, 1957), 1129; *Minerals Yearbook, 1955* (Washington, DC: GPO, 1958), 1164-1165; *Minerals Yearbook, 1956* (Washington, DC: GPO, 1958), 1230; *Minerals Yearbook, 1957* (Washington, DC: GPO, 1959), 1184; "Van Stone: American Smelting's Newest Zinc Operation," *Mining World* (April 1953): 26.

[69] Fritz E. Wolff, Donald T. McKay, and David K. Norman, "Inactive and Abandoned Mine Lands – Van Stone Mine, Northport Mining District, Stevens County, Washington," 9 (Plaintiff-00053586); Mill to Start Operating Soon," *Spokesman-Review* (10 August 1952), 2 (WADNR-HQ-10-08-09-021833); John West and M. R. Lickes, inspection report of Van Stone dated 3 April 1957 (00008648); Paul Lovejoy to Lloyd J. Neil, November 24, 1952 (WAARCH 0000684); Don Earnest to Clarence P. Pautzke, letter dated 7 December 1952 (WAARCH 0000685); Walter Saxton to file, memorandum dated 27 February 1953 (WAARCH0003458) "Mine Tailings Dam Breaks, Onion Cr. Damage Heavy," *Statesman Examiner* 26 April 1961 (WADNR-HQ-10-08-09-001106); Randy Miller to Dave Coleman, letter dated 27 November 2000 (WAECY-ERO-10-05-09-013083); HAI, "Van Stone Mill Site Report," unpublished report prepared for this case and dated 29 September 2010.

[70] *Minerals Yearbook, 1964* (Washington, DC: GPO, 1965), 1080; *Minerals Yearbook, 1965* (Washington, DC: GPO, 1967), 869; *Minerals Yearbook, 1966* (Washington, DC: GPO, 1967), 833;

Equinox Resources, Ltd, purchased the Van Stone property from Callahan Mining in 1990 and reopened the mine and mill in March 1991, shipping concentrates by truck to the Cominco zinc smelter at Trail. Although Equinox operated the mill at its 1,100-ton/day capacity for a period, it ceased operating in October 1991 because of low prices. Equinox reopened the mine and mill in August 1992, again shipping concentrates to Trail. After a few months of operation, mine and mill closed in January 1993. Zicor Mining Ltd purchased the property in 1995. After the mine closed in 1993, Equinox and Zicor worked to improve the stability of the tailings impoundment, but neither company was able to activate the mine or mill again.[71]

Beginning in 1974 and continuing until recent years, multiple studies and assessments have noted the environmental effects of Van Stone tailings piles and failing impoundments on Onion Creek and other nearby creeks and the need for remedial action. [72] In addition to tailings discharged from the Van Stone mill into the Columbia River watershed, Asarco extracted waste rock and low-grade materials which were piled near the mine and which may have released contaminants to the environment, resulting in either a release or a threatened release of hazardous substances, such as zinc or lead.

Minerals Yearbook, 1967 (Washington, DC: GPO, 1968), 841; *Minerals Yearbook, 1969* (Washington, DC: GPO, 1971), 793; *Minerals Yearbook, 1970* (Washington, DC: GPO, 1972), 764; *Minerals Yearbook, 1971* (Washington, DC: GPO, 1973), 767; USBOM, Permanent Individual Mine Record forms for the Van Stone mine (Plaintiff-00044482, 44484).

[71] *Minerals Yearbook, 1991* (Washington, DC: GPO, 1991), 550; *Minerals Yearbook, 1992* (Washington, DC: GPO, 1992), 581-582; Robert E. Derkey, et al, "Washington's Mineral Industry – 1992," *Washington Geology* 21 (March 1993): 24 (Plaintiff-00046914); Robert E. Derkey, "The Metallic, Nonmetallic, and Industrial Mineral Industry of Washington in 1995," *Washington Geology* 24 (March 1996): 15 (Plaintiff-00047045).

[72] C. Daniel Kealy, Richard A. Busch, and Michael M. McDonald, "Seepage-Environmental Analysis of the Slime Zone of a Tailings Pond," U.S. Bureau of Mines Report of Investigations 7939, (1974), 24, Table A-3, 30 (TECK 0061188); "Potential Hazardous Waste Site Preliminary Assessment, Summary Memorandum: Callahan Mines," 9 November 1984 (WAECY-ERO-10-05-09-023815); Knight Piesold Ltd., "Van Stone Mine Tailings Dam Inspection," unpublished report dated 16 October 1995 (WADNR-HQ-10-08-09-001156); "Fact Sheet for State Waste Discharge Permit ST-5287, Facility Name: Equinox Resources Inc. (WA)," 14 December 1998, pp 3-4 (WADNR-HQ-10-08-09-001601); Washington State Department of Natural Resources to Equinox Resources (Wash.) Inc., "Reclamation Permit No. 70-012667, Van Stone Mine-Failure to Reclaim," 15 November 2000 (WAECY-ERO-10-05-09-013085; Region 10 Superfund Technical Assessment and Response Team-2, "Upper Columbia River Expanded Site Inspection, Mines and Mills, Northeast Washington Sampling and Quality Assurance Plan," report dated June 2001, pp 1-28 (1137450; CTRL094331); Region 10 START-2, "Preliminary Assessments and Site Inspections Report, Upper Columbia River Mines and Mills, Stevens County, Washington," report dated October 2002, pp 6-23, 6-25 (CCT1-011479); Fenggang Ma and John Blacklaw, "Periodic Inspection Report: Van Stone Tailings Dam," 18 January 2008, p 4 (WAECY-ERO-10-05-09-011673)..

Admiral Consolidated Mill

The Admiral Consolidated Mining Company's Admiral mine and mill were located along Hartbauer Creek north of Leadpoint in Stevens County. The mine went into production in 1947, the year the company built a flotation mill reported to have a capacity of 100 tons/day. The mine produced 687 tons of zinc ore, which also yielded gold, silver, copper, and lead values. In 1948, the Admiral mine produce 364 tons of ore, some of which was treated at the company's mill, now reported to have a capacity of 75 tons/day, and some of which was shipped to a concentrator in Utah. The mine and mill operated in 1949 until September, treating about 390 tons of ore and shipping 25 tons of zinc concentrate and one ton of lead concentrate. The Admiral Consolidated's output increased dramatically in 1950, when it operated about six months, mining and treating about 15,000 tons of ore and producing 252 tons of zinc concentrate. Production diminished considerably in 1951 and 1952.[73]

Admiral Consolidated apparently did not operate its property in 1953 or thereafter, but there is evidence of other parties leasing and operating the mine and/or mill. The Pacific Northwest Mining Company organized in 1952 to lease and explore the Lucille group of claims. The company then leased and operated the adjoining Red Top mine (in section 25, just north of the Admiral mine), and it leased the Admiral mill to treat Red Top ore, shipping concentrates bearing lead, zinc, and silver to the Bunker Hill smelter. In 1954, A.C. Nieman operated the Admiral mine and two nearby mines (Red Top and Lead Trust), treating ore from all three mines at the Admiral mill. Nieman continued to operate the Admiral mine and mill in 1955. In 1956 he treated ore from the Red Top mine at the Admiral mill. Bonanza Consolidated Mining Company took control of the Admiral mine in 1957 under a lease agreement in which it would share profits with Admiral Consolidated.[74] Admiral Consolidated leased the Admiral mine to American Zinc, Lead, and Smelting Company in the mid-1960s, but there is no evidence that American Zinc put the mine back into production.[75] A 1980 report by W.R. Green corroborates that there was no further production from the Admiral mine

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[73] *Minerals Yearbook, 1947* (Washington, DC: GPO, 1949), 1534; *Minerals Yearbook, 1948* (Washington, DC: GPO, 1950), 1625-1626; *Minerals Yearbook, 1949* (Washington, DC: GPO, 1951), 1598; *Minerals Yearbook, 1950* (Washington, DC: GPO, 1953), 1612-1613; *Minerals Yearbook, 1951* (Washington, DC: GPO, 1954), 1616; *Minerals Yearbook, 1952* (Washington, DC: GPO, 1955), 967; USBOM, Permanent Individual Mine Record forms for the Admiral mine (Plaintiff-00043938).

[74] Pacific Northwest Mining Company, Application to the Department of Licenses dated c1952 (WAARCH0000964-965); *Minerals Yearbook, 1952* (Washington, DC: GPO, 1955), 967; *Minerals Yearbook, 1953* (Washington, DC: GPO, 1956), 1081; *Minerals Yearbook, 1954* (Washington, DC: GPO, 1957), 1129; *Minerals Yearbook, 1955* (Washington, DC: GPO, 1958), 1165; *Minerals Yearbook, 1956* (Washington, DC: GPO, 1958), 1230; *Minerals Yearbook, 1957* (Washington, DC: GPO, 1959), 1184; USBOM, Permanent Individual Mine Record forms for the Admiral mine (Plaintiff-00043935-938).

[75] Marshall T. Huntting to H.A. Erickson, letter dated 29 June 1965 (Plaintiff-00011671).

after 1955.[76]

Admiral Consolidated's mine was located (according to Metsker) on the NE¼, SW¼ of section 36, T40N, R41E, which was school land owned by the State of Washington. John Colby entered a twenty-year lease with Washington's Commissioner of Public Lands in order to explore and mine on 40 acres at that location in September 1945. He assigned the contract to the Admiral Consolidated Mining Company in January 1946. The Commissioner of Public Lands' Mineral Lease Record shows that annual rents of $10.00 were paid from 1945 through 1964 and that intermittent monthly royalty payments were made from 1947 until 1955. Some monthly royalties were as little as about $40.00 (e.g. October 1947) and some were almost $500.00 (e.g. January 1951). Admiral Consolidated paid the State a total of about $5,350 in royalties. At 4% of sales, the royalties paid indicate that Admiral Consolidated earned a total of about $134,000 in smelter returns from the ore and concentrates it shipped to smelters.[77] The period of operation and the levels of production indicated by the royalty payments are consistent with the production reported in *Minerals Yearbook* and described above.

Ben Johnson took out a lease for the NW¼, SW¼ of section 36 in 1946 and assigned it to Admiral Consolidated, but the Mineral Lease Record for that lease shows that only rents were paid and that no royalties were paid. In 1948, Mary Perry Brown did likewise for the NW¼, NE¼ and the NE¼, NW¼ of section 36, Frank Funkhouser did likewise for the SW¼, NE¼ and the SE¼, NW¼ of section 36, Charles F. Hankinson did likewise for SE¼, SW¼ of section 36, and O.L. Hood did likewise for the W½ of NW¼ of section 36, but again there were no royalties paid against those leases.[78]

Admiral Consolidated Mining Company continued hoping to mine on State land in section 36 outside its original contract area which Colby assigned the company in 1946. The record shows evidence that the company paid the Commissioner of Public Lands annual fees to keep the mining contracts in force. These rents for were mining contracts which four individuals had entered with the State in about 1948 to conduct mining activities on lands in section 36 outside the "Colby" lease in the NE¼ of the SW¼ of section 36. After American Zinc began leasing the Admiral mine, it took over the rent payments to the state.[79] No subsequent royalties were paid from production from

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[76] W.R. Green, "Report on the Admiral Property," unpublished report dated 5 February 1980, pp 3-4 (43173-174).

