On the afternoon of November 5, 2015, a dam failure at an iron ore mine in Brazil flooded a small mining town with a catastrophic wave of chemical-laden sludge. The orange mud killed more than a dozen people and polluted hundreds of miles of rivers and streams before depositing into the Atlantic Ocean (Hudson-Edwards, 2016). The disaster brought renewed attention to the human and environmental risks associated with storing mine waste in large earthen dams—a practice that also occurs across the Western U.S. An engineer told the Wall Street Journal earlier this year that mine waste impoundments are among the highest-risk and largest man-made structures on Earth (Kiernan, 2016).

Overall, impoundment failures are rare—and they have become rarer in recent decades. But the disasters that have occurred recently are more likely to be categorized as “serious” or “very serious” (Bowker et al., 2015). Bowker et al. (2015) predict that 11 “very serious” and 12 “serious” impoundment failures would likely occur in mining regions throughout the world between 2010-2020, resulting in a public liability of $6 billion.
This decade has already seen massive environmental disasters related to impoundment failures. In addition to the tragedy in Brazil, a dam break at the Mount Polley copper and gold mine in Canada released more than 1.3 billion gallons of waste into surrounding streams, lakes, and drinking water sources.

The U.S. has also had notable impoundment failures, primarily at coal mining operations. The Buffalo Creek disaster in West Virginia killed 125 people in 1972 (Erikson, 1976). More recently, a coal impoundment failure in Martin County, Kentucky, polluted local waterways with more than 300 million gallons of toxic slurry in 2000 (McSpirit et al., 2007).

Natural resource extraction often involves a cleaning or preparation process that separates out “impurities” from the core mineral. The waste material, often called “tailings,” are pumped into large holding ponds or dams known as “impoundments.” The waste can sometimes include concentrations of toxic chemicals used in the washing process, as well as trace amounts of heavy metals.

Concerns about mine waste are also mounting within the scientific community. Many of the earth’s high-grade resources have already been extracted. Therefore, companies must now extract lower-quality ores that are comprised of more waste materials (Hudson-Edwards, 2016). Mine waste production is projected to increase tenfold every 33 years—while the risk of an impoundment failure is expected to increase twentyfold over the same time period (Robertson, 2011).

Despite the potential risks posed by mine waste impoundments, few sources provide an accounting of impoundments across the West.

**MINE WASTE IMPOUNDMENTS IN THE WEST**

Mining companies operate more than 200 mine waste impoundments in 52 counties across the West, according to data obtained from the federal Mine Safety and Health Administration (MSHA). This count only includes active impoundments related to metal and coal mining that are large enough to fall under MSHA’s regulation.

Impoundments are most commonly found at coal (83), copper (73), gold (37), and molybdenum (18) mining operations in the Western U.S. Other impoundments are related to zinc (2), platinum (3), silver (5), and uranium (4) mining. Figure 1 highlights counties with impoundments, and the type of mining operation that accompanies them. (If counties had impoundments related to two types of mining, they were categorized based on which type of mining was more prevalent.)
The data in Figure 1 shows that mine waste impoundments are found primarily in rural counties. The United States Department of Agriculture (USDA) classifies 41 of the 52 counties with impoundments as nonmetropolitan. The most common classification is nonmetropolitan and non-adjacent to metropolitan areas (29 out of 52 counties). Mining operations often require large swaths of land, so it’s unsurprising that they would be located in rural areas.

The remote location of impoundments may suggest that only sparsely populated areas are at-risk from environmental impacts, but impoundment failures—or even tailings leaks—can impact populations hundreds of miles away and damage environmental resources. Concentrations of heavy metals contamination have been documented in trout more than 200 miles downstream from certain mining operations (Moore et al., 1990).

Many of the West’s impoundments are located at prominent mining operations. For example, the Kennecott Copper Mine outside of Salt Lake City—the largest man-made excavation in the world—operates a 9,200-acre (or 14-square mile) impoundment north of Magna, Utah. The company completed a $500 million update of their impoundment operation in 2001, according to an educational brochure (Kennecott Copper Utah, 2007).

However, mining experts are more concerned with impoundments operated by smaller companies who may not have the financial resources to invest in the latest impoundment technology (Bowker et al., 2015).

