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COMING TO THE SURFACE

THE ENVIRONMENT, HEALTH, AND CULTURE IN BUTTE, MONTANA

1950-2010

By

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Dissertation

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Abstract

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Coming to the Surface: The Environment, Health, and Culture in Butte, Montana
Chairperson: Pat Munday

Butte is a small town in southwest Montana that was profoundly shaped by over a century of mining and smelting activities. Today, Butte is a post-industrial city that is the focal point of America's largest Superfund site as well as the nation's largest National Historic District. There are two types of remediation occurring in Butte: environmental and cultural. Environmental remediation occurs throughout the city, most notably at the operable units of the Butte Superfund sites. This remediation does not restore the environment to its original state but instead reclaims it to a level of risk deemed acceptable by the EPA. Much like environmental remediation, community members practice acts of reclaiming history, landscape, and community. These are acts of cultural reclamation.

To understand the current interrelationship between the environment, health, and culture in Butte, it is first necessary to understand the cultural foundations. Butte is a mining town that practices mining culture. A mining culture has several characteristics: physical and/or cultural isolation; pride in resilience, toughness, and craftsmanship; strong sense of community and kin networks; distrust of institutions, politics, and positions of power; historic pride and romanticizing the past; and gender division. These cultural values are at the core of Butte's culture and heritage. These values are a basis for historic preservationists who oppose environmental remediation and promote the preservation of the historic mining landscape. This is in sharp contrast to the environmental groups that promote environmental remediation and cite elevated risk levels and potential health effects in their reasoning.

Debate about risk levels and the consequences of living in a toxic landscape do not provide answers regarding health issues, however. The community does not track disease rates and has never performed a longitudinal epidemiology study. By remaining unaware of disease rates, the community and those in positions of power are left with only opinions. As a remedy, this study set out to investigate mortality rates in Butte and compare them to the state of Montana and the United States.

This study showed that the majority of the mortality rates in Butte are greater than the state of Montana and United States rates for all disease groups, and that mortality rates fluctuate over time but are consistently elevated. It also showed that mortality rates correlate with the target systems of concern. It did not show a clear reduction in mortality rates after remediation. Several diseases, such as neurological disease, did decrease after remediation, and this potentially correlates to the extensive lead abatement program in the city.

Acknowledgements

I would like to thank the members of my committee for agreeing to be a part of an interdisciplinary study and providing a wide breadth and depth of knowledge. I would like to thank Dr. Pat Munday, in particular, for supporting me through this process and having an amazing ability to switch from a poet to an expert in environmental issues to an authority in studies of technology and science. He also reminded me that rust never sleeps. Dr. Holly Peterson provided me with the impetus to start the health study and a background in risk analysis, toxicology, and environmental impacts. Her studies of domestic pets and forest animals as bioindicators of exposure to contamination have greatly increased the knowledge of ecological receptors in metal contaminated areas. Dr. Bob Ziegler kept my poetic heart beating throughout the study. Our special topics classes on the poetics of the environment were the best experience of my academic career, and I cannot thank him enough for introducing me to Gaston Bachelard. Dr. Janet Finn opened my eyes to many of the cultural issues in the Butte community. Her works *Tracing the Veins* and *Motherlode* were a constant source of information and context. Dr. Greg Campbell provided me with a background in cultural heritage issues, particularly the cultural landscape, authorized heritage discourse, and traditional cultural properties. I found these frameworks invaluable in the understanding the interconnection of the environment, health, and culture in Butte.

I would also like to thank the Butte Health Department for its support of the health study. Dan Powers, in particular, was a champion of the study. He didn't have to stand up for me or the study in the face of bureaucracy and I am incredibly grateful that he was in my corner. Other Butte-Silver Bow departments and employees I am indebted to include the Butte Archives, Butte GIS Department, Tom Malloy, and Rick Larson. I would also like to thank the members of the Butte community groups Butte Restoration Alliance and Citizen's Technical Environmental Committee for allowing me to be a part of their ranks.

I would like to thank my friends and family for their ideas, support, input, and editing skills. Mark Peterson was my partner through this study and I couldn't have done it without him. My mother, Nancy Barry, spent countless hours helping me with the health data and understanding community values and connections. My sister, Heather Snyder, was a great source for support, interdisciplinary thinking, and ideas. Not many people can quote Mary MacLane and HIPPA laws at the same time. Rich Myers was a great editor, and I truly appreciate his willingness to deal with tight deadlines and an unconventional subject. I would also like to thank my previous employers. The good people of Heritage Research Center taught me about environmental history, law, and heritage issues and expanded my horizons greatly. I still can't believe you paid me to go to archives around the country. The Mine Waste Technology program at Montana Tech was an incredible experience of research, science, outreach, support, and education. Finally, I would like to thank my current employer, the National Center for Appropriate Technology, for their support and the opportunity to complete this study.

Acronyms

ALS	Amyotrophic Lateral Sclerosis, also called Lou Gehrig's disease
AMR	Abandoned Mines Reclamation Bureau
ARCO-BP	ARCO-British Petroleum
ATSDR	Agency for Toxic Substance and Disease Registry
BRA	Butte Restoration Alliance
BPSOU	Butte Priority Soils Operable Unit
BRES	Butte Remediation Evaluation System
CBD	Central Business District
CDC	Centers for Disease Control
COC	Contaminant of concern
CHPO	Community Historic Preservation Officer
CFWEP	Clark Fork Watershed Education Program
CTEC	Citizens Technical Environmental Committee
DPHHS	Department of Health and Human Services
EPA	Environmental Protection Agency
GIS	Geographic Information System (computer program)
HIPAA	Health Insurance Portability and Accountability Act
MDEQ	Montana Department of Environmental Quality
mg/kg	milligrams per kilogram
MRI	Montana Resources Incorporated
MS	Multiple Sclerosis
NEPA	National Environmental Policy Act
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NPL	National Priorities List
NPS	National Park Service
NRDP	National Resource Damage Program
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCP	Pentachlorophenol
PPB	Parts per billion
PPM	Parts per million
PRP	Potentially responsible party
RHPP	Regional Historic Preservation Plan
SHPO	State Historic Preservation Office
SMR	Standardized mortality ratio
URA	Urban Revitalization Agency
WPA	Works Progress Administration
µg/dL	micrograms per deciliter
µg/l	micrograms per liter

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"Invisible threads are the strongest ties."
~ Friedrich Nietzsche

1.0 Introduction

This dissertation is a truly interdisciplinary work. It is not just a melding of two similar subjects; it is a holistic investigation of the environment, health, and culture of a community living in both a Superfund site and National Historic Site in Butte, Montana. This approach incorporates environmental science, anthropology, history, public health, literature, environmental engineering, and studies of society and technology. Together, these disciplines provide a deeper understanding of the interconnection of environmental, cultural, and health issues. This study includes the investigation of cultural values and heritage issues, the extent and impact of environmental contamination and remediation, and a longitudinal epidemiology study of the area to determine potential health issues in the community.

The investigation focuses on the years 1950-2010. This allows for a sharper focus on environmental contamination and remedial actions and does not repeat the plethora of works on early Butte history. Additionally, there was a more stable, albeit declining, population in this era than in the early boomtown years of the city. This period covers the closure of underground mining in Butte and the conversion to open pit mining, and the end of mining as Butte's main economic activity.

This investigation will not include several cultural issues that are important to the community. These issues include labor history, because it was a more important cultural issue before 1950, and because it has been researched extensively by others, such as Calvert in *The Gibraltar* (1988). Gender divisions are not considered in this study in any great depth for similar reasons, and interested readers should refer to Finn's *Tracing the Veins* (1998) or Mary Murphy's *Mining Cultures* (1997) for an exploration of this issue. Early Butte history, particularly town settlement, boomtown years, and the World War I and World War II eras have also been researched extensively by other scholars and are not the focus of this study.

Butte is a community of approximately 34,500 people in southwestern Montana, located in Summit Valley. It is bound on the north and east by the Continental Divide, south by the Highland Mountain Range, and west by low hills. Silver Bow Creek, a headwater of the Clark Fork River, begins in Butte and flows westward. The town is named after a butte located in the western portion of the city, known as Big Butte, and is a part of Silver Bow County. It has a consolidated city-county government that is known as Butte-Silver Bow. The county covers a 718.31-square-mile area, and 88 % of the occupants reside within Butte city limits (Butte-Silver Bow Health Department 2011a). The largest employers in the county are the local, state, and federal governments, which account for roughly 20% of jobs. The largest private employers in the area are St. James Health Care, Northwestern Energy, Wal-Mart, Town Pump, and Montana Resources (Butte-Silver Bow 2009). The median household income in Butte is 71.6% of national, due in part to the higher levels of poverty, particularly in the older areas of town. Of the major counties in Montana, Butte-Silver Bow has the highest crime rate for the seven index crimes: homicide, rape, robbery, aggravated assault, burglary, larceny, and motor vehicle theft. It also has a high rate of domestic violence, and the occurrence of severe emotional disturbance in children between the ages of 9 and 17 is significantly higher than the national rate (Butte-Silver Bow Health Department 2011a).

The city began as a mining camp in the early 1870s, and the cultural identification as a mining community is important to this day. The climate in Butte consists of long, cold winters and brief, cool summers. The average annual precipitation in Butte is approximately 13 inches, the bulk occurring between May and June (U.S. Environmental Protection Agency 2006a). Harsh winters are a partial reason for the way neighborhoods clustered on the Butte Hill, near the mine yards. The steep, rocky terrain made it difficult to travel long distances for work, social gatherings, or commerce, and this resulted in a patchwork pattern of houses, churches, businesses, and social halls interspersed among mine yards and industrial structures-all factors that contributed to a tight sense of community. Initial settlers typically built homes in close proximity to one another and property lines were more dependent on the terrain than a typical settlement of measured lots (NPS 2006).

In 1983, the Environmental Protection Agency (EPA) designated Butte a part of the largest Superfund site in the country and then, in 2006, the National Park Service designated the Butte-Walkerville-Anaconda area as one of the largest National Historic Districts in the country. These contrasting monikers illustrate the culture's complexity, its relationship to the landscape, and the continued attempts at defining its sense of place. Indeed, Butte has been called many things. Its history is riddled with superlative claims of being the richest, hardest, ugliest, deepest, and largest. Residents often make these claims in a dissenting manner, defensively turning a negative attribute into a positive by claiming the city is, at least, the largest Superfund site or the toughest city in the state. The city's claim of infamy is so strongly embedded in the cultural consciousness, it is known, both positively and negatively, as "Butte, America." Early 20th century authors romanticized and demonized Butte as a "Wide Open Town" and "The Perch of the Devil." Subsequent generations have romanticized both descriptions. Mining companies promoted it as "The Richest Hill on Earth" and miners as the "Gibraltar of Unionism." Environmentalists call the town an environmental disaster, and the EPA and ARCO-British Petroleum promote the area as a remediation success story. Figure 1-1 shows a postcard of Butte promoting several of these themes.

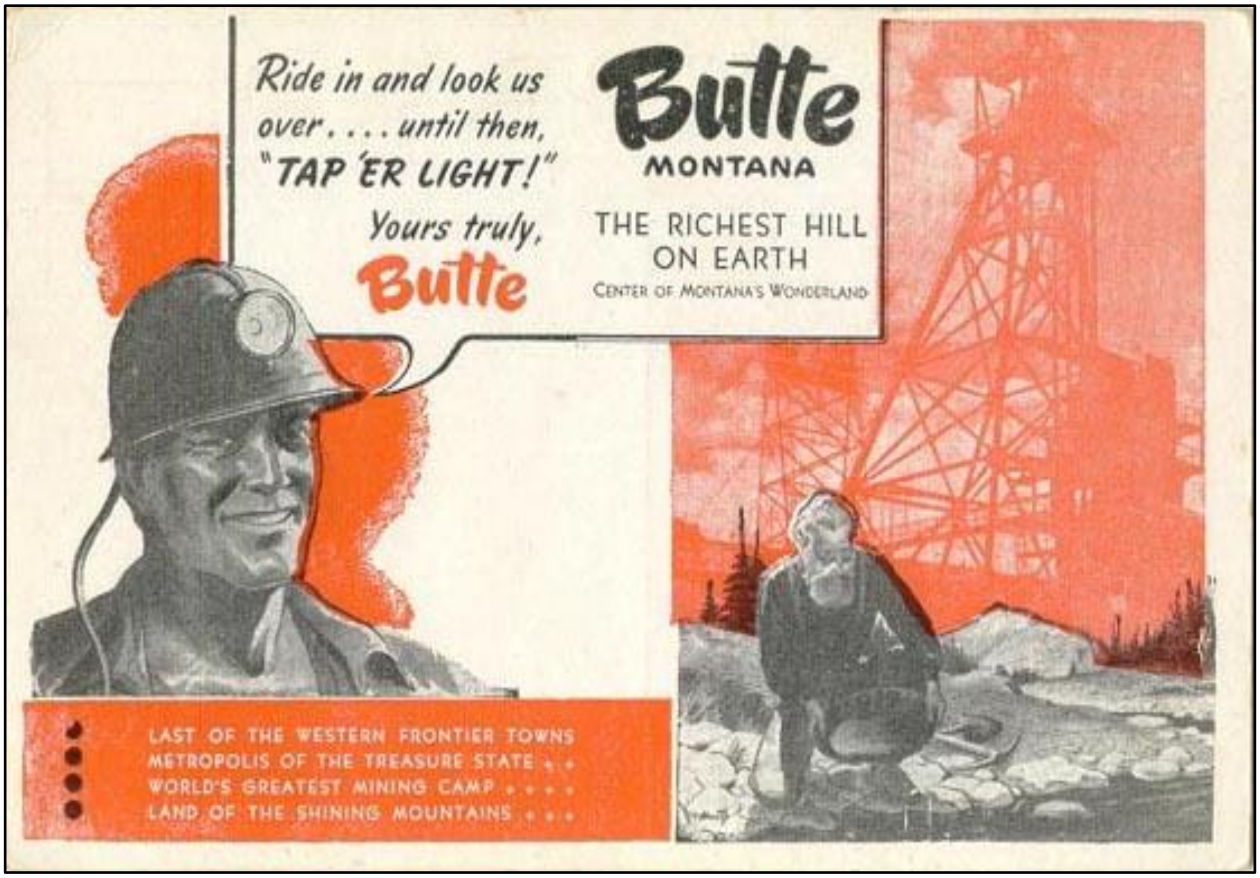

Figure 1-1. Postcard Showing Butte's Contrasting Identities

1.1 Operational Definitions

1.1.1 Environmental Contamination, Remediation, and Restoration

Environmental contamination occurs when toxic materials are introduced into the environment. These materials can cause adverse health effects to the ecosystem, including humans, and in the case of metals are persistent and do not break down into nontoxic materials naturally. In Butte, the chief contaminants are the metals deposited during mining activities. The metals, also known as heavy metals, with toxic impacts to the ecosystem are known as "contaminants of concern" or COCs. These COCs can be found throughout the Butte landscape in the form of mine waste, a blanket term for contaminated mining-operation refuse. Examples of mine waste include mine dumps, slag piles, leach ponds, tailings piles, contaminated soils and water, and metal-bearing dust from aerial deposition. Discussions of the extent of contamination and remediation activities and the toxicology of the COCs are included within this study.

To address the impacts to the ecosystem, environmental engineers employ remediation and/or restoration techniques. These two methods differ in the intent and extent of treatment. Remediation techniques aim to render the toxic material less toxic, or, in the case of a Superfund site such as Butte, to bring the level of exposure to the contaminant to an acceptable level as defined by the EPA's policies and procedures. In Butte, this type of action includes "waste in place" or "in situ" treatment, where toxic mine waste is covered or "capped" with 18 inches of nontoxic dirt. Another example is the removal of portions of mine dumps and their consolidation into a larger mine waste repository designed to minimize public exposure. The EPA and Montana Department of Environmental Quality (MDEQ) oversee remediation efforts at the Butte Superfund sites.

Restoration is the act of returning the environment to its original state. This goal requires a more in-depth cleanup and a much higher standard of soil, air, and water quality and revegetation of native species. In the Butte area, the National Resource Damage Program (NRDP), overseen by Montana's Department of Justice, is the lead agency for the restoration work. This program is chiefly funded by $24 million recovered from the former mining company's parent corporation, ARCO-British Petroleum. This company is known as the main Potentially Responsible Party or PRP (U.S. EPA 2006a). There are several other PRPs including the following:

- Burlington Northern and Santa Fe Railway
- Union Pacific Railroad
- Montana Western Railway
- Butte-Silver Bow City-County Government
- Montana Resources, Incorporated

1.1.2 Cultural
1.1.2.1 Culture

The conceptualization of culture, as it pertains to the study of the interrelation of the environment, health, and culture, is a broad umbrella that covers the meanings, meaning systems, behaviors, shared understandings, distinctive ways of life, attitudes, ideas, and symbols that shape the way the community perceives itself and the rest of the world. The theoretical basis for the conceptualization of culture draws from the fields of sociology and anthropology. Anthropologists such as Michael Brown describe culture as: "the unique mix of beliefs, practices, values, and institutions shared by members of society. Culture is an abstraction distilled from behavior and shared understandings. It serves as a shorthand way to talk about habits and attitudes that give each society a distinctive signature" (Brown 2003).

This concept was further explained by anthropologist Heather Gill-Robinson who describes culture as situation dependent and includes "any form of belief, history, archaeology, oral history, literature, art, music, skill, or traits attributable to a specific group" (Gill-Robinson 2007). Jeanette Rodriguez and Ted Fortier, an anthropologist and priest, considered culture to be a social construct that is best understood through it traditions, modes of action, ideals, images, interpersonal relations, and language (Rodriguez and Fortier 2007).

Meaning, behaviors, beliefs, practices, institutions, and shared understandings form a cultural meaning system. This conceptualization is based on an interpretation of culture as a system of meaning rather than as a system of symbols or classifications that formulate and express the culture. In this research, symbols will be considered as vehicles for cultural meaning. This is based on a framework that studies culture from the actor's point of view (Ortner 1984).

Sociologist Kai Erickson provides a useful framework for understanding culture in his work *Everything in Its Path*, a study of the cultural impact of an environmental disaster in an Appalachian mining community. In this book, he proposes the concept of an "axis of variation that cuts through the center of a culture's space and draws attention to the diversities arranged along it" (Erickson 1976). By employing this method, not only are the core values and cultural meaning system identified, so are the divergent aspects. This allows for a more diverse and encompassing understanding of a culture and the contrast of the behaviors, attitudes, and understandings of its members. According to Erickson, responses to social and cultural change occur along this axis. Conflict and contradiction also occur along this axis.

By investigating culture, we are able to better understand the significance of behaviors, meaning systems, and attitudes, and the influence and repercussions they have on the community. The conceptualization of community will have a three-pronged approach. It will include place, social interaction, and shared social and political responsibility. This approach will provide a spatial boundary (the Butte City limits), the cultural landscape, and social boundaries (such as a network of social relationships or neighborhoods), and political boundaries (Silver Bow County).

1.1.2.1 Practice

In her description of practice theory, Sherry Ortner proposed an approach in which society is a system that is powerfully constraining, but can be made and unmade through human action and interaction (Ortner 1984). Practice theory looks at the cultural values in everyday life as well as large-scale social movements and attempts to determine how social beings make and transform the world that they live in. This theory proposes that systems, such as social institutions, relations, routines, cultural categories, norms, values, relational processes, and economic arrangements shape the way people act (Ortner 1984). This socio-cultural perspective allows for a holistic approach to understand the ways in which people give meaning to their experiences, negotiate power relations, and take action.

1.1.2.2 Heritage

Heritage is an important framework in the analysis of culture. While it includes the preservation of tangible items, such as monuments and preserved artifacts, it also includes intangible items such as meaning, memory, sense of place, performance, and dissonance. As described by Laurajane Smith, heritage is a cultural practice that can manage and conserve a culture, include performance of cultural practices, and construct meaning and identity (Smith 2006). Smith made a powerful argument that all heritage is, in fact, intangible because the tangible items that are preserved are preserved because they are valued and have meaning to a community. According to Smith, "It is values and meaning that are the real subject of heritage preservation and management processes and as such all heritage is 'intangible,' whether these values or meanings are symbolized by a physical site, place, landscape, or other physical representation, or are represented within the performance of language, dance, oral histories, or other forms of heritage" (Smith 2006). By understanding the intangible meaning and values of heritage, the cultural meaning system is better understood, as are the motivations for the action of the people within the culture. Heritage also serves other purposes. Heritage creates a useable past that serves our present needs. In doing this, it connotes authenticity, integrity, venerability, and stability (Shackel 2001).

1.1.2.3 Authorized Heritage Discourse

Smith (2006) made an important distinction between authorized heritage discourse and dissenting heritage discourse, and this distinction will be employed to understand Butte heritage issues. Authorized heritage discourse focuses on aesthetically pleasing places, objects, or landscapes curated by the current generation with the intention of passing the items on to future generations that will form an identity and cultural meaning system based on this discourse. A key function of this discourse is the legitimization of the culture's spokespeople. Because conceptions of culture and the past are vague, they are most often left to experts, such as historians, archaeologists, and government groups. This reduces heritage from a community action to a set of data, texts, or objects. It also serves to disengage members of the current community from engaging with the present because they are consumed by curating the past. Another important facet of this discourse is the belief that all heritage is innately good and valuable. The belief that heritage is necessarily positive and good, as defined by the dominant discourse, serves to silence the alternative discourse. By devaluing negative aspects, these aspects are delegitimized and may be at risk of being forgotten by the culture. The authorized heritage discourse framework is similar to the hegemony and dominant meta-narrative frameworks, which describe power relations in social groups, where one class or group dominates others, particularly through discourse.

In addition to ignoring negative aspects, authorized heritage discourse often ignores all but the dominant social class and promotes the experience and values of the dominant social class. By focusing on one class, one memory, and potentially one site or type of historic site, heritage is compartmentalized and becomes easily manageable by experts and the ruling class. However, by employing frameworks such as the cultural landscape described later in this report, a broad range of discourses are brought to the surface.

As noted by Smith, mining companies are often the purveyors of authorized heritage discourse in mining communities[1]. Dissenting heritage discourse, on the other hand, is the practice of creating alternative meanings for cultural practices, tangibles, and the past. Dissenting heritage discourse is often performed when there are many dissenting views in the culture or when a heritage or the past is foisted upon a culture by an entity outside the culture.

Nostalgia is closely linked with heritage. As noted by Shackel "nostalgia is a way to veil disharmony and the angst of progress" (Shackel 2001). Ugly portions of history are ignored, events are romanticized, and nostalgia wins out over labor disputes, gender disparity, poverty, illness, and all manner of unpleasantness.

1.1.2.4 Community Literature

Community literature, defined here as literature written by community members about the community, can preserve a culture and illuminate the meaning of cultural values. It can also describe power relations and motivations for action. Literature includes both dominant and dissenting discourse and can select cultural memories. It can create, promote, or reject nostalgia. It also appoints the authors as community spokespeople, authenticating the viewpoints expressed in the literature. Community narratives provide a resonant grasp of an individual's situation within a culture and provide detailed accounts of behaviors, ways of life, shared understandings, attitudes, ideas, and imaginings. By understanding the individual, light is shed on the culture as a whole (Charon 2006). Paul Fussell's work *The Great War and Modern Memory* was a seminal work that showed that literature can be used to express the experience and memory of large groups and cultures (Fussell 1975).

The exploration of community literature in this dissertation is in no way an exhaustive accounting of every literary work set in Butte. Rather, it is focuses on novels set in Butte that have rich imagery and illuminate connections between the culture, environment, and health in Butte.

1.1.2.5 Environmental Poetics

Gaston Bachelard was a French scientist and philosopher who began his career investigating the philosophy of the sciences and the nature of scientific knowledge. He eventually became the Chair of Philosophy at the Sorbonne in Paris. His initial inquiries led him to studies of the fundamental nature of the world around him. As a part of his inquiry, Bachelard began a study of the elements. These investigations examined the poetics of earth, air, fire, and water. Poetics, in this sense, is a broad description of the imagination and poetry, particularly the phenomenology of the poetic image. In these

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[1] This does not explain the complexity of authorized heritage discourse in Butte, however. In addition to the mining company, historic preservationists, government entities, and environmental engineers all purvey authorized heritage discourse and create a complex power dynamic.

works, Bachelard placed imagination before reason and science because he felt that a philosophical inquiry into a subject "necessarily requires a complete philosophical study of poetic creation" (Bachelard 1969). He based this conclusion on his belief that the poetic image is the origin of imagination and, subsequently, reality[2]. By understanding the poetics of the fundamental elements in the world around him, Bachelard attempted to understand the origin of the world itself. Applied to a study of Butte's industrialization, contamination, and environmental recovery, this line of inquiry provides a deeper understanding of the community's interaction with the elements and the elemental reaction of the world. It is used in this study as a means to interpret the community literature in Butte.

1.1.2.6 Memory

Individual and cultural memories play an important part in heritage. According to Rodriguez and Fortier (2007), the power of memory stems from the conscious decision of a culture to select certain memories and give them a more prominent place in the culture. By affirming one version of a memory, the power is placed in the hand of the portion of the culture that developed and believes the memory. After the memory is passed through the culture into subsequent generations, it can attain the power of myth or even sacred status.

Because cultural memories are transmitted through different institutions, there can be a conscious effort by parts of the community to subvert the dominant memory. This allows the collective memory to not rely solely on professional historical scholarship, government entities, or institutions; but also allows for contributions by families, friends, and special-interest groups. Smith (2006) sees memory as a cultural act of remembering and forgetting that constructs the culture's conception of the world. The continual re-creation of the past serves the present by giving meaning, context, legitimization, and power. While it is shaped by the dominant discourse of the present, alternative discourse can enter the memory as cultural values change.

1.1.2.7 Cultural Landscape

A cultural landscape can be used to better understand the interaction between people and place, particularly highlighting spaces where community members derive a part of their cultural identity (King 2003). Cultural landscapes can also show how a community perceives, modifies, and interacts with its environment. The interconnection of themes throughout a landscape can be more significant than a single salient feature (Altschul 2005). In this study, the cultural landscape entails a visual perimeter of the city and includes cultural, commercial, residential, industrial, and recreation areas used by the community.

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[2] This belief is also explored in the Greek notion of "poiesis". Interested readers should also reference Martin Heidegger's work "Questions Concerning Technology" for an understanding of poiesis and its application to technology (Heidegger 1977).

A cultural landscape provides a framework to understand the interconnection of social and environmental issues. Environmental issues, such as contamination, have social ramifications in the way the contamination affects the health, positions of power, economy, perception, and beliefs in the community. It also influences heritage issues in the spaces where the cultural landscape is threatened by change from environmental remediation or degradation. Cultural preservation can, in turn, influence this remediation or degradation and consequently have an impact on environmental health issues.

1.1.2.8 Traditional Cultural Properties

Traditional cultural properties are places that are eligible for the National Register and are associated with the cultural practices of a living community, which are both a part of the community's history and important in maintaining the cultural identity. By definition, traditional cultural properties contain one or more of the following five qualities: spiritual power, practice, stories, therapeutic quality, and remembrance (King 2003). In this study, these properties were identified and used as a framework to better understand the cultural landscape and the interconnection of themes throughout the landscape.

1.1.2.9 Designations

Designations, such as being included in the Nation Historic Landmark Program, serve as an authentication of significance to a historic place (Little 2005). These designations shape the public perception of the place, including the persons residing within it. Cultural meaning systems often include a sense of place. This sense includes the construction of position in both the physical and social world. In addition to providing a physical anchor in a geological space, it also allows for the negotiation of social value and cultural identity (Smith 2006). In Butte, two main designations set the stage for sense of place conflict: the National Historic Landmark designation and the Superfund designation. As noted by Brown (2003), cultural conflict can cause cultural items to become more valuable to a community. This study will include an investigation into the nature of this conflict as well as the repercussions of the conflict on cultural meaning systems and health issues.

1.1.2.10 Additional Places of Cultural Significance

In addition to traditional cultural properties, there are several other places in Butte that are considered significant to the cultural identity of the community but cannot be considered traditional cultural properties because they are not old enough to be considered eligible for the National Historic Register, no longer exist, or because they do not meet one of the five criteria set forth by King. It is interesting to note that several of the features lie outside of the mining district and greatly expand the cultural landscape from the Butte Hill, to the approximate size of the contemporary community. A large majority of these are natural features that are used for social gatherings, recreation, landmarks, and sacred spaces.

1.1.2.11 Cultural Impacts and Environmental Epidemiology

Anthropologist Ellin Corin argued that a thorough consideration of health determinants would create a framework for understanding environmental influences in the production of health and disease (Corin 1995). By considering culture in addition to epidemiological research, Corin proposes, a researcher is able to delve more deeply into causal relationships and uncover mechanisms of influence. This framework will be applied to the understanding of the interrelationship between cultural and environmental influences and disease rates, with the intention of uncovering mechanisms of influence.