[77] Office of the Commissioner of Public Lands, Mineral Lease Record for Mining Application No. 38301, Contract No. 320 dated 7 September 1945.

[78] Mineral Lease Record for Lease No. 3114, Contract No. 327 dated 6 February 1946; Mining Application No. 40124, Contract No. 343 dated 14 May 1948; Mining Application No. 40128, Contract No. 344 dated 14 May 1948; Mining Application No. 40129, Contract No. 348 dated 14 May 1948.

[79] Agreement between Atlantic Consolidated Mining Company and Mary Perry Brown, et al, dated 17 February 1964 (Plaintiff-00011286-288); set of invoices and receipts from the Commissioner of Public Lands exists for 1965 and 1966 (Plaintiff-00011620-626); Bert L. Ford to American Zinc, Lead and Smelting Company, letter dated 3 February 1966 (Plaintiff-00011395); Karl W. Jasper to

State lands associated with the Admiral mine.

Although little evidence exists in available sources regarding historical waste streams at the Admiral mill, waste discharge permits filed in 1956 and 1961 indicate its proximity to Hartbauer Creek. Additionally, a 1981 survey and later investigations noted a tailings dump near the old mill site.[80] In addition to tailings discharged into the watershed of the Columbia River, Admiral Consolidated extracted waste rock and low-grade materials which were piled near the mine and which may have released contaminants to the environment, resulting in either a release or a threatened release of hazardous substances, such as zinc or lead.

Anderson-Calhoun Mill

This property had a brief period of operation with minor production under the ownership of Goldfield Consolidated Mines Company in the early 1950s, when it was called the Anderson mine, and then had a brief period of operation with major production under ownership of American Zinc, Lead and Smelting Company in the mid-1960s, when it was called the Calhoun mine. Although the mine yielded significant output in the 1960s, it closed because of poor zinc prices. The mine has not operated since then, but the mill operated briefly in the early 1980s, treating ore from another mine. The U.S. Environmental Protection Agency implemented a time-critical removal action (certain drums and containers of hazardous substances) at the site in 2002, and in 2007 the EPA proposed a non-time-critical action to remove certain tailings and to consolidate and cap other tailings at the site. Since that time, the EPA has settled with potentially responsible parties, which have agreed to contribute toward response costs at the Anderson Calhoun mine.[81]

Goldfield Consolidated Mines Company owned two nearby mining properties in Stevens County in 1950, the Anderson open-pit mine in section 2, T39N, R41E, and the Deep Creek mine several miles to the west in R40E. *Minerals Yearbook* for 1950 reported that the company produced 49,980 tons of zinc ore from its Deep Creek and Anderson properties in 1950, treating it at a 260-ton mill. Most years, *Minerals Yearbook* only reported activity for Goldfield Consolidated at the Deep Creek mine. Other than the 1950 reference, *Minerals Yearbook* did not reference the Anderson mine again until 1953, when it reported that Goldfield Consolidated had closed it in June 1952. Yet the 1952 volume did not report any production from the Anderson mine. Fulkerson and Kingston also did not list any production for the Anderson mine, but Huntting did, reporting about 100,000 tons of ore having been mined from the Anderson mine during the period 1948-1952.[82]

Commissioner of Public Lands, letter dated 25 January 1966 (Plaintiff-00011606).

[80] Pollution Control Commission, Waste Discharge Permit date 24 May 1956 (WAECY-HQ-10-07-09-001230-231); Pollution Control Commission, Waste Discharge Permit dated 16 June 1961 (WAECY-HQ-10-07-09-001228-229); David S. Beck, "Geologic Report on the Admiral Mine Property," report dated 7 November 1981 (Plaintiff-00043152).

[81] Settlement Agreement between U.S. Environmental Protection Agency, Goldfield Corporation, and Combustion Engineering, Inc., and the Matter of the Anderson Calhoun Mine and Mill Site, dated 18 June 2009; *Federal Register* 75 (24 February 2010): 8346.

[82] *Minerals Yearbook, 1950* (Washington, DC: GPO, 1953), 1613; *Minerals Yearbook, 1951*

The American Zinc, Lead and Smelting Company purchased the Anderson property from Goldfield Consolidated in 1964, renaming it the Calhoun mine. American Zinc developed the property as an underground stope mine and built a large flotation mill with a capacity to treat about 1200 tons/day of zinc ore. The mill was completed in late 1966, and the property went into production in October of that year. The Calhoun mine and mill operated a full capacity throughout 1967. Mine and mill continued operating in 1968 until October, when American Zinc closed the property because of a poor zinc market. During its brief run, American Zinc treated about 875,000 tons of zinc ore at it mill. It discharged its tailings to a 40-acre impoundment adjacent to the mill and about a tenth of a mile from the North Fork of Deep Creek.[83]

In addition to tailings discharged into the Columbia River's watershed, Goldfield Consolidated and American Zinc extracted waste rock and low-grade materials from the Anderson and Calhoun mining operations which were piled near the mine and which may have released contaminants to the environment, resulting in either a release or a threatened release of hazardous substances, such as zinc or lead.

b. Chewelah Mining District

According to Fulkerson and Kingston, the Chewelah district was the second largest producer in Stevens County in terms of ore mined by the mid-1950s. The United Copper mine accounted for more than 90% of the ore mined in the Chewelah district during that period.

United Copper Mill

The United Copper mine is located in sections 31 and 32, T33N, R41E of Stevens County, Washington. It is in the Chewelah mining district about three miles northeast of the town of

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(Washington, DC: GPO, 1954), 1616; *Minerals Yearbook, 1952* (Washington, DC: GPO, 1955), 966-967; *Minerals Yearbook, 1953* (Washington, DC: GPO, 1956), 1076-1077; Fulkerson and Kingston, *Mine Production of Gold, Silver, Copper, Lead, and Zinc in Pend Oreille and Stevens Counties, Wash., 1902-1956* U.S. Bureau of Mines Information Circular 7872 (Washington, DC: Government Printing Office, 1958), 36; Marshall T. Huntting, *Inventory of Washington Minerals*, Part II Metallic Minerals, Vol. I (Olympia: State Printing Plant, 1956), 375.

[83] *Minerals Yearbook, 1966* (Washington, DC: GPO, 1967), 833; *Minerals Yearbook, 1967* (Washington, DC: GPO, 1968), 841; *Minerals Yearbook, 1968* (Washington, DC: GPO, 1969), 785; G.J. McGinn, "Report on the Calhoun Mining Property," unpublished report dated August 1979, p 2 (WADNRHQ9425); Washington State Pollution Control Commission, "Waste Discharge Permit," 12 January 1966 (WAARCH0003275); E. W. Asselstine to Files, "American Zinc, Lead & Smelting Co.—Stevens County," memorandum dated 7 June 1967 (WAARCH-10-09-09-000257-275); Howard Bunten to Files, "American Zinc Co. Leadpoint Unit," memorandum dated 1 May 1968 (WAARCH-10-09-09-000257-275; Joseph A. Jensen to Bill Calhoun, letter dated 26 July 1968 (WAARCH-10-09-09-000257-275).

Chewelah. For a time, it was the largest copper producer in northeast Washington.[84]

United Copper Mining Company began shipping copper ore to the copper smelters at Granby and Greenwood, British Columbia, and at Northport, Washington, in 1906. In 1910, after the Northport smelter had closed, United Copper shipped its product only to Granby. The company built its first copper concentrator near the mine in 1911, using it to treat copper sulfide ore. The mill's initial capacity was 75 tons/day, and it only treated 108 tons of ore that year. The company also direct-shipped about 1,100 tons of ore in 1911, sending its material (concentrates and first-class ore) variously to copper smelters at Granby, Greenwood, and Trail, BC, and Tacoma, WA. In 1912, with its concentrator fully operating, the company milled about 7,700 tons of ore. It shipped 584 tons of concentrates and 5,715 tons of first-class ore to the smelters at Trail and Tacoma. In 1913, the company doubled the capacity of its concentrator and milled almost 11,000 tons of ore, shipping 1,101 tons of concentrates and 3,838 tons of first-class ore to the smelters at Granby, Trail, and Tacoma. In 1914, the company milled about 13,000 tons of ore, shipping about 1,500 tons of concentrates and the same tonnage of first-class ore as in 1913 to the smelters at Granby and Trail. United Copper was facing two problems at its concentrator, however: it did not have enough water to operate the entire mill, and it was having difficulty recovering copper from the slimes (the very fine portion of the crushed ore). In an effort to address these problems, the company worked to develop additional water resources and began experimenting with flotation. Another problem vexing United Copper was insufficient electrical power from its supplier, Stevens County Light & Power Company.[85]

Over the next several years, United Copper experimented with various methods of flotation and struggled with lack of water and electrical power. Based on the results of its experiments with flotation, the company remodeled its old mill in 1916 and also built a larger new mill. One mill was adjacent to the mine adit; it housed equipment for crushing and grinding the ore and for treating the pulp on tables using gravity concentration. The other mill was located a few hundred yards away near the old tailings dump. It served as the flotation unit of the milling operation, treating the tailings of concentrating tables and, when throughput at the gravity concentrator allowed, retreating old tailings from the dump.[86]

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[84] Fulkerson and Kingston, *Mine Production of Gold, Silver, Copper, Lead, and Zinc in Pend Oreille and Stevens Counties,* 28.

[85] USGS, *Mineral Resources of the United States Calendar Year 1911* (Washington, DC: Government Printing Office, 1912), 788; *Mineral Resources of the United States Calendar Year 1913* (Washington, DC: Government Printing Office, 1914), 800; *Mineral Resources of the United States Calendar Year 1914* (Washington, DC: Government Printing Office, 1915), 652-653; USBOM, Permanent Individual Mine Record forms for the United Copper mine (Plaintiff-00044476).

[86] *Mineral Resources of the United States Calendar Year 1915* (Washington, DC: Government Printing Office, 1917), 573-574; *Mineral Resources of the United States Calendar Year 1916* (Washington, DC: Government Printing Office, 1919), 615; Ernest N. Patty, *The Metal Mines of Washington*, Washington Geological Survey Bulletin No. 23 (Olympia, WA: State Printer, 1921), 129-130; L.O. Howard, "The Chewelah and Colville Districts of Northeastern Washington," *Mining*

Output continued to increase, primarily in the form of concentrating ore run through the mill. United Copper milled about 32,000 tons of ore in 1915, 39,000 tons in 1916, 59,000 tons in 1917, and 63,000 tons in 1918. The company preferred shipping is ore and concentrates to Trail, but labor unrest there forced the company to ship material to Granby and Tacoma for smelting in 1917 and 1918. The company changed its name to United Silver-Copper Mining Company in 1919. Despite the slump in the copper market after World War I, United Copper sustained a fair high level of production for a couple years, milling about 50,000 tons of ore in 1919 and 36,000 tons in 1920 and shipping its ore and concentrates exclusively to Tacoma. Thereafter, however, the company's fortunes languished, milling less than 5,000 tons per year during the years 1921-1924 and shipping only 355 tons of first-class ore in 1925.[87]

There was no production from the United Copper mine in 1926. The Chewelah Union Mining Company acquired the property in 1927 and leasers began producing small volumes of first-class ore, shipping 218 tons of ore in 1927 and lesser volumes through 1931. Neither Chewelah Union nor the leasers operated the mill during this period.[88]

The United Copper property sat idle through the 1930s and 1940s, although parties did periodically explore its prospects. In 1951, the Chewelah Copper Company was incorporated and acquired the United Copper property, hoping to be able to redevelop it. The company began exploration in 1952, development work shortly thereafter, and in 1955 began shipping ore to the Bonanza mill near Colville, which it had leased. The old United Copper property yielded about 7,500 tons of ore in 1955, all but 22 tons of which was concentrated. Although Chewelah Copper

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and Metallurgy 6 (June 1925): 273 (INT0056713).