Ultimately, it is difficult to determine the exact risks that impoundments pose to rural communities and environments in the West. The chemical characteristics of mine tailings, the design of impoundments, and geophysical factors could all play a role in determining the risk associated with specific impoundments (Vick, 1990). Further, the potential of natural disasters such as earthquakes or floods could impact impoundment stability.

NEGOTIATING EXTRACTIVE LEGACIES AND MODERN HAZARDS
In addition to the technical and scientific risks, it’s important for regulators, Extension agents, and other community leaders to understand the social dynamics that may impact risk perceptions of mine waste in resource-dependent communities.

Many communities throughout the West are proud of their resource extraction legacies—despite the environmental harms left behind. In some cases, residents advocate for mining industry renewal, even in the wake of major health problems.

For example, communities in Colorado and Utah champion the return of uranium extraction—even while dealing with numerous health problems caused by mine waste (Malin, 2015). Other research has found that residents with ties to extractive industries are slightly more likely to downplay the risks associated with waste impoundments (McSpirit et al., 2007).

Therefore, it is important to understand the social context of resource-dependent communities in the West in order to increase awareness of the risks associated with mine waste.

For example, communities may also feel frustration towards environmental regulations—as in the case of Idaho’s Silver Valley.

A manhole cover at the intersection of Bank Street and Sixth Street in Wallace, Idaho, conspicuously marks the “Center of the Universe.” The cover depicts a miner surrounded by arrows pointing to the area’s most prominent silver mines. The “center of the universe” claim pokes fun—and frustration—at
the EPA’s decision to expand a Superfund site related to historic mining operations.

Many of the Silver Valley’s prominent mines shuttered in the early 1980s—and left behind millions of tons of toxic waste from decades of resource extraction (National Academy of Sciences, 2005). The EPA identified a 21 square-mile Superfund site around the Bunker Hill mine for remediation in 1983 (Aiken, 2005). The agency later proposed a major 1,500 square-mile expansion of the site in 1998 that called for 30 more years of clean up at a cost of more than $300 million (NAS, 2005).

Former mayor Ron Gartione claimed that if the EPA could declare that Wallace was not a “good and healthy place to live” with scant evidence to the contrary, then Wallace could declare itself the center of the universe under the same logic (Marsh, 2016).

Many residents perceive the EPA’s presence in Silver Valley as a “Superfund stigma” that can damage the region’s economic prospects (NAS, 2005). Like many former mining towns, the region has attempted to capitalize on its natural amenities by transitioning to a tourism-based economy with ski resorts and biking trails.

While most of the attention in the Silver Valley centers on past extraction practices, the few mining operations left in the region continue to operate large waste facilities near communities.

A scenic overlook off of Interstate 90 outside of Mullan, Idaho, now features a tailings impoundment nestled among the majestic Rocky Mountains. According to an informational placard at the site, the impoundment was built to hold more than 2.6 million tons of waste tailings from the nearby Lucky Friday silver mine.

Data from Idaho’s Department of Water Resources (IDWR) shows that the impoundment is 120-feet high and has been classified as a “high hazard”—meaning that a breach or failure would likely lead to a loss of life and property. (The hazard classification does not account for the construction or stability of the impoundment, but it requires dam operators to file Emergency Action Plans and meet other regulatory requirements.)

In addition to the Lucky Friday impoundment, there are seven impoundments in the Silver Valley that are actively being regulated by the IDWR. The largest of those is a tailings impoundment in Osburn, Idaho, that has a normal storage capacity of 580 million gallons of mine tailings and wastewater.

While an impoundment failure is a rare event, the potential impacts may be too severe for Western communities—like those in the Silver Valley—to ignore.

Therefore, greater attention should be paid to both the past and present environmental and human risks associated with resource extraction. Extension agents, researchers, regulators, and citizens could collaborate to increase awareness of mining hazards, while addressing community concerns about local economic prospects.

“In addition to the technical and scientific risks, it’s important for regulators, Extension agents, and other community leaders to understand the social dynamics that may impact risk perceptions of mine waste in resource-dependent communities.”

PICTURED: Downtown Wallace, Idaho, a community in the Silver Valley region/P.Greenberg