1.1.3 Health

1.1.3.1 Longitudinal Epidemiology Study

While there are several studies regarding contamination extent and remediation alternatives in Butte, there has not been an in-depth study of chronic exposure and long-term health impacts for residents exposed to a mix of contaminants in the soil, air, and water on a daily basis. Contemporary investigations into other populations that live in areas containing mine waste have shown elevated adverse health impacts, particularly in children (Hu et al., 2007; Wright et al., 2006; Mayan et al., 2006; Ferreccio et al., 2006). Of the contaminants present in elevated quantities in Butte, arsenic is a known carcinogen that can have neurological, cardiovascular, respiratory, renal, hepatic, dermal, musculoskeletal, and endocrine effects (Watson et al., 2007; Kapaj et al., 2006; Tchounwou et al., 2006; Tsuji et al., 2004; Szymańska-Chabowska et al., 2002). Aluminum, cadmium, chromium, lead, mercury, molybdenum, copper, zinc, and manganese are also present in Butte. These metals can also have toxic effects on the neurological, cardiovascular, respiratory, renal, hepatic, dermal, musculoskeletal, and endocrine systems (Aschner et al., 2007; Bressler et al., 2007; Houston et al., 2007; de Burbure et al., 2006; Järup, 2003; Lech, 2002).

To evaluate whether there are health impacts, this research included a longitudinal epidemiology study of Butte-Silver Bow County. The Butte-Silver Bow Board of Health funded a portion of this work which will be discussed in the course of this dissertation:

- Compilation and interpretation of toxicology information for the Butte area
- Compilation and interpretation of longitudinal mortality statistics for Butte
- Compilation and interpretation of health studies for Butte
- Compilation and interpretation of cultural influencing factors for mortality rates in Butte

Butte is well suited for a longitudinal epidemiology study because of its size and well-defined contamination. Additionally, the current population in Butte is relatively static, and few residents move out of the area. In fact, many residents are third or fourth generation residents (Hollis 2011, U.S. Census Bureau 2011a, U.S. Census Bureau 2011b).

The mortality data cover two time periods: 1978-1998 and 1999-2007. By analyzing mortality data for two distinct time periods, it will be possible to see potential connections between mortality rates and environmental exposure to contamination and will also show the public health effects of the widespread remediation. In addition to the general objective of performing a longitudinal mortality analysis, Table 1-1 contains four practical questions that will be addressed in this project, including the corresponding hypotheses to be tested.

Table 1-1. Longitudinal Study Questions and Hypotheses

Question	Hypotheses to Be Tested
1. What are the mortality rates in the Butte Superfund area and how do they compare to Montana and the United States?	H_0: The majority of mortality rates in Butte are less than Montana and the United States. H_1: The majority of mortality rates in Butte are greater than Montana and the United States.
2. Do the two time periods have different mortality rates in Butte?	H_0: Mortality rates in Butte do not fluctuate over time. H_1: Mortality rates in Butte fluctuate over time.
3. Can remediation be correlated to a decrease in mortality rates?	H_0: Mortality rates in Butte do not decrease after remediation. H_1: Mortality rates in Butte decrease after remediation.
4. Is there a correlation between the target systems of concern in Butte and the cause of mortality?	H_0: Mortality rates in Butte do not correlate with the target systems of concern. H_1: Mortality rates in Butte do correlate with the target systems of concern.

1.2 Materials and Methods

The research approach for the project included a literature review, creation of a series of maps, personal interviews, work with the Butte-Silver Bow Health Department, attendance of community meetings, a survey of medical professionals, and joining several community groups.

1.2.1 Literature Review

The literature review included local archival collections, community plans, annual reports of the Urban Revitalization Agency, the National Historic Landmark District Registration and its supporting documents, general histories of the city, local newspapers, contemporary magazine accounts, mining histories, environmental histories, local cookbooks, health statistics, community group newsletters, and the EPA documents and records. Research locations included the Butte –Silver Bow Public Archives, Montana Historical Society Archives, Montana Tech Library, University of Montana Library, Citizens Technical Environmental Committee Library, online government agency resources, and countless interlibrary loans.

1.2.2 Maps

To study the cultural landscape in the spatial terms, a series of maps showing neighborhoods, historic and contemporary mining locations; extent of contamination; contemporary park land, trails, and open space; historic districts and structures; and culturally significant places were created in the Geographic Information System (GIS). In keeping with the premise that the cultural landscape is continually written over by human, physical, and cultural interactions, the maps were not developed for one specific time period but were instead created to include both historic (diachronic) and contemporary (synchronic) interactions with the environment.

Maps often illustrate sites of struggle and hegemonic discourse. As noted by Edward Said, maps can function as a form of hegemonic exclusion (Said 1978). Said used the concept of "imaginative geographies" that illustrate cultures, experiences, stories, and intertwined histories (Al-Mahfidi 2011). The maps created for this dissertation are intended to illustrate community discourse, including the cultural landscape, historic preservation areas, extent of contamination, and areas of environmental remediation.

1.2.3 Community Groups

Community research included attendance of meetings of the Butte Restoration Alliance, a civic group that includes representative members of local groups involved in restoring the economy, environment, infrastructure, historic places, parks, and recreation. These meetings and relationships with group members provided a better understanding of the extent of current and future cultural values, social institutions, interaction, relations of power, government involvement and relationships, and sources of conflict. Meetings of the Citizens Technical Environmental Committee gave a background on community perceptions, engagement, interactions, and beliefs regarding environmental issues, governmental relations of power, environmental remediation methods, and efficacy of the remediation. Meetings with the Butte Board of Health, Health Department, Remediation Department, and Fire Marshall provided background regarding the impact of environmental health issues, environmental remediation issues, relationships between governmental agencies, and arson on cultural meaning systems.

1.2.4 Local, State, and National Government Agencies

Research included contacting, visiting, and collecting data and literature from several government agencies. National agencies included the EPA, Centers for Disease Control, Agency for Toxic Disease Registry, Occupational Safety and Health Administration, Department of Health and Human Services, and National Cancer Institute of Health. State of Montana agencies included the Department of Environmental Quality, Department of Health and Human Services, Department of

Health and Environmental Sciences, and Montana Historical Society Archives. Local agencies included the Butte-Silver Bow Health Department, Board of Health, GIS Department, Planning Department, Park and Recreation Department, Historic Preservation Office, Public Archives, Clerk and Recorders Office, Urban Revitalization Agency, and Fire Department.

1.2.5 Longitudinal Epidemiology Study Methods

To compile and interpret the mortality statistics in Butte-Silver Bow County, this study developed standardized mortality ratios (SMR) for all reported diseases. The mortality data for diseases in Butte-Silver Bow County, the state of Montana, and the United States were obtained from the Centers for Disease Control (CDC) WONDER database for the years 1978-1998 and 1999-2007. There are two data sets because the Centers for Disease Control began a different reporting system, ICD 10, in 1996, as a replacement for the ICD9 codes used for the 1978-1998 data. The two data sets also provide a mechanism to understand whether there were changes in mortality rates after remediation began in the Butte area.

A standardized mortality ratio is calculated by comparing the number of observed deaths from a specific disease in Butte-Silver Bow County to the number of deaths from the same specific disease in the United States as a whole. A second set of data was also developed by comparing the Butte rates to the State of Montana rates. The SMRs were determined by the following equation (Merrill 2008):

SMR = Observed Mortality Rate ÷ Expected Mortality Rate

Where the observed rate is the Butte mortality rate. The expected rate was determined by the following equation, also based on Merrill:

Expected Mortality Rate = Observed Population x Comparison Mortality Rate

Where the observed population is the population of Butte-Silver Bow County and the comparison mortality rate is the National mortality rate or the State of Montana mortality rate, depending on which group is serving as the comparison group.

The 95% confidence intervals were developed by using Merrill's equation: $\left(\sqrt{Observed} \pm \frac{1.92}{2}\right)^2$ /Expected Mortality Rate.

This method was used to answer all four hypotheses of the health study. The SMRs show whether the mortality rate in Butte is greater than the national average, whether the mortality rate changes over time, whether the mortality rate decreases after remediation of portions of the Butte Superfund area, and whether the mortality rates correlate with the target systems of concern.

1.2.6 Survey of Butte Medical Community

The research included a confidential survey of the medical community in Butte in order to afford an understanding of the perceptions of the medical community regarding environmental health, remediation, and cultural influencing factors. Survey questions regarded environmental health effects, incidence of health problems, perception of environmental remediation and action levels, risk perception, and cultural influences. Appendix D contains a copy of the survey questions. The University of Montana Institutional Review Board (IRB) approved this survey and documentation is included in Appendix D.

"We are all sons and daughters of the mine."
~ Ed Lahey

Part 1: Cultural Foundations: What Lies Beneath

To understand the current interrelationship between the environment, health, and culture in Butte, it is first necessary to understand the cultural foundations as well as the relationship of the community with the landscape and what is known about health issues in the community. This chapter provides a background on historic and contemporary mining and a brief description of the environmental impact of these mining operations. Subsequent chapters discuss environmental contamination, remediation, and health effects in much greater detail. This chapter then describes Butte in the greater context of a mining culture and describes the values associated with this culture. This framework provides an understanding of interactions with the mining landscape and the environment.

A brief history of previous health studies of the community provides a background for health issues in the community and the extent of research completed to date. The chapter concludes with an interpretation of Butte literature and the poetics of poison. This investigation of community interpretations of interactions with the environment and the associated health effects brings a deeper level of understanding of cultural values and meanings held by the community.

2.1 Historic and Contemporary Mining

Mining is very important to the economy, landscape, health, and cultural identity of Butte. Mining activity began in Butte in the 1870s with the discovery of gold, silver, and copper deposits. By 1890, copper production approached 113 million concentrated pounds per year, and Butte soon became the largest North American copper producer. In the early years of Butte mining (pre-1900), many enterprises employed a process known as heap roasting. In this process, sulfide ores were slowly burned for two to three weeks in large, layered woodpiles, often as large as a city block, to remove the sulfur from the ore. The process inundated the Butte area with metal-bearing smoke, which was often thick enough to immerse the town in darkness (MacMillan 2000). Figure 2-1 is a stereoscope image that shows smoke leaving the many smelters in the Anaconda Hill area of Butte. This area was near the present day Berkeley Pit. The residential neighborhoods of Dublin Gulch, Finn Town, and Meaderville were also in this area.

Figure 2-1. Stereograph of Smelters at the Base of Anaconda Hill (Dennis 1899)

Statistically, the city produced more metals than any other mining community in the United States. Between 1880 and 1993, the mines produced over 20.8 billion pounds of copper, 4.9 billion pounds of zinc, 3.7 billion pounds of manganese, and 855 million pounds of lead (National Park Service 2006). During the century of large-scale mining operations, over 500 underground mines (entailing 3,000 miles of workings) and several open-pit mines, including the Berkeley Pit, operated on the Butte Hill. These mines, along with several mills, smelters, and concentrators created millions of cubic yards of mine waste, which was left in the area. This waste included mill tailings, slag, waste rock, and dust from aerial deposition. This waste is often in contemporary residential areas and is mobilized during storm events (U.S. EPA 2005a). Figure 2-2 provides an example of mine waste in the residential area of Dublin Gulch. The photograph shows the Never Sweat-Washoe operations in the background and numerous piles of mine tailings and dumps among the houses. In the forefront of the photograph, children play on a mine dump as an adult watches.

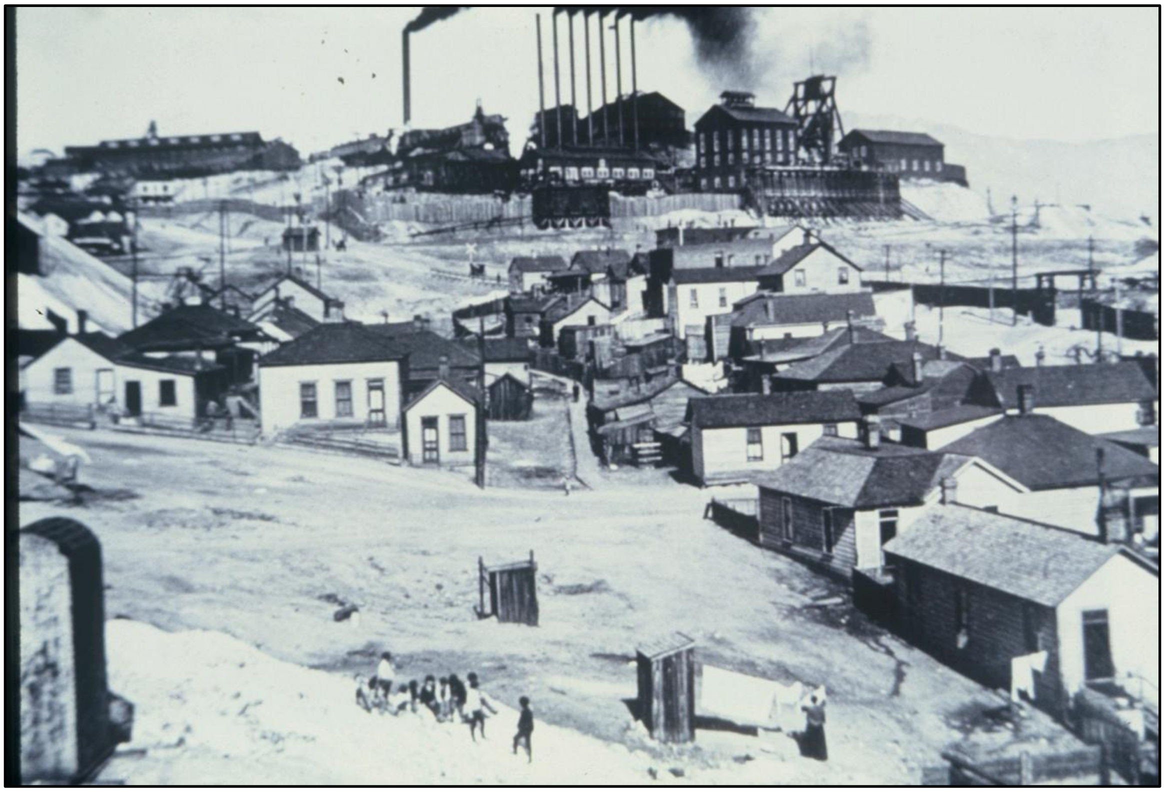

Figure 2-2. Mine Waste in Residential Areas (Butte-Silver Bow Public Archives Photo Collection 2010)

Mining activity continued in the Butte and Anaconda area throughout the 20th Century, particularly during World Wars I and II, but dwindled at the close of the 20th Century following the closure of Anaconda Copper Mining Company operations in 1982 (U.S. EPA 2006a). Currently, Montana Resources Incorporated runs a large-scale operation adjacent to the old Anaconda Company workings. Figure 2-3 shows historic and contemporary mining activity in Butte and illustrates its importance in the landscape. The Anaconda Company controlled the bulk of these operations and conglomerated the majority of mines, mills, and smelters in the district in the early 1900s.

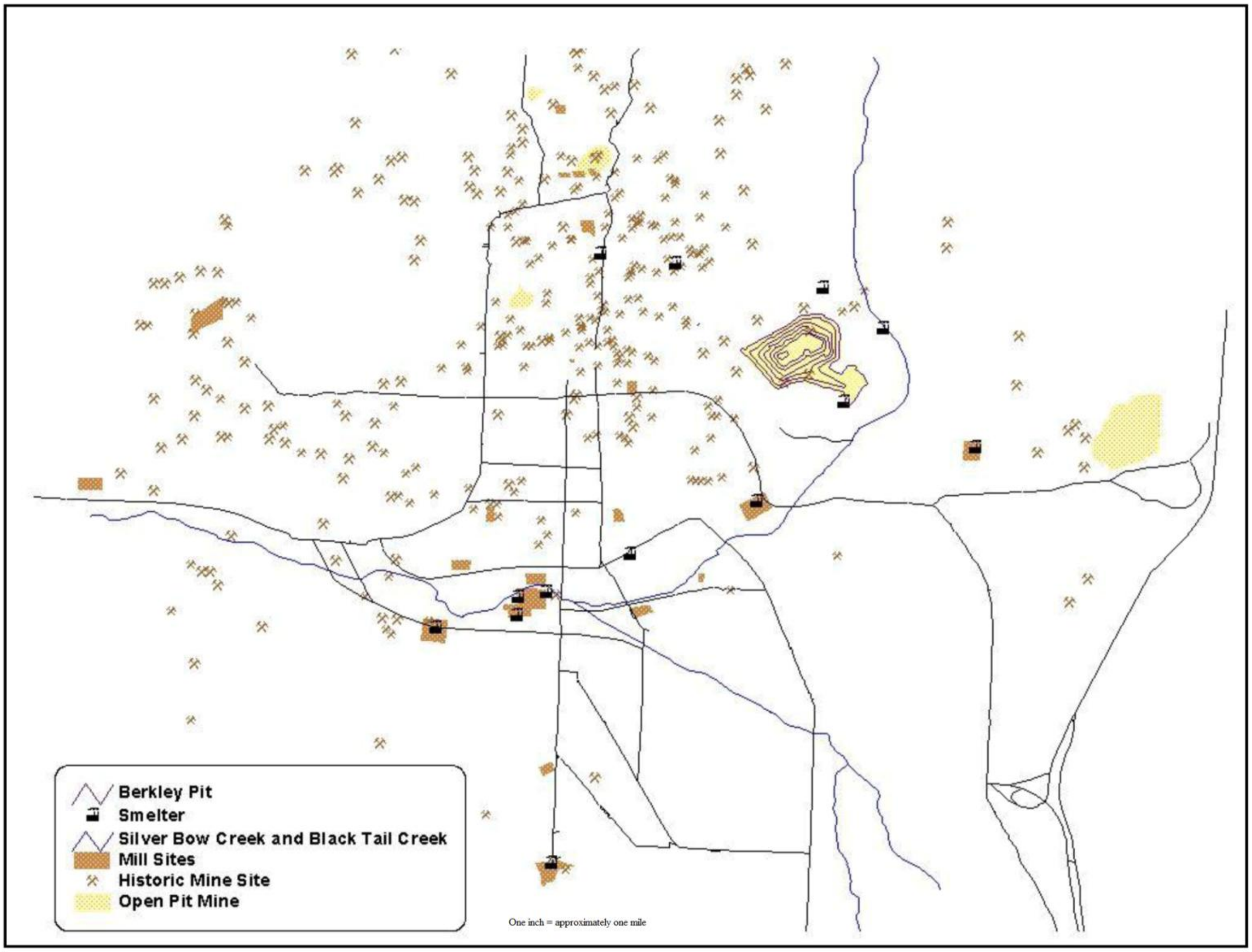

Figure 2-3. Historic and Contemporary Mining Activity in the Butte Area (Map by Author)

2.2 Environmental Impact/Overview

Environmental contamination covers the Butte landscape. Mining operations left millions of cubic yards of mine waste, including tailings, slag, smelter fall-out, and waste-rock throughout the city, often in residential and recreational areas. There is no cultural denial of the source or scale of the contamination. Undisturbed Rocky Mountain forest lands surround the residential community and provide a natural baseline. There is also a constant reminder from outsiders who express shock and condemnation of the city (Hammett 1935, Williams 1993, Dobb 1996, Mitchell 1998, St. Clair 2003). This creates an "us versus them" identity in Butte and promotes strong cultural bonds between community members (Langewiesche 2001, Dobb 2010). Butte residents are aware of the negative image of the town and realize that this image is an impediment to economic growth and diversification. It is also a deterrent to young people staying within the community, causing a breakdown of familial ties and neighborhoods. The large majority of the town does not, however, subscribe to this negative image. Instead, it employs a dissenting heritage practice by rejecting the notions of identity received by outsiders and places value on the city's history and the potential for remediation. Just as the community once held a constant faith that the future would bring untold mining wealth, it now holds an optimistic belief that the town itself will return to its former prominence (Langewiesche 2001, BRA 2007a). Community groups are at an impasse regarding environmental reclamation and preservation of the historic mining landscape, however. While environmental groups want to see the contamination removed, based on health effects associated with the contamination and the one-time nature of Superfund cleanup, historic preservation groups sometimes insist that the waste should be left in place as a historic mining landscape (RHPP 1993, Butte Restoration Alliance 2007a).

The largest physical reminder of the scale of Butte mining activities is the Berkeley Pit and its ancillary tailings ponds, mine waste dumps, and leach pads. The Berkeley Pit, shown in Figure 2-4, is the site of an open-pit copper mine that operated from 1955 to 1982. The Anaconda Mining Company dewatered the 675-acre, $1.2x10^{10}$ cubic-foot pit and associated underground mines during mining operations, but after mine closure, the company stopped dewatering operations, and groundwater from underground mine workings flooded the pit (U.S. EPA 2006a). This groundwater is connected to bedrock and alluvial aquifers and is known to affect the groundwater flow within the alluvial aquifer (U.S. EPA 2006a).

Figure 2-4 provides an illustration of the landscape surrounding the Berkeley Pit. For scale, the Berkeley Pit measures approximately 1.2 miles east to west and 1 mile north to south (Pitwatch 2005). The tailings pond located directly north of the Pit, is known as the Yankee Doodle Tailings Pond, is approximately 700 feet high and is the largest dam in Montana (State of Montana, Department of Military Affairs 2010). The EPA designated 100 acres of the area between the Berkeley Pit and the Yankee Doodle Tailings Pond as "historic mining landscape," and this area will not be reclaimed under Superfund clean-up efforts (BRA 2007a). The area east of the Berkeley Pit is the location of the Montana Resources Incorporated contemporary open-pit mining operations. The pit north of the area labeled "terraces" in the photograph is known as the Continental Pit, and it is quickly reaching the size and scope of the Berkeley Pit. The Berkeley Pit and the lands surrounding it are the former site of the Finn Town, Dublin Gulch, Meaderville, McQueen, East Side, and East Butte neighborhoods. The neighborhood south of the Berkeley Pit is known as "the Flats." Uptown Butte lies east of the Pit and this photograph shows portions of Finn Town, Centerville, and the community of Walkerville.

In 1995, 342 snow geese landed on the acidic waters of the Berkeley Pit and died from burns to their internal organs and oral cavities. This dark marker of cultural contamination is best summarized by Dobb who stated: "In each bird autopsied the oral cavity, trachea, and esophagus, as well as digestive organs, like the gizzard and intestines, were lined with burns and festering sores. To even so much as sip from the Pit, it seems, is to risk being eaten alive, from the inside out." On a tour of the area, his guide, local reclamation specialist Steve Blodgett, offered: "The pit is the receptacle of our sins" (Dobb 1996). While community members believed that the birds died as a result of being poisoned by the pit, ARCO spokespeople claimed that the birds died as a result of eating wheat fungus (Adams 1995). Subsequent autopsies found that the community members were right (Curtis 2004).

The main natural water body in the Butte valley is known as Silver Bow Creek. This creek bisects the landscape and marks the division between uptown and downtown Butte. This creek is one of the headwaters of the Clark Fork River, which eventually joins the Columbia River on its way to the Pacific Ocean. Portions of Silver Bow Creek are now referred to as the Metro Storm Drain. This drain is a man-made water conveyance used to transport storm water, mine water, and sewage. Historically, the drain was used by the Anaconda Company to convey wastewater from the Berkeley Pit. Silver Bow Creek currently begins at the confluence of the Metro Storm Drain and Blacktail Creek and becomes a headwater of the Clark Fork River (U.S. EPA 2006a). Currently, a group of community members are petitioning the State of Montana to change the name of the current Metro Storm Drain to the original Silver Bow Creek (Silver Bow Creek Headwaters Coalition v. State of Montana 2012). This is an act of contesting history and dissenting heritage discourse, as described by Smith (2006).

Figure 2-4. Aerial View of Berkeley Pit Area in Butte in 2006 (NASA 2006)

The EPA designated the Silver Bow Creek area as a Superfund site in September of 1983. It then expanded the site in 1987, when it became the Silver Bow Creek/Butte Area NPL site. This expansion did not include new mining activities (Montana Standard 1985b). The site consists of several operable units, including: Butte Priority Soils (BPSOU), West Side Soils, Streamside Tailings, Rocker Timber Framing and Treating Plant, and Warm Springs Ponds (U.S. EPA 2006a). Groundwater, surface water, soils, and inhalable dust pose a threat to human health and the environment. There is a general perception held by the community as well as the EPA and the Potentially Responsible Parties that the extent of contamination is too large, and consequently too costly, for total remediation or remediation (U.S. EPA 1994, PEER 2005, BRA 2007a, BRA 2007b, CTEC 2008).

Many soil, sediment, and water samples have been collected in the Butte area as a part of the Superfund activities in the region. The Butte Priority Soils Database was created as part of the Remedial Investigation Report for the Butte Priority Soils Operable Unit (BPSOU). The database contains concentrations of arsenic, cadmium, copper, lead, and zinc measured in approximately 2,700 soil samples collected in the Butte area. Concentrations as high as 11,900 ppm arsenic; 56,100 ppm cadmium; 138,000 ppm copper; 67,100 ppm lead; and 315,000 ppm zinc were recorded (Butte GIS Department 2006). The average and maximum arsenic concentrations from 2,739 soil samples are 214 ppm and 11,900 ppm, respectively. Reference or background concentrations of arsenic can be highly variable, but a reasonable value in soil is 7 ppm (Washington State 1994). The Record of Decision for the Butte Priority Soils Operable Unit of the Butte Superfund site (U.S. EPA 2006a) lists the following metals in elevated quantities in Butte soil, air, water, and/or house dust:

- Aluminum
- Arsenic
- Cadmium
- Copper
- Iron
- Lead
- Mercury
- Silver
- Zinc

It is important to note that there is a second Superfund Site in Butte, the Montana Pole Plant. This site operated from 1964 to 1984 as a wood-pole treatment plant that employed pentachlorophenol and other wood preservatives in southwest Butte (MDEQ 2006). The site contains several polycyclic aromatic hydrocarbons (PAHs), chlorophenols, dioxin/diobenzofurans, and metals (MDEQ 2006). Chemicals at the site include:

- 2,3,7,8-tetrachlorodibenzofuran (TCDF)
- 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)

- 2,4,6-trichlorophenol
- 2,4-dichlorophenol
- 2,4-dinitrophenol
- 2,4-dinitrotoluene
- 2-chlorophenol
- 4-chloro-3-methylphenol
- Acenaphthene
- Anthracene
- Arsenic
- Benzo(b)fluoranthene
- Benzo(ghi)perylene
- Benzo(k)fluoranthene
- Benzo(e)fluoranthene
- Benzo[a]anthracene
- Benzo[a]pyrene
- Chromium (hexavalent)
- Chrysene
- Copper
- Dibenzo(a,h)anthracene
- Dioxins/dibenzofurans
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- Lead, inorganic
- Manganese
- Naphthalene
- PAH
- Pentachlorophenol
- Phenanthrene
- Pyrene
- Zinc

Figure 2-5 illustrates the extent of contamination in Butte.

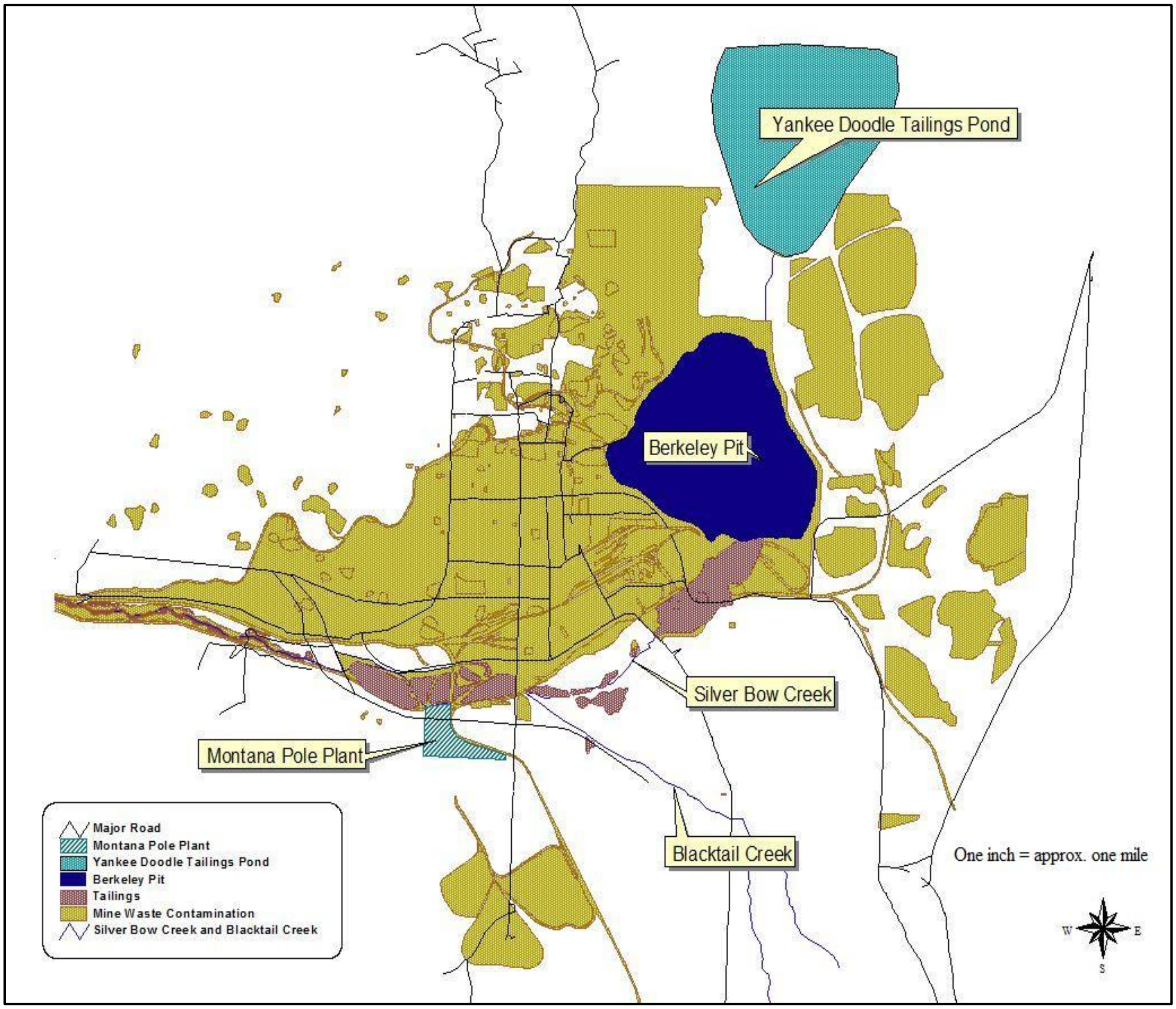

Figure 2-5. Extent of Major Contamination in Butte (Map by Author)

2.3 Cultural Background

2.3.1 Mining Culture

Mining cultures often share several characteristics (Pattinson1999, Critcher 1991, Bulmer 1978), namely:

- Physical and/or cultural isolation
- Pride in reliance, toughness, and craftsmanship
- Strong sense of community and kin networks
- Distrust of institutions, politics, and positions of power
- Historic pride and romanticizing of the past
- Gender divisions

The settlement of Butte occurred at a time when the western United States was sparsely populated and travel to the area was difficult. While railroads were quickly built once the large metal deposits proved profitable, this form of travel remained too expensive for most residents. As in many other mining communities, once residents arrived in Butte, they did not have the means to leave. The physical and social isolation of the mining landscape is also discussed in Gary Pattison's *Restructuring Culture*, a study of former mining communities. The study concludes that isolation promotes homogeneity inside the mining community, which promotes strong familial, labor, and political ties. This isolation is often forced. Once a miner, particularly one with a family, moves to an isolated mining area, he is often physically and financially incapable of moving (Pattison 1999). One mining community in Northumberland, England was built with a single road leading to it, creating a dead end. Local mine agents saw this as "necessary to breed miners as no one else would accept the work as a result of the conditions" (Pattison 1999).