[87] *Mineral Resources of the United States Calendar Year 1915* (Washington, DC: Government Printing Office, 1917), 573-574; *Mineral Resources of the United States Calendar Year 1916* (Washington, DC: Government Printing Office, 1919), 615; *Mineral Resources of the United States Calendar Year 1917* (Washington, DC: Government Printing Office, 1921), 505; *Mineral Resources of the United States Calendar Year 1918* (Washington, DC: Government Printing Office, 1921), 509; *Mineral Resources of the United States Calendar Year 1919* (Washington, DC: Government Printing Office, 1922), 495-496; *Mineral Resources of the United States Calendar Year 1920* (Washington, DC: Government Printing Office, 1922), 269; *Mineral Resources of the United States Calendar Year 1921* (Washington, DC: Government Printing Office, 1924), 428; Patty, *The Metal Mines of Washington*, 123; USBOM, Permanent Individual Mine Record forms for the United Copper mine (Plaintiff-00044472, 44474).

[88] *Mineral Resources of the United States Calendar Year 1928* (Washington, DC: Government Printing Office, 1931), 702; *Mineral Resources of the United States Calendar Year 1929* (Washington, DC: Government Printing Office, 1932), 428; *Mineral Resources of the United States Calendar Year 1930* (Washington, DC: Government Printing Office, 1933), 675; *Mineral Resources of the United States Calendar Year 1931* (Washington, DC: Government Printing Office, 1934), 478; USBOM, Permanent Individual Mine Record forms for the United Copper mine (Plaintiff-00044472).

reportedly bought the Bonanza mill in 1955, the company was evidently not able to maintain production from the United Copper mine. The United Copper mine did not produce thereafter.[89]

A 2003 report by the Washington Inactive and Abandoned Mine Lands Program (IAML, Department of Geology and Earth Resources) indicated that during a site visit, IAML personnel observed two tailings disposal areas at the United Copper property. IAML investigators estimated the "upper" five-acre site at 64,500 cubic yards of tailings and the "lower" ten-acre site at 117,500 cubic yards of tailings, and noted that "erosion [had] begun to compromise embankments at both sites, forming long narrow gullies."[90] In addition to tailings discharged from the United Copper mill into the watershed of the Columbia River, United Copper extracted waste rock and low-grade materials which were piled near the mine and which may have released contaminants to the environment, resulting in either a release or a threatened release of hazardous substances, such as zinc or lead.

c. Orient Mining District

In the mid-1950s, the Orient district was the third-largest producer in Stevens County in terms of tons of ore mined. The largest producer in the district was the Napoleon group of mines, operated by the British Columbia Copper Company to mine ore used for flux at its copper smelter at Greenwood, BC. The company valued the ore mainly for its characteristic as a flux, but it did yield values in gold, silver, and copper. A mill did operate at the mine in 1911 and 1912 to recover gold and silver by amalgamation and cyanidation, but the mill only treated about 17,000 tons of ore in those two years.[91] The other major producer was the First Thought mine, which had a mill operating during the late 1930s and early 1940s. The mill used a cyanide process to treat gold ore.[92]

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[89] Washington DNR abstracts of articles about the United Copper property, 1937-1941 (WADNR-HQ-10-08-09-021441); Prospectus of the Chewelah Copper Company, incorporated 27 November 1951 (WAARCH0000971); Chewelah Copper Company, application to the Washington Department of Licenses (WAARCH0000984-985); "Bonanza Mill Option Taken, Loan Obtained," newspaper clipping from 1954 (WADNR-HQ-10-08-09-021444); "Chewelah Firm Buys Ore Mill," newspaper clipping from 1955 (WADNR-HQ-10-08-09-021445); "Chewelah Company Buys Bonanza Flotation Mill," newspaper clipping dated 13 January1955 (WADNR-HQ-10-08-09-021448); USBOM, *Minerals Yearbook, 1955* (Washington, DC: GPO, 1958), 1164.

[90] Fritz E. Wolff, Donald T. McKay, Jr., and David K. Norman, "Inactive and Abandoned Mine Lands – United Copper Group Mines, Chewelah Mining District, Stevens County, Washington," Washington Division of Geology and Earth Resources report dated July 2003, p 4 (TECK 0060513).

[91] USBOM, Permanent Individual Mine Record forms for the Napoleon mine (Plaintiff-00044301-302); HAI, "Napoleon Mill Site Report," unpublished report produced for the defendant in this case and dated September 2010.

[92] USBOM, Permanent Individual Mine Record forms for the First Thought mine (Plaintiff-00044099-4102); HAI, "First Thought Mill Site Report," unpublished report produced for the defendant in this case and dated September 2010.

d. Bossburg (Clugston) Mining District

The Bossburg district was home to some of the earliest hardrock mineral discoveries in northeast Washington. Although some of the mines shipped ore in the 1880s, the district did not yield much ore until the mid-twentieth century, when flotation made it profitable to mine them.

Bonanza Mill

The Bonanza mine was located in sections 2 and 11, T37N, R38E, in the Bossburg mining district of Stevens County, Washington, about fifteen miles north of Colville. The Bonanza mill at Palmers siding was located about three miles northwest of Colville near the banks of the Colville River.

As noted above, the Bonanza mine was one of the earliest to be developed in the Bossburg (Colville) mining district, dating back to 1885. There is no precise record of its production in the nineteenth century, but it began producing shortly after the Deer Trail Consolidated Mining Company purchased it in 1900. Deer Trail Consolidated shipped about 1,500 tons of lead-silver ore in 1900 and 1901 and then suspended production through 1906. The Bonanza mine shipped ore from 1907 through 1920, reaching as much as about 1,400 tons in 1911 and dropping to as little as 42 tons in 1919. Deer Trail Consolidated was the operator of the mine most of those years, except in 1916 and 1917, when G. Vervaeke operated the mine, and 1920, when W.A. Corey operated the mine. Shipments of lead-silver ore went variously to the nearby Northport smelter as well as to smelters at Everett and Tacoma, Washington, Trail, British Columbia, and Ponderay, Idaho.[93]

After the mine sat idle through 1921 and 1922, Vervaeke put the mine back in operation in 1923 and 1924. In 1924, he built a small concentrator at the mine, but it burned in June 1925. The Bonanza mine produced no more ore through 1927. In 1928, the Bonanza Mining & Milling Company built a flotation mill with a capacity to treat 50 tons of ore daily and the following year milled 3,000 tons of lead-silver ore from the dump at the mine, which apparently did not operate that year. This is another example of mineralized material being excavated from a mine and stockpiled on the landscape. In 1930, the Northern Lead Mining & Milling Company leased the property and treated 1,350 tons of lead-silver ore. The mine and mill sat idle for the rest of the decade.[94]

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[93] Henry Landes, William S. Thyng, D.A. Lyon, and Milnor Roberts, *The Metalliferous Resources of Washington, Except Iron*, Part II of Volume I of Annual Report of the Washington Geological Survey for 1901 (Olympia, WA: Gwin Hicks, State Printer, 1902), 7; USBOM, Permanent Individual Mine Record forms for the Bonanza mine (Plaintiff-00044001-002).

[94] Olaf P. Jenkins, *Lead Deposits of Pend Oreille and Stevens Counties*, Washington Division of Geology Bulletin No. 31 (Olympia, WA: Frank Lamborn, Public Printer, 1924), 118-119; USBOM, *Mineral Resources of the United States 1925* (Washington, DC: Government Printing Office, 1928), 560; "Bonanza Mill to Get Power," *Spokane Chronicle* (27 October 1928); *Mineral Resources of the United States 1929* (Washington, DC: Government Printing Office, 1932), 428; *Mineral Resources of the United States 1930* (Washington, DC: Government Printing Office, 1933), 675; USBOM, Permanent Individual Mine Record forms for the Bonanza mine (Plaintiff-00043997-4000).

Russell Parker leased the Bonanza property in 1942, and for the next three years he shipped small lots of ore directly to the Bunker Hill smelter. His greatest output of first-class ore occurred in 1943, when he shipped 232 tons to Bunker Hill. He closed the mine in June 1944, after shipping 24 tons of ore. Victory Metals, Inc., a company of which Ira M. Hunley was president, took over operations at the Bonanza mine in July 1945 and treated about 1,800 tons of ore that year at the mill at Palmer siding (also called Palmers), owned by Hunley and Earl B. Gibbs and located about 14 miles from the mine. (A 1949 report by Tabor states that Gibbs and Hunley had built the mill in 1942 and operated it as a custom mill until they acquired the Bonanza mine and could use it to treat their own ore. A newspaper article describing the mill's construction has a hand-written date of September 1945. Either the 1949 report is in error, or the hand-written date should be 1942.) In 1945, Hunley acquired the Bonanza mine from Vervaeke. In 1946, Hunley and Gibbs, doing business as the Bonanza Lead Company, treated Bonanza ore at the Palmers mill, and through the remainder of the decade, the volume of ore they sent from the Bonanza mill increased steadily, from 3,750 tons in 1946 to about 20,000 tons in 1950. Bonanza Lead shipped lead concentrates most years to the Bunker Hill smelter in Idaho.[95] The historical record concerning the ownership of the property through the late 1940s is somewhat convoluted.

The Anaconda Copper Mining Company acquired an option on the Bonanza property in 1951 and began operating mine and mill. The mill at Palmer siding treated 13,672 tons of ore in 1951 but only 5,514 tons in 1952 before the Anaconda Company suspended operations, focusing its attention on exploration. Anaconda gave up its option in 1953, after exploration failed to show enough ore.[96] As described above, the Bonanza mill operated briefly in 1955 on ore from the United Copper mine.

The Bonanza mill next operated in 1962, when the Tri-Nite Mining Company used it to treat 3,100 tons of zinc ore from the Shumaker mine. Five years later, the Calix American Corporation bought the Shumaker mine and used the Bonanza mill to treat about 1,760 tons of ore. There is no record of the Bonanza mill operating since.[97]

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[95] *Minerals Yearbook 1942* (Washington, DC: GPO, 1943), 515; *Minerals Yearbook 1943* (Washington, DC: GPO, 1945), 494; *Minerals Yearbook 1944* (Washington, DC: GPO, 1945), 473; *Minerals Yearbook 1945* (Washington, DC: GPO, 1947), 488; Deed between G.J. Vervaeke and I.M. Hunley dated 5 January 1945 (00004756-758); "Company Builds Zinc-Lead Mill," *Spokesman Review* clipping dated September 1945 (Plaintiff-00049407); E.Y. Dougherty, "Preliminary Report on the Bonanza Lead Mine, unpublished report dated 30 September 1946, pp 3-6 (00004885); John W. Taber, "The Bonanza Lead Mine, Stevens County, Wash," USBOM Report of Investigation dated c1949, pp 13-14 (00004843-844); USBOM, Permanent Individual Mine Record forms for the Bonanza mine (Plaintiff-00043997-998).