While they are in isolated spaces, mining communities are often settled tightly around the mineral deposit. Francaviglia (1991) describes this dense settlement pattern as a means to huddle together and fend off the elements and concludes that this pattern promotes a sense of togetherness. This was the case in Butte's initial settlement, but after transportation such as the trolley car and the automobile developed, the settlement pattern spread out, and land use in the post-war era followed a typical 20th century American style. This calls into question whether the initial settlement was based on mining needs or transportation limitations.

Robertson sees the physical isolation and boomtown nature of the American mining camp as a reason for the high percentage of foreign labor. Many industrial North American communities, such as those in Oklahoma, Michigan, Utah, California, Arizona, Pennsylvania, Nevada, Colorado, and Montana served as a locus for European immigration in the late 19th and early 20th Centuries (Robertson 2006). In part because of Marcus Daly's patronage, thousands of members of the copper mining communities of Ireland relocated to Butte in the late 19th Century, helping to establish a strong Irish community that continues to this day (Emmons 1990).

As population increased in Montana, Butte remained culturally isolated. Many surrounding communities were agricultural or lumber-producing regions, in sharp cultural contrast to the industrial city of Butte. This distinction continues to this day, albeit in a more negative manner. The surrounding non-mining communities (there are numerous other mining operations in Montana) pass judgment on the contamination, industrial nature, and mining landscape of Butte (Langewiesche 2001). This condemnation isolates Butte from the rest of the state and the rest of the country, with the exception of other mining and industrial landscapes. This isolation has led to a strong development of community, cultural identification, and social networks. Many observations of mining communities have placed an undue amount of importance on aesthetics, such as the industrial landscape, and lack of suburban housing and amenities, and have not considered the community and culture behind the inferred ugliness of the landscape (Robertson 2006).

Mining landscapes, in contrast to more agricultural or less industrialized spaces, are often viewed as negative, exploited places where humanity has pillaged the earth. This is an example of the shock and condemnation of technology in the pastoral scene, as described by Leo Marx in *The Machine in the Garden* (Marx 1964). The conflict between social demands for industrially produced comforts and the pastoral ideal is one-sided in a mining town. The landscape forces the viewer to acknowledge the price paid for metals and coal, and a viewer socially conditioned to look for the pastoral ideal rejects the landscape and the community readily, often placing negative associations on the character of both. Robertson (2006) describes the dichotomy between this stigma and the way these landscapes function as meaningful communities and homes to mining district residents in spite of and often as a result of this stigma. To the American society, however, mining landscapes are emblematic of decay, contamination, and greed. The value ascribed to the landscape is more often a negative value.

Often, this condemnation of the landscape leads to a condemnation of the people residing within it and a tendency to ignore conditions such as blight, drug abuse, mental illness, lawlessness, and poverty because they are assumed to be a function of the mining way of life (Robertson 2006). As Robertson notes, outsiders often view mining cultures as having a "derelict land mentality," concluding that negative social issues are the result of constant interaction with a "deranged and corrupting environment" (Robertson 2006).

Mining cultures value resilience, toughness, strength, and craftsmanship. The National Summit of Mining Communities logo of "Too Tough To Die," shown in Figure 2-6, and the Yorkshire, England motto, "Only the Strong Survive" illustrate this value. Mining was tough, dangerous work that required skilled labor and miners, and the mining community valued all of these qualities. Figure 2-6 also illustrates several common themes in the mining landscape. In a dissenting discourse to the American suburban ideal, residential houses are adjacent to mine waste piles and mining operations, symbolized by the head frame. This industrial and residential mix is ringed with trees and the area is surrounded by a forest. This gives the landscape a nontoxic appearance and bucolic setting.

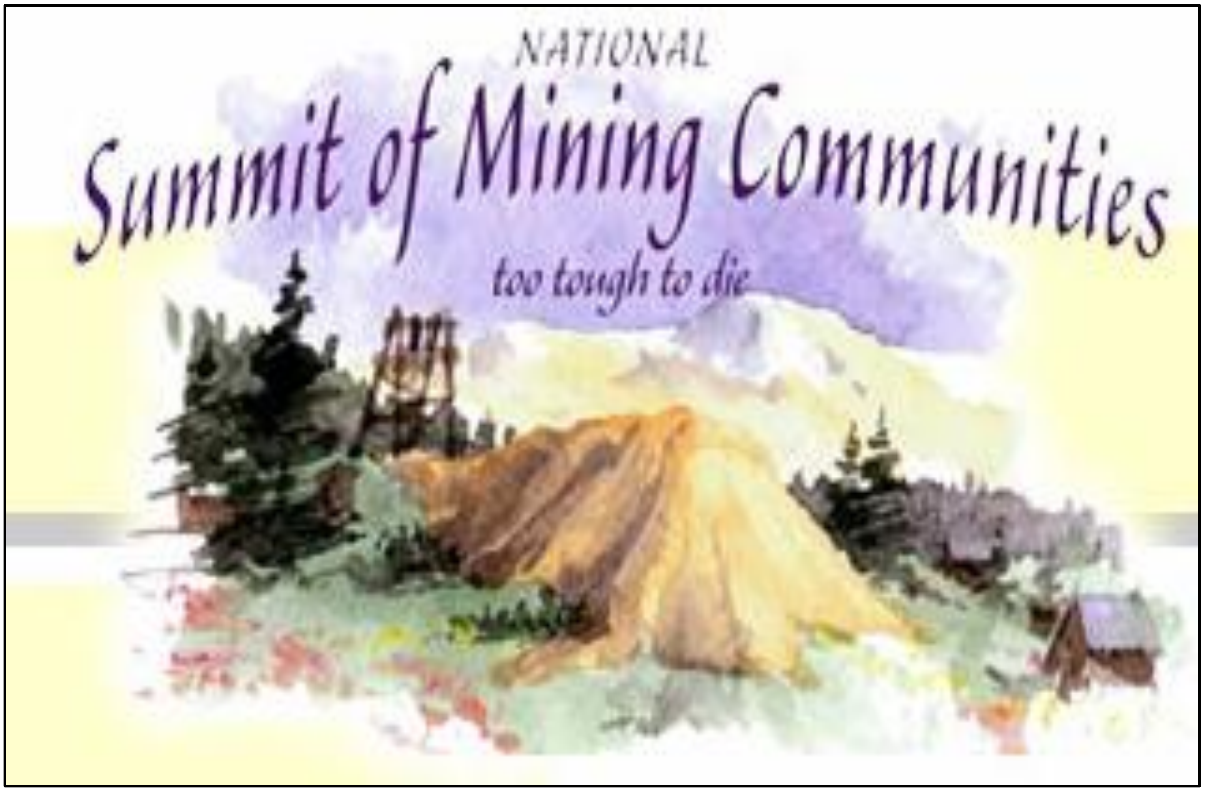

Figure 2-6 National Summit of Mining Communities Logo (National Summit of Mining Communities 2007)

The dangerous nature of mining work led to a deep sense of work camaraderie and cooperation. It also often led to a sense of hard work and hard play. During the early years of the camp, the Butte community styled itself as a "wide open town" (Brinig 1993, Murphy 1997, National Park Service 2006). The dangerous nature of underground mining attracted workers with a "high tolerance for uncertainty, physical danger, and uprootedness, men for whom the prospect of disabling injury or crushing indigence was always present, instilling in them an almost religious devotion to the pleasures of the moment"(Dobb 1996). Gambling, drinking, fighting, and prostitution flourished, owing largely to the male-dominated population and a large working class. In later years, prohibition, a greater number of women in the community, and a rising middle class did not alter this aspect of the cultural identity (Murphy 1997). Women workers in Butte were most often in the service industries and often the only source of family income during strikes. Murphy notes the excessive use of alcohol in Butte and describes early barrooms as "theatres of excessive machismo" (Murphy 1997). This machismo often manifested in fighting and translated into domestic violence away from work and socialization. This is perhaps correlated to the violent nature of mining. A study of community needs in Butte-Silver Bow describes the city as having the highest rate of domestic violence in the state and attributes this rate to the mining culture (Butte-Silver Bow Health Department 2011a). It is worth noting that lead contamination has also been linked to violent behavior, and lead is one of the contaminants of concern in Butte (Denno 1990, Needleman 2002, Dietrich 2001, Wright 2008, Stretesky 2001).

The mining economy also affected the community and culture. The community constantly hoped for mining wealth, but in reality, the boom-and-bust cycle of mining often plunged the town into poverty along with poor working conditions and adverse health effects. This cycle of gambling with the earth for financial security continues today. The dangerous nature of mining, along with low wages and constant strikes, led to strong worker and community solidarity in the form of unions, social groups, and close-knit neighborhoods. Known by labor historians as the "Gibraltar of Unionism," Butte's mines and businesses operated under a union system until the close of Anaconda Company operations (Calvert 1988, Everett 2004). During this time, the community experienced several riots, periodic strikes, mining disasters, lynching, shutdowns, and martial law (Everett 2004, Calvert 1988, National Park Service 2006). This conflict made the labor aspects of mining more culturally valuable, and they became a part of the cultural identity as a result. With the advent of the Berkeley Pit, underground miners were laid off in large quantities and were replaced by smaller numbers of truck operators. In 1975, the Steward and Mountain Con mine closures marked the end of underground mining in Butte. Financial troubles at the Anaconda Company accelerated in the early 1970s, when the Chilean government nationalized its mine in Chuquicamata, Chile (Finn 1998). The Atlantic Richfield Company (ARCO, now ARCO-BP) bought the floundering company in 1977 and shut down operations at the Berkeley Pit in 1982. ARCO closed all of its Butte workings the following year. Currently, Montana Resources Incorporated (MRI), owned by the Washington Corporation, runs a large-scale operation adjacent to the Berkeley Pit, known as the East Pit or Continental Pit, and employs approximately 350 nonunionized workers (MRI 2007).

Mining communities use the environment as a commodity and view the resultant pollution as a necessary evil (Pattison 1999). The permanent threat of mine closure and poverty created stronger focus on portable cultural capital, such as trades, stories, familial connections, remembrances, friendships, and financial resources. This is one reason for the strong sense of kinship in mining cultures. It is a highly valued cultural aspect and is often a large part of community survival, particularly after mine closure. Kinship networks promote mutual assistance, social and economic support, and shared memories and are often sources of dissenting heritage discourse (Pattison 1999). It also promotes friendliness and tolerance. This is demonstrated in Butte in its self-promotion as "the Friendly City" and the "Festival City" and residential acceptance and promotion of festivals that are free and open to the community, such as the National and Montana Folk Festivals, Evel Days, and St. Patrick's Day festivities.

The fourth characteristic is that of distrust in institutions, politics, and positions of power. This stems from historic interactions with mining companies in labor disputes, boom-and-bust cycles of operation, contamination, and, ultimately, mine closure. There is often involvement by the mining company in remediation, but a deep distrust of the company has typically occurred before this point. Distrust of institutions also stems from historical bias. Local, regional, and national governments often work directly with the mining company in operation, closure, and remediation decisions, making mining community members feel insignificant (Pattison 1999).

In a study of the mining community of Dawdon, England, there was a cynicism toward political organization and institutional leadership, and this belief saw communities members "as persons passed about, used, and abused by those in positions of power" (Pattison 1999). Pattison concluded that this distrust led the community to its current state, which was neither apathetic nor politicized, but had an outlook of antagonistic cynicism.

Like Dawdon, contemporary Butte does not have a highly politicized ideology, but it does convey a cultural memory of having one in the past. If a highly politicized ideology does exist, it is not expressed in traditional sources. The mythical period of both communities is located in the early 1900s, particularly before 1930. The romanticizing of the past in Dawdon often led to a difficulty in coping with change in the community. The idealized past became the yardstick for all future projects and stymied development.

In his description of perceiving the mining landscape, Francaviglia (1991) placed a large importance on historic preservation, landscape and memory, and visual symbolism. He states: "…before mining landscapes could be valued, however, a romanticized version of their place in history and nature had to be developed. It took a merging of prose, poetry, and art to depict the landscapes that had been left in the wake of mining" (Francaviglia 1991). In Butte, this occurred early in the town's history, in novels such as *Wide Open Town*, *The Perch of the Devil*, and *Red Harvest*. Contemporary fiction such as *Buster Midnight's Café; Mile High, Mile Deep*; and *The Thin Air Gang* are often set in the early days of the mining city and further romanticize mining and its culture in the community. This process is also described by John Evans in a study of the coal region of the South Wales valleys in England in *How Real is My Valley*? (Evans 1994). In this study, Evans describes former mining areas that were romanticized and re-imagined in Llewellyn's novel *How Green was My Valley* (1939) as theme parks, with reenactments, media presentations, and cultural centers.

Francaviglia (1991) drew a parallel between mining and war, noting that both are "regarded with nostalgia only after they are finished" and that the general public has a desire for both to be performed by someone else. Mixed with the nostalgia for mining landscapes is the perception that the landscape has been altered in a negative way. This is probably due to the toxic nature as well as the aesthetic appearance of the landscape. According to Francaviglia, one of the chief sources of the discomfort comes from the landscape reminding the viewer that actions have consequences.

Because the main reason for a mining community's existence is the occupation of mining, mine closure often leads the community to have a sense of disorder and abandonment. But because the community is part of a culture that values strength, resilience, hard work, strong social ties, and the ability to overcome and thrive in harsh physical, economic, and emotional conditions, the mining community is well suited to endure mine closure.

For the community members who chose to stay after mine closures, the shared memory of hardships is central to their cultural identity and serves as a form of dissenting heritage, while the dominant discourse says that mining communities end when the mines close. This leads to a sense of resignation and resilience, particularly in the face of contamination (Pattison 1999, Robertson 2006).

Studies of Picher, Oklahoma, and surrounding mining communities showed that after mine closure, residents focused on social and community networks, as they did in previous difficult times throughout the town's history (Robertson 1999). This also happened in Butte, when networks and ways of survival crafted during the labor strikes and mine shutdowns served as a template for community survival after mine closure. In Picher, also a Superfund site, people continued to live in the lead-contaminated landscape, to the condemnation and disbelief of outsiders. Beyond the strong sense of place, cultural values, and community ties, residents had a strong distrust of government institutions and were skeptical of the EPA findings, motives, involvement, and ability to address and remediate the contamination. A local doctor noted that there was "an undercurrent of opinion that the place wasn't worth the money being spent to clean it up" (Robertson 2006). This is also the case in Butte, where the EPA has a history of removing entire communities, such as nearby Mill Creek, because the cost of remediation exceeded the monetary value of the community. There is also a sense that the extent of contamination is too large, and particularly too expensive, to remediate or restore the landscape completely. Remediating the Berkeley Pit and dewatering the underground mines, for instance, were never considered as a remediation options, despite the impact to the landscape and community desire for this option (BRA 2007a).

In both communities there is also a lack of resolve to address the area's environmental problems. Picher has the nation's highest incidence of juvenile lead poisoning, but it took over a decade for government institutions to address long-term health effects. In Butte, residents welcomed a rigorous lead program, but other metals are largely ignored, and until this study, there has never been an epidemiologic investigation of the town (Larson 2008).

Nostalgia is closely linked with heritage. As noted by Shackel, "nostalgia is a way to veil disharmony and the angst of progress" (Shackel 2001). Ugly portions of history are ignored, events are romanticized, and nostalgia wins out over labor disputes, gender disparity, poverty, illness, and all manner of unpleasantness. This is a common occurrence in Butte documentaries and histories. There is little mention of disease, poverty, crime, gender disparity, or contamination. One documentary funded by ARCO-BP, called *Butte*, *The Original*, lionized former miners for their bravado and camaraderie, celebrated the former neighborhoods destroyed by the Berkeley Pit, and used the movie as a way to promote remediation efforts (Maney Telefilm 2010).

There are typically strong gender divisions in a mining community (Pattison 1999). While this has changed with the rest of the country's attempt to normalize gender inequalities, women do not typically work in the mining industry, and in the past they were not allowed in underground or surface mining operations. The separation between above and below ground was also a separation of gender and class in mining districts. From ancient times, women were not permitted to enter a mine or be present during the smelting process. Societal taboos most often stemmed from the fear of fertile women stealing the mine's fertility (Eliade 1978). In the smelting process, men were often required to remain abstinent because they were considered symbolic husbands and fathers of the smelting kiln (Gier 2006, Eliade 1978). Typically, mine owners and wealthy mining community members did not work or venture underground, either. In Butte, however, the wealthiest mine owners, William Clark and Marcus Daly, had worked underground early in their career and crossed this cultural divide (Malone 1981). They were not mine investors such as Hearst, Haggin, etc.; they were mine developers, an important distinction.

Finn (1998) discussed the gender disparities in the mining communities of Butte and Chuquicamata, Chile in *Tracing the Veins*. In this discussion, she described the work done by women to maintain the ordinary way of life and hold the family and community together and calls this practice "crafting the everyday" (Finn 1998). In this practice, women mobilized kin and social networks to support their families and greater community. Social groups, such as churches and women's organizations, offered material aid, often anonymously, and emotional support in times of community crisis. Women also worked extra jobs, particularly in the service industry, to make up for lost mining wages.

Murphy also described gender divisions in leisure activities in Butte during the 1914-1941 time period. Over the course of this era, women went from not being allowed in bars to attending dance halls and barrooms on their own. Women also developed unions, boarding houses, the red-light district, schools, and hospitals (Murphy 1997). Currently, women are not banned from any facet of public life, but there is a stronger presence of men in local mining operations.

2.3.2 Mining Landscape

Robertson theorized that society's view of the mining landscape can be defined as the "mining imaginary," which contains a "popular body of images that defines society's view of mining landscapes (and) represents an external view of place" (Robertson 2006). Robertson points to mining communities in the anthracite coal regions of Pennsylvania, which have a strong sense of place, as an example of the need to consider both the physical landscape as well as the intangible rewards offered by the landscape, such as meaning and sense of place.

As noted previously, mining landscapes are often condemned as spaces of dereliction and decay, without the understanding of how they function as the community's home with meaningful sense of place and symbol of heritage. Shifting focus to the intangible, as described by Smith (2006), affords a better understanding of a sense of place in Butte and other mining landscapes. The landscape serves as a constant physical reminder of community memory. Head frames (known locally as "Gallows Frames"), for example, hold layered memories of mining and the sacrifice of family members, company power, and current festivals and recreation. They are not found in nearby cities and serve as a mark of distinction for Butte residents. This function of landscape as memory keeper serves to explain the resistance to change or alteration of the landscape. The frames, named by local miners aware of the great risks associated with their profession, were used to lower miners into the underground mines and to hoist ore from the workings. This choice of place name is telling. As with other traditional cultural properties, place names are often intended as a form of storytelling, warning, and remembrance (King 2003).

The altered landscape, particularly the Berkeley Pit, serves as a reminder of the size and scale of the mining operations, the hard work, and the impact the community had on the land. Contamination strewn across the landscape has been there for generations and serves as a familiar landscape. It is interesting to note, however, that newcomers to the community sometimes function as the strongest opponent to any alterations to the landscape. Historic preservationist Mark Reavis, for example, campaigned against environmental remediation in Butte and saw the EPA as an opponent (Williams 1993). In an article regarding revitalization in Butte Reavis stated: "Odd as it may sound, these dumps are historic resources. The historic preservation community here is worried we're going to lose, bury, and cover up all signs of mining" (Williams 1993). It would be difficult, if not impossible to cover up all signs of mining, considering the size and scale of mining contamination and the number of historic mining structures throughout the Butte landscape. Several large-scale sites, such as the Berkeley Pit, were deemed technical impracticable for cleanup by the EPA and will remain untouched as mining landscape (U.S. EPA 1994).

It is important to note that all Butte residents do not agree with Reavis, as will be discussed further in the community groups section of Chapter 7. In the same article regarding revitalization, third generation Butte resident Mary Kay Craig stated: "I don't know what's likely to happen now that a ridiculously shaped thing like the Alice Knob, which is just a big mound of toxic crap, is considered a valuable historic resource" (Williams 1993).

According to Francaviglia (1991), commercial architecture in a mining town differs from that in an agricultural town in that it has a visual and architectural intensity that contributes to an urban ambiance. Francaviglia described this contrast as most noticeable in the Main Street of a mining town versus an agricultural town. In Butte, the contrast and architectural intensity, when compared to other agricultural Montana towns, are striking. It is important to note that this contrast is not just within the confines of Main Street. It can be seen in the entire Central Business District, which is now considered a National Historic Landmark. The Central Business District covers more than 40 square blocks and contains 289 close-standing masonry buildings that range from two to eight stories in height (NPS 2006). Bozeman, Montana, a comparably sized agricultural town has a Main Street area known as Downtown that covers a 5-square block area and contains approximately 78 structures, including parking lots and garages (Downtown Bozeman 2011).

Francaviglia (1991) also describes a difference between mining and non-mining architecture owing to the large percentage of single males who were dependent on other community members for goods and services. While this was the case in the initial settlement of Butte, as evidenced in the boarding houses and red-light district, women and families also shaped the Butte architectural landscape. It should be noted that the boarding houses were often run and operated by women, and women also ran restaurants from these houses (Finn 2005). The red-light district, while built for male customers, was populated by women. The Butte Miner's Union Hall was also used by women as early as 1890 for the Women's Protective Union. The local hospital was built and operated by the Sisters of Charity of Leavenworth, the same group that operated several schools in the city.

Mining landscapes also have a high density of construction, along with an emphasis on indoor social activities and a scarcity of flat space. The competition for commercial space often led to a small amount of open, public space, particularly for parks and squares. This was certainly the case in the earliest settlements in Butte. Parks, such as the Columbia Gardens and Clark's Park, were privately owned and built on the perimeter of the city once the transportation and capital to build the parks were available. There was another reason for the lack of park space, however. Before circa 1920, smoke pollution from heap roasting and smelting inside city limits was so oppressive, it had killed almost all vegetation within the city (Macmillan 2000). Today, parks dot the Butte landscape. The majority of park land occurs in the residential areas, with smaller parks on the Butte Hill and larger parks on the flat areas of town. It is interesting to note that open space within the uptown residential area is most often a former mine site and/or contamination site, and open space outside of the urban core or city limits is more often undisturbed forest (Butte-Silver Bow 2009).

Architectural density also led to more elaborate detailing of the building facades in many mining towns (Francaviglia 1991). This was certainly the case in Butte, as evidenced by the hundreds of historic buildings in the National Historic Landmark District, many based on Chicago and Beaux-Arts style architecture (National Parks Service 2006). Figure 2-7 is an example of an ornate façade at the Motherlode Theatre.[3] This figure also shows the Masonic Temple, adjacent to the theatre. A Jewish synagogue is directly behind the theatre, giving an example of the architectural density and diverse architectural styles of the area.

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[3] The Masons built the Motherlode Theatre, originally known as the Temple Theatre, and the adjoining Masonic Temple as ceremonial and recreational spaces in Beaux-Arts style architecture in 1923 (Butte Center for the Performing Arts 2011).

Figure 2-7. Ornate Façade at the Motherlode Theatre in Butte (Photo by Author)

Industrial architecture gives strong visual definition to the mining landscape. Gallows frames, former mine yards, and current mining activity dominate the uptown Butte landscape. Because the community places a large value on mining architecture, several gallows frames and pieces of mining equipment are lit to provide visual definition to the landscape even at night.

Francaviglia also discussed the importance of graveyards in the mining landscape. He notes that the location and design of the graves reveal ethnic and economic segregation in the community as well as the vernacular traditions. He views cemeteries as a microcosm of the urban environment in the mining landscape. Butte cemeteries, particularly the oldest, mirrored the city in terms of segregation into ethnic neighborhoods and economic status. The Jewish B'Nai Israel is adjacent to Mount Moriah, which was developed by Masons and Odd Fellows, and both are surrounded by Chinese cemeteries (McGlashan 2010). St. Patrick's Cemetery, directly south of Mount Moriah, is a Catholic cemetery. B'Nai Israel, Mount Moriah, and St. Patrick's all have stratifications of wealth, as seen in the ornate headstones, sculptures, and colonnades. There is very little remaining of the Chinese cemetery and no conclusions concerning economic status can be drawn.

Former miners take an active interest in preserving the mining landscape and mining heritage in Butte. Former miners lead underground tours at the World Museum of Mining and also took part in a project known as the Story Tellers Project, which included an oral history campaign and preservation work at local mine yards (Dobb 1999). Another example of former miners involved in local preservation efforts occurred when Arco began removing or destroying gallows frames. The Butte Ironworkers Union supported preserving the frames, and several members reported that they built the frames (Montana Standard 1985e). Former miners also feature prominently in film interpretations of the town's mining history, such as *Butte, America* and *Butte: The Original* (Rattlesnake Productions 2008, Maney Telefilm 2010).

2.3.3 Butte, America

In Butte's early days as a mining camp, Montana was not yet a state. By the time the state was admitted to the union in 1889, Butte was a prominent mining community and major commercial center in the West (National Park Service 2006). In these early years, workers coming from Ireland knew the city as simply Butte, America (Emmons 1990). Contemporarily, the term is used as dissenting discourse that characterizes an "us versus them" conflict with other Montana communities. While Butte was originally the locus of the state's economy, with over three-quarters of wage earners in Montana working in Butte in the early 1900s, this prominence faded as mining dwindled in the late 20th Century. The town's environmental and economic hardships quickly created an adversarial relationship with the rest of the state (Dobb 1996). As a part of this conflict, if the term "Butte, America" is used by someone inside the Butte community, it is meant as a source of pride, often in terms of the contribution to national labor and mining history; if used by someone outside of the community, it is most often meant in a disparaging way, to imply that the rest of the state does not want to be associated with the community and its wide-spread contamination. Recently, the term has been used by Butte community members as a promotional tool and is seen in advertisements for the National Folk Festival, National Summit of Mining Communities, Evel Days (a celebration of native son Evel Knievel), and the An Ri Rah Irish heritage festival.

2.3.4 The Hill and the Flats

The environmental setting of Butte created a major cultural distinction in the landscape. The town is divided into two portions, the hillside and the flatlands of Summit Valley. These sections are alternatively known as the Hill and the Flats or as Uptown and Downtown. The Hill, or Uptown, is filled with historic architecture, hundreds of mine sites, a large number of low-economic areas, and the greatest portion of environmental contamination. The Flats, or downtown, contain contemporary commercial businesses, chain stores, a mall, suburban homes, fewer mine sites, larger park lands, open space, more prosperous economic areas, and less environmental contamination.

The original Butte town site began on the Hill, among the mines and mills. The Hill itself is comprised of steep terrain with rocky gulches and outcroppings. It was common to build houses as close as possible to the mines in this area, with dwellings often jutting up against mine yard fencing. The patchwork nature of housing and mine yards led to an enmeshment of the residential and industrial landscape, and this ultimately resulted in mining contamination throughout the residential community. It also resulted in a democratic settling pattern. It is common to see a mansion alongside a row of workers cottages and commercial businesses interspersed with residences (Renne 1939). Figure 2-8 provides an example of this phenomenon.

Figure 2-8. Democratic Housing Pattern in Uptown Butte (Photo by Author)

There is a topographic and economic distinction between the north and south sides of the street in this area, however. More prominent, wealthy homes were often built on the north (uphill) side of the street, faced south, and had large retaining walls, while smaller, less expensive houses were built on the south side of the street and faced north (BSB Historic Preservation Office 1998). From a practical standpoint, the houses on the north side of street are in the sun, and the south-side houses are bathed in shadows; in winter this leads to icier sidewalks in front of the houses on the south side. Figures 2-9 and 2-10 illustrate this distinction and show the retaining walls and sunny nature of the north side and the smaller houses on the south side in shadows.