[96] *Minerals Yearbook 1952* (Washington, DC: GPO, 1955), 966; *Minerals Yearbook 1953* (Washington, DC: GPO, 1956), 1081; USBOM, Permanent Individual Mine Record forms for the Bonanza mine (Plaintiff-00043995-996).

[97] "Mill Reopened After 4 Years," *Spokane Daily Chronicle* (19 April 1962) http://news.google.com/newspapers?id=TpgSAAAAIBAJ&sjid=VfcDAAAAIBAJ&dq=palmer-siding&pg=5401%2C5626064; *Minerals Yearbook 1962* (Washington, DC: GPO, 1963), 1132;

The Bonanza mill at Palmer discharged its tailings to an impoundment along the banks of the Colville River. The Environmental Protection Agency Superfund Technical Assessment and Response Team conducted a drive-by inspection of the site in May 2000 and observed a tailings/waste rock pile within ten to fifteen feet of the Colville River. START investigators "assumed that the surface water from the tailings/waste rock pile flow[ed] overland into the river at a probable point of entry approximately 11.25 miles east of its confluence with the Columbia River." In an April 2002 site visit to the property, START investigators found an estimated 17,500 cubic yards of tailings and waste rock at the mill site and described the tailings as "fine orange silt overlying native soil." They identified a drainage ditch on the southeast end of the site that conveyed water to the Colville River from another ditch running parallel to the railroad tracks. According to the START investigators, the property owners constructed the drainage ditch in 1997 when severe flooding caused the river waters to back up onto the site. They noted that eight acres of tailings and fill occupied the area north and south of the drainage ditch. START investigators concluded that tailings eroded into the Colville River via the drainage ditch and even during dry periods, fine-grained tailings left the site via dust clouds. As a result of the site investigations, the EPA began a remediation effort on the property in October 2002.[98]

In addition to tailings discharged from the Bonanza mill into tributaries of the Columbia River, operators of the Bonanza mine extracted waste rock and low-grade materials which were piled near the mine and which may have released contaminants to the environment, resulting in either a release or a threatened release of hazardous substances, such as zinc or lead.

Young America Mill

The Young America mine is located in 28 and 33, T38N, R38E in the Bossburg mining district, Stevens County, Washington. It is located on a steep west-facing hillside overlooking the Columbia River. Its mill was located along the river flat roughly midway between the mine and the river, about a mile upstream from Bossburg.

The Young America mine was discovered in 1885, and during the late nineteenth century the

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newspaper clippings from 1967 (00004694); USBOM, Permanent Individual Mine Record forms for the Shumaker mine (Plaintiff-00044389-390).

[98] Gerald T. Orlob and Walter W. Saxton, "Mining and Mill Waste Pollution in the Upper Columbia River Basin and Lake Roosevelt," unpublished report prepared for the Washington Pollution Control Commission dated 1950, p 8 (INT0027146); Region 10 START, "Bonanza Mill Preliminary Assessment Report, Stevens County Washington," report dated November 2000, pp 2-2, 3-2 (CTRL087943); Herrera Environmental Consultants, Inc., "Site Inspection Report, Bonanza Mill Site, Stevens County, Washington," report dated 3 October 2002, pp 6-13 (CTRL082659); Herrera Environmental Consultants, Inc., "Removal Action Report Bonanza Mill Colville, Washington," report dated 23 January 2003, p 45 (CTRL089167); Herrera Environmental Consultants, Inc., Removal Site Evaluation, Bonanza Mill, Colville, Washington (October 28, 2002), 5-11 (1183601; CTRL088979).

Young America Consolidated Mining Company shipped several carloads of lead ore to smelters. The property passed through several owners and produced only intermittently. For example, the Young America Cliff Consolidated Mining Company shipped 150 tons of lead ore to the smelter at Everett, Washington, in 1905. The mine then sat idle for a few years until 1912, when the Robena Silver-Lead Mining Company shipped 19 tons of lead ore to the Trail smelter. The following year, Jacquish & Carlson shipped eight tons of lead ore to Everett. The mine was idle again until 1917, when C.W. Connell shipped 78 tons of zinc ore to the Anaconda works in Montana. Production continued on a small and intermittent basis through the 1920s and 1930s. All of the material shipped was first-class ore, and none of the ore was concentrated, although the Cuprite Mining Company did build an experimental concentrator near the mine in 1919, but the company could not effect a good separation of the lead sulfide and zinc sulfide minerals. When Frederic Keffer visited the Young America in 1937, he reported that nothing remained of the experimental mill except a few small piles of what appeared to be tailings.[99]

The Young America property saw renewed activity in the 1940s. Leasers shipped 70 tons of zinc-lead ore to J.J. Budd's custom concentrator near Kettle Falls in 1941. Sam Halsey and others leased the property in 1945 and began shipping ore and concentrates to the Bunker Hill lead smelter and the Sullivan zinc works in Idaho. Records do not indicate where they concentrated their ore in 1945, but in 1946 they shipped their ore to the Combined Metals Reduction Company's custom flotation mill in Bauer, Utah. The leasers built a small flotation mill (30 tons per day) in 1947 on the flat below the Young America mine, between the highway and the railroad tracks, and put it into operation in December. About 3,000 tons of ore was milled at the Young America property in both 1948 and 1949, but then production began to decline. Young America Mines, Inc., acquired the property in 1951, and the mine sent about 600 tons of ore to the mill that year. The Young America property was operated by the owner for the first part of the year and then by the Bonanza Lead Company in the latter months. The Bonanza company had recently sold its nearby mine to the Anaconda Copper Mining Company. In 1952, the Bonanza company mined and milled another 660 tons of ore from the Young America mine, and in 1953 Bonanza's output from the Young America property jumped to about 3,600 tons. During this period, several other small mines, including the Farmer (1948), Lucille (1948), and Longshot (1952) also sent ore to the Young America mill to be concentrated.[100] There is no record of ore being treated at the Young America mill after 1953.

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[99] George A. Bethune, *Mines and Minerals of Washington*, First Annual Report (Olympia, WA: O.C. White, State Printer, 1891), 75-76; Howland Bancroft, *The Ore Deposits of Northeastern Washington*, USGS Bulletin 550 (Washington, DC: GPO, 1914), 62-63; Ernest N. Patty, *The Metal Mines of Washington* , Washington Geological Survey Bulletin No. 23 (Olympia, WA: State Printer, 1921), 119-121; Frederic Keffer to A.C. Frost, letter dated 31 October 1937, pp 5, 8 (00009442, 9445) ; USBOM, Permanent Individual Mine Record forms for the Young America mine (Plaintiff-00044511-514).

[100] *Minerals Yearbook 1941* (Washington, DC: GPO, 1943), 487; *Minerals Yearbook 1945* (Washington, DC: GPO, 1947), 488; *Minerals Yearbook 1946* (Washington, DC: GPO, 1948), 1558; *Minerals Yearbook 1947* (Washington, DC: GPO, 1949), 1534; *Minerals Yearbook 1949* (Washington, DC: GPO, 1951), 1598; *Minerals Yearbook 1951* (Washington, DC: GPO, 1954), 1616; *Minerals Yearbook 1952* (Washington, DC: GPO, 1955), 966; *Minerals Yearbook 1953* (Washington, DC: GPO, 1956), 1081; USBOM, Permanent Individual Mine Record forms for the

During its period of operation, the Young America discharged its tailings onto a flat area below the mill, about 100 feet from the bank of the Columbia River (alternatively referred to in source materials as "Lake Roosevelt"). The flat area was separated from the Columbia River by the railroad embankment, but there was a culvert beneath the embankment, and a report from 1950 indicated that tailings had likely flowed through the culvert and down to the river.[101]

In addition to tailings discharged from the Young America mill into the Columbia River, operators of the mine extracted waste rock and low-grade materials which were piled near the mine and which may have released contaminants to the environment, resulting in either a release or a threatened release of hazardous substances, such as zinc or lead.

e. Deer Trail Mining District

Although a relatively small producer in Stevens County, the Deer Trail district was home to mines which produced some of the rarer metals, like molybdenum and tungsten.

Germania Mill

The Germania mine is located in the Deer Trail mining district near Springdale in Stevens County. The tungsten ore deposit was discovered by J.S. McLean in 1894 and acquired by the Germania Mining Company, owned by German nationals. The German company began developing the Germania mine for its tungsten ore (wolframite) in the early part of the twentieth century. The mine was closed from late 1907 through late 1909 as a result of litigation. By the time the mine went into production in August 1909, the company had built a concentrator with a capacity to treat 25-30 tons of wolframite ore daily. The mill went into operation in December 1909, and plans were made to ship concentrates to Germany. In 1910, mine and mill operated most of the year, being idle from late August to mid-November, and the concentrates were indeed shipped to Germany. The Germania produced little tungsten thereafter, and when the United States entered the First World War against Germany, the federal government's Alien Property Custodian took control of the property. The mill was reportedly destroyed by fire during the war.[102]

Young America mine (Plaintiff-00044507-510); HAI, "Young America Mill Site Report," unpublished report prepared for the defendant in this case and dated September 2010.

[101] Gerald T. Orlob and Walter W. Saxton, "Mining and Mill Waste Pollution in the Upper Columbia River Basin and Lake Roosevelt," unpublished report prepared for the Washington Pollution Control Commission dated 1950, p 9 (Plaintiff-00049857).

[102] USGS, *Mineral Resources of the United States, 1909* (Washington, DC: Government Printing Office, 1911), 580; USGS, *Mineral Resources of the United States, 1910* (Washington, DC: Government Printing Office, 1911), 739; Howland Bancroft, *The Ore Deposits of Northeastern Washington*, USGS Bulletin 550 (Washington, DC: Government Printing Office, 1914), 118, 122-123; C.E. Weaver, *Mineral Resources of Stevens County, Washington*, Washington Geological Survey Bulletin 20 (Olympia, WA: State Printer, 1920) 213-216; Ernest N. Patty & Sheldon L.

Around 1930, McLean interests, in the form of the American Tungsten Company, gained control of the Germania property. Tungsten Producers, Inc., acquired the mine from American Tungsten in 1931, built a new mill with about the same capacity as the old one, and began shipping concentrates. The Germania became one of the major tungsten producers in the U.S. General Electric bought the property from Tungsten Producers in 1936. By the late 1930s, General Electric had increased the capacity of the mill to 200 tons/day and was mining and treating about 100 tons/day. In order to increase the output of tungsten from its Germania operation, General Electric began leasing adjoining parcels of property on the Spokane Indian Reservation. When General Electric sold the Germania mine in 1943 to Robert Mills, it petitioned the Commissioner of Indian Affairs to cancel the lease. Mills sold the mill equipment and then leased the Germania property to three men who installed a small mill to treat materials they recovered from dumps and working through hand sorting. This operation was short-lived.[103]

The last period of operations at the Germania mine and mill was in the 1950s. The stage was set for resumed operations when the Tungsten Mining & Milling Company of Spokane leased the property from Mills. Tungsten Mining & Milling installed equipment for gravity concentration in the Germania mill and began retreating old tailings dumps. Gravity concentration proved inadequate, however, so the company obtained a loan from the federal government's Reconstruction Finance Corporation to remodel the mill again by installing flotation equipment. The company intended to treat ore extracted from the previously worked stopes of the mine, an estimated 120,000 tons of tailings, and other mineralized material excavated from the surface. Tungsten Mining & Milling expended all the funds in the loan, however, before it was able to get its remodeled mill operating. In late 1953, Penticton Mines Ltd. of British Columbia leased the Germania mine with an option to purchase. Penticton Mines had only a small output of concentrates before it sold the Germania mine and mill to Tungsten Uranium Mines, Inc., in 1954. The new company got the mill operating in July 1955.[104] The operation was apparently short-lived, however, and there is no

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Glover, *The Mineral Resources of Washington with Statistics for 1919*, Washington Geological Survey Bulletin No. 21 (Olympia, WA: Frank M. Lamborn Public Printer, 1921), 89; "The Story of the Germania," *Northwest Mining* (July 1936): n.p. (WADNR-HQ-10-08-09-013510).