Figure 2-9. Mansions on the North Side of Granite Street (Photo by author)

Figure 2-10. Houses on the South Side of Granite Street (Photo by author)

Because the industry, commerce, and government were located on the Hill, the Flats were not densely settled until transportation, in the form of trolley cars and automobiles, became available. After the Flats settlement and the construction of the commercial strip on Harrison Avenue, the Uptown began a slow decline, particularly in the Commercial Business District area. In 1957, a four-lane interstate[4] bisected the Flats, bringing more traffic and business to Harrison Avenue and further depressing the Uptown area. In 1962, the Butte airport opened at the south end of the Flats, marking the area as the new, progressive part of the city.

The smelter district of the town lies at the boundary between the two areas, along Silver Bow Creek. As a part of remediation efforts in this area, the creek now hosts a community walking trail and bird preserve. The largest reminder of mining activity in the city, the Berkeley Pit, also serves as a boundary between the two areas.

In contrast to other late 19th and early 20th Century mining companies, the Anaconda Company did not build company houses, recreation centers, or churches and did not require shopping at a company store (Murphy 1997). While the city was responsible for its own infrastructure, it did not make infrastructure, other than ornate buildings, a priority, even in prosperous times. There were few amenities in neighborhoods, such as sidewalks, paved streets, sewers, parks, or playgrounds, until the Works Progress Administration intervened in the 1930s (Works Progress Administration 1943). While infrastructure was limited, this hands-off management approach also provided workers and their families a greater latitude in creating their cultural identity through neighborhood settlement, commercial districts, recreation, housing, schooling, labor organization, social clubs, and religious practices. It also reinforced a disregard for the environment in terms of sewers, waterlines, garbage collection, parks, trails, open space, and local outdoor recreation. This dovetailed with the environmental disregard of the mining companies, which filled the hill, valley, and waterways with mine waste.

2.3.5 The Underground

A Depression-era study of Butte by the Works Progress Administration reported: “Butte is not one, but two cities, one above and one below ground” (WPA 1943). The city below ground, known locally as the Underground, contains over 3,000 miles of underground mine workings (NPS 2006). Community memory of the underground is

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[4] After the construction of this interstate, known as I90, local leaders began lobbying for a second interstate to come through the town and serve as a junction between the east-west and north-south interstates of Montana and the United States, thereby promoting tourism and future industrial and trade prospects for the community. This interstate route was highly contentious and many other Montana communities lobbied for it. After over a decade of political debate, including the enlistment of Butte-born Senator Mike Mansfield, Interstate I15 also went through Butte, creating a “control point” for both interstates (Chittin 1971, Mansfield 1971).

seen in folk tales that range from communities that lived in the tunnels to keep warm during strikes to lemon trees growing from seeds that fell from workers lunches to (WPA 1943). Photographs such as Figure 2-11 give credence to these stories. This photograph shows both women and men, indicating a community rather than a work group. The women are in dresses and men are not in work clothes. The area is electrified and there is substantial infrastructure, such as rail lines, piping, and reinforcement beams, indicating that this is possibly a well-developed mine adit or entrance. As with mining in other countries, such as the Bolivian tin mines studied in the work *We Eat the Mines and the Mines Eat Us*, local miners held a common superstition that the Underground would kill them if it knew what they were planning (Nash 1993). To avoid this fate, workers often quit their jobs without notice (Murphy 1997).

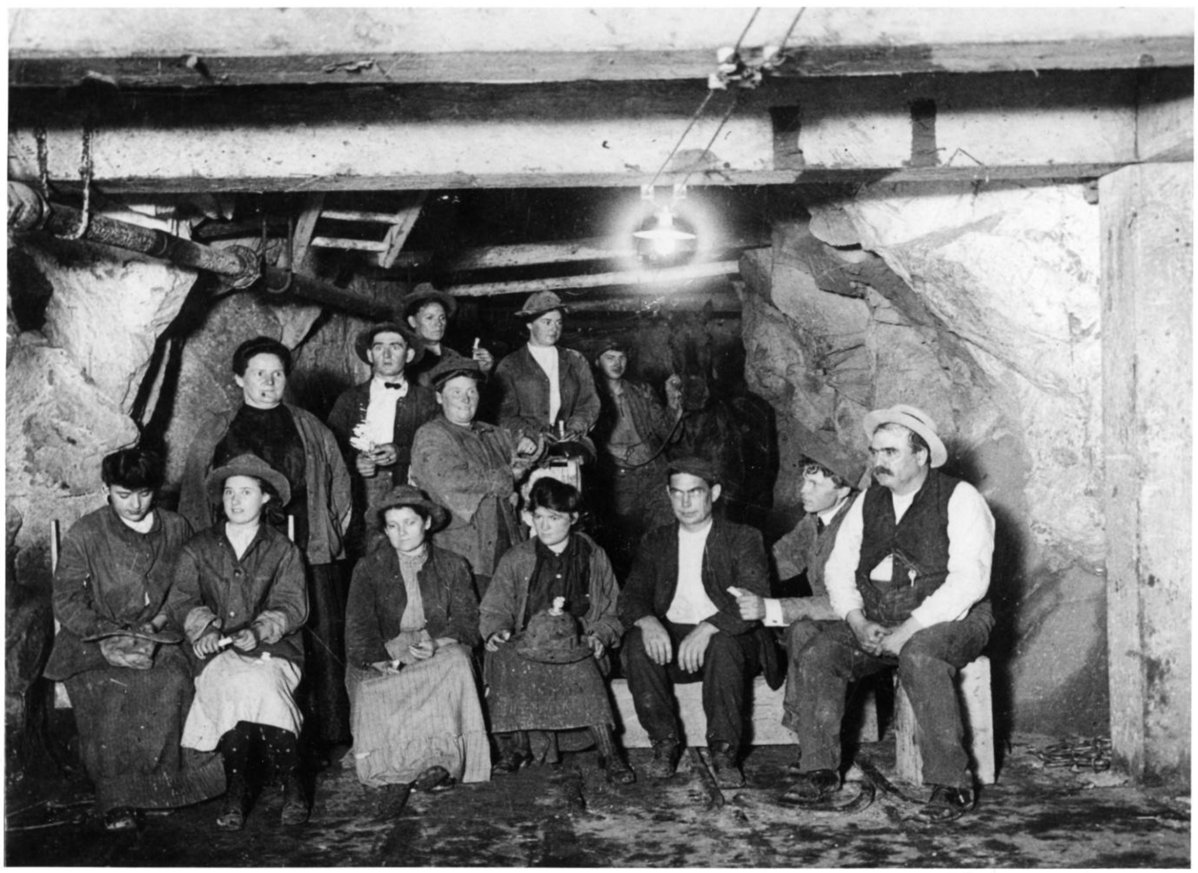

Figure 2-11. Underground Community in Butte (Butte-Silver Bow Public Archives Photo Collection 2010)

Mine workings are only a part of the Underground, however. According to local stories, tunnels connected bars, brothels, opium dens, and businesses in Uptown Butte (Finn 1998). Few of these tunnels remain; most, such as the tunnels leading from the Dumas Brothel, were filled in with sand by the city government to avoid cave-ins (Baumler 1998). Montana Tech, the local college, still maintains a system of tunnels between buildings that is heavily used in inclement weather. The Rookwood Speakeasy, one of several underground bars built during prohibition, is still in operation and employs costumed heritage workers during special events. The Central Business District employed a series of steam-power conduits to heat the large brick buildings and these conduits still exist throughout the district (National Park Service 2006). There are plans to excavate tunnels in the Central Business District for tourism and archaeological study. These excavations, as well as the speakeasy and remaining tunnels, serve as a cultural remediation of the underground city. This continued interaction with the underground shows the will of the community to remember and value this landscape.

2.3.6 Neighborhoods

Figure 2-12 aids in the understanding of the spatial nature of neighborhoods in Butte. In keeping with the concept of cultural landscape, the map is not separated into time periods and represents neighborhoods throughout the history of Butte that are still known by residents today. Neighborhood boundaries are based on National Historic Landmark District descriptions, local histories, and consultation with local residents.

At one time Butte had over 50 ethnicities (McGrath 1976). The former ethnic diversity of Butte is a source of pride to current residents. Butte's oldest neighborhoods were settled on the Butte Hill, in the western portion of the camp, near the main mine workings. Several of these neighborhoods, such as Dublin Gulch, Corktown, Finn Town, Meaderville, Centerville, Walkerville, and China Town were also based on ethnicity. These ethnic pockets were typically based on the working location of the ethnic group. Early Italians, for instance, typically worked at the Boston and Montana Company mines and smelters near Meaderville (National Park Service 2006).

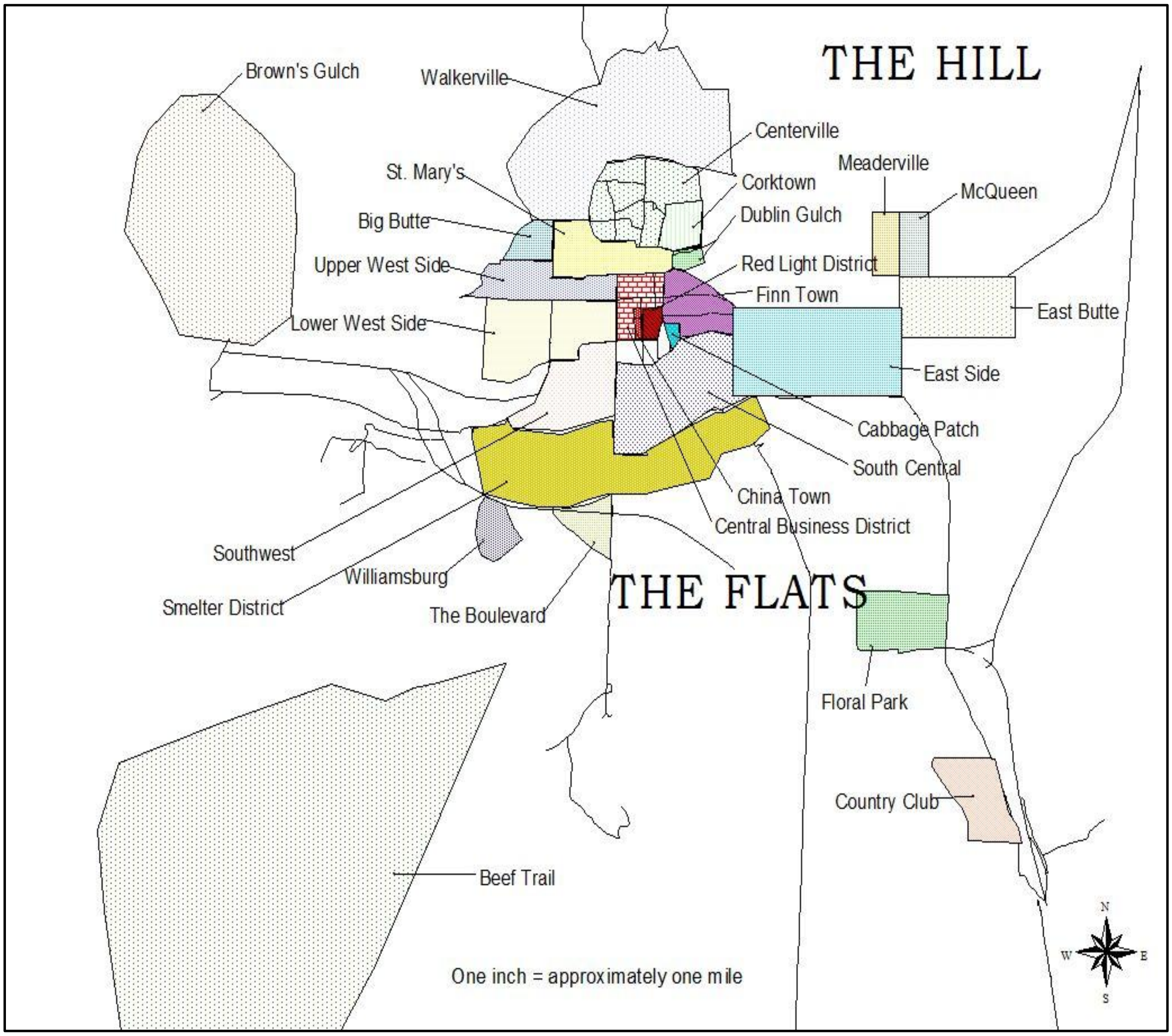

Figure 2-12. Neighborhoods of Butte

Irish and Cornish workers typically worked at Anaconda Company mines in Walkerville, Centerville, and along Anaconda Road in Dublin Gulch (National Park Service 2006). The nearby Finn Town neighborhood was comprised of Finnish workers and their families and had a substantial number of boarding houses and steam baths. The boarding houses supplied housing to single miners of any ethnicity and also sold packed lunches and meals to miners on their way to work at the nearby mines. Today, one steam bath remains in Finn Town: the Helsinki Yacht Club, named for its proximity to the Berkeley Pit. An area of Finn Town, known as the Cabbage Patch, was originally home to a Syrian/Lebanese neighborhood. Historically, this area was the most poverty-stricken neighborhood in the city and is now the site of the low-income housing project known as the Silver Bow Homes (National Park Service 2006). Early residents of the McQueen neighborhood were typically Slovenians from what was then part of the Austria-

Hungarian Empire. The neighborhood also housed English and Italians, Finnish, Swedish, Norwegian, and French communities.

The red-light district did not have an ethnic bias and was frequented by portions of the whole community, as was the nearby Central Business District. The red-light district followed the boom-and-bust cycles of the mining industry and continued operations until the last brothel, the Dumas, closed in 1982, coinciding with the closure of the Berkeley Pit operations. Today the Dumas is a museum and offers tours of the historic rooms, known as cribs. The Urban Revitalization Agency actively works to preserve historic structures in the red-light district and created a park, known as Copper Block Park, in this area to commemorate the women who worked in this district (Baumler 1998).

A large drainage, known as Missoula Gulch, blocked westward expansion of the city until it was filled in by mine waste and cinders from a fire in the Central Business District in 1879. This fire prompted a mandate from the city that required all buildings in the district to be constructed of brick or stone. As a result, a large number of the structures built after the mandate are still standing and have good architectural integrity (National Park Service 2006). Neighborhoods along Butte's Westside developed once the gulch was filled in. These neighborhoods were not based on ethnicity and contain an eclectic mix of workers houses, middle-class homes, and opulent mansions. Similarly, the midtown areas of South West and South Central were not based on ethnicity. These areas had large populations of American-born workers as well as a mixture of European immigrants (National Park Service 2006).

The second expansion of the town also included the smelter district. The smelters employed workers from a nearby neighborhood known as the Boulevard, which was comprised of Montenegrin and Yugoslavian ethnicities (National Park Service 2006, McGrath 1976). This area was also home to the majority of Butte's breweries, which were operated by German, Bavarian, and Prussian immigrants (Lozar 2006). A German neighborhood known as Williamsburg is adjacent to the Montana Pole Plant in this area. The third phase of town settlement occurred on the Flats, south of the Butte Hill.

A decline in mining forced more than half of the residents out of the city in the 1920s, draining the community of a large part of its ethnic diversity. Today, ethnic neighborhoods such as Finn Town, the Boulevard, Williamsburg, and Centerville still exist. Other ethnically based neighborhoods, such the Italian enclave of Meaderville and the Slovenian McQueen, were destroyed to make way for the Berkeley Pit.

2.3.7 Risk Perception

Environmental health issues have always been a concern in Butte. From early struggles between profits and disease rates, the manipulation of negative health effects into positive community attributes is a power relationship and example of authorized heritage discourse, as described by Smith (2006) that continues to this day. It is seen in other mining cultures as well, as previously described in the "Too Tough to Die" slogan of the National Summit of Mining Communities. This cultural value was exemplified in Butte in a fascination and identification with a dog known as The Auditor. The Auditor lived a long life, by dog standards, roaming the toxic lands that surround the Berkeley Pit. He is shown in Figure 2-13 standing near a water line running through an expanse of mine waste. Mine waste matted his long fur into dreadlocks and he shied away from local miners who fed him and attempted to rescue him from the hard surroundings. His survival in the toxic landscape served as a beacon of hope to a community living in an extension of the toxic landscape. His resilience gave the community hope that they too can beat the odds and endure (Vincent 2002).

Figure 2-13. The Auditor (Graham 2000)

An increased aptitude for risk-taking behavior, associated with mining cultures, has influenced the community's perception of risk from environmental exposure to contamination. As shown in Figure 2-14, high levels of risk were an everyday part of life in a mining culture, and this perhaps gave the people in that culture a different threshold of risk perception. Smoke and tailings did not appear as an imminent threat after a day spent packing explosives. This is exacerbated by the lack of health monitoring and limited diagnostic and treatment opportunities available in the community's rural setting.

Figure 2-14. Miners Faced High Levels of Risk in Their Day to Day Lives (Butte-Silver Bow Public Archives Photo Collection 2010)

In addition to the mining culture, the mining company also actively shaped or manipulated risk perception. The Anaconda Company owned the major daily newspaper in Butte, as well as the majority of other Montana papers, until they were sold as a group to Lee Enterprises in 1959 (Montana Standard 1959). Because of this, the Anaconda Company had control over the reporting of mine fatalities, health risks, and disease prevalence (Swibold 2006). Disease and chronic illness from exposure to contamination were rarely mentioned in the local press. While the community held the constant fear of a mining accident or a company shut-down, the dangerous and transitory nature of mining left little concern for long term health effects. As stated by a local newspaper: "The thicker the fumes, the greater our financial vitality" (Murphy 1997). The idea of financial wealth equaling physical health as a form of vitality still pervades the community.

Despite company ownership, in 1890 the editor of the *Montana Standard* newspaper launched one of Montana's first journalistic campaigns against environmental contamination. This came in response to a heavy blanket of smoke pollution that covered the valley, as a result of heap roasting and smelters in the city. This smoke was so thick and toxic that residents complained that they needed lanterns to see in the daylight. More sobering were the respiratory disease rates. Butte's rates equaled Paris and New York and were higher than London and Chicago (Swibold 2006, MacMillan 2000). The *Montana Standard*, backed by local doctors, continued to rail against the practice of open air roasting almost daily for a year, calling it a "War of Wealth against Health." A year later the city passed an order to ban open-air roasting and the *Montana Standard* declared a victory. This ban did not eliminate air pollution, however. The pollution worsened as more smelters were built to process increasing amounts of ore in and around the city.

At this same time, copper magnate William Clark gave a speech claiming that the smoke had health benefits and it served as a disinfectant for germs. He also claimed that arsenic within the smoke gave local women pale complexions he found beautiful (Murphy 1997). He also said "… although disagreeable in some respects, it would be a great advantage for other cities to have a little more smoke and business activity and less disease" (Swibold 2006).

The *Standard* newspaper took an opposing environmental stance years later when the Anaconda Company stacks in Anaconda, Montana were the subject of a lawsuit by local farmers who lost livestock and crops. The company-owned *Standard* and *Butte Intermountain* newspapers attacked these farmers and called them "smoke farmers." The *Standard* described them as "too lazy to work, preferring instead to coerce money out of the smelter through the threat of litigation." The papers also ran stories describing the Deer Lodge valley as an agricultural paradise. But when the farmers were able to document their claims, the paper changed gears and began praising the new technologies at the smelter and its increased production, concluding the land and livelihood of a few farmers could not be compared to the smelter's local, state, and national economic contribution (Swibold 2006).

The Anaconda Company was also involved in public health issues in other ways. In 1950, Anaconda constructed the Butte Community Hospital, now known as St. James, at a cost of $4.4 million and gave it to the city of Butte as a gift (Montana Standard 1989). A decade later, the Sisters of Charity started Silver Bow General Hospital on a lease from the company (Montana Standard 1960). With the advent of Silver Bow General Hospital, the older hospital was closed in 1962 (Montana Standard 1962). The Silver Bow Tuberculosis Clinic closed two years later, in 1964 (Montana Standard 1964). The public perception of the Anaconda Company as a community caretaker still endures. The 1993 Regional Historic Preservation Plan, partially funded by ARCO, states: "Since the early 1980s, state and federal pollution control and reclamation programs, plus ARCO initiative, have substantially reduced health hazards and environmental threats" (RHPP 1993).

2.4 Health

2.4.1 Previous Health Studies

A review of previous health studies helps to understand health issues faced by the Butte community. These health studies focus on the time period of this study, 1950 forward. Together, the studies detail elevated rates for several diseases, particularly cancer, and demonstrate a need for a comprehensive study of disease rates in the city over time. These studies are summarized in chronological order as follows.

2.4.1.1 Mortality from Cardiovascular and Non-Cardiovascular Diseases for U.S. Cities; 1949-1950, 1959-1961, 1969-1971 with Selected Environmental Descriptions.

This report, authored by the National Heart, Lung, and Blood Institute, Epidemiology Branch, contains data for Butte showing total mortality counts along with more detailed tables containing specification of cause, including cardio-vascular-renal, heart, non-cardio-vascular-renal, and cancer for the time periods 1949-1961 and 1969-1971. In an inventory of cities ranked by cancer mortality rates in 1950, Butte is listed as having the eighth highest mortality rate from cancer in the country. In this same list for the year 1960, Butte was ranked fifteenth (National Heart, Lung, and Blood Institute 1971).

2.4.1.2 U.S. Cancer Mortality Rates and Trends, 1950-1979

Dr. Wilson B. Riggan compiled a study of cancer mortality rates and trends for the time period 1950 to 1970. This resource contains three volumes that detail total cancer rates as well as cancer types, which are further characterized by race and gender on a county level. The study also provides cancer mortality rates for 1960-1969 and 1970-1979 as wells as percent change for each type of cancer for the 1960s versus 1950s, 1970s versus 1960s; 1970s versus 1950s; and 1970s rates. The report also highlights any cancer mortality rates that are "significantly more than expected." The cancer mortality rates with this designation for Silver Bow County are detailed below, separated by time period (Riggan, National Cancer Institute, 1983). Silver Bow County cancer deaths that occurred at significantly higher rates than expected are as follows:

1950-1959

- all cancers in white males
- all cancers in white females
- cancer of the large intestine in white females
- liver and gallbladder cancer in white males
- cancer of the trachea, bronchus, and lung in white males
- cancer of the trachea, bronchus, and lung in nonwhite females
- connective and soft tissue cancer in white females
- leukemia in nonwhite males
- secondary site and previously unlisted cancers in white males
- secondary site and previously unlisted cancers in white females

1960-1969

- liver and gallbladder cancer in white males
- cancer of the trachea, bronchus, and lung in white males

1970-1979

- all cancers combined in white females

- salivary cancer in white females
- rectal cancer in white males
- liver and gallbladder cancer in white females
- pancreatic cancer in white females
- cancer of the nose, nasal cavities, middle ear, and accessory sinuses in white females
- cancer of the trachea, bronchus, and lung in white females
- connective and soft tissue cancer in nonwhite males
- bladder cancer in nonwhite females
- kidney cancer in nonwhite males
- Hodgkin's Disease in white females
- multiple myeloma in nonwhite males

This study shows a clear negative health issue in Butte. The cancer rates are significantly higher than expected in all cancer, internal organ cancers, and in many other sites. The elevated rates are consistent over time, indicating a chronic cause. It is also seen in both males and females, indicating that the source does not stem from exposure to work in the mine, which was almost exclusively done by men.

2.4.1.3 Mutagen Screening in an Isolated High Lung Cancer Area of Montana, June 1979

The Montana Department of Health and Environmental Science conducted a mutagen screening study in Anaconda and Butte in 1979. The study attempted to determine whether the presence of mutagenic substances in the urine of school children could be correlated with air pollution in the study areas. The study employed the Ames test to determine mutagenicty. The study was prompted by "high lung cancer death rates in Deer Lodge and Silver Bow Counties" (Montana Department of Health and Environmental Sciences 1979). The introduction refers to studies performed by the Montana Department of Health and Environmental Sciences and the National Cancer Institute that show lung cancers in Silver Bow and Deer Lodge counties at twice the national rate. This study was conducted at the Monroe school in Butte and the Lincoln school in Anaconda in May and October 1978.

Of the 47 children sampled in Butte in May, seven had significantly high levels of mutagens. None of the Anaconda children had significantly high levels of mutagens. Butte children with the highest mutagen levels lived near Front Street. A second study in Butte was conducted at the Emerson school in October. The Monroe students had higher levels than the Emerson children at this time, and the four Emerson children who had significantly high mutagen levels lived "relatively close" to Front Street. The authors theorize that the Front Street area is close to the railroad tracks and the tracks could be a source of contamination.

Researchers also analyzed mutagen levels in filter samples of atmospheric pollutants. The May 1978 samples indicated that the particulate air pollutants in Butte were more mutagenic than those in Anaconda.

2.4.1.4 Histologic Types of Bronchogenic Carcinoma among Members of Copper-Mining and Smelting Communities, 1976

This study, authored by Dr. John A. Newman of St. James Community Hospital, investigated lung cancer rates in Butte and Anaconda. The study found elevated rates of lung cancer in Butte men and women and in Anaconda men. It also found that "the county areas outside of Butte and Anaconda do not have significantly elevated lung cancer rates for men or women." Newman states that he based this article on his pathology records at St. James. When questioned, the hospital would not provide these records.

2.4.15 Relationship between Human Health and Inhalable Particulates, Montana Air Pollution Study, 1980

The Montana Department of Health and Environmental Sciences conducted a study of pulmonary-ability tests in Anaconda, Butte, Missoula, Great Falls, and Billings. There were no significant findings that correlated directly to Butte. In Anaconda, "males tested about average, the Anaconda females were unusually low" (Montana Department of Health and Environmental Sciences 1980).

2.4.1.6 Arsenic and Respiratory Cancer in Humans: Follow-Up of Copper Smelter Employees in Montana, 1983.

This study is a continuation of a study of workers employed at the Anaconda smelter. The smelter workers were exposed to varying levels of arsenic trioxide. The study compiled mortality rates in 8,045 white male workers from the 1938 to 1977 time period to investigate the role of arsenic in carcinogenesis in humans. The study compared cancer rates of this group to the white male population in the region.

The mortality rates of the smelter employees were elevated for respiratory cancer and heart diseases. To better understand the respiratory cancer mortality rates, the study analyzed the date of mortality with respect to the date of hire, length of employment, and "degree of exposure to arsenic trioxide and sulfur dioxide" (Lee-Feldstein 1983). Respiratory cancers were seven to eight times higher than expected in those first employed prior to 1925 that had heavy or moderate exposure to arsenic trioxide. The respiratory cancer rates were greater than four times than expected in those employed from 1925 to 1947 with heavy exposure. The respiratory cancer mortality rate increased "in direct proportion to degree of arsenic trioxide exposure." The study concluded that "inhaled arsenic trioxide is the primary agent associated with the excess respiratory cancer, with sulfur dioxide perhaps enhancing the effect" (Lee-Feldstein 1983).

2.4.1.7 Cumulative Exposure to Arsenic and its Relationship to Respiratory Cancer among Copper Smelter Employees, 1976.

This study is a continuation of the epidemiology study of workers employed at the Anaconda smelter (Lee-Feldstein 1983). This study estimated amounts of arsenic trioxide exposure. The estimations were based on industrial hygiene reports for various work areas and the average concentrations in the smelter. Respiratory cancer mortality rates were then analyzed by time of first employment and maximum lifetime arsenic trioxide exposure. Arsenic trioxide exposure was estimated with arithmetic means of measured concentrations.

For the cohort employed prior to 1925, respiratory cancer mortality rates "increased linearly with increasing cumulative exposure group, ranging from two to nine times expected" (Lee-Feldstein 1986). For the cohort first employed during the 1925 to 1947 time period, respiratory cancer mortality rates also increased linearly with increasing cumulative exposure.

2.4.1.8 Respiratory Cancer in a Cohort of Copper Smelter Workers: Results from More Than 50 Years of Follow-up, 2000.

In a continuation of the Anaconda smelter cohort, this study investigated white male workers employed prior to 1957 for greater than 12 months. The mortality statistics for this study are for the January 1, 1938, through December 31, 1989, time period. At the time of the article, 62% of the cohort (8,014 men) was deceased, with 446 deaths attributed to respiratory cancer. The study determined that there were significantly increased standardized mortality ratios (SMRs) for "all causes (SMR = 1.14), all cancers (SMR = 1.13), respiratory cancer (SMR = 1.55), diseases of the nervous system and sense organs (SMR = 1.31), nonmalignant respiratory diseases (SMR = 1.56), emphysema (SMR = 1.73), ill-defined conditions (SMR = 2.26), and external causes (SMR = 1.35)." While the study concluded that respiratory cancer was the only cause of death correlated to inhaled arsenic trioxide exposure, it also determined that there was a "significant, linear increase in the excess relative risk of respiratory cancer with increasing exposure to inhaled airborne arsenic. The estimate of the excess relative risk per mg/m^3-year was $0.21/(mg/m^3$-year) (95% confidence interval: 0.10, 0.46)" (Lubin et. al. 2000).