[103] "The Story of the Germania," *Northwest Mining* (July 1936): n.p. (WADNR-HQ-10-08-09-013510); WADNR abstracts of mining articles for 1938-1941 (WADNR-HQ-10-08-09-013541-542); S.W. Hobbs, USGS memorandum dated October 1943 (00004021). For the leasing of mining lands from the Spokane Indian Reservation, see the several Mining Leases of Unallotted Lands on Spokane Indian Reservation dated 1936, 1937, and 1938 and copied at the National Archives (TECK0017655-685); F.A. Gross to Commission of Indian Affairs, letter dated 6 November 1943 (TECK0017683).

[104] Tungsten Mining & Milling Company, application to the Washington Department Licenses (WAARCH0000897); WADNR clippings on Germania mine from 1951 and 1952 (WADNR-HQ-10-08-09-013544-546); USBOM, *Minerals Yearbook, 1953* (Washington, DC: Government Printing Office, 1956), 1062; W.S. Anderson & Willard P. Puffett, "Tungsten Mining & Milling Company," unpublished USGS report dated January 1954, pp 3-4 (00003625-626); WADNR clippings on Germania mine from 1954 and 1955 (WADNR-HQ-10-08-09-013463, 544-546).

subsequent record of operations at the Germania mine and mill by Tungsten Uranium Mines or others.

Documents available in this case also suggest that another company, Germania Consolidated Mines, Inc., continued the leasing of nearby lands on the Spokane Indian Reservation and treated materials excavated from those lands in its own mill. This operation was sometimes called the Keeth mine. Fire destroyed the Germania Consolidated mill in 1960.[105]

The Germania site is located in a ravine that drains into Sand Creek, which flows to the southeast and into the Spokane River. A 1947 memo regarding testing of tailings for beneficiation states: "it appears that about one-third of the tailings has been washed down the creek so that approximately […] 80,000 tons still remain." Donald McKay of the Washington Department of Natural Resources Inactive and Abandoned Mine Lands Program visited the site in September 2001 and noted a "large volume" of waste rock that stretched down from the mill site into a gully. He observed tailings spreading down into the gully.[106] In addition to tailings discharged from the Germania mill into the Columbia River watershed, operators of the mine extracted waste rock and low-grade materials which were piled near the mine and which may have released contaminants to the environment, resulting in either a release or a threatened release of hazardous substances.

In addition to tailings discharged from the Germania mill into the Columbia River watershed, operators of the mine extracted waste rock and low-grade materials which were piled near the mine and which may have released contaminants to the environment, resulting in either a release or a threatened release of hazardous substances.

Deer Trail Monitor Mill

The Deer Trail Monitor mine was a small molybdenum producer located near Fruitland in southwest Stevens County. It was operated by the Deer Trail Monitor Mines Company, based in Spokane. Based on annual reporting in *Minerals Yearbook*, it could appear that the mine produced about 9,000 tons of ore. As described below, however, there is also reason to doubt this figure and put the total production at about 3,000 tons of ore. According to *Minerals Yearbook*, the company did sufficient development work in 1936 to be able to put the mine in production by December. That year, Deer Trail Monitor mine produced about 2,000 tons of ore, assaying at about 1% molybdenum. Most of the ore was extracted in the course of development. The company built a 50-ton flotation mill in 1936, treating about 200 tons of ore and producing two tons of concentrates. The

[105] Mining Leases of Unallotted Lands on Spokane Indian Reservation dated 1948-1951 and copied at the National Archives (TECK0016035-053); WADNR clippings on Germania mine from 1953 and 1960 (WADNR-HQ-10-08-09-013463, 551, 559); Germania Consolidated Mines, Inc., Offering Circular dated 15 July 1955 (00003926-931).

[106] J.D. Bardill to Shelton, "Mill dump tailings sample for beneficiation tests," dated 10 November 1947 (00003643); Donald T. McKay, Jr., "Field Notes," Washington Division of Geology and Earth Resources, 12-17 September 2001 (Plaintiff-00050547).

Deer Trail Monitor Mining Company produced about 2,000 tons of ore from its Monitor mine in 1937, concentrated about 1,000 tons of ore at its flotation mill, yielding about a five tons of concentrates. The following year, the company mined about 3,000 tons of ore, treated about 300 tons at its mill, and produced about three tons of concentrates. Deer Trail Monitor must have been stockpiling its output, because the *Minerals Yearbook* report on 1938 activities indicates that the mill produced only three tons of concentrates but shipped five tons. The last year of reported production was 1939, when output from the mine was about 3,000 tons of ore averaging only 0.5% molybdenum. The mill treated about 1,000 tons of ore yielding about 10 tons of concentrates. *Minerals Yearbook* reports that the concentrates were stored at the mine.[107]

A 1942 USGS report summarized the operations at the Deer Trail Monitor mine and mill. It stated that intermittent operations yielded a total of 3,000 tons of ore. It could be that each of the annual reports in *Minerals Yearbook* of 2,000 tons of ore was cumulative, that there was little increase in the total of 2,000 tons produced in 1936-1937 until the brief renewed activity in 1938, which brought the cumulative total to the 3,000 reported in *Minerals Yearbook* that year. Such a scenario is consistent with the small bursts of activity at the Deer Trail Monitor outlined in the USGS report and would explain the reporting in *Minerals Yearbook*. Suffice it to say, the USGS report was prepared during World War II, when the United States placed a high priority on finding and developing strategic metals for the war effort. The report concluded that the grade of the molybdenum deposit was too low to merit further development, even though there was an estimated 5,000 tons of reserves remaining in the mine. The report noted that the Cleveland mine, four miles distant from the Deer Trail Monitor, was leasing the mill to treat lead-zinc ore.[108]

Based on the Mestsker atlases, it appears that the State of Washington acquired the land on which the Monitor claim was located sometime between 1963 and 1973.[109]

In addition to tailings discharged into the watershed of the Columbia River, Deer Trail Monitor extracted waste rock and low-grade materials which were piled near the mine and which may have released contaminants to the environment, resulting in either a release or a threatened release of hazardous substances.

e. Colville (Old Dominion), Kettle Falls, Springdale, and Valley Mining Districts

These mining districts produced relatively small volumes of ore, but there were some mills

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[107] *Minerals Yearbook, 1937* (Washington, DC: GPO, 1937), 654; *Minerals Yearbook, 1938* (Washington, DC: GPO, 1938), 566; *Minerals Yearbook, 1939* (Washington, DC: GPO, 1939), 618; *Minerals Yearbook, 1940* (Washington, DC: GPO, 1940), 620.

[108] Charles A. Anderson, "Report on the Deer Trail Monitor (Molybdenite) Mine," unpublished U.S. Geological Survey report dated November 1942, box 189, accession ANS-070-96-0054, Record Group 70, Records of the U.S. Bureau of Mines, National Archives, Denver, CO.

[109] Metsker map for T30N, R37W (1963); Metsker map for T30N, R37W (1973).

which operated in them for brief periods of time. Foremost among them was the Old Dominion, which operated at the Old Dominion mine, one of the first hardrock claims in the northeast part of the state. Another important mine which had a mill was the Cleveland, in the Springdale mining district. It's first mill dated to 1918 and operated intermittently until 1925. The second mill operated during World War II and until 1948. A small mill operated at the Daisy mine in the Kettle Falls district in the 1920s and 1930s.[110]

C. Ferry County (Republic Mining District)

The Republic mining district was known primarily for its gold values, but its complex ores were difficult to treat. The Knob Hill mine was the first to have a successful mill, but there were numerous earlier efforts to recover precious metals from the ores of the Republic district. The Knob Hill mill is described first, followed by some of the earlier mills.

1. Knob Hill Mills

The Knob Hill mill is located in section 27, T37N, R32E, about 1.5 miles north of Republic in Ferry County, Washington. Operating from 1937 to 1995, it was the most productive mill in the Republic district. When the mine and mill closed in February 1995, it was owned by the Hecla Mining Company, which had operated the mill at capacity (treating 325 tons of ore per day) throughout the previous year.[111]

Knob Hill Mines, Inc., completed construction of the Knob Hill mill in April 1937, and the mill started operating in June. The mill was designed to treat 400 tons of gold ore daily from the nearby Mud Flat claim using the cyanide process. The Mud Flat mine was operated as an open pit. Prior to being treated with cyanide, the ore was ground in ball mills. Tailings from the process were pumped to a large impoundment adjacent to the mill. When the mill went into operation, it became the largest producer in the Republic district. In 1938, its first full year of operation, it treated 147,514 tons of Knob Hill ore as well as 4,565 tons of tailings from the nearby Mountain Line property. The Knob Hill mill treated 156,176 tons of ore in 1939. Most of the ore came from its own property and the Mountain Lion, which it also operated. That year the Knob Hill mill also began treating ore from the Eureka Mining & Milling Company's Quilp mine. Eureka had closed and dismantled its own cyanide mill the previous year. In 1940, the Knob Hill company added a flotation circuit to the mill to handle sulfide ore it was excavating from the mine at depth. The tailings dam failed in July 1941, releasing thousands of tons of tailings into the creek and the San

[110] HAI, "Old Dominion Mill Site Report," unpublished report produced for the defendant in this case and dated September 2010; HAI, "Cleveland Mill Site Report," unpublished report produced for the defendant in this case and dated September 2010; USBOM, Permanent Individual Mine Record forms for the Cleveland mine (Plaintiff-00044033-040) ; HAI, "Daisy Mill Site Report," unpublished report produced for the defendant in this case and dated September 2010.

[111] Robert E. Derkey, "The Metal Mining Industry of Washington in 1994," *Washington Geology* (March 1995): 16 (CTRL090251).