2.4.1.9 An Ecologic Study of Skin Cancer and Environmental Arsenic Exposure, 1992.

This study investigated skin cancer rates in Silver Bow County, Deer Lodge County, Gallatin County, and Park County. The Silver Bow and Deer Lodge county populations were assumed to have an increased exposure to arsenic from the mine waste and smelter, and Gallatin and Park counties were considered controls with no excess arsenic exposure. The study included the collection of skin cancer incidence rates from dermatologists and pathology services in these counties and in urban referral areas adjacent to the counties. The study determined that the skin cancer incidence rates in the control counties were higher than in Silver Bow or Deer Lodge counties. It also determined that "clinical features of the skin cancers in the exposed counties were not similar to those described for arsenic-related skin cancer" (Wong et al. 1992).

2.4.1.10 An Epidemiological Study to Determine if Heavy Metals are a Factor in the Etiology of Amyotrophic Lateral Sclerosis, 1995.

This study reported higher rates of Amyotrophic Lateral Sclerosis (ALS), also known as Lou Gehrig's disease, in Butte on a consistent historical basis, as seen in the Table 2-1 (Satterly 1995). As with standardized mortality ratios (SMR), a ration value greater than one indicates that there is a greater incidence in Butte than in the United States.

Table 2-1. ALS Incidence Rates in Butte

Cases of ALS in Butte	Time Span	Total Population	Butte Incidence vs. National Incidence Ratio
5	1943-1950	37,000	1.930
5	1950-1960	28,000	1.790
8	1960-1970	28,000	2.857
9	1970-1980	42,000	2.143
22	1980-1993	35,000	4.840

2.4.1.11 Health Consultation: Silver Bow Creek/Butte Area, Butte-Silver Bow and Deer Lodge Counties, Montana, 2002.

This study compares cancer incidences in Silver Bow County to the state of Montana and to the United States for the years 1979 to 1999. The study investigates six types of cancer (urinary bladder, kidney, liver, lung, prostate, and skin) because these cancer types are most often linked to arsenic exposure.

The study concluded that Silver Bow County had higher cancer rates than the rest of Montana, and higher rates than the rest of the U.S., in at least one age group for all six types of cancer except prostate cancer, which was lower than the national average but higher than the rest of Montana (Dearwent and Gonzales 2002).

2.4.1.12 U.S. National Cancer Institutes of Health State Cancer Profiles, 2004.

In 2004, Silver Bow County was the only county in Montana that was assigned a "Priority 1" index by the National Cancer Institute, in 2004. Priority 1 indicates an area where the annual death rate from cancer is above the national rate, and an area that also exhibits a rising trend of deaths from cancer. Table 2-2 summarizes these findings (U.S. National Cancer Institute of Health 2004).

Table 2-2. Cancer Mortality in Silver Bow County, United States, and Montana 2004

Area	Annual Cancer Deaths per 100,000 people	Higher or lower than the National Rate?	Annual Percent Change	Rising, Stable, or Declining Trend?
Silver Bow County	238.6	Higher	+3.2	Rising
Montana	195.0	Lower	-0.6	Declining
United States	199.8		-1.1	Declining

2.4.1.13 U.S. National Cancer Institutes of Health State Cancer Profiles, 2001-2005

Recent cancer mortality rate information, shown in Table 2-3, indicates that the rate of cancer mortality continues to increase, but the rate of increase of 12.9% is considered stable by the National Cancer Institute. It is important to note that the annual percent change for the 2004 data of 3.2% increases to 12.9% for the 2001 to 2005 time period (U.S. National Cancer Institute of Health 2009).

Table 2-3. Cancer Mortality in Silver Bow County, US, and Montana 2001-2005

Area	Annual Cancer Deaths per 100,000 people	Higher or Lower than the National Rate?	Annual Percent Change	Rising, Stable, or Declining Trend?
Silver Bow County	205.5	Higher	+12.9	Rising
Montana	186.6	Lower	-0.9	Declining
United States	189.8		-1.8	Declining

The National Cancer Institute also provides county-level data for cancer incidence and mortality. Table 2-4 is a summarization of the information provided in the State Cancer Registry for 2001-2005. The incidence rates and mortality rates for Silver Bow County are marked in bold if the rate is higher than national or state rates. The data indicate that there are elevated incidence rates of total cancer; bladder; kidney and renal pelvis; leukemia; lung and bronchus; pancreas; prostate; and melanoma of the skin. It also indicates elevated mortality rates for total cancer; bladder; leukemia; lung and bronchus; pancreas; and prostate cancer.

Table 2-4 Cancer Incidence and Mortality Rates 2001-2005

Cancer Site	Silver Bow County	United States	Montana
Total Cancer (Incidence)	417.7	468.2	471.9
Total Cancer (Mortality)	205.51	189.8	186.6
Bladder (Incidence)	25.4	21.7	23.8
Bladder (Mortality)	8.9	4.3	4.7
Kidney & Renal Pelvis (Incidence)	12.5	13.9	12.5
Leukemia (Incidence)	13.9	12.3	13.6
Leukemia (Mortality)	8.7	7.4	7.5
Lung and Bronchus (Incidence)	68.4	69.1	66.7
Lung and Bronchus (Mortality)	65.8	54.4	53.3
Non-Hodgkin Lymphoma (Incidence)	9.1	19.2	18.8
Oral Cavity and Pharynx (Incidence)	9.7	10.6	10.5
Pancreas (Incidence)	9.6	11.3	10.3
Pancreas (Mortality)	11.5	10.6	9.9
Prostate (Incidence)	163.6	157.0	182.8
Prostate (Mortality)	27.2	26.7	29.2
Melanoma of the Skin (Incidence)	20.7	17.5	16.7
Uterus (Incidence)	18.4	23.7	24.7

These health studies show historic elevated rates of cancer and ALS in Butte. This indicates that there is a history of community interaction with negative health issues. This correlates with community health concerns expressed in the Medical Professionals Survey discussed in chapter 7, and the longitudinal mortality study discussed in Chapter 8. It also correlates to health concerns in Butte literature. This literature often employs the poetics of poison to express the complicated connections between the community, the environment, and health. Cancer is just one health issue described in this exploration. Characters suffer illnesses that burrow into their souls and are forced to dig deep inside themselves to find solace, if not a cure.

2.5 The Poetics of Poison

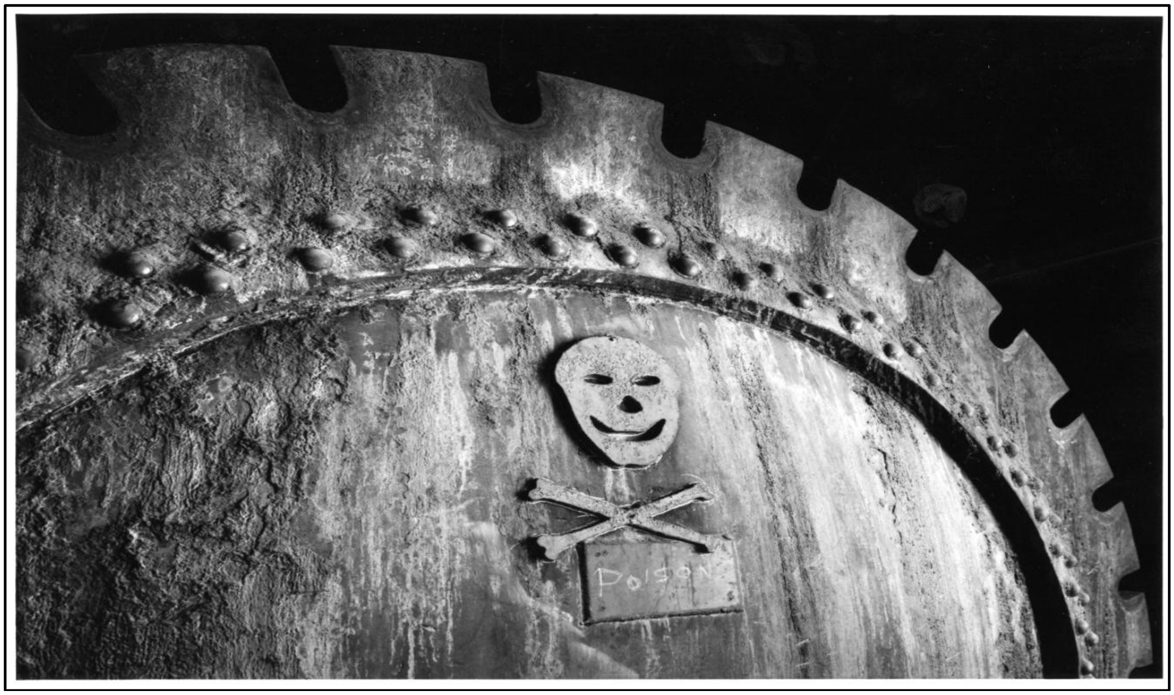

Figure 2-15. Poison Sign at the Anselmo Mine Complex in Butte (Butte-Silver Bow Public Archives Photo Collection 2010)

Butte literature offers a window into the relationship between the community and the environment and health issues. Narrators focus on ore extraction, sulfurous air, the omnipresent threat of fire, and the poisoned landscape. Interestingly, Butte literature consistently sees the environment as the foundation of character. More often than not, the characters are poisoned with an essential flaw that cannot be overcome. The lost people are damned, and the good people are resigned to view their home with the blindness of love. Like the town itself, the novels and poems are not candy-coated. They are startling in their truthfulness and gritty to their core. They stand as a testament to the people who have worked and lived in an inhospitable land.

Butte owes its existence to the Earth. Were it not for the staggering mineral deposits, the arid landscape would have been passed over by prospectors and farmers alike. As it is, however- perched on the Continental Divide, at the point where two plates collide, atop the Boulder Batholith, honeycombed with copper, gold, silver, manganese, and molybdenum- Butte is a monument to the will of humanity. As O'Malley describes: "The town grew on the side of The Hill, pulled on its flanks and the shacks sprouted like weeds around the mines. There were families that followed and it was Butte all at once, out of the copper womb" (O'Malley 1986).

The ore did not come easily; the Earth did not want to give up her treasure, and the miners pushed back with dynamite, tunnels, and smelters. In a vision of the Earth as the feminine, impregnated with ore, Butte poet Ed Lahey wrote: "from the womb she was no tender lover…midwife to the mine he taught me how to spit a round and slat a lifter…soon the shudder of ground brought us back to witness birth"(Lahey 1983). This is an example of what Bachelard called the "dynamic resistance of the external world" (Bachelard 2002). The Earth resists the miner and is forced to give birth, her child is stolen, and her womb is destroyed. Not only is there a debt of conscience to the Earth for not returning what is owed, there is also a debt in destroying any future generation. The resistance of the Earth is a fundamental flaw in the morality of mining, one that does not rest easily in the imagination. The debt is not forgiven in any Butte novel.

After the extraction, the ores are brought like shining stars through the dark tunnels to the surface: constellations wrapped in poison. This poison is the centerpiece of Butte literature; it permeates the people, the poems, the stories, and songs. In *The Story of Mary MacLane* (1902), the writer contemplates: "the long sand wastes, the red, red line of the sky at the setting of sun, the cold gloomy mountains under it, the ground without a weed, without a grass blade even in their season, for they have years ago been killed off by the sulfur smoke from the smelters. This sand and barrenness form the personality of me". She later describes the act of poisoning herself to quiet her tempestuous heart and soul: "I give them poison. They snatch it and eat it hungrily. Then they are not so hungry. They become quieter. The ravaging disease soothes them to sleep – it descends on them like rain in autumn" (MacLane 1902).

The contamination of character is a central theme in Butte literature: from MacLane, who cultivated a decadent contrast by describing herself as a young woman in love with the devil who reveled in graveyards and mine runoff, to Zola, the lead female character in Myron Brinig's *Wide Open Town* (1931), a prostitute from Butte's red-light district who tried unsuccessfully to live a reformed life with a miner. In their first meeting, the miner, John, calls Zola a lost woman and she replies: "We're all lost here, in the mountains... all lost, lost forever" (Brinig 1931). This highlights the feeling of isolation, central to mining culture. It also speaks to the feeling of being surrounded by earth, cut off from the other elements, far from other people. It shows the grasp of the earth and provides a backdrop for the conscience- a town in great debt to the earth surrounded by earth. There is no escaping, and there is no other element to borrow and replenish. The debt cannot be ignored or repaid, damning everyone in the community, which continues its dependency like an addict.

The surrounding mountains also serve as a contrast to the mined earth. Brinig illustrates this contrast beautifully: "…the unblemished loftiness of the mountains that ringed the town were pale with snow. No man trod there. There were no mines or smelters up there, the high atmosphere was unbreathed by man. That now up there is part of the unattainable, something for which we reach and cannot grasp, a purity beyond pleasure, a purity we cannot soil because we cannot reach that far" (Brinig 1931). This purity surrounds Zola, but she feels lost in it because she is contaminated and cannot find her way out of a life she despises. To Brinig, contamination is an inevitable and ubiquitous scourge of humanity. The female earth and women themselves can remain pure only if they are untouched by man.

The poisoned landscape was also fertile ground for the imagination. In Sandra Dallas' *Buster Midnight's Café,* two of the lead characters meet the third in a mine yard, near an open pit called by the euphemistic term "glory hole." A glory hole is a large excavation or pit that often fills with water after the mine is abandoned. This is her description of their first meeting: "The glory hole was fenced off because it was just a big open pit, but the fence never kept anybody out, especially kids. May Anna stood at the edge real quiet, just looking down into that hole. When we spotted her, me and Whippy Bird were playing on a mine dump. We thought the whole world was made up of mine dumps. We must have been ten years old before we found out other places didn't have dumps the way Butte did. Butte was just lucky" (Dallas 1998). This illustrates the sense of place as wells as a lack of natural innocence, even in childhood, in Butte. In the imagination of Butte children, the world is a place of exploited earth, frightening ponds, and poisoned dumps. This shows the familiarity with contamination and the acceptance and enjoyment of the landscape. The mine dumps were a recreational space, and the distinction of having them made the narrator feel lucky. Because the view is one of an insider, this play is not condemned and no judgment is passed. It is described with nostalgia for the innocence of childhood. The danger of the mining landscape is not ignored and romanticized in all Butte literature, however. Lahey recollects a young friend that died after he fell into a mine shaft in "*Elegy in a Mine Yard*" (Lahey 1983). Lahey describes the area:

On Taboo Hill where hoist drums
Rust and slat toward glory holes
That gape like hungry mouths
Of stone giants banged wide
By lust.

O'Malley, too describes the dangers of mining by recounting the death of a friend in the mines. In his grief he laments: "You got him, you dirty rock bastard, I said to The Hill. You got half of us all right. But you won't get me. Not ever." (O'Malley 1986).

It is important to note that there is a difference in the feelings associated with the Earth by the early writers, who were not born into the community but joined it as it settled and saw the contamination negatively, and later writers such as Dallas and Lahey, who attempt to describe their complex relationship with contamination in terms of resignation, pride, economy, and strength. Throughout *Buster Midnight's Café,* the characters are described in terms of mined earth. The character May Anna grows into a prostitute in the red-light district and eventually becomes a famous Hollywood actress. The narrator describes her with "eyes that looked like two glory holes. They were dark and that deep. Some writer in *Photography* said they were like 'twin pools of water.' Maybe so, but I never saw May Anna's eyes except that they reminded me of two mine pits." (Dallas 1998). This shows the depth of character and is an attempt to paint a mine pit as something beautiful, like the eyes of a Hollywood actress. However, it also shows the essential contamination of the character and the permeation of the narrator's imaginative landscape with mined earth. Even after seeing May Anna grow into a beautiful woman, the narrator could not perceive her as anything other than a mine yard. This shows the effect mining had on the eyes of the narrator as much as it shows its effect on the character. As Nietzsche said, “If you gaze long enough into an abyss, the abyss will gaze back into you” (Nietzsche 1907). The mine pit, the abyss, repeated throughout the Butte landscape, peers into all of its literature.

Illness, too, permeates Butte literature. May Anna, the movie star, cannot escape cancer, even in California, and her body returns to the appearance of a mine: “Instead of the blonde halo the fan magazines always wrote about, her hair was back to the color of mine runoff. May Anna looked like a little kid in Butte again, not the famous Marion Street. Seeing her that way broke my heart…’your eyes still look like glory holes.’ I told her after I kissed her. Big enough for a kid to fall into. How come I always think about you and glory holes” (Dallas 1998). This shows the inescapable nature of contamination, of how it is carried within, like guilt and cancer, because it is a foundation for the personality. The magic of movies and the phoenix-like recreation of May Anna as Marion Street are not enough to absolve her because she is the personification of Butte. Her fame is short-lived, and she is destined to return to being a contaminated, used-up mine yard.

May Anna’s love interest, a famous boxer from Butte with a similar rags-to-riches story, was also described in mining terms. His description, however, is more violent. As part of his training, he soaked his hands in blood from the local packing plant and rubbed it on his face to make them “as tough as ore -- hard rock hands” (Dallas 1998). While the female is described as a mine pit, a feminine receptacle, the male is described as the ore itself. This echoes the idea of the earth being female and the ore coming from her womb. The male is made tough and strong, but is a piece of the female, in an inversion of the Adam and Eve myth. It also illustrates gender divisions in a mining culture. The female and male characters are clearly defined, with little cross over.

It is important to note the number of female lead characters who are prostitutes in Butte literature. This is another metaphor for the contamination of the earth and the feminine. Butte itself is described in terms of a prostitute in books such as *Copper Camp*, a folk history by the Works Progress Administration, which relates the story of two miners talking about Butte: “I’ve never looked down on her in the sun’s light that she doesn’t remind me of a painted old trollop waking up after a wild night.’ ‘Aye’ agreed the other, ‘a painted old trollop but with a heart as big as a mountain” (Writers Project of Montana 1945).

MacLane thought that the earth formed the personality, similar to the “derelict land mentality” described by Robertson (2006). She saw this as a positive formulation in herself, but she did not feel the same about the town’s inhabitants. In a scathing description of the city, she wrote: “…and so this is Butte, the promiscuous, the Bohemian. And all these are the Devil’s playthings. They amuse him, doubtless. Butte is a place of sand and barrenness. The souls of these people are dumb” (MacLane 1902). For MacLane, the poison burrows into the very souls of the people, the depth of its reach unimaginable: its influence echoing through the thousands of miles of tunnels, sprawling underneath the surface of the soul. As Lahey notes, Butte is no superficial place. It is "a home of minerals, a place with an underground to face" (Lahey 1983). This underground serves as a home for the subconscious. As with the contamination above ground, the earth must be faced underground. It is there that the miners are most vulnerable, as the subconscious serves as the most vulnerable place for the psyche. The miners descend into the earth, vulnerable and surrounded, to push their will against the "dynamic resistance of the external world." In the subconscious, this translates into the confrontation of fears, the extraction of knowledge, good or bad, from the depths of one's being and the essential removal of the foundation of character by bringing this knowledge to the surface. By tunneling through the subconscious, the personality is left exposed, innocence is, lost, and one's true nature must be faced.

The city beneath the surface, tunneled into the earth, was fertile ground for Butte stories. Local folklore ranges from tales of underground communities to subterranean opium dens and passageways between businesses, brothels, and banks. These stories all imply that there is more going on beneath the surface than is seen at first glance. It illustrates the deep connection between the landscape and the community and shows a dissenting history to the one on the surface. It is also a way for the city to show its depth and is a means of redemption for a town condemned for its surface.

The idea of more going on beneath the surface was echoed in *Perch of the Devil,* where the main character attempts to understand her husband: "I suspect him of having many kinds of leads and cross-cuts, and pockets and veins full of different kinds of ore in him as we've got right under out feet in the Butte Hill. 'Do you think'-she spoke with a charming wistfulness- 'that when I know more, have opened up and let out my top story, as it were, I shall understand him any better'?" (Atherton 1914) This describes the two characters as being connected through the earth. The wife wants to dig deep enough to find a connection to her husband. Later in the story, she literally crawls into his mine to find him. This personification of the characters as a mine shows the connection of the characters to the mining landscape. Because they are formed of the earth, the narrator does not see them as being contaminated, but as containing value and connections. This novel is also written from the perspective of the mine owner, not the working class, which is the typical Butte perspective.

The narrator in *Buster Midnight's Café* also described her connection to her friend in these terms, saying that the death of her friend "was like the ore vein in me had pinched out." This is death in the Butte imagination, the end of a mineral vein and a return to the earth. In talking over the funeral plans, the friend requests that she not be cremated "because no matter where you scatter my ashes, they'll blow into the mine pit and I'll end up as a copper pipe in somebody's bathroom" (Dallas 1998). To return to the mine is not to return to the earth. It is the return to production. Burial must occur far from the mine, the poisoned earth, for the soul to rest easy and for the mine to remain productive.

Butte air was rarely described in terms of reverence, as in Lahey's: "The candle of the smelter stack leaves copper rings around the moon" (Lahey 1983). More often, the air is described as it is by writers like Dashell Hammett in *Red Harvest.*

> The city wasn't pretty. Most of its builders had gone for gaudiness. Maybe they had been successful at first. Since then, the smelters, whose brick stacks stuck up tall against a gleaming mountain to the south, had yellow smoked everything into a uniform dinginess. The result was an ugly city of forty thousand people, set in an ugly notch between two ugly mountains that had been dirtied up by mining. Spread over this was a grimy sky that looked as if it has come out of the smelter's stacks (Hammett 1935).

In this vision, the sky itself was created by mining, which contaminated everything in its path. The harsh view of Butte stemmed from Hammett's outsider observation of Butte while he worked in the city as a Pinkerton detective. In his tenure, he saw corruption, riots, and martial law and crafted his Butte story accordingly. His characters are deeply flawed and dirty, willing to do anything for money and rotten to the core.

Brinig also describes the air in terms of contamination and negative health effects: "…the smoke was so thick you could cut it with a knife. It choked you, burned in your throat, in your gizzard. It was hard air, five thousand feet above sea-level, impregnated with sulfur. Many died from it. But men were always dying in Silver Bow" (Brinig 1931). To Brinig, the air was not just dirty; it was dangerous and caused physical harm. But, as he notes, every aspect of life in Butte was dangerous. In Brinig's Butte, there was nothing soft, not even the air; life was a battle, and death came easily. Brinig dreamed of pure, healthy air. When the miner, John, leads Zola up the mountain known as Big Butte to breathe the clean air, he exclaims:

> Look Zola, how wild and beautiful it is up here! And look down there at the mines, men going down thousands of feet and never breathing fresh air. There are men who never stood up here like we are now, men who have lived the better part of their lives away from the sun and the air! To think of men living in these altitudes and catching consumption in the mines! Their skin getting yellow, their lungs shriveling away.

As with his description of the earth, Brinig contrasts the unnatural air of the earth with the pure air of the mountains. The air of Butte is the air of illness and the grave, but the pure air in the mountains is the breath of warmth and life.

Atherton shared a disdain for the sulfurous air but also gave a sarcastic comment on the improvement that came with the removal of the smelters to Anaconda: "Since the smelters have gone to Anaconda, patches of green, of sad and timid tenderness, like the smile of a child too long neglected, have appeared between the sickly grey boulders of the foothills, and, in Butte, lawns as big as a tablecloth have been cultivated" (Atherton

1914). This description reveals the author's belief that the city is too contaminated to reclaim. It is a child too long neglected, and attempts at reclamation, as with Brinig's Zola, cannot save it. O'Malley, too described the sulfurous air: "The smoke rolled out over the prairies and the trees and the grass, thick and sulfurous, suffocating. The grass went first, then the leafed trees. Only the firs and pines remained. When they weren't chopped down, dug up, and dragged into the deep dark where the men gouged for copper" (O'Malley).

In *Buster Midnight's Café*, the narrator described the sulfur as more harmful to the health of outsiders and is careful to describe the bulk of the air contamination as a thing of the past. "On bad days in old-time Butte the smoke from the smelters turned the sky dark, even at noon. Sometimes the town left the street lights on twenty-four hours a day. You'd see the miners coming down off the hill in the middle of the day with their carbide lights like a chain of moving stars…The sulfur made you sick to your stomach and kind of woozy if you weren't used to it. Of course, it didn't bother me and Whippy Bird, but as I say, May Anna was new. All of a sudden the sulfur fumes must have gotten to her, and she started to weave like her legs were giving out. If May Anna had fallen into that hole-which goes down about a million feet-you never would have seen Marion Street win an Academy Award for *The Sin of Rachel Babcock*" (Dallas 1998). To Dallas, the air was something to overcome, and insiders were strong enough to bear it. The real fear is falling into the earth. The poisoned air is not condemned, as it is by Hammett; it is instead described in terms of fantasy, with miner's lanterns floating in the air like moving stars. The reverie for the miner's homecoming shows the perspective of an insider. The miners and the air are not ugly and corrupt to Dallas; they are the place of childhood and imagination. Any contamination she does concede to, she sees as a merit badge for Butte children strong enough to endure it. MacLane doesn't share this positive outlook of air contamination. She sees the sulfurous air as another environmental aspect forming the personality of the community: "the entire herd is warped, distorted, barren, having lived in smoke-cured Butte" (MacLane 1902).

Bachelard views impure waters as a symbol for evil. Perhaps this is why MacLane reveld in the impure waters of Butte: "I sit for two hours on the ground by the side of a pitiably small narrow stream of water. It is not even a natural stream. I dare say it comes from some mine among the hills. But is well enough that the stream is not natural-when you consider the sand and barrenness. It is singularly appropriate" (MacLane 1902). MacLane then walks to the graveyard, which she loves for its pitiabileness and for the way it delights the devil, and is soothed by it: "It is more pitiable than I and my sand and barrenness and my poor unnatural stream.' I say over and over and take my comfort." The only comfort for the poisoned water, poisoned earth, and poisoned person is death. Later, MacLane sees a dark pool of water as a metaphor for death and she flirts with it. "I often walk out to a place on the flat valley below the town, to flirt with death. There is within me a latent spirit of coquettery, it appears. Down on the flat there is a certain deep, dark hole with several feet of water at the bottom. This hole completely fascinates me…There is something wonderfully soothing, wonderfully comforting to my unrestful, aching wooden heart in the dark mystery of this fascinating hole." MacLane is fascinated with the hole, with the water, and with death, because they are the unknown. To her yearning sensibility and dark imagination anything is better than her current existence and the hole must hold something better.

"I am a phoenix who runs after arsonists."
~ Saul Bellow

3.0 The Turning Point: 1950 – 1980

Despite being one of the most successful long-term mining towns in the United States, Butte faced the mining industry's hard economic realities like any other mining community. These realities included the conversion of underground to open pit mining and, ultimately, mine closure. This chapter discusses the effects of mine operations leading up to closure, including several specific issues, such as the loss of neighborhoods, historic structures, and heritage that altered the power dynamic between the community and the mining company. This chapter also includes a discussion of the community's heritage preservation practices during this time of transition and the poetics associated with transformation in community literature.

3.1 Berkeley Pit

In the late 1940s, the Anaconda Company adopted new tactics in their mining operations and began employing a system known as block-caving at the Kelley Mine in Dublin Gulch. This system removed large blocks of rock and low grade ore and proved more profitable than earlier methods. The company called this new system The Greater Butte Project. The project called for expansion of mining throughout historic neighborhoods and business districts and included the removal or destruction of many homes, neighborhoods, buildings, and mining structures[5]. This included the removal of many gallows frames, as shown in Figure 3-1, notably the Anaconda, Neversweat, St. Lawrence, Rarus, Berkeley, Mountain View, High Ore, Leonard, East Colusa, West Colusa, Alex Scott, Parnell, Buffalo, Speculator, Milwaukee, Elm Orlu, Alice, and Sarsfield (RHPP 1993).

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[5] According to local archivist Ellen Crain, this method of underground mining required removal of above ground structures because the Greater Butte Project included the construction of a large surface plant and warehouses to process and store the large amounts of ore mined in the block caving operations (Crain 2011).

Figure 3-1. Destruction of a Gallows Frame in Butte (Butte-Silver Bow Public Archives Photo Collection 2010)

This extraction method didn't prove extensive or profitable enough, however, and in 1955 the Anaconda Company began open-pit mining at the Berkeley Pit. The decision to begin open-pit mining marked a major cultural shift in the Butte community. While underground mining before the Greater Butte Project could extract minerals beneath the city's surface and leave homes, businesses, neighborhoods, and infrastructure relatively unscathed, open pit mining called for the consumption of all structures in its path.

3.2 Lost Neighborhoods

The Berkeley Pit began in the current active mining area, east of the Central Business District and adjacent to the East Side, McQueen, and Meaderville neighborhoods. By 1960, Anaconda announced plans to relocate residents of these neighborhoods. Because the neighborhoods were built on lands leased from the company, residents were unable to refuse buy-out offers (Shovers 1998).

In 1962, the historic Meaderville Mercantile, a community gathering place, and the Brass Rail Bar were destroyed in a major fire. Within the year, very few active businesses or residential areas remained. In 1964, the fire department disbanded and St.

Helena's church closed. Today the church is a display building at the World Museum of Mining (Montana Standard 1989). The Meaderville neighborhood contained an estimated 488 structures, including residential, education, religious, and commercial buildings and is shown in Figure 3-2 (RHPP 1993). This figure also illustrates the mix of mining structures and mine waste in the neighborhood.

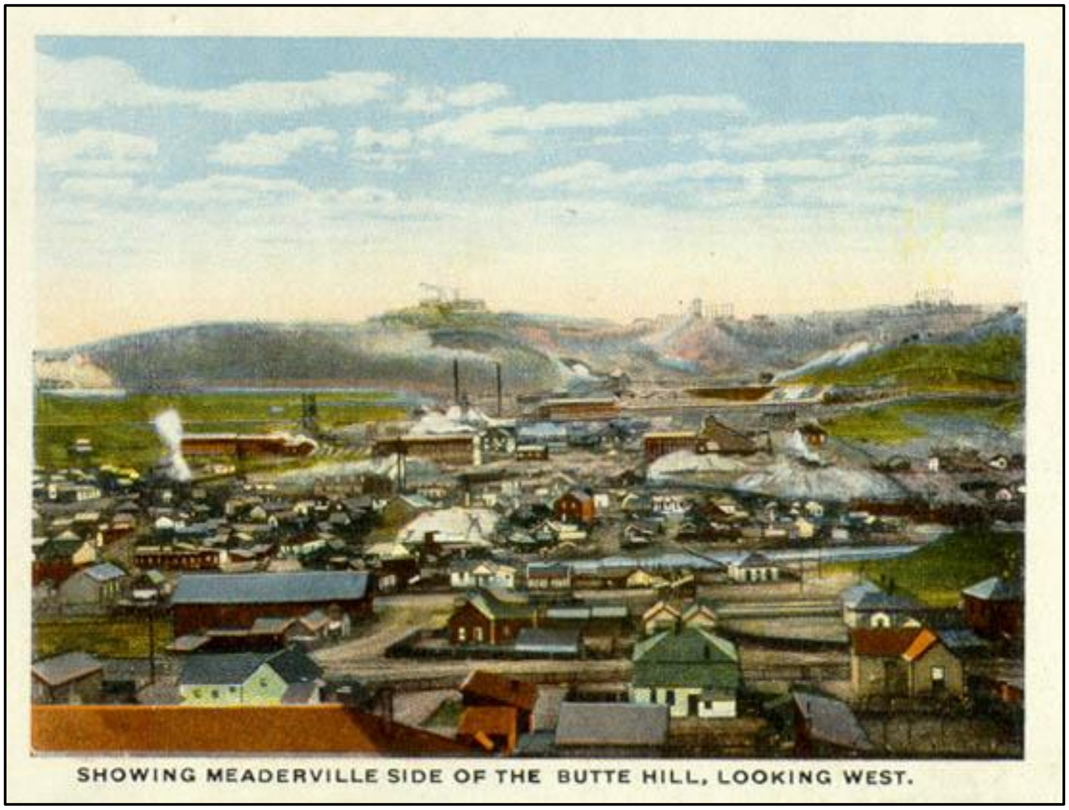

Figure 3-2 Meaderville Neighborhood (Butte-Silver Bow Public Archives Photo Collection 2010)

The nearby McQueen neighborhood met a similar fate. Residents accepted buy-out offers, moved their houses to the nearby Flats, or lost their homes and businesses to fire. The destruction of the McQueen came at a slower pace than Meaderville's consumption, and Albert Pajnich, the last resident, left in November 1978. The Anaconda Company buried the Holy Savior church and school in their entirety nine months later. Figure 3-3 is a photograph of the burial, and it highlights the intersection of the sacred and the profane in mining. By destroying the neighborhood, the mining company destroyed a portion of the community and its cultural values. The local natural landmark known as Sunflower hill survived for several years but was eventually sacrificed for the pit. (Montana Standard 1989). The McQueen neighborhood contained an estimated 330 structures. The nearby East Butte neighborhood contained approximately 344 structures that were also consumed by the pit (RHPP 1993).

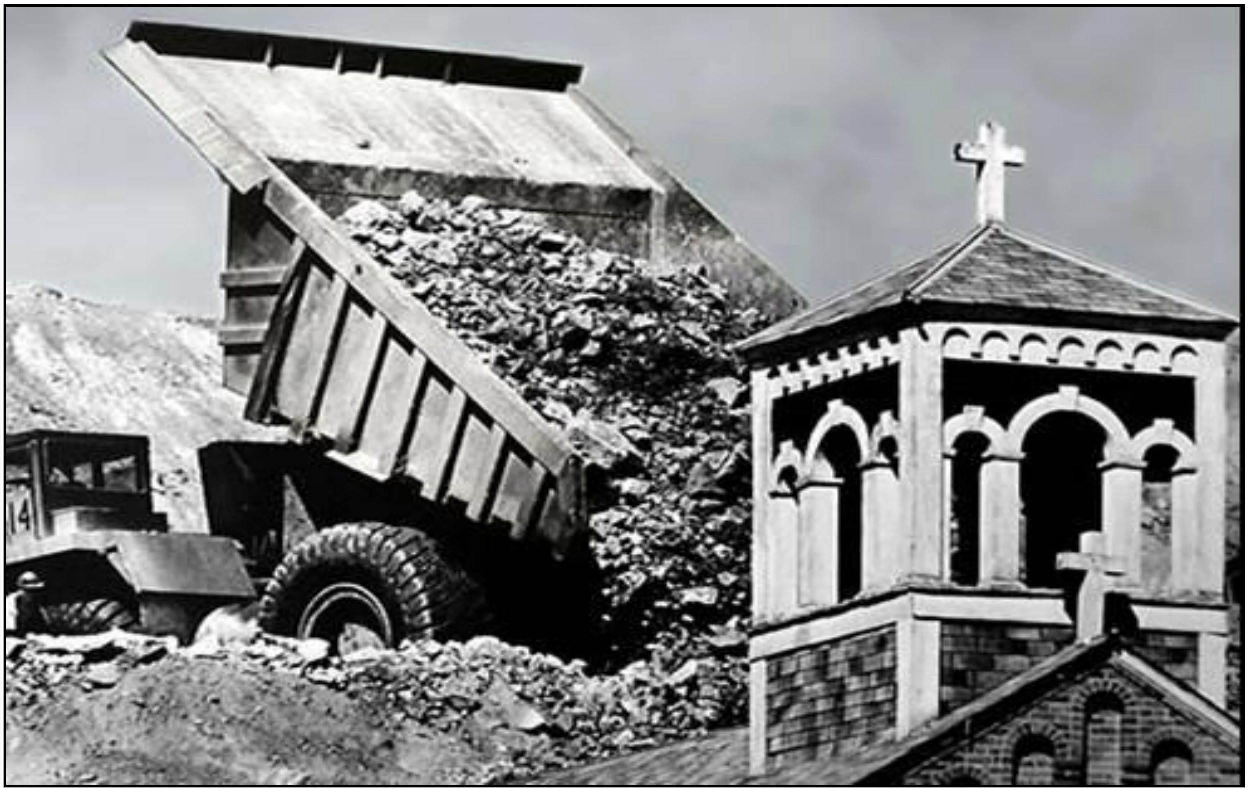

Figure 3-3. Anaconda Company truck burying St. Mary's Church (Hinick, 1977)

3.3 The Lost Garden

In 1890, smoke pollution inundated the area, leaving just four trees inside the Butte city limits (National Park Service 2006). To placate the community and promote his Senate bid, copper magnate William Clark built the Columbia Gardens at the base of the mountain known as the East Ridge, overlooking the city (Carl 2011). The Gardens, shown in Figures 3-4 and 3-5, contained an amusement park, dance pavilion, and botanical gardens. In figure 3-4, men row a boat in a lake that eventually became a tailings pond. The pavilion north of the lake held many community events, such as weekly dances and weddings (Ekness 1999). Many community members are currently working to re-create the merry-go-round shown in figure 3-4, but there is no final plan for the project (BRA 2007a, Spirit of the Columbia Gardens 2011). In describing Butte's culture, the Works Progress Administration noted: "… aware of her ugliness and half ashamed of it, she points with pride to her Gardens" (WPA 1943).

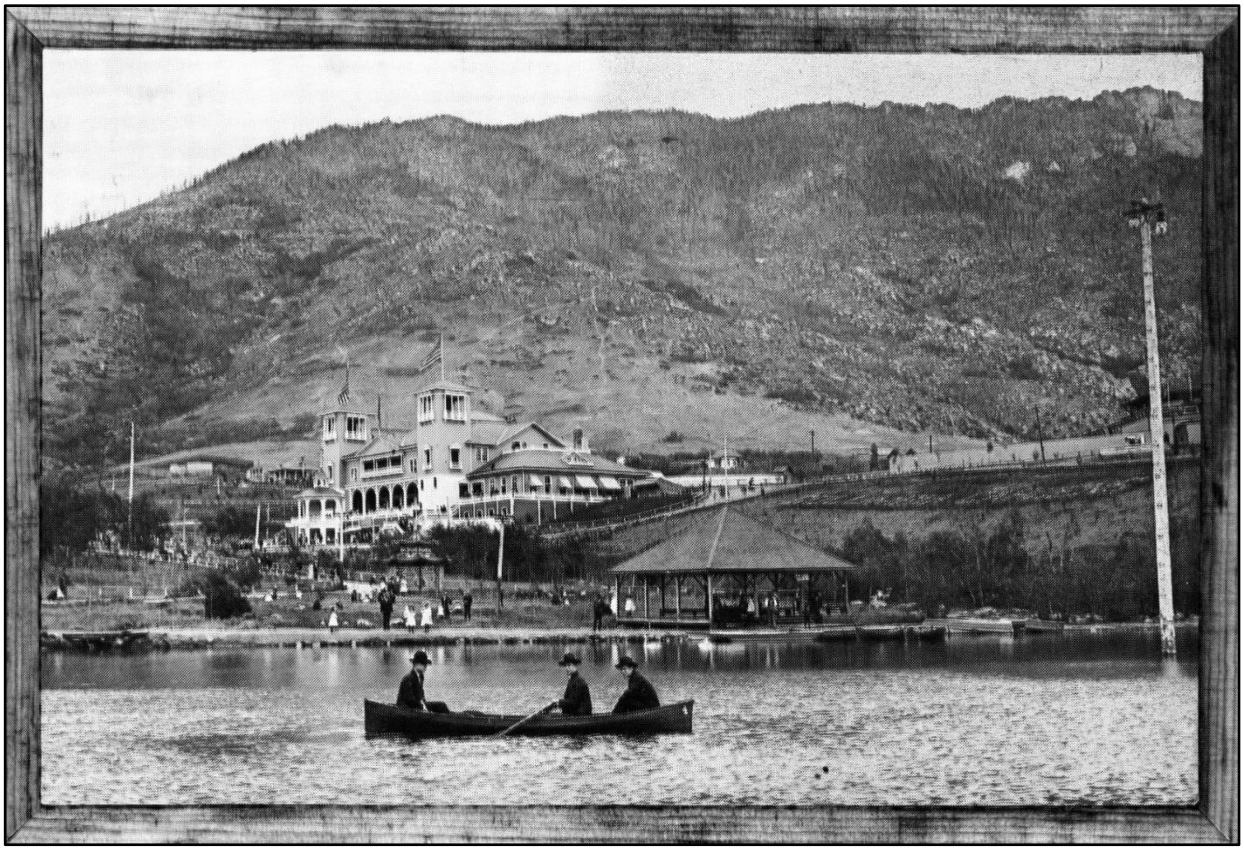

Figure 3-4. Columbia Gardens (Butte-Silver Bow Public Archives Photo Collection 2005)

Figure 3-5. Columbia Gardens Rollercoaster (World Museum of Mining Archives 2010)

When the Anaconda Company purchased Clark's holdings in 1925, it also gained ownership of the Columbia Gardens. The Gardens consistently operated at a loss (Carl 2011). In a study of the Columbia Gardens, Matthew Carl concludes that the Anaconda Company continued to operate the park at a loss as a form of "welfare capitalism," which promoted community and the idea that worker and company interests overlapped (Carl 2011). The Anaconda Company continued to operate the Gardens until 1973 when, facing economic problems and a desire to expand the Berkeley Pit, it announced plans to close the Gardens and established a tailings pond near the dance pavilion. Later that year, a massive fire destroyed the Garden's merry-go-round, arcade, and swings. Many in the community believe that the Anaconda Company set the fire because the lands underneath the Gardens were slated for an expansion of the Berkeley Pit (Tyler 2011, Wolstien 2011, Ekness 1999, Rattlesnake Productions 2008). Community outcry at the loss of the Gardens quickly reached a fever pitch and, as reported in a Butte newspaper retrospective sixteen years later "Butte is still angry" (Montana Standard 1989).

3.4 Fires

The loss of the Columbia Gardens, East Side, Meaderville, and McQueen weighed heavily on the community, as did the loss of numerous structures in Uptown Butte, particularly in the Commercial Business District. A deep sense of betrayal permeated the community and reinforced the mining cultural value of distrust in positions of power. This sense of betrayal is seen in the documentary *Remembering the Columbia Gardens* (Ekness 1999) where residents recount the community belief that the Anaconda Company destroyed the gardens by fire, destroying any future hope of resurrecting the Gardens at another location. This belief is also stated in the documentary *Butte, America* (Rattlesnake Productions 2008). Carl's study of the Columbia Gardens provides excerpts from newspaper editorials concerning the closure of the Columbia Gardens. One of these editorials connects the loss of neighborhoods, the Columbia Gardens, and community: "It (the Anaconda Company) is tearing the town to pieces; first Meaderville, then McQueen, now the Gardens area; and most likely in a matter of time the uptown Butte area will be taken also. Will the Company have us all live in trailers so we can move on each time a rich vein of ore shows up?" (Montana Standard 1973a) Another editorial states "I have had a difficult time convincing my friends that the Anaconda Company is not an industrial octopus which is swallowing the city and polluting the environment. After this decision concerning the Gardens, however, I'm beginning to have doubts myself" (Montana Standard 1973b). These examples of dissenting discourse show the shift in power from the Anaconda Company to the community. The community members change their memory of the company in these editorials, a process described by Smith (2006) and Rodriguez and Fortier (2007) that places power in the hands of the community members that are creating or affirming the memory.

It is interesting to note that the largest number of fires coincides with the greatest expansion of the Berkeley Pit. It is also important to note that while there were fewer major fires in the 1970s, when compared to the 1960s, as seen in figure 3-6, the size was much greater, and the majority of the fires occurred in the Commercial Business District, where the Anaconda Company announced plans to expand the Berkeley Pit in 1975. In the three-year span between 1972 and 1975, fire destroyed over 20 major buildings in the Commercial Business District. In 1972, a fire at the J.C. Penney store spread to 12 other structures, destroying all of the businesses. The following year, fire claimed the prominent Medical Arts Building, and in 1974, the historic Pennsylvania block was consumed by fire (Shovers 1998). It is ironic to note that one of the blocks in this area is known as the "Phoenix Block." The source of many of these fires remained unsolved, such as J.C. Penny block fire, which many local residents considered "a torch job" (Montana Standard 1973c). The large number of unsolved cases caused tension between local fire and police officials and the state Fire Marshall (Montana Standard 1976). In a 1976 interview, the state Fire Marshall reported that he felt that Butte investigations were lax and stated: "we have felt the need time and time again to take over and get the job done" (Montana Standard 1976). Butte fire and police officials denied these accusations and stated that the problem stemmed from a lack of cooperation between local and state officials (Montana Standard 1976).

All of the 20 major fires that occurred in the 1970s occurred between 1972 and 1975. Then, in late 1975, Anaconda Company officials announced plans to expand the Berkeley Pit into Uptown Butte. This plan called for the relocation of the Central Business District to the Flats (Shovers 1998).

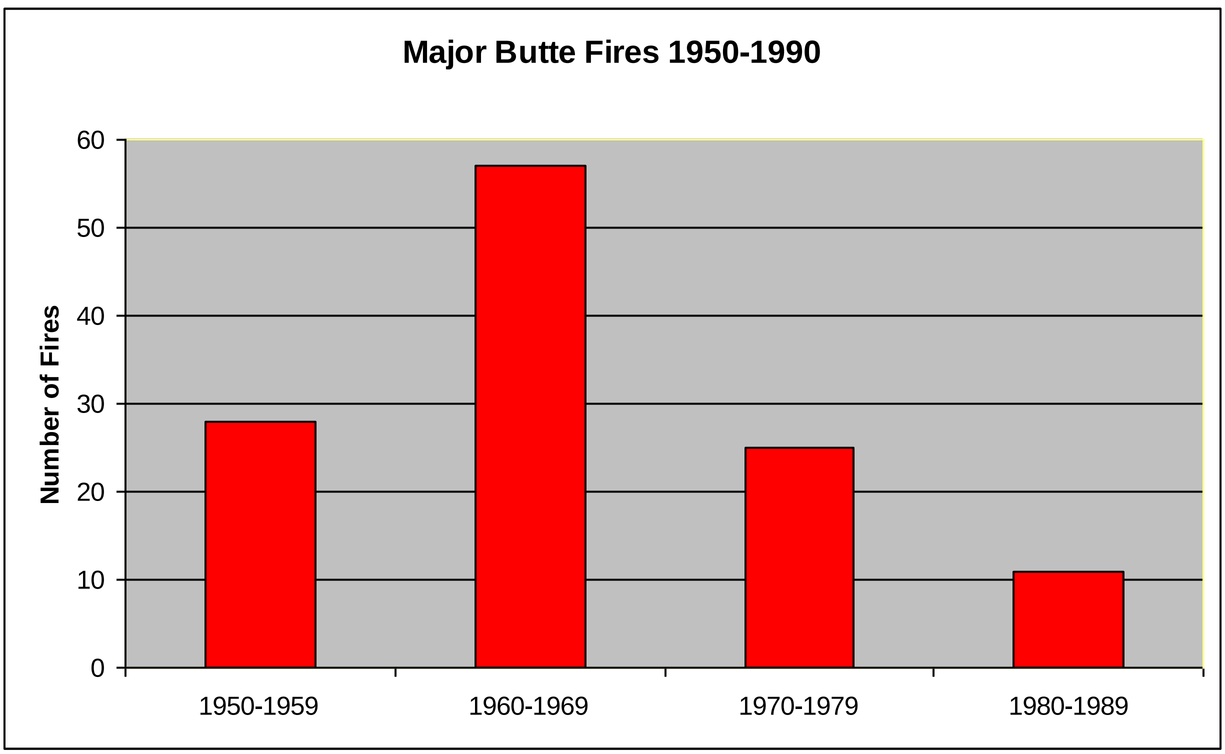

Figure 3-6. Major Fires in Butte 1950 -2009

3.5 Turning Point of Community's Relationship with the Anaconda Company

Soon after this announcement, the Butte City Council created a group known as Butte Forward to study the feasibility of relocating the Central Business District (Shovers 1998). The group, which included Anaconda Company officials, quickly gave a recommendation favoring the relocation. The estimated cost of the project hampered progress, however. The group estimated the project would cost over $50 million, and the Anaconda Company pledged $11 million. The project became a matter of intense community debate until July of 1976, when the city council voted against relocation (Shovers 1998). This marked a major cultural shift in the power relationship between the city government and the Anaconda Company, as well as community relations with the company. When considered in the context of the fires and the loss of neighborhoods, Columbia Gardens, and underground mining jobs, the act becomes a marker of cultural remediation and dissenting discourse. For the first time in the city's history, cultural capital became more important than financial capital. This shift in community value was due in part to the community's being less transient and to the area being designated as a National Historic Landmark in 1969 (Quivik 2001). Community interest in historic structures and their preservation led to an architectural survey of the Landmark District and a plan to transform Butte's historic resources into an interpretive park system that included the historic industrial landscape (Shovers 1998, Quivik 2001).

3.6 Historic Preservation

The Historic Sites Act of 1935 led to the creation of the National Landmark Designation program in the United States. This act aimed to preserve historic buildings, objects, and sites with national significance. In 1966, the National Historic Preservation Act (NHPA) established requirements, guidelines, and practices for federal agencies working with buildings, sites, structures, districts, or landmarks that are eligible for the National Register of Historic Places. Section 106 of this act created the National Register of Historic Places, a list of historically significant landmarks, buildings, structures, sites, and districts. In 1969, the National Environmental Policy Act (NEPA) set regulations for the federal government, requiring its agents to use every practicable means to preserve significant cultural, historic, and natural aspects of American heritage. Butte received National Landmark District designation from the National Park Service in 1962. Because this designation came before the National Historic Preservation Act, the 12-square-mile area was not surveyed at the time of designation (Shovers 1998).

In 1969, Butte received funding for the Model Cities Program. The funding, amounting to over $22 million in federal grants, was used in infrastructure projects in the historic district, such as street repair and building demolition, business development projects, such as the start of the Local Development Corporation, housing projects, and construction, such as the local public safety building. The program also included funding for political restructuring, aided in the development of neighborhood councils, and aided the promotion of the City-County consolidation, which occurred in 1976 (Shovers 1998).

In 1978, the city council hired a group of architects, planners, and historians from the Historic American Engineering Record to develop a rehabilitation plan for Uptown Butte that focused on developing new uses for buildings and an economic development plan for the district (URA 1983). In 1984, the State Historic Preservation Office (SHPO) and the city funded the first Community Historic Preservation Officer (CHPO) in the state and then funded a historic inventory (RHPP 1993).

In 1978, the Butte Local Development Corporation authored an Overall Economic Development Plan, which stated that the renovation and preservation of the Central Business District was one of the most important issues in Butte. The following year, the Butte-Silver Bow Council of Commissioners created the Urban Revitalization Agency (URA) after passing a resolution that stated: "… blighted areas exist in Butte-Silver Bow and rehabilitation, redevelopment, or a combination thereof of such areas is necessary in the interest of the public health, safety, morals, or welfare of the residents of Butte-Silver Bow, Montana" (URA 1983). The agency goals include the encouragement of economic revitalization and preservation of architecture and cultural resources, particularly in the Central Business District. In 1982, the URA petitioned Butte-Silver Bow to expand the boundaries of the Central Business District. The county approved the petition, and the new boundaries included 46.5 acres in Uptown Butte (URA 1983).

The URA is funded by tax increment financing, makes loans and grants for private buildings in the Uptown area, and invests in other public and private improvements. URA activities include maintaining sidewalks, painting benches, maintaining roads and bus shelters, mothballing buildings, increasing parking, landscaping, maintaining flower boxes, sponsoring arts festivals, printing historic walking tours, installing Christmas decorations, and general upkeep of the Central Business District. In 1985, the URA began using historic theme signs for park and bus stop signs based on historic photographs of historic Butte scenes. The same year, the group funded a mural in Heritage Park and partially funded a film-makers guidebook to attract film makers to Butte (URA 1985). In 1986, the URA used a tax increment bond to fund the renovation and expansion of the public library and the public archives. At the same time, the URA partially funded, with the Federal Economic Development Administration, the Butte-Silver Bow Business Development Center (URA 1986). This coincided with a URA appropriation of $50,000 for the demolition of several buildings that were "beyond redemption." The annual report cited subsidence from past mining activities as exacerbating the poor condition of the structures (URA 1986).

These acts of historic preservation served several purposes. First, they were designations that served to authenticate and give significance to the historic areas of Butte, as described by Little (2005). Second, they established an authorized heritage discourse, as described by Smith (2006), wherein the discourse of historic preservation became the authorized discourse and this legitimized historians and preservationists as the culture's spokespeople. This promotion of historians as spokespeople was in line with the promotion of Butte literary authors as spokespeople because the literary works also focused on Butte's wide open past and crystallized this time in community memory. The preservation of community memory served as a means of support during transformative times in Butte. Butte literature grapples with change by employing metaphors that are consistent with the community experience – fires, silence, and transformation.

3.7 Poetics of Transformation

The impact of fire and transformation on the Butte landscape and, consequently, the community, can also be found in Butte literature. As the Phoenix rises and transcends death through fire, humanity finds hope of transcendence in fire. It represents both the little deaths of daily life and the great end of life each person faces. It echoes the cyclic nature of the seasons and the regeneration of sunlight each morning. It is the hope of the spirit and the lesson of life. Because death cannot be avoided, it should be seen as an art; because each thing that it doesn't annihilate brings a certain measure of transcendence, the trials of existence should not be feared, but embraced.

This transcendence is a form of purification, a leaving behind of the old self, the last season, in an attempt to enter the next phase as a pure being. This purification is short lived, an instant perhaps, but it represents the original state yearned for by man and perhaps the environment, too. As the fire burns, it purifies, giving off pure light and destroying the impurities that are fueling it[6].

In addition to the use of fire in mining processes, fire shaped the Butte industrial landscape in other important ways. Over the course of its history, the town has seen more than its share of horrific fires. The most enduring fire in the community consciousness is the destruction of the Columbia Gardens. The community still mourns the Gardens and describes them repeatedly as a paradise lost.

Butte literature exalts the Gardens. In describing the Gardens, Atherton wrote: "Butte is a city of few resources, and the Gardens at night looked like fairyland"

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[6] This notion of purification by fire was also employed by alchemists, who attempted to transform other metals to gold through fire and in metallurgy by the purification of ores by smelting. In his work *The Forge and the Crucible* Mircea Eliade describes mythological associations with fire and purification dating back to primitive man and the early shamans and magicians that were considered "masters of fire" that could transform the world around them by fire and use fire as a source of power (Eliade 1978). Ancient Greeks also developed concepts of purification by fire. Heraclitus saw the human soul as part of a divine fire and that "logos" burned and purified the soul. The term logos has many associations from reason, to accounting, to intelligence, and has often been translated as "Word" (Minar 1939). This notion is also seen in Christianity, where fire is described as a means of purification that destroys the self and leaves only the divine (Malachi 2004).

(Atherton 1914). Dallas too saw the Gardens as a paradise: "Sometimes when I can't sleep, I think back to when I was a kid in the pansy garden. I think heaven is being in that garden by yourself with as much time as you want to pick the flowers" (Dallas 1998). In *Wide Open Town*, John the miner takes Zola to the Gardens and proposes marriage. He tells her how he longs to be in nature and to be done with the mines and proposes they move to California: "God's country" (Brinig 1931). This inversion of the Adam and Eve story brings two impure lovers to the garden where they are tempted by purity.

The loss of the Gardens, a place of purity, by fire and, by association, industrialization, is one of the most important cultural events in the town's history. After the fire, the community no longer trusted the mining company, no longer had a source of pride or natural purity, and had no means to recreate in nature within the city limits. This destruction and conflict transformed the city. The town no longer allowed the mining company free reign to destroy its neighborhoods, historic buildings, or historic mining structures. As noted by Brown (2003), cultural conflict can cause cultural items to become more valuable to a community. The town emerged from the fires with a sense of pride in its culture and history and a will to protect both. Times where fire dominated the other elements in the Butte industrial landscape mark great change, transformation, destruction, and rebirth.

Destruction and transformation in Butte also precipitated great stillness. This feeling is described by Lahey in *Deep Bells* (Lahey 1983):

Mystic mountains
blue sky that furls around the town
still as hesitant air.

The peaceful air surrounding the city attains a mystical quality and achieves a preternatural silence. The quiet comes from the timing of Lahey's poem, which was written after a mining shut down. He describes this quiet air again in *Dust on the Feather* (Lahey 1983):

Birds wheel in dirty light
pulleys sag from rusted beams
in this mill my father worked
quiet dissolves the wings.

Even though the mining has stopped, the air is not pure. It is covered in the dust of the past. Without movement, without wind, the dust settles and "dissolves the wings." This captures the desperation of the declining mining town. As Emily Dickinson wrote, "Hope is the thing with feathers" (Dickenson 1960). Without wings, without mining, the town would sink, the hope would be lost, and the dust would take over. The air is poisoned in this poem not by extracting from the earth, but by stopping the transformation of the earth. Without the wind created by the movement of mining, the air became dead and decomposed into dust.

The fear of silence and fire is also explored in *Wide Open Town*. The town crier, Roddy, loses his voice, his source of employment, and is forced to live the life of a mute. Roddy searches for a reason for the affliction and concludes: "It may be that for too long I have spoken the words that came to my lips without thinking of the deeper words that a man never speaks. Words that are terrible in their truth and elude the familiar pronunciation and accents of voluble men…Yes! Yes! I'm trying to find courage for new words that nobody ain't ever said before" (Brinig 1931). Roddy decides he must dig deeper within himself to find the truth and the words to express it, as the miner must dig deeper to find ore and create new tunnels to carry it out.

Roddy's battle with silence carries over from the air element to the fire element. After losing his home, he gets a room in a boarding house and keeps his cherished painting of Sampson inside it. One cold winter night, on returning home, Roddy sees that the boarding house is on fire, and he rushes to save his painting. The other tenants don't think the picture is worth saving, but to Roddy: "The picture spoke of heroism and beauty, the sky beyond man's reach, the choir beyond his ears, the profound silence behind his innumerable and senseless words." Roddy rescued the painting from the burning building, but when he pulled it away from his chest, it disintegrated. He then fell to his knees in disbelief and raised his arms "and sounds of terrific, piercing beauty came from his mouth, the voice of Roddy Cornett as it has been in the old days . 'The words is dead' he sobbed, 'Look, look at the fine words, the beautiful words!' He pointed to the ashes at his feet. 'Dead!' he cried, and buried his face in his hands and wept aloud. 'Dead, the beautiful words. Dead the deep words of my heart and my soul. The wind has blown them away…away" (Brinig 1931). When Roddy brought purity and truth to the surface, the elements destroyed them. This is a repetition of Brinig's belief that anything touched by man is instantly ruined. While the words were wrapped in Roddy's silence, they were pure and true. Once his voice returned and the words were touched by man, they were dead. To Brinig, things are best left beneath the surface if they are valuable or pure. Transformation inevitably causes destruction. Transformation for Roddy brought silence, the loss of his voice. In the community, transformation brought silent mines, machinery, and workers. Like the community, it was only after a fire, after destruction that his voice returned.

Part 2: Resurfacing

At the still point of the turning world. Neither flesh nor fleshless;
Neither from nor towards; at the still point, there the dance is,
But neither arrest nor movement. And do not call it fixity,
Where past and future are gathered. Neither movement from nor towards,
Neither ascent nor decline. Except for the point, the still point,
There would be no dance, and there is only the dance.

- T.S. Eliot, Burnt Norton

4.1 Mine Closure

After several years of cutbacks, thwarted plans to relocate the city, and a shift in focus in the global metals market, ARCO announced the closure of the Berkeley Pit in 1982. The announcement sent shockwaves throughout the community. In all, hundreds of people lost their jobs, and the ripple effect on the local economy was devastating. Some met the announcement with denial, believing the mines would reopen under different ownership. Many simply could not afford to remain without employment and relocated immediately.

In addition to the economic impact, the mine closure brought devastating environmental impacts. ARCO turned off the pumps that dewatered the thousands of miles of underground tunnels and the Berkeley Pit, and the areas quickly flooded. This act signified the end of mining for the Butte community. There was no longer any doubt as to the future of underground mining or an expansion of the Pit. The Underground was lost forever.

There is little written about this time in Butte history. As Robertson found in his study of Oklahoma mining towns, "… the lack of attention to the particulars of mine closure again reveals the influence of the mining imaginary…almost exclusively, historians have preferred to remember Toluca as a wild mining boomtown" (Robertson 2006). Histories and novels set in Butte are almost exclusively pre-1980, and most are set in the wild boomtown years of 1890-1920. This speaks again to the discomfort of the public with the consequences of industrialization. It prefers a view of the mining town as a productive boomtown, replete with wild characters and lawless ways. This leaves little room for the pollution and health effects or the silence suffocating the community after the music stops.

This chapter investigates the effects of mine closure in the Butte community. It first looks at cultural impacts and then specifically discusses the statue known as Our Lady of the Rockies as an example of community networking and behaviors after mine closure.

Within a year of mine closure, the EPA designated the Silver Bow Creek area a Superfund site. This marked a great shift in community interactions with the environment and brought environmental and human health concerns to the surface of the community consciousness. This chapter includes a discussion of Superfund designation, including risk assessment studies that provided the basis for remedial actions levels and a description of the nine operable units in the Butte area.

4.2 Cultural Impacts

The announcement of the closure of Berkeley Pit operations enveloped the town in the feeling of an Irish wake. There were a few holdouts that looked for signs of life, but the rest knew a corpse when they saw one. The town was in deep mourning (Curran 1986, Langewiesche 2001). It had lost its economic base and its sense of value. Mining was the reason for the town's existence and without it the town experienced an identity crisis. It was no longer the largest producer of copper in North America, and it hadn't been for some time. It had been abandoned by the mining company and left with extensive contamination, giving it a severe handicap in the attraction of new business and industry. But the fact that it did not become a ghost town shows the value and sense of place the community held by Butte residents. This is due, in part, to the cultural values of a long-term mining community. After decades of persevering through strikes, shut-downs, and times of prosperity, Butte had become tough and stoic in the face of adversity. The landscape itself reminded the community of these qualities and gave it strength. The difficulties of mining life instilled Butte with the ability to endure. This resilience, particularly from strong community and kin networks, was one of the chief reasons for community survival.

As the cultural identity changed from a prominent mining town to the purveyors and victims of an environmental disaster, the community experienced a deep loss of pride, intensified by an economic recession. As with other mining communities that have faced mine closure, the main concern was everyday survival (Robertson 2006, Pattison 1999). This, along with distrust of positions of power, devalued concerns about environmental quality and health effects and created a culture of silence surrounding both.

4.2.1 Lady of the Rockies

One of the best examples of community networking in Butte is the construction of a statue known as Our Lady of the Rockies. The idea for the statue started in 1979, when a local miner's wife was battling cancer. On the advice of a coworker and friend who was of Hispanic heritage, the miner prayed to the Virgin of Guadalupe and promised to build a statue in her honor if his wife survived. The miner's wife did survive, and he began a plan to build a 10 foot statue in his front yard. Over time the plans for the statue became much larger and the placement changed to a place that could be seen by the whole town (Johanek 2004). Because the volunteer group working toward creating the statue felt that a nondenominational statue would hold more appeal to the general public, particularly tourists, the statue was named Our Lady of the Rockies and was "dedicated to women, especially mothers" (Lady of the Rockies Foundation 2008).

Soon to be out of work miners comprised a portion of the volunteer group and they used the craftsmanship learned in mining to help build the statue. A former mining engineer performed the engineering design of the statue. The interior support is made of 16 gauge steel and is structurally similar to a gallows frame. The fingers of the statue are made from the exhaust pipes of dump trucks used at the pit. The steel pipe, blasting materials, power drills, compressors, construction equipment, and even the gas used to haul materials to the top of the mountain were taken from the Berkeley Pit operations (Johanek 2004).

While the community built the road to the eventual resting place of the statue on the top of a mountain known as the East Ridge, it wasn't able to haul the statue over the road; it needed to be airlifted piecemeal because of its immense size. This took a surge of community networking, involving the Montana Congress and President Reagan, and resulted in a National Guard helicopter airlift. The helicopters transported the statue in five pieces, and when complete the statue stood 90 feet tall (Johanek 2004). In the manner of many Butte traditional cultural properties, the statue is lit by large spotlights at night.

The statue, shown in Figure 4-1, is deeply valued by the community and has many complex associations. It is a symbol of femininity, a spiritual protector, a testament to the craftsmanship of miners, and a talisman for resilience against crisis, change, and cancer. When viewed through the lens of health, Our Lady serves as a powerful symbol of resilience and a talisman against health effects from the landscape. She also served as a symbol of permanence in a time of great community crisis (Finn 1998).

In a study of mining culture and Mary cults, Pat Munday describes Our Lady of the Rockies as a plea for divine intervention that is historically similar to other mining community altars to the Catholic Mary in South America, Mexico, and the southwestern United States (Munday 1996). These shrines harken back to miner's prayers and rituals with the earth mother goddess in pre-modern western culture, as described by Eliade (1978).

Figure 4-1. Our Lady of the Rockies (Photo by Author)

Within two months of the statue's placement on the mountain, the Washington Corporation announced plans to purchase ARCO's Butte holdings and operate under the name Montana Resources Incorporated (MRI). The purchase included the Berkeley Pit, East Pit, Concentrator, underground mines, watershed properties, and the Butte Water Company but did not include the Colorado Tailings, or the Anaconda smelter and storage ponds (Montana Standard 1985a). Community members hold the belief that the statue served as a talisman and that the economic rebound and return of mining and community pride in recent years are tied to its placement upon the ridge. Others point out that the resumption was likely due to a three-year tax break and the reduction of power and freight costs (Dobb 1996). Several community members also attributed the recommencement of mining to the power of positive thinking in the community. In 1987, the Seattle firm Pacific Institute filmed a video in Butte documenting the power of positive thinking in the community. In an article regarding the video, Montana Resources manager Ray Tillman stated that positive thinking was a main reason for the resumption of mining in Butte (Montana Standard 1987a). MRI continued operations at the Continental Pit, located east of the Berkeley Pit, until 2000, when it closed down operations for three years, citing rising electrical power costs. MRI has continuously operated the Continental pit and nearby lands since 2003.

The story of Our Lady is an example of memory passed through the culture and attaining sacred status. Today, the statue contains hundreds of prayers and offerings, as seen in Figure 4-2. Similar to Catholic offerings to saints for answered prayers, many people make donations to the Our Lady of the Rockies Foundation in honor of people and intentions and print these offerings in the local newspaper.

Figure 4-2. Offerings to Our Lady of the Rockies (Photo by Author)

4.3 Superfund Designation

Within a year of mine closure, the EPA designated the Silver Bow Creek area as a Superfund site. The EPA then expanded the site in 1987, when it became the Silver Bow Creek/Butte Area National Priorities List (NPL) site. Many members of the community embraced this designation and saw it as a source for future employment. The education and many of the skills associated with mining translate well into the world of environmental remediation. In addition to funding and potential jobs associated with Superfund, the designation also offered a way for the community to make the town more appealing to future industry and less toxic for its residents. The designation also changed the way the community interacted with the environment. The EPA designation authenticated the toxicity of the landscape, and this made the residents fully aware of potential health impacts. While the community still viewed the environment as a source of employment, now in remediation, it could no longer claim it was unaware of the risk associated with it. As described in subsequent sections, there is some question as to the validity and the extent of characterization of these risks. Importantly, the Superfund designation established the EPA as the authorized spokespeople for environmental issues and they, along with their contractors, established the authorized heritage discourse for environmental contamination and remediation issues.

This Butte Superfund area consists of several operable units including Butte Priority Soils (BPSOU), West Side Soils, Active Mining Area, Streamside Tailings, Rocker Timber Framing and Treating Plant, and Warm Springs Ponds (U.S. EPA 2006a). Groundwater, surface water, soils, and inhalable dust pose a potential threat to human health and the environment. Contaminants of concern at the site include arsenic, cadmium, copper, iron, lead, manganese, mercury, sulfate, zinc, and others (U.S. EPA 2006a). To date, the BPSOU and the Montana Pole Plant Operable Unit are the only two portions of the Superfund complex that have reached a Record of Decision.

As part of the Superfund activities in the region, many soil, sediment, and water samples have been collected in the Butte and Anaconda area during the past two decades. In particular, the database submitted as part of the Remedial Investigation report for the BPSOU contains concentrations of arsenic, cadmium, copper, lead, and zinc measured in approximately 2,700 soil samples collected in the Butte area. Figures 4-3 through 4-7 are maps depicting spatial distributions of arsenic, cadmium, copper, lead, and zinc concentrations, respectively. Concentrations as high as 11,900 ppm arsenic; 56,100 ppm cadmium; 217,000 ppm copper; 67,100 lead; and 62,800 ppm zinc were observed. Overall, areas of maximum environmental impact coincide with the historical mining, milling, and smelting activities, but some of the samples collected outside of the BPSOU also had elevated levels of arsenic, copper, lead, and zinc.

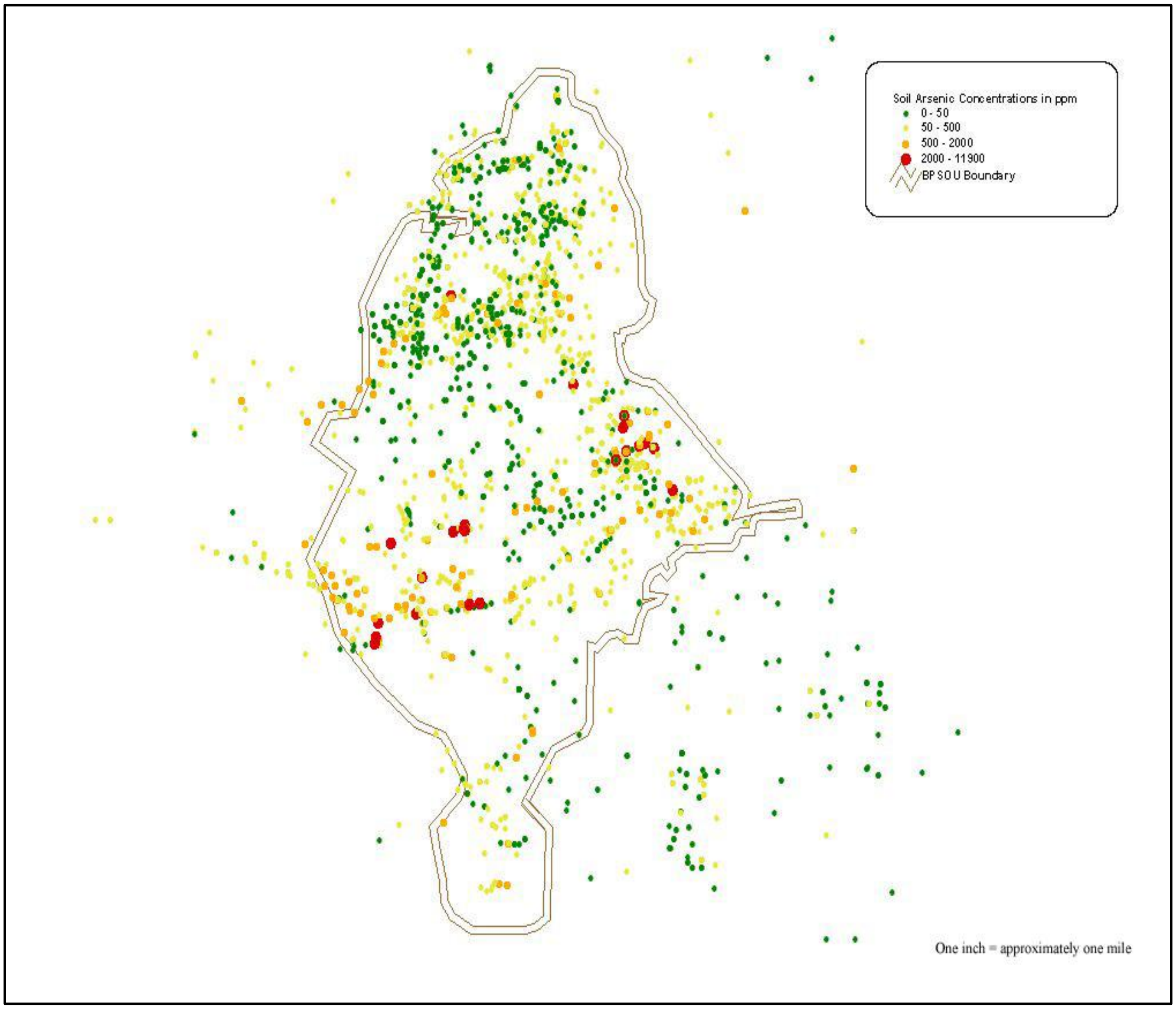

Figure 4- 3. Map of Arsenic Concentrations in the Soil from the BPSOU Database.

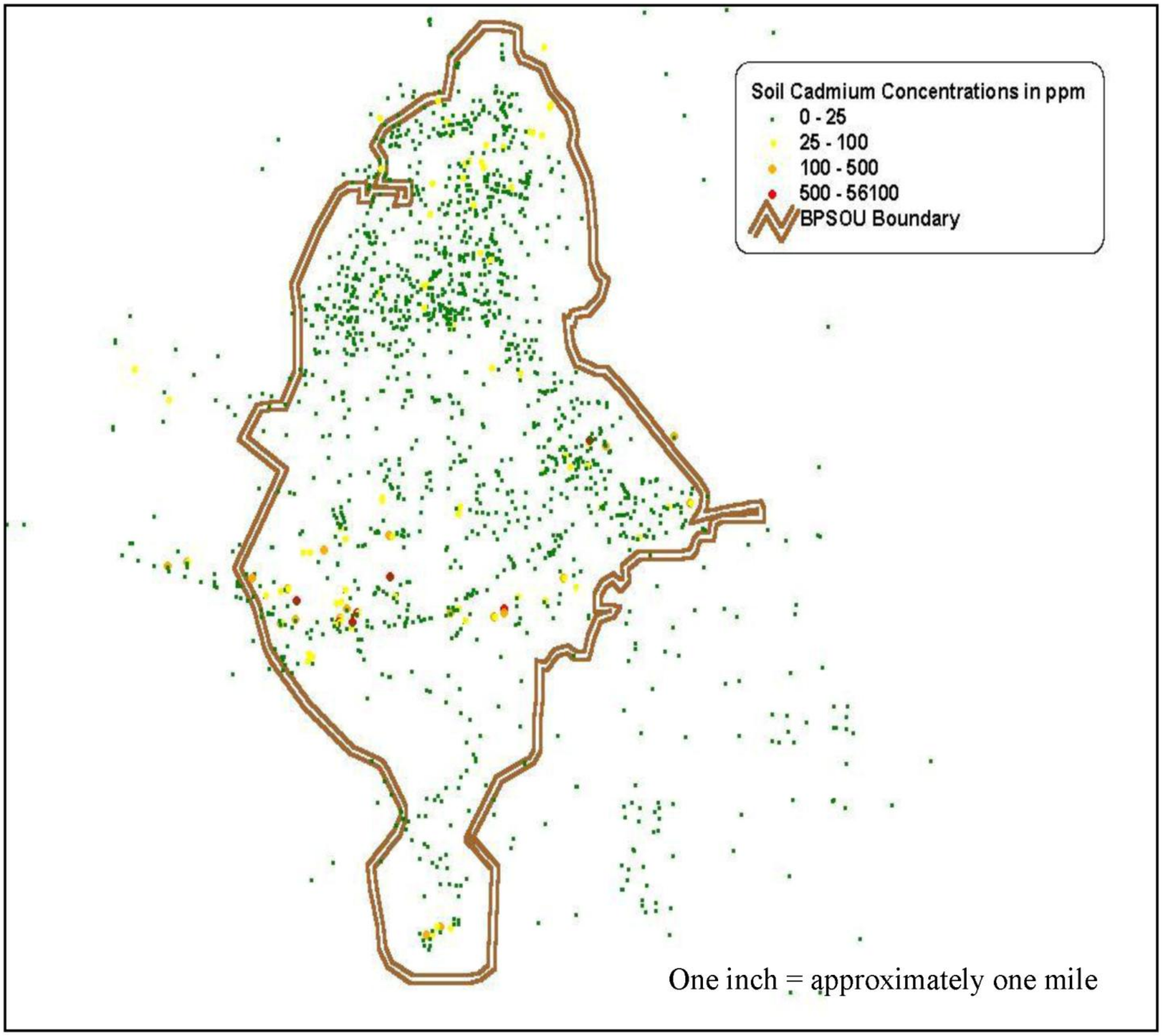

Figure 4- 4. Map of Cadmium Concentrations in the Soil from the BPSOU Database.

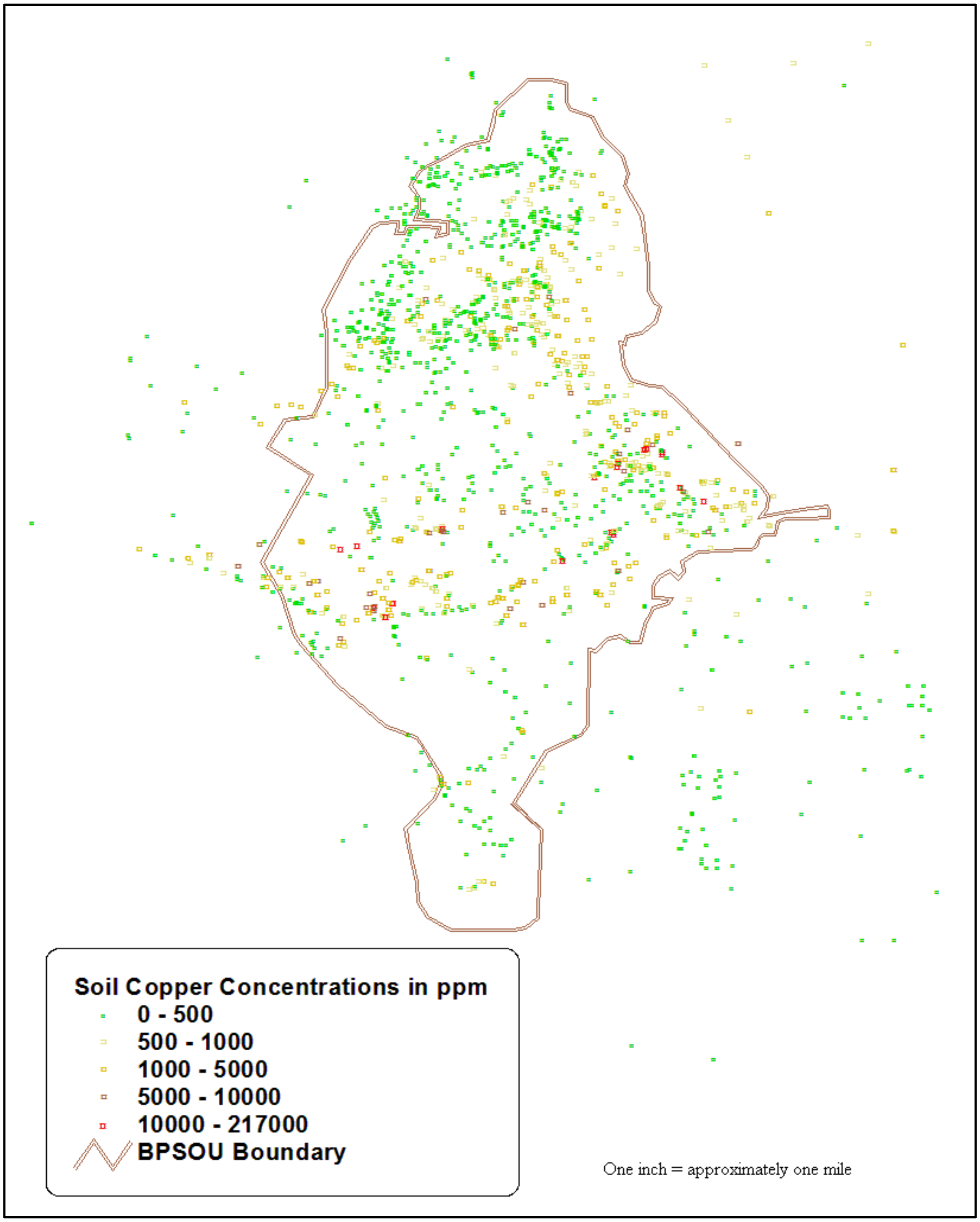

Figure 4- 5. Map of Copper Concentrations in the Soil from the BPSOU Database.

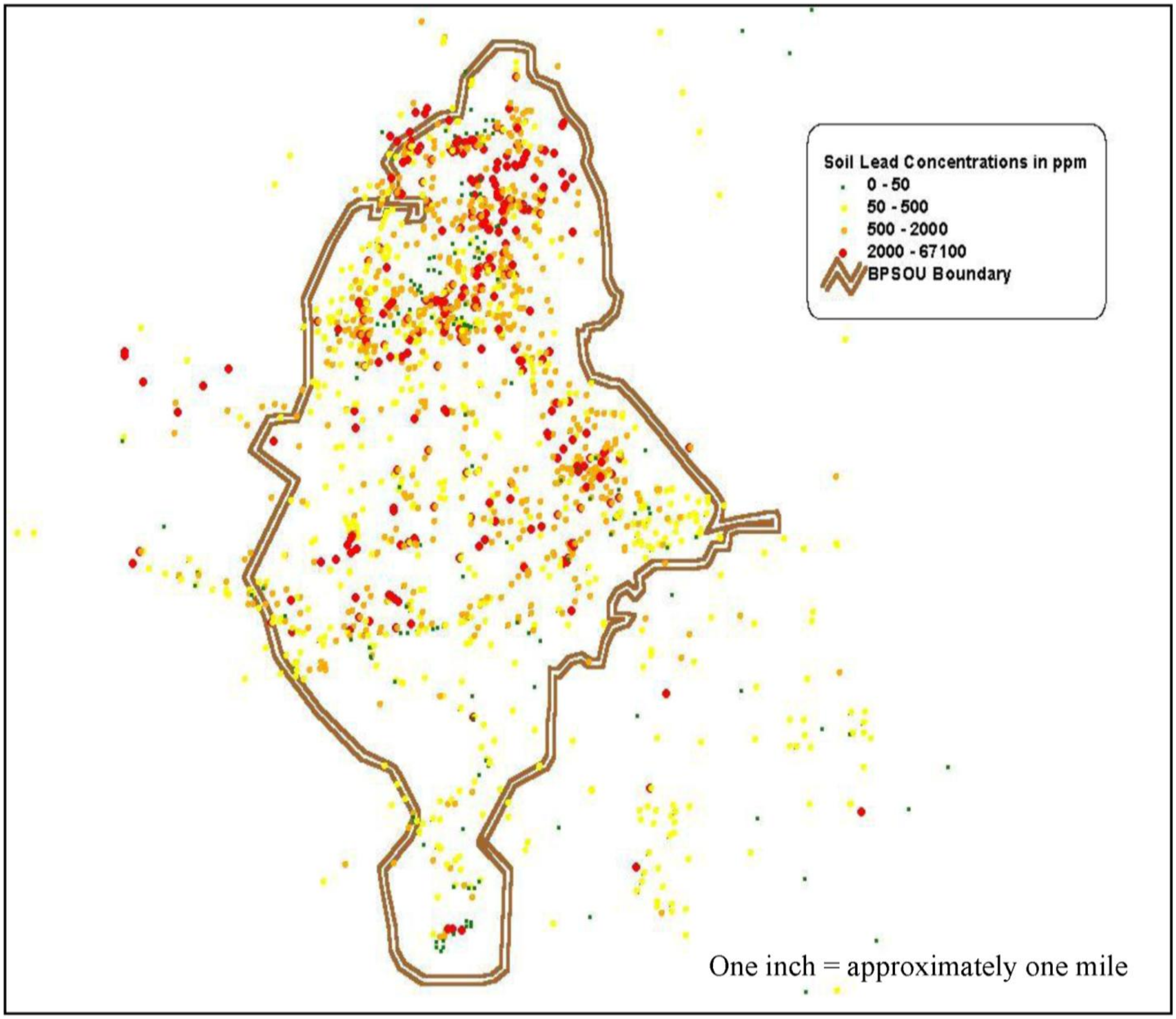

Figure 4- 6. Map of Lead Concentrations in the Soil from the BPSOU Database.

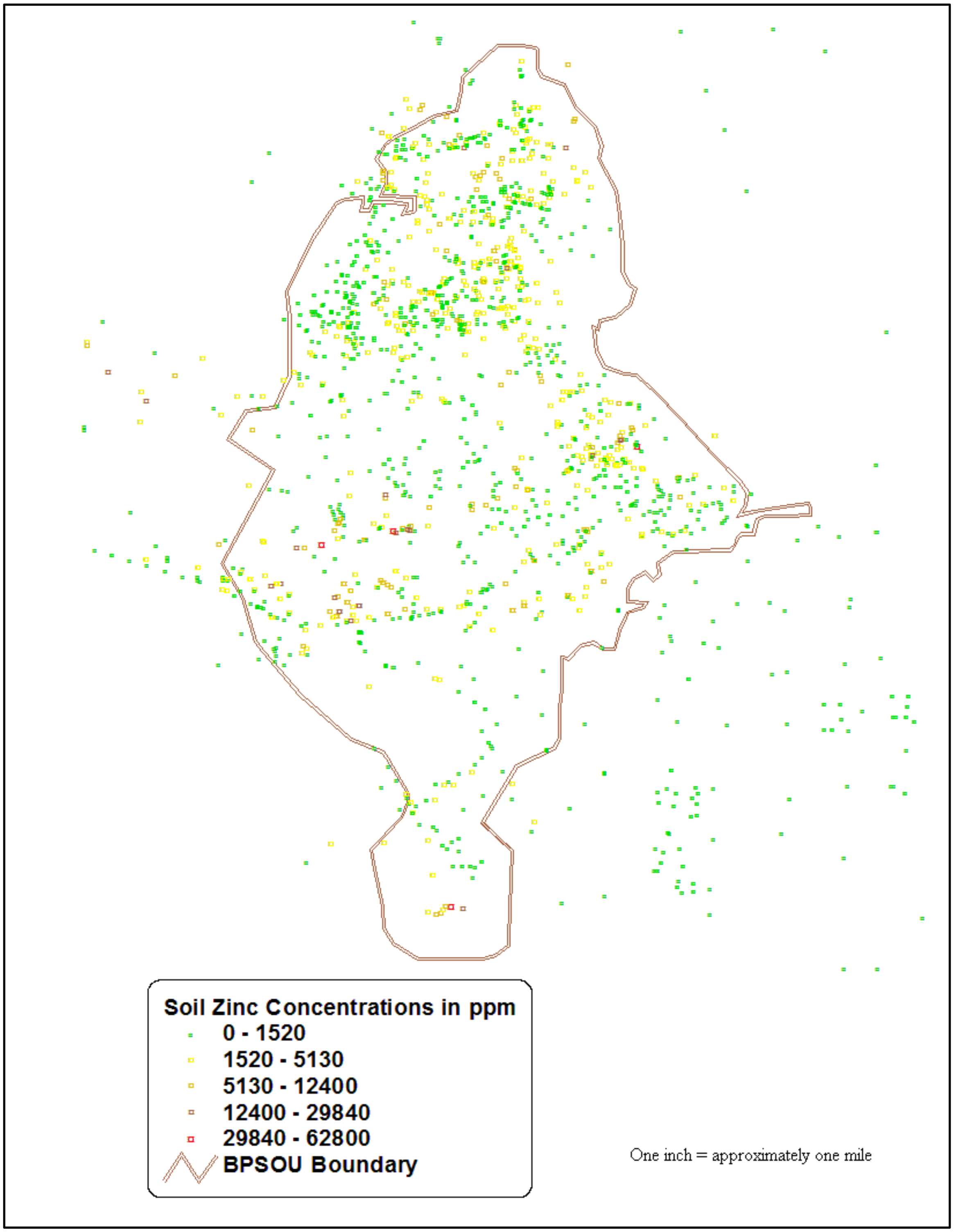

Figure 4- 7. Map of Zinc Concentrations in the Soil from the BPSOU Database

4.3.1 Risk Assessment Studies

The risk assessments performed for the Butte Priority Soils Operable Unit investigated risks associated with arsenic and lead and did not investigate the other contaminants of concern. The Record of Decision for the Butte Priority Soils Operable Unit of the Butte Superfund site (U.S. EPA 2006a) lists the following metals in elevated quantities in Butte soil, air, water, or house dust: aluminum, arsenic, cadmium, copper, iron, lead, mercury, silver, and zinc. In a study of domestic dogs as bioindicators of mining contamination in Butte, the following eight elements were identified as elements of concern (Peterson 2007): aluminum, arsenic, boron, lead, lithium, manganese, molybdenum, and selenium. Importantly, the synergistic, additive, and antagonistic toxicological aspects of the interactions between the chemicals were never investigated.

The BPSOU Superfund Program Cleanup Proposal states that the highest concentrations of arsenic, lead, and mercury are in attic dust, but because the attics are not considered living space, they are not considered in the risk assessment (U.S> EPA 2004). This same document states: “Although previous response actions have eliminated some exposure pathways in many areas, mining-related contaminants are still present at concentrations that exceed acceptable risk levels.” The document also reports that an ecological risk assessment has not been performed “because the site is in an urban setting” (U.S. EPA 2004). It is worth noting that Butte is in a rural setting in Montana, with numerous ecological receptors. It is classified as a rural community by the U.S. Census Bureau because it has a population less than 50,000 (U.S. Census Bureau 1995). Figure 4-8 illustrates the rural nature of the Butte community.

Figure 4-8. View of Butte from Beef Trail Area, Looking North (Photo by Author)

The preliminary remediation goal of 250 milligrams per kilogram (mg/kg) for residential arsenic represents a 1 in 10,000 cancer risk. This is significant because government agencies such as the U.S. EPA and U.S. Food and Drug Administration commonly use 1 in 1,000,000 as the acceptable risk level or de minimis risk level. Additionally, arsenic action levels in Butte for commercial/industrial areas and open space areas used for recreational purposes are 500 mg/kg and 1,000 mg/kg, respectively (U.S. EPA 2004). In a study regarding soil arsenic levels in Records of Decision at Superfund sites, the average residential exposure ranges from 25.3 mg/kg to 84.4 mg/kg and the average industrial exposure ranges from 62.5 mg/kg to 272.2 mg/kg, depending on the target risk level (Davis 2001). The study notes that the demonstration of low solubility and bioavailability of mine waste in the Anaconda area influenced the regulatory decision to increase the residential and industrial standards (Davis 2001).

Risk assessments regarding lead were the basis of the current remediation goal of 1,200 mg/kg (ppm) lead in Butte soils. The EPA typically recommends a lead screening level of 800 ppm in soils for adults. The EPA considers lead concentrations over 1200 ppm as a Tier 1 response level. Lead levels ranging from 400 to 1,200 ppm are considered Tier 2 response levels (U.S. EPA 2003). This indicates that the 1,200 ppm level is inadequate to be protective of adult human health and is even less protective in the case of children. Additionally, risk assessments also only studied acute exposure of 15 days, not the chronic exposure equivalent to Butte residential exposure (U.S. EPA 1993).

The lead remediation goal is based on Uptake Biokinetic (UBK) models that predict blood lead in children aged 0-6. These studies were not based on Butte samples, but were instead based on interpretations of studies in East Helena, Montana and Midvale, Utah. No actual data from Butte tap water, dust, or air samples were used in this study and urban air quality default values were used, even though Butte is a rural community. Additionally, pathways such as exposure from dermal contact, fetal uptake and newborn uptake from the mother, and ingestion of food from gardens were ignored. The model also assumes that lead paint is the source of lead exposure, not lead in mine waste (U.S. EPA 1993).

Actual blood lead studies of Butte children showed that 50% of houses in the study had environmental lead levels that would result in blood lead levels over 10 micrograms per liter (µg/l). In this study, Integrated Exposure Uptake Biokinetic (IEUBK) model bioavailability rates were manipulated from 30% to 12% based on rat studies funded by the PRP, Atlantic Richfield Company (ARCO), that showed that the lead in Butte soils was less bioavailable than other forms of lead (CDM 1994).

A subsequent bioavailability study in young swine tested lead absorption into organs over a 15 day period (Casteel1998). While this study did use actual mine waste from Butte, it did not use residential soils or attic dust. The chief problems with this study were as follows:

- The 15-day test period is an acute exposure period
- Results were determined based on concentrations found in the internal organs, which are usually indicative of chronic exposure
- The small sample size of 15 pigs made the study statistically insignificant
- The high levels of calcium in the samples (16,000 ppm) likely competed with and reduced lead absorption

Risk assessments evaluating the potential for adverse health effects from arsenic exposure did not consider dermal pathways or exposure from sediment, surface water, or groundwater (U.S. EPA 1997a). Bioavailability studies of arsenic in Butte mine wastes were the basis for the current arsenic action levels. These studies used young swine as an animal model for oral absorption of arsenic from soils. Casteel's study emphasizes that it was meant to be used as a preliminary estimate, not to set the final action levels and states "When reliable data are available for the bioavailability of arsenic in soil, dust, or other soil-like waste material at the site, this information can be used to improve the accuracy of exposure and risk calculations at that site" (Casteel 1997). This study exposed 10 groups of 4-5 swine to arsenic-bearing soil for 15 days and then measured the arsenic in urine. The study used smelter slag and Clark Fork River tailings, not soils from the Butte Priority Soils Operable Unit. The study had fundamental trouble with the mixing of drinking water and urine samples and a mass balance analysis of arsenic was able to show only 23-36% recovery. The data for relative bioavailability had widespread variability, and this limits the reliability of the data (Casteel 1997). A subsequent bioavailability study by the same researcher performed a similar test for 12 days using composite soil samples from the Butte Priority Soils Operable Unit. Similarly, drinking water was mixed with the swine urine samples (Casteel 2003). This study was used to reduce the relative bioavailability of arsenic in Butte soils to 0.17-0.22 instead of the 0.8 value typically used by the EPA.

However, the arsenic was bioavailable and the Anaconda Company knew it. The Anaconda Company packaged arsenic produced at the Washoe Smelter and sold it as an insecticide (MacMillan 2000). In 1923, for example, the value of Anaconda's arsenic trioxide approached the value of copper (MacMillan 2000). Figure 4-9 shows the arsenic warehouse in the middle right portion of the map of the reduction works. The arsenic was obviously bioavailable if it functioned as an insecticide. Chapter 8 includes a detailed explanation of arsenic toxicity and associated health effects.

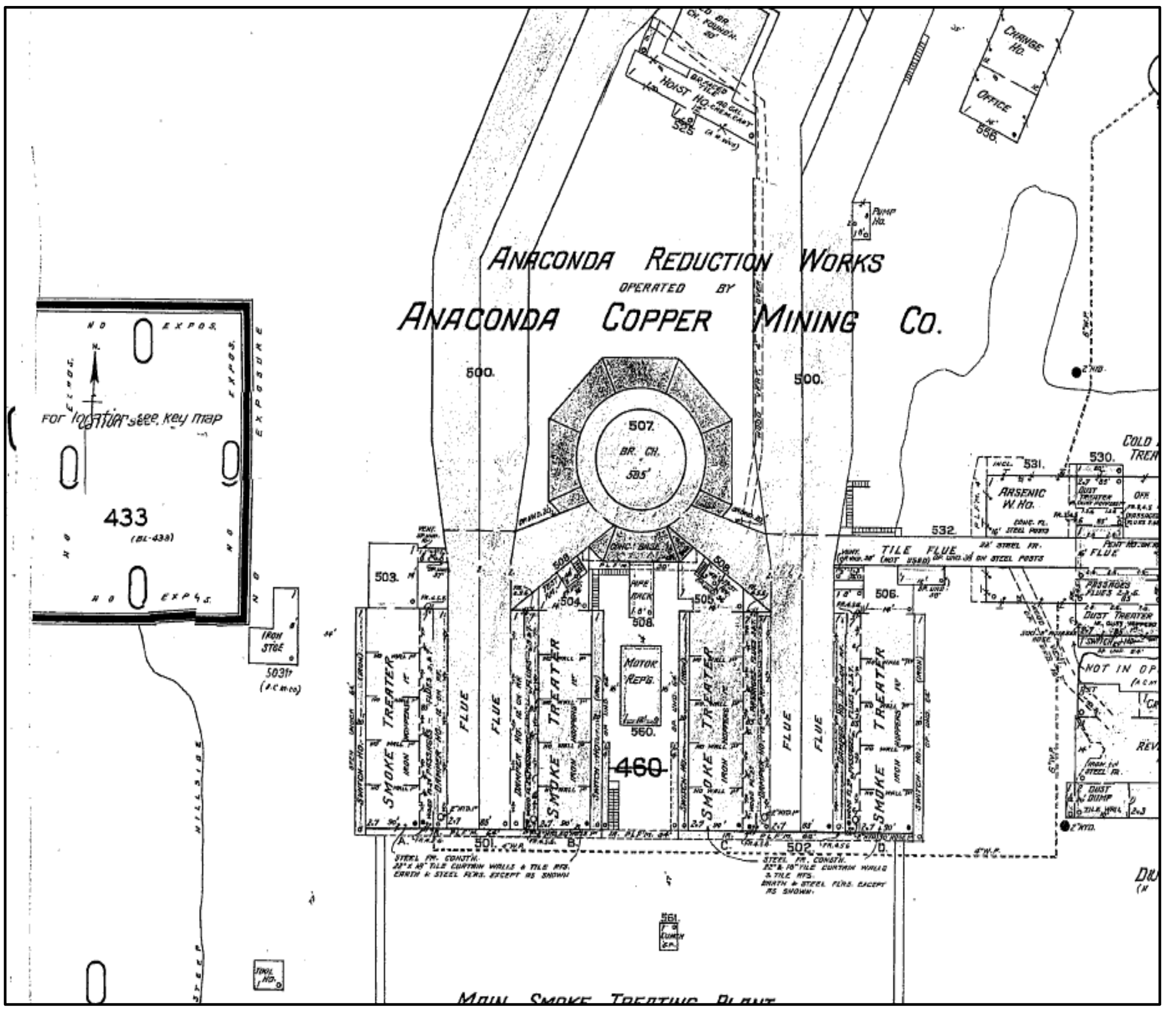

Figure 4-4. Sanborn Map Showing Arsenic Plant at Anaconda Company's Washoe Smelter (Sanborn 1929)

Additionally, the Montana Pole Plant Superfund Site, located in southwest Butte, contains several chemicals of concern, including polycyclic aromatic hydrocarbons (PAHs), chlorophenols, dioxin/diobenzofurans, and metals (MDEQ 2006). Like the metals in the BPSOU, these chemicals also have additive, synergistic, and antagonistic reactions. The cleanup levels at the Montana Pole site are based on a 1 in 1,000,000 cancer risk level for recreational land use at the site for each contaminant of concern for the most susceptible exposure pathway. The selected remedy states that the area must be prohibited from residential use in the future because recreational and industrial cleanup levels are not protective of human health on a residential basis (U.S. EPA 1993).

Ulrick Beck describes an additional social aspect of pollution: "A significant consequence of the environmental risks produced through industrialization is that our senses no longer provide us with adequate information about our surroundings…a disenfranchisement of the senses forces us to turn to science for help in discriminating between what is harmful and what it not" (Beck, 1992). This forms a power relationship between the mining company and the community, not only for the source of occupation but also as a source of scientific authority, health information, and implied stewardship. In cases where the community is unable to supply its own scientific resources, and where the EPA fails to act with due diligence on behalf of the community, it is often forced to rely upon the mining company to test the local environment and determine what is harmful. This has often been the case in Butte. The current mining company performs sampling for air pollution, governmental agencies employ contractors to test the remaining landscape, and the local community has scant resources to garner a second opinion. Because the mining landscape is the baseline for the senses of the Butte community, it must rely on those in position of power. But this goes against its cultural values, and this leads to a disenfranchisement or the antagonistic cynicism described by Pattison.

4.3.2 Clean-up Levels

The following clean-up levels are from the Partial Remedy Implementation Work Plan for the Butte Priority Soils Operable Unit/Butte Site (EPA 2011).

Table 4-1 Soil, Dust, and Vapor Action Levels in Residential Areas

Contaminant of Concern	Exposure Scenario	Concentration
Lead	Residential	1,200 mg/kg
	Non Residential	2,300 mg/kg
Arsenic	Residential	250 mg/kg
	Commercial	500 mg/kg
	Recreational	1,000 mg/kg
Mercury	Residential	147 mg/kg
	Residential (vapor)	0.43 ng/m^3

Table 4-2 Action Levels for Contaminated Soil Media in Nonresidential Areas

Contaminant of Concern	Commercial/Industrial	Recreational
Lead	2,300 mg/kg	2,300 mg/kg
Arsenic	1,000 mg/kg	1,000 mg/kg

Table 4-3 Standards for Groundwater

Contaminant of Concern	Dissolved Standard
Arsenic	10 µg/L
Cadmium	5 µg/L
Copper	1,300 µg/L
Lead	15 µg/L
Mercury	2 µg/L
Zinc	2,000 µg/L

Table 4-4 Water Quality Standards

Contaminant	Human Health Standard (µg/L)	Chronic Aquatic Standard (µg/L)	Acute Aquatic Standard (µg/L)	Notes
Aluminum	--	87	750	Dissolved fraction
Arsenic	10	150	340	
Cadmium	5	0.097	0.52	Hardness-dependent
Copper	1,300	2.85	3.79	Hardness-dependent
Iron	--	1,000	--	
Lead	15	0.545	13.98	Hardness-dependent
Mercury	0.05	0.91	1.7	
Silver	100	--	0.374	Hardness-dependent
Zinc	2,000	37	37	Hardness-dependent

4.3.3 Operable Units

There are nine interconnected areas of contamination in the Butte area, known as "operable units" by the EPA. These operable units are treated individually by the EPA and decisions about remediation and restoration occur separately. Of these nine units, the Butte Priority Soils Operable unit will be the focus of this study because it has the greatest effect on health issues in the area and it has reached a Record of Decision. The nine operable units are the following:

- Butte Priority Soils/Butte Residential Soils
- Butte Mine Flooding and the Berkeley Pit
- The West Camp and Travona Mine

- Lower Area One
- Streamside Tailings
- Non-Priority Soils/Westside Soils
- The Rocker Timber Site
- Montana Pole & Treating
- The Warm Springs Ponds

Figure 4-10 provides an illustration of the operable units. The figure also illustrates the extent of contamination and shows the location of the nearby city of Anaconda, which housed the Anaconda Company's Washoe Smelter and Reduction works. The figure shows the Streamside Tailings, Warms Springs Ponds, and Rocker operable units, which are outside the scope of this study but illustrate the widespread contamination downstream of the Butte units. The map also illustrates the considerable overlap in the Mine Flooding and Butte Priority Soils operable units. Put simply, one unit is above ground (BPSOU) and one is below ground (Mine Flooding). The figure also gives a visual explanation of the extensive size of the West Side Soils Operable Unit. Based on the map, this operable unit is equivalent in size to the Butte Priority Soils Operable Unit.

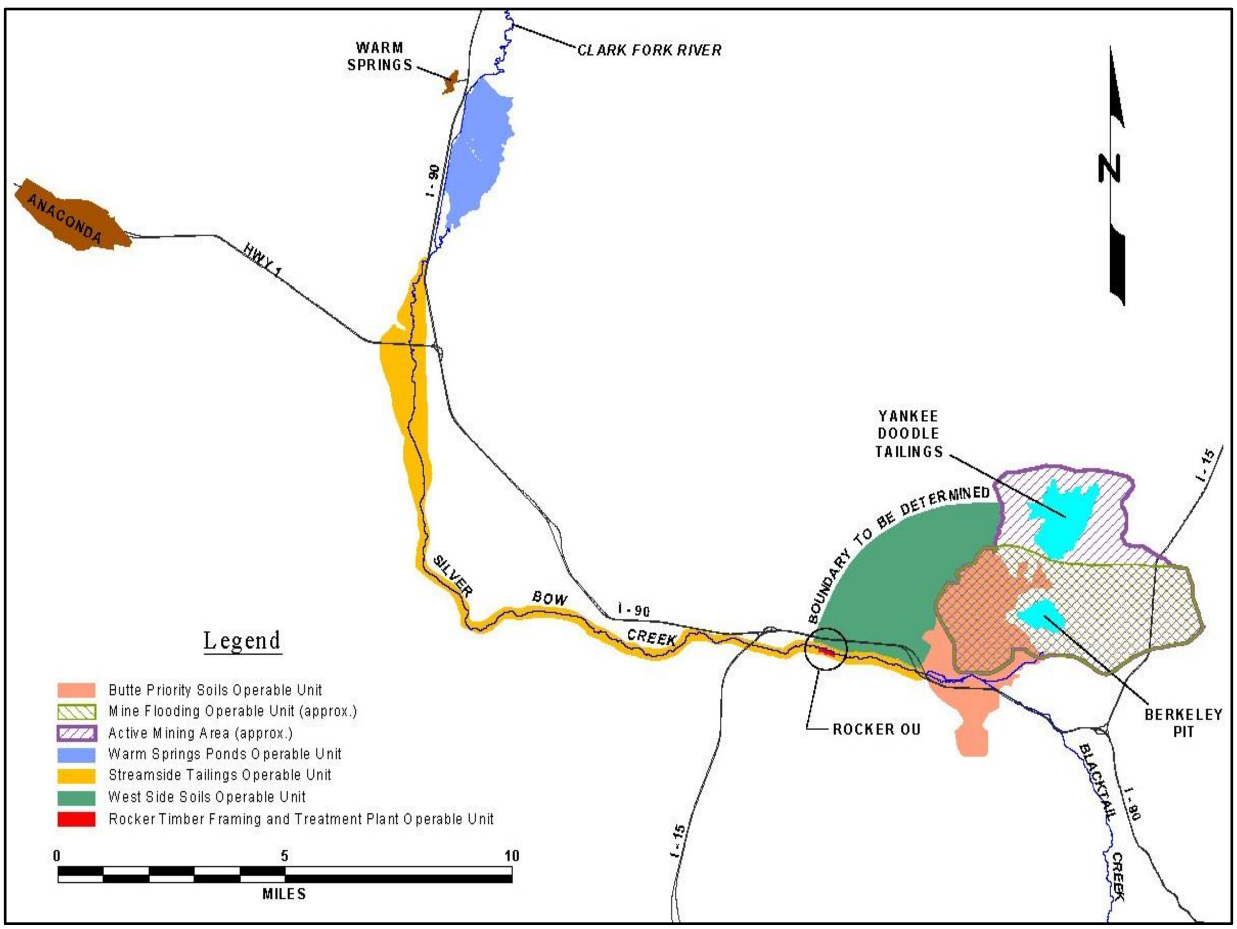

Figure 4-10. Operable Units at Butte Area Superfund Sites (U.S. EPA 2006a)

4.3.3.1 Butte Priority Soils/Butte Residential Soils Site

The Butte Priority Soils Operable Unit/Butte Residential Soils Site includes the majority of the mining-impacted surface soils in uptown Butte and Walkerville as well as the surface water and alluvial aquifer. Remedial actions have included capping or removal of mine waste, including dumps, throughout the landscape. Remedial actions at this and other operable units are described in Section 5. The outline of the BPSOU is shown in Figure 4-11.

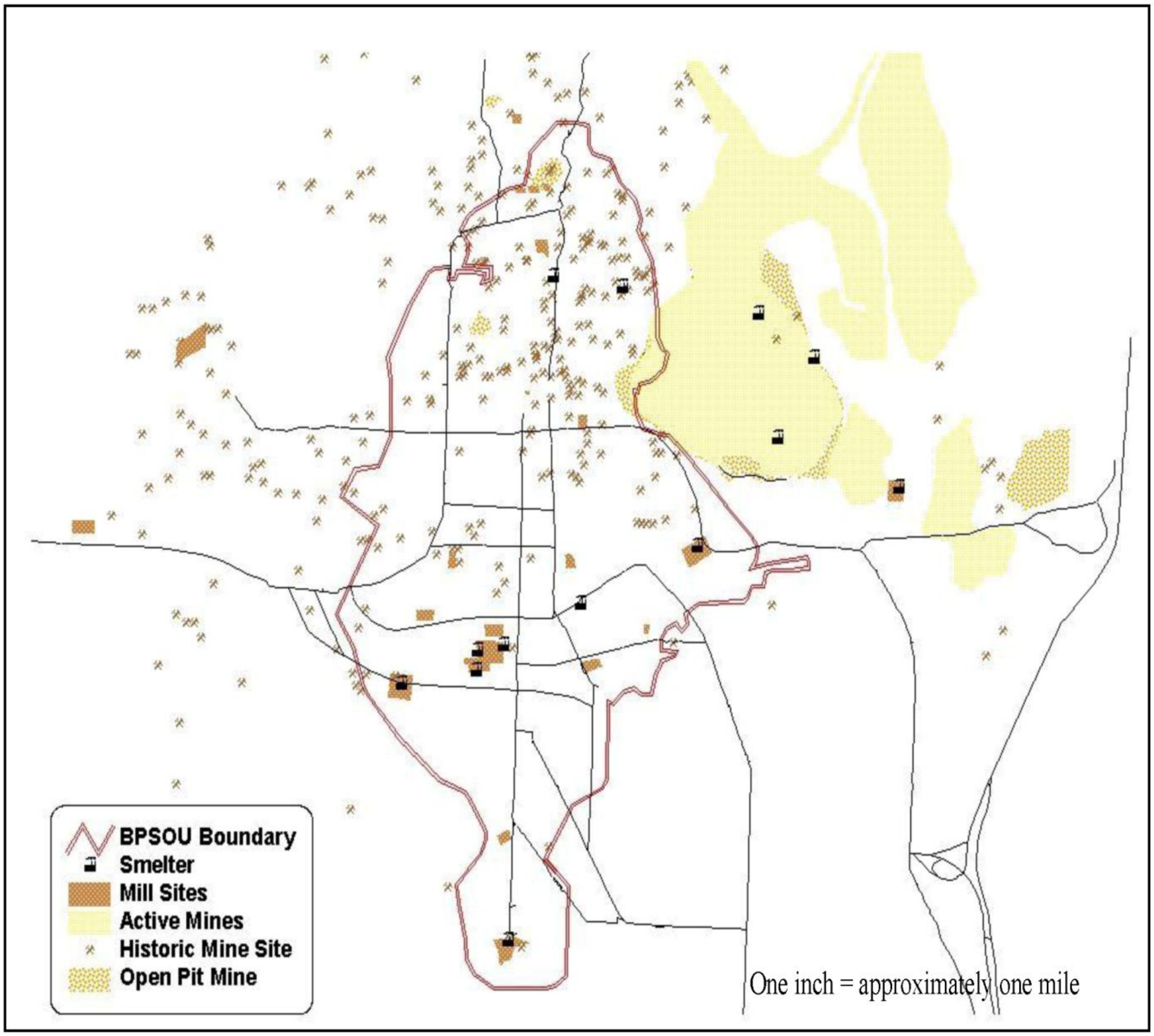

Figure 4-11. Historical Mining Activity in the Butte Area (Including the Boundary of the Butte Priority Soils Operable Unit) (Map by Author)

4.3.3.2 Butte Mine Flooding

The Butte Mine Flooding Operable Unit includes groundwater contamination in the uptown Butte and Walkerville areas. There are approximately 500 mine shafts dotting the Butte landscape. The shafts lead to 3,000 miles of underground workings (NPS 2006). Figure 4-12 shows the extent of underground mining and its effect on the underground landscape. As seen in this map, underground mining occurred primarily on the Butte Hill and occurred within residential areas. The majority of the underground mine workings occurred in or adjacent to the Berkeley Pit workings, with a few outlying shafts in the western reach of the uptown area.

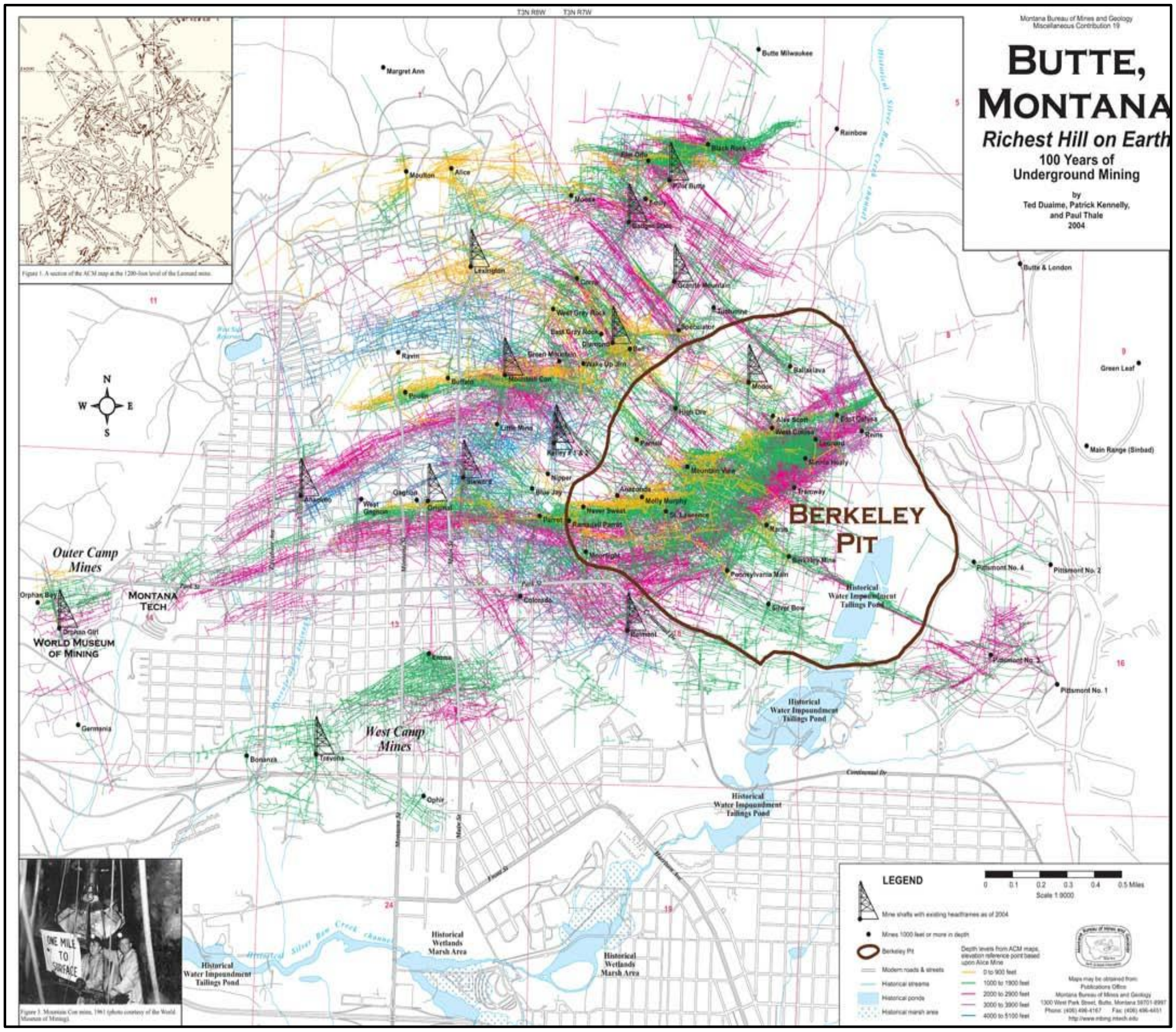

Figure 4-12. Extent of Underground Mining in Butte (Duaime, 2004)

Upon closure of the Berkeley Pit operations in 1982, ARCO turned off the pumps that dewatered the underground mine working and the Berkeley Pit itself. Since this time, the underground workings have flooded, and the Berkeley Pit contains over 40 billion gallons of acidic waters that have high concentrations of heavy metals (Pitwatch 2011).

The EPA plan for remedial actions at the Berkeley Pit includes maintenance of the water level at 5,410 feet, known as the “Critical Water Level.” It also includes permanent control of surface waters that enter the pit. The remedial action calls for continued control of the underground mine flooding known as the West Camp/Travona system as well as compliance monitoring systems and institutional controls to restrict the underground and Berkeley Pit waters from entering bedrock aquifer waters. The plan also calls for increased public education efforts. The Berkeley pit is expected to reach the “Critical Water Level” in 2023. Past remedial action at the site includes the 2003 construction of the Horseshoe Bend Water treatment plant. This plant is used to control inflow to the Berkeley Pit. The plant treats the inflow with lime and the resulting waters are used by the current mining operations as makeup water. This plant will be part of the remedial action employed to maintain the “Critical Water Level” at the pit. Figure 4-13 contains a summary of information regarding the Berkeley Pit.

▼ Pit Facts at a Glance

Years of Operation:	1955 - 1982
Ore Mined from the Pit:	316 million tons (286 million metric tons)
Waste Rock Removed from the Pit:	700 million tons (635 million metric tons)
Pit Depth:	1,780 feet (543 meters)
Pit Lake Water Depth:	Over 1,000 feet (over 300 meters)
Pit Width:	1.25 miles (2 km) East-West, 1 mile (1.6 km) North-South
Pit Circumference:	4 miles (6.4 km)
Total Volume of Water in the Pit Lake:	Over 40 billion gallons (over 150 billion liters)
Current Water Level:	5,280.29 (1,609.43 meters)
Critical Water Level:	5,410 feet (1,649 meters)
Level at which Pit water would reach a surface outlet:	5,509 feet (1,679 meters)
Current Rate of