Poil River, where the tailings killed fish and discolored the water fifteen miles below its point of entry. The Republic News-Miner reported that "some believe the recent disaster will carry its silt to the Columbia River." The Knob Hill mill continued operating during World War II, but at a reduced rate. In 1943, despite operating at about a third the level of 1939, the Knob Hill operation was Washington's leading silver producer and its gold production was in second place, due to diminished production by other precious metals mining operations during the war effort. Knob Hill was allowed to continue operating because its mill produced some concentrate, which it shipped to Asarco's Tacoma smelter, where it was used as flux.[112]

The Knob Hill operation continued following the war, treating ever more ore through the late 1940s, increasing from about 40,000 tons in 1946 to about 55,5000 tons in 1950, with the mill using both flotation and cyanidation. In 1947, the company added a jig to its process so that gold could be recovered from jig concentrate by amalgamation. In 1950, about half the ore run through the mill was treated by cyanidation and half by flotation. Concentrates produced by flotation were sent to a smelter, typically at Tacoma, and the flotation tailings were further treated by cyanidation to produce a bullion. The Knob Hill company ceased surface mining in 1951 and relied entirely on selective underground mining. In order to backfill old underground workings as the mining progressed, the company installed a classifier in the mill to separate sand tailings from finer slimes, sending the sand tailings to the mine to be used as backfill and sending the fine tailings to the impoundment.[113]

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[112] "Knob Hill is Lake of Mud," newspaper article from DNR clipping file (13 November 1937, WADNR-HQ-10-08-09-022440); Corwin L. Cooper, "Mining and Milling Methods and Costs at Knob Hill Mine," *Northwest Mining News* 6 (30 October 1940): 9-10 (00000661-662); "Changed Mill Fine Performer," newspaper article from DNR clipping file (24 November 1940, WADNR-HQ-10-08-09-022447): "Where Roaring Flood of Tailings Caused Havoc in Republic Gulch," *Spokesman Review* (13 July 1941, CCT1-006716); "Mine Tailings Dam at Knob Hill," *Republic News Miner* (18 July 1941): 1 (WADNR-HQ-10-08-09-022462-465); *Minerals Yearbook, 1937* (Washington, DC: GPO, 1937), 551; *Minerals Yearbook, 1938* (Washington, DC: GPO, 1938), 458-459; *Minerals Yearbook, 1939* (Washington, DC: GPO, 1939), 489; *Minerals Yearbook, 1940* (Washington, DC: GPO, 1940), 477; *Minerals Yearbook Review of 1940* (Washington, DC: GPO, 1941), 473; *Minerals Yearbook, 1941* (Washington, DC: GPO, 1943), 485; *Minerals Yearbook, 1942* (Washington, DC: GPO, 1943), 513; *Minerals Yearbook, 1943* (Washington, DC: GPO, 1945), 485, 492; *Minerals Yearbook, 1944* (Washington, DC: GPO, 1946), 471; *Minerals Yearbook, 1945* (Washington, DC: GPO, 1947), 487.

[113] *Minerals Yearbook, 1946* (Washington, DC: GPO, 1948), 1557; *Minerals Yearbook, 1947* (Washington, DC: GPO, 1949), 1533; *Minerals Yearbook, 1948* (Washington, DC: GPO, 1950), 1624-625; *Minerals Yearbook, 1949* (Washington, DC: GPO, 1951), 1597; *Minerals Yearbook, 1950* (Washington, DC: GPO, 1953), 1611; USBOM, Permanent Individual Mine Record forms for the Knob Hill mine (Plaintiff-00043464, 43466); Gerald T. Orlob and Walter W. Saxton, "A Preliminary Survey of the Sources of Mining and Mill Waste Pollution in the Upper Columbia River Basin and Lake Roosevelt," unpublished report prepared for the Washington Pollution Control Commission (c1950), 11 (Teck0025236; "Knob Hill Sand-Fill System Combats Heavy, Blocky Ground," *Engineering and Mining Journal* (November 1953, WAARCH0003544-545).

The Knob Hill mill treated about 47,000 tons of ore in 1951. Steady production at the mine and mill continued during the early 1950s, and in 1954 the company began leasing and operating the adjacent Gold Dollar property, owned by Day Mines, Inc. In 1956, the Knob Hill operation became the leading gold and silver producer in the state, a distinction it held throughout the remainder of the 1950s. Volume of ore treated reached a peak of about 71,000 tons in 1958 before falling back to about 67,000 tons in 1959 and 1960. Knob Hill continued to ship most of its concentrates to Asarco's Tacoma smelter, but it also shipped materials to the Selby and Wildberg works in the San Francisco Bay area. The company continued to direct its sand tailings to underground workings and to pump its finer slime tailings to the impoundment above the mill.[114]

Production from the Knob Hill operation increased again in the 1960s, beginning with about75,000 tons mined and milled in 1961, peaking at 85,000 in 1964, holding at about 82,000 tons for a few years, and then dropping back to about 75,000 tons in 1970. Knob Hill continued to be Washington's largest producer of both gold and silver, and the company continued to operate both its own Knob Hill mine and Day Mines' adjoining Gold Dollar mine. Knob Hill sent its concentrates to the Selby smelter near San Francisco during the 1960s. The company continued separating its sand tailings from slimes, sending the sand tailings underground to fill mined-out stopes and sending the slimes to the tailings pond. In about 1962, Knob Hill established a new tailings pond for slimes by building an impoundment in a canyon near the mill. Some water decanted from the tailings pond was recycled back to the mill, but some water from the pond was discharged downstream, especially during spring run-off. By 1970, state pollution-regulation personnel had grown concerned with the cyanide and zinc concentrations in that run-off. The mill historically discharged waste water from its tailings ponds into Eureka Creek to reduce pressure on the dikes. The discharge was allowed under waste discharge permit No. T-3831.[115]

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[114] *Minerals Yearbook, 1951* (Washington, DC: GPO, 1954), 1614; *Minerals Yearbook, 1952* (Washington, DC: GPO, 1955), 961; *Minerals Yearbook, 1953* (Washington, DC: GPO, 1956), 1073; *Minerals Yearbook, 1954* (Washington, DC: GPO, 1957), 1121; *Minerals Yearbook, 1955* (Washington, DC: GPO, 1958), 1155; *Minerals Yearbook, 1956* (Washington, DC: GPO, 1958), 1220-221; *Minerals Yearbook, 1957* (Washington, DC: GPO, 1959), 1179; *Minerals Yearbook, 1958* (Washington, DC: GPO, 1959), 1007; *Minerals Yearbook, 1959* (Washington, DC GPO, 1960), 1071; *Minerals Yearbook, 1960* (Washington, DC: GPO, 1961), 1099; USBOM, Permanent Individual Mine Record forms for the Knob Hill mine (Plaintiff-00043462, 43464); John E. Hogan to Alfred T. Neale and George H. Hansen, memorandum dated 22 May 1956 (WAARCH0003553-554).

[115] *Minerals Yearbook, 1961* (Washington, DC: GPO, 1962), 1106; *Minerals Yearbook, 1962* (Washington, DC: GPO, 1963), 1135; *Minerals Yearbook, 1963* (Washington, DC: GPO, 1964), 1160; *Minerals Yearbook, 1964* (Washington, DC: GPO, 1965), 1178; *Minerals Yearbook, 1965* (Washington, DC: GPO, 1967), 866-867; *Minerals Yearbook, 1966* (Washington, DC: GPO, 1967), 832; *Minerals Yearbook, 1967* (Washington, DC: GPO, 1968), 841; *Minerals Yearbook, 1968* (Washington, DC: GPO, 1970), 785; *Minerals Yearbook, 1969* (Washington, DC: GPO, 1971), 793; *Minerals Yearbook, 1970* (Washington, DC: GPO, 1972), 764; USBOM, Permanent Individual Mine Record forms for the Knob Hill mine (Plaintiff-00043460, 43462); E.W. Asselstine, memoranda to the files dated 28 June 1961 and 18 August 1965 (WAARCH0003549, 3550); Howard Bunten, memorandum to the files dated 4 August 1966 (WAARCH0003543)); Warren

The Knob Hill operation started a steady decline in production during the 1970s, beginning at about 71,000 tons of gold-silver ore mined and treated at the mill in 1971, and dropping to about 39,000 tons in 1977. Day Mines, Inc. bought the Knob Hill mine and mill in 1978. Knob Hill Mines, Inc., ceased operations in February, and Day Mines commenced a drilling program to explore for more minerals. The Knob Hill property yielded about 24,000 tons of ore in 1978, 44,000 tons in 1979, and 63,000 tons in 1980. Hecla Mining Company bought Day Mines in 1981 and thereby acquired Day Mines' Ferry County properties in the Republic mining district, notably the Knob Hill property. Hecla continued operating mine and mill and commenced its own exploration program in the area. Hecla's output from the Knob Hill property continued at 56,000 tons in 1981. The ore body was expected to be exhausted in 1984, but Hecla's exploratory program discovered a new mineralized zone, called the Golden Promise. The company drove a new shaft to the Golden Promise zone, which went into operation in 1987. Hecla called the Knob Hill property its Republic Unit, and it soon became Hecla's best revenue producer. In 1989, Hecla celebrated the Knob Hill property having produced its millionth ounce of gold. By this time, Hecla was pumping slime tailings from the mill to a third tailings impoundment located above the mill and roughly midway between the other two. Hecla ceased mining at its Republic Unit in 1995.[116]

In addition to tailings discharged from the Knob Hill mill into tributaries of the Columbia River, Knob Hill and Hecla extracted waste rock and low-grade materials which were piled near the mine and which may have released contaminants to the environment, resulting in either a release or a threatened release of hazardous substances.

2. Republic Mills

The Republic mining district in Ferry County opened to mining in 1896 when the federal government opened the northern half of the Colville Indian Reservation to mineral entry. Prospectors quickly moved into the area, found ore rich in gold, and staked numerous claims. The ore deposits of the Republic district, however, were unlike any others known in the United States, and mine developers therefore had a difficult time finding treatment methods suitable for recovering the gold.[117] The first truly successful mill to operate in the district was Knob Hill, which began

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Myers, memorandum to the files dated 13 August 1971 (WAECY-HQ-10-07-09-007005).

[116] USBOM, Permanent Individual Mine Record forms for the Knob Hill mine (Plaintiff-00043461-460); *Wallace Miner* (13 April 1978, DNR2-027426; Hecla Mining Company, "Annual Report, 1981," p 7 (00000690); excerpt from an unidentified 1983 document, p 63 (00000692); William L. Rice to Chief, Memorandum dated 19 March 1987 (00000633); Monte Kieling and Michael R. Wickline, "Hecla Dedicates New Shaft at Knob Hill Mine," *Coeur d'Alene Press* (7 January 1987, Plaintiff-00045970); 7, map on last page (WAECY-ERO-10-05-09-021709-717); "Knob Hill," in Robert Derkey, et al, *Metal Mines of Washington – Preliminary Report* (Washington Division of Geology and Earth Resources open file report dated November 1990), 55 (Plaintiff-00013087); *Washington Geology* 20 (March 1992): 17 (Plaintiff-00047189); Hecla Mining Company, Fact Sheet for State Waste Discharge Permit, undated (CCT1-006958).

[117] Joseph B. Umpleby, *Geology and Ore Deposits of the Republic Mining District*, Washington

operating in 1937 (see previous sub-section of this report). Others had tried in earlier years but with little success. The first mill was the Patrick Clark mill (1897-1899). The last was the Blaine-Republic mill, which was operating intermittantly at the time the Knob Hill mill went into service. This section provides a brief history of several of the other mills in the Republic district.

Mills were built and operated at the New Republic mine, just south of the town of Republic, around the turn of the twentieth century. The Republic Gold Mining and Milling Company was a very well capitalized enterprise, and in 1897 it built a mill, sometimes called the Patrick Clark mill after one of the investors in the company, in an effort to recover gold and silver from the complex ores of the district. It employed the Peletan-Clerici process, which used an electric current in addition to cyanide to separate gold and silver from the ore. The attempt was not successful. Although the ore had a fairly high grade, the mill's recovery rate was only about 50%. The company dismantled the Patrick Clark mill and replaced it with an entirely new building and array of equipment in 1900. This mill was sometimes referred to as the Republic Power & Cyanide Company mill. The new facility, featuring crushing, roasting, and leaching departments, was designed for the company by D.C. Jackling, the well-known mining engineer of Utah. His approach was to use chlorination to recover the precious metals, but it likewise did not succeed. The Republic mill treated about 21,000 tons of ore during the nine months it operated. The literature provides two reasons for the mill failing: 1) the Republic mine was not developed sufficiently to be able to supply the mill with enough ore to operated at capacity (200 tons/day), and 2) the mill charged other mines too much, so those mines were unwilling to send their ores to the Republic to be treated on a custom basis. The only way the Republic and nearby companies could make a profit was to ship high-grade oresl to smelters, which used Republic district ores as flux.[118]

The Mountain Lion mine was located in the northern part of the Republic district, north of the Knob Hill mine and north Mud Lake. The Mountain Lion Gold Mining Company built a mill in 1899 that went into operation in March 1900. Using amalgamation and cyandization, it operated until November, treating about 12,000 tons of ore, but like the two mills at the Republic mine, the Mountain Lion mill was not a success. It was recovering only 55% of the gold, which was not enough to pay costs. In 1903, the Mountain Lion added the Hendryx process (utilizing both electrical current and cyanide) to its mill, but this failed as well.[119]

Geological Survey Bulletin No. 1 (Olympia, WA: E.L. Boardman, Public Printer, 1910), 32-34, 43.

[118] M.H. Joseph, "The Republic Mine, Washington," *Engineering and Mining Journal* (hereafter *E&MJ*) 68 (16 December 1899): 726); "The New Gold Mill at Republic, Washington," *E&MJ* 70 (1 December 1900): 638 (Plaintiff-00046594); Fritz Cirkel, "Treatment Problem of the Republic (Wash.) Gold Ores," *E&MJ* 85 (1 February 1908): 246-247; Umpleby, *Geology and Ore Deposits of the Republic Mining District*, 44-45; Francis A. Thomson, "Ore-Treatment at Republic, Wash.," *Transactions of the American Institute of Mining Engineers* 43 (1913): 678-680; Herbert A. Megrew, *Details of Cyanide Practice* (New York: McGraw-Hill, 1914): 168.

[119] Cirkel, "Treatment Problem of the Republic (Wash.) Gold Ores," 246-247; Thomson, "Ore-Treatment at Republic, Wash.," 678-679.

The second decade of the twentieth century brought renewed efforts to the Republic district. Around 1910, D.W. Rathfon built a small cyanide mill near the tailings dump of the old Clark mill. He retreated the entire tailings pile, reporting a profit for his enterprise, but his mill was not equipped to crush and grind raw ore from a mine.[120] The North Washington Power & Reduction Company built a new mill in 1911 about a quarter-mile from the Jackling mill at the Republic mine. Using improved cyanization methods to treat ores from the Republic mine and custom ores, it began operating in May 1912, but the company went into receivership in 1913. The San Poil Consolidated Mining Company put a new cyanide mill into operation about a mile north of the North Washington P&R mill in 1912. It treated its own ore as well as some custom ore from the Knob Hill mine. The San Poil was the only mill operating in the Republic district in 1913, but it soon also closed. The Knob Hill Company made most of its profit by shipping ore directly to smelters. Northport Smelting & Refining bought the property of the Republic Consolidated Mining Company in 1916 and began shipping ore from the Republic mines directly to the Northport smelter, where the ores served as flux for smelting lead ores. As the 1910s ended, there were no mills operating in the Republic district, and the only producing mines, including the Knob Hill, the Republic group, and the San Poil, shipped their ores directly to smelters.[121]

The last mill to operate in the Republic district, before the Knob Hill mill began its successful run, was the Blaine-Republic Company's mill, which used the cyanide process and often operated on old tailings in the 1930s. It operated in 1934 and 1935, closed in early 1936, and then reopened late in the year, being operated by the Eureka Mining & Milling Company to treat ores from the Quilp mine. The Eureka company treated about 22,000 tons of Quilp ore at the mill in 1937 and about 10,000 tons in 1938 before the company closed and dismantled the mill in June 1938.[122]

In addition to tailings discharged from the Republic District mills into the watershed of the Columbia River, operators of the mines extracted waste rock and low-grade materials which were piled near the mines and which may have released contaminants to the environment, resulting in either a release or a threatened release of hazardous substances, such as zinc or

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[120] Sidney Norman, "Mines of the Republic District, Washington," *Engineering & Mining World* (6 July 1912): 12-4 (Plaintiff-00046-373-375); Thomson, "Ore-Treatment at Republic, Wash.," 678, 682.

[121] Norman, "The Development of the Republic District, Wash.," *E&MJ* 105 (24 August 1912): 235; Norman, "Mines of the Republic District, Washington," 235-236; Thomson, "Ore-Treatment at Republic, Wash.," 682-683; Howland Bancroft and Waldemar Lindgren, "The Republic Mining District," in *The Ore Deposits of Northeastern Washington*, 136; Norman, 194, 200-201; Ernest N. Patty, *The Metal Mines of Washington*, Washington Geological Survey Bulletin No. 23 (Olympia, WA: Frank Lamborn, Public Printer, 1921), 167-188.

[122] USBOM, *Minerals Yearbook, 1935* (Washington, DC: GPO, 1935), 352-353; *Minerals Yearbook, 1936* (Washington, DC: GPO, 1936), 217; *Minerals Yearbook, 1937* (Washington, DC: GPO, 1937), 551; *Minerals Yearbook, 1938* (Washington, DC: GPO, 1938), 458; *Minerals Yearbook, 1939* (Washington, DC: GPO, 1939), 489-490.

lead.[123]

Conclusion

A considerable volume of lead, zinc, copper, gold, and other ores have been produced in northeast Washington. Many of the mines producing ores operated concentrators to treat their ores before shipping concentrates to smelters for further treatment. These operations generated considerable volumes of waste. For example, concentrators discharged tailings containing contaminants into the Columbia River watershed. Some of the concentrators even discharged tailings directly into the Columbia River or its tributaries. Likewise, the Northport smelter discharged slag directly into the Columbia River. In addition, the mines extracted materials other than ore from their mines and set those materials aside near their mines. Such piles of mine waste and overburden also contained contaminants which could have been released.

This report is based on available information. I reserve the right to revise this report and these opinions based on additional information, if it becomes available.

[123] Region 10 START, "Mountain Lion Mine and Mill Draft Site Inspection Report," unpublished report dated September 2004, pp2-6 (CCT1-008454).

IV. Personal Background/Qualifications

As an industrial historian, I am academically trained in the history of technology and I have extensive experience in the field of industrial history, both in the context of litigation and in other applications. I earned a PhD in History and Sociology of Science from the University of Pennsylvania, and I have developed expertise in the history of technology, especially mineral processing technologies, as well as expertise in related fields, such as the history of big construction projects like bridges and dams. I have worked as a consultant since 1982, when I formed an historic preservation consulting firm, Renewable Technologies, Inc. (RTI), in Butte, Montana. Through both my academic training and my professional experiences, I have developed expertise in using the historical method.

The historical method is well-established and widely used by reputable historians in conducting inquiries and reaching conclusions. It allows historians to ask questions about the past which spring from our concerns in the present. The purpose of the historical method is to allow a historian to reconstruct, as reliably as possible, a truthful rendition of occurrences in the past. It involves developing questions to guide research, finding sources of information that allow one to answer those questions, evaluating the authenticity and credibility of the information, and then using the information to create a coherent and verifiable narrative recitation of the past. Such a work of history must include sufficient detailed references to the sources of information upon which it relies to allow a reader to evaluate the work.

In the process of my academic course work and professional experience, I have had to demonstrate my ability to use the historical method, both by evaluating the effectiveness of various other authors and scholars in applying the historical method, and by writing research reports using the historical method.

I obtained a Bachelor of Arts degree from St. Olaf College in Northfield, Minnesota, in 1971. As part of my coursework, I took classes in mathematics and the sciences; my science courses included chemistry and physics. In those classes, I was introduced to the scientific method. The scientific method involves developing hypotheses and conducting tests in a laboratory or the field to test those hypotheses. I also learned how the scientific method had evolved historically. This knowledge about the scientific method has helped me to identify problems that need to be solved, and to decide how to approach them from a scientific viewpoint, and is thus relevant to my work as a historian of technology.

I obtained a Bachelor of Environmental Design from the School of Architecture at the University of Minnesota in Minneapolis in 1975. Through that course work, I increased my general familiarity with the engineering profession with more specific knowledge about the kinds of problems that engineers face and how they solve them. I also took courses in architectural history, the history of technology, and American history, all of which provided me with important background and experience.

I then obtained a Master of Science in Historic Preservation from the Graduate School of Architecture and Planning at Columbia University in New York City. At Columbia, I took specialized courses in preservation design and American architecture. I also took graduate level

courses in the History Department. The graduate level courses in history provided my first formal introduction to the historical method. I learned the method and applied it in papers that I wrote at Columbia.

In 1990, after working for more than thirteen years in Butte, Montana, I decided to return to graduate school and work toward a PhD in the history of technology. I was accepted into the Department of History and Sociology of Science at the University of Pennsylvania in Philadelphia. The history of technology program in the Department of History and Sociology of Science is widely regarded as one of the best in the United States. Through my course work for the PhD at Penn, which I obtained in 1998, I received further training in history and the historical method. I chose to focus my scholarly work on industrial history and in particular the history of mining and mineral processing.

While at Penn, I worked as a research assistant to Professor Thomas Parke Hughes, who at one time had been Chairman of the Department of the History and Sociology of Science. One of Professor Hughes' specialties is the study of the organization and management of complex, large-scale technological systems. Through my work for Professor Hughes, and the courses that I took with him, I learned to analyze historical examples of such systems. I also received more intensive training in historical methods, research and writing. I have used this experience with Professor Hughes in my work as an expert witness.

After completing course work and passing qualifying exams for the PhD degree, I worked on my dissertation. A PhD dissertation is a work of significant and original scholarship. My dissertation is entitled "Smoke and Tailings: An Environmental History of Copper Smelting Technologies in Montana 1880-1930." I completed it in 1998. My dissertation is a historical analysis of the mining and metallurgical technologies employed by the Anaconda Copper Mining Company and its predecessors in Butte and Anaconda, and in particular the ways in which those technologies interacted with the environment. Because of my knowledge and training in history and the history of technology, I was able to understand the technologies and then to research and analyze how developments in metallurgy were related to political and legal conflicts of the time concerning the impacts of those technologies on the environment.

While a student at Penn, I prepared and presented several papers at scholarly conferences. The papers were on such topics as the history of EPA's Superfund program as a technological system, and the environmental impacts of mining and smelting. Since receiving my PhD from Penn in 1998, I have continued to present papers on these and other topics at scholarly conferences. I have revised some of the papers for publication. A complete list of my scholarly presentations and publications may be found in my curriculum vitae, attached to this report as Exhibit 1.

In addition to my scholarly training, I have considerable professional experience as an historian. In 1982, I founded the firm of Renewable Technologies, Inc. (RTI), a historic preservation consulting firm in Butte. I did some work in preservation architecture, but I moved my focus toward projects involving historical research and writing. For example, I worked on an evaluation of the historic mining town of Jardine, Montana, including a survey of the structures and landscapes that were associated with mining and processing gold and tungsten ores. I also

worked on several projects involving old mining camps where present-day mining companies wanted to resume mining. All of these projects involved research into relevant primary and secondary documents. To prepare myself for these projects, I studied relevant historical engineering texts that described such fields as the theory and practice of mining and ore processing.

During the 1980s, RTI had a contract with the Butte Historical Society to develop a master plan for the preservation and interpretation of industrial sites in Butte and Anaconda, most of which were associated with mining and metallurgical enterprises. Anaconda is the smelter city about 26 miles west of Butte. The project included researching the histories of the thirteen surviving steel head frames in Butte and their associated mine yards. It also included researching the three historic smelter sites adjacent to Anaconda. As a part of the project, I researched the corporate and technological history of the Anaconda Copper Mining Company.

During two summers while studying for the PhD at Penn, I worked for the Historic American Engineering Survey, National Park Service, researching and writing a business and technological history of the Connellsville Coke Region in southwestern Pennsylvania. The project gave me the opportunity to study large corporate combinations in the early twentieth century and to study the history of an important energy sector, that which provided metallurgical fuel to the iron and steel industry.

I also have experience as an industrial archeologist. Unlike many historians who generally derive information from written documents, archaeologists derive information through their analysis of artifacts, features, and other patterns resulting from human activities. Not all information about our industrial past was written down. Industrial archeologists supplement the written record of our industrial past with information derived from artifacts. Such artifacts may be maps, illustrations, photographs, objects produced by an industrial operation, pieces of industrial equipment, buildings that house industrial equipment, entire industrial complexes or sites, or even an industrial landscape.

I became a member of Society for Industrial Archeology in about 1980. As a result of membership in the organization, I have been able to work with others who practice in the field of industrial archeology. I have learned from their experiences about the kinds of analyses they do, and I have applied those skills in my own work. At annual meetings of the Society for Industrial Archeology, one full day is dedicated to studying industrial processes at operating industrial enterprises. The Society arranges for process tours through industrial operations, some of which are old and historic, and some of which are very modern. The purpose of these tours is to see the processes and systems of production, to talk to employees and managers, and thus to develop a better ability to understand a wide array of industrial processes. I apply these experiences when I study a particular industrial site; it makes me better able to comprehend whole systems. The information I derive from non-written sources makes me better able to understand what is described in written documents. This deeper comprehension helps me to ask more informed questions of the documents.

I served on the board of directors of the Society for Industrial Archeology for three years (1990-1993) and served as president of the organization for two years (1996-1998). Serving as

president also entailed being vice president for two years (1994-1996) and past president for two years (1998-2000).

My experience in industrial archeology has allowed me to bring to bear on my work in this case information derived from visits to several of the mining, milling, and smelting sites under investigation in northeast Washington and southern British Columbia, as well as from historic maps, historic photos, and other non-written sources. For example, my experience in industrial archeology enhanced my ability to analyze historical technical drawings concerning operations of Pend Oreille Mines and Metal Company at the Josephine mine.

As a result of my expertise in industrial archeology, Michigan Technological University offered me a teaching position at the Associate Professor level. I accepted the offer and began teaching there in January 2010. I teach courses in industrial heritage, history of technology, and environmental history in the Department of Social Sciences, which houses a graduate program in industrial archeology and industrial heritage. It is the only graduate program in industrial archeology in the U.S., offering both M.S. and PhD degrees. I am part of the group of faculty in the industrial archeology graduate program. Prior to accepting the position at Michigan Tech, I had been a lecturer at the University of Pennsylvania, the University of California at Berkeley, Montana State University, and Montana Tech.

My expertise as a historian of technology, particularly a historian of mineral processing technologies, has been employed in several cases of Superfund litigation. Two of them involved the histories of ARCO and the Anaconda Copper Mining Company. I served as an expert historian for the United States in *U.S. v. ARCO* (the Clark Fork Superfund case in Montana). My opinions in the case included estimates of the volumes of tailings produced and discharged by several silver mills in Butte and by several copper, zinc, and manganese concentrators in Butte and Anaconda. I was deposed by ARCO, but I did not testify at trial because the parties agreed to settle. I served as an expert historian for the Pinal Creek Group in *Pinal Creek Group. v. Newmont Mining Corporation, et al* (the Pinal Creek Superfund case in Arizona). I was deposed by ARCO (one of the defendants in addition to Newmont), but I did not testify at trial because ARCO and the Pinal Creek Group agreed to settle. My opinions in this case concerned the corporate relationships between the Anaconda Copper Mining Company and its subsidiaries, including the Inspiration Consolidated Copper Company.

I have worked on two cases for which I testified at trial. I served as an expert historian for the United States in *U.S. v. Asarco, et al* (the Bunker Hill Superfund case in Idaho). My expert report concerned the history of silver, lead, and zinc mining and metallurgical operations in the Coeur d'Alene mining district, including the history of how the several operations discharged and managed, both individually and collectively, the tailings produced by their concentrators in the Coeur d'Alene basin. I was deposed by Asarco and the other defendant mining companies in the case, and I testified at trial in Boise, testifying in the liability phase of the case in January 2001 and in the counter-claims phase in July 2001. Judge Lodge ruled in favor of the U.S. citing my expert testimony in his opinion.

I served as an expert historian for the United States in *U.S. v. Newmont Mining Corporation, et al* (the Midnite Mine Superfund case in the state of Washington). I was deposed

by Newmont, and I testified at trial in Spokane in July 2008. Newmont's defense was to assert that under U.S. corporate law a parent corporation is not liable for its subsidiary's actions; therefore, Newmont should not be held liable for its subsidiary's operations at the Midnite mine. In my expert report and in my testimony I showed that historically Newmont had managed its subsidiary's operations. Judge Quackenbush ruled that Newmont had managed its subsidiary's operations and so was liable under CERCLA as an operator of the Midnite mine. The judge cited my testimony in his opinion.

I have also worked on several cases in which I prepared expert reports but did not testify. I served as an expert historian for the United States in *Mobile Oil v. U.S.* (the Yellow Pine Superfund case in Idaho). My expert report concerned the history of gold, antimony, and tungsten mining and metallurgy in the Yellow Pine mining district. I was deposed by Mobile Oil but did not testify at trial because the parties agreed to settle. I served as an expert historian for the United States in *U.S. v. W.R. Grace* (the Libby Superfund case in Montana). My expert report concerned the history of vermiculite mining and asbestos contamination at Libby. I was deposed by W.R. Grace and was scheduled to testify at trial until summary judgments by the Court and concessions by W.R. Grace just prior to the trial rendered my testimony moot. The court ruled in favor of the U.S. I served as an expert historian for the United States in *TDY Holdings v. U.S.* (the Li Tungsten case on Long Island, NY). My research concerned tungsten metallurgy and industrial operations at the Li Tungsten plant. I did not complete an expert report before the parties agreed to try to settle. I testified at a mediation hearing on behalf of the United States in January 2005. The parties agreed to settle.

One other recent project also prepared me to develop expert opinions in this case involving gold mining in California. In 2000 and 2001, working under contract to the Historic American Engineering Record, I wrote a history of the Standard mill at Bodie, California, for Cal State Parks. Bodie is one of the largest ghost towns in the U.S., and the Standard mill is one of the most intact nineteenth-century stamp mills in the nation. Researching and writing the report afforded me the opportunity to familiarize myself with the history of the technologies used in mining and milling gold and silver ores in the American West.

V. Materials Considered and Methods Used

I used my training and experience in history, the history of technology, and industrial archaeology in writing my report in this matter. I began by examining some of the general histories, prepared by government agencies, of mining in northeast Washington and Canada from nineteenth century until the recent past. In order to compare these broad histories with a more detailed record of the past, I conducted preliminary research on mining in northeast Washington in *Engineering and Mining Journal*, the principal trade journal for the mining industry in the U.S., and in *Mining and Scientific Press*, another prominent trade journal for the mining industry prior to 1922. I also spent time in the field visiting several of the mine and mill sites described in this report.

While I was familiarizing myself with the broad history of mining in northeast Washington, Teck retained the services of History Associates, Inc. (HAI), to gather published

information they could find on mines and mining in Stevens, Pend Oreille, and Ferry counties. HAI also researched state and federal archives holding records generated and maintained by the Washington Division of Mines and Geology, the U.S. Bureau of Mines, and other state and federal agencies which have produced or collected pertinent holdings concerning the operations of mines, mills, and smelters in northeast Washington. HAI has copied and organized the documents it has gathered. HAI also assisted in organizing documents produced by the plaintiffs. I have been given access to and reviewed documents produced by both sides in this case.

Next I developed general chronological histories of mining and milling operations to which the State of Washington has a connection. The principal source for these chronologies was *Mineral Resources of the United States* and *Minerals Yearbook*, which are annual publications of the federal government describing activities of the mining industry in the U.S., including, in many cases, annual production at individual mines or mills. I have used these sources in previous cases and have found them to be reliable. For some of the mines and mills, like the Pend Oreille Mines & Metals operations, I was able to find additional detailed information in historical issues of *Engineering and Mining Journal* and other trade journals. I presented my expert opinions concerning milling operations based on ores produced from State lands in a separate report dated 20 September 2010.

Then I continued my research into mining and metallurgical operations in northeast Washington, examining facilities other than those described in the September 2010 report. My opinions concerning the broader spectrum of mining and metallurgical activities in northeast Washington are presented in this report, which includes sections on the facilities about which I developed opinions in the September report.

As I reviewed documents in this case, I evaluated them to make sure that the information they contained was authentic and credible. One of the key sources of information against which I compared other documents for accuracy is the Permanent Individual Mine Records (PIMR), compiled for almost every individual mine in the U.S. by the U.S. Bureau of Mines. This collection of data produced over the decades by the U.S. Geological Survey and the U.S. Bureau of Mines is a very detailed yearly accounting of ore produced by each mine, including ore shipped to smelters and ore treated in concentrators. The PIMR data sheets also show volumes of concentrates shipped and of the metals content of the ores and concentrates produced. Miners and mining companies reported this information to the federal agency so that the government could assemble and publish annual statistics on the productivity of the nation's mineral industry. The State of Washington has provided digital copies of PIMR data sheets for mines located and operated in the subject area of this litigation.

As an essential part of my work as an historian, and for purposes of serving as an expert in this matter, I organized the pertinent information I found and assembled it into my expert report, which is a narrative recitation of the research questions I answered and the conclusions I reached. The report contains appropriate citations to sources. Appropriate citation to sources is important for historians, because it allows the reader to locate the sources upon which historical conclusions rely, and then to evaluate whether the sources support the conclusions reached in the report. The footnotes in this report comprise the list of documents I relied upon.

VI. Compensation

I am being compensated by Teck as an expert witness in *Pakootas, et al, v. Teck Cominco* at the rate of $175.00/hr. for pre-trial consulting and at the rate of $265.00/hr. for depositions and trial testimony. As of 1 November 2010, I have invoiced Teck $50,945.39 for services in this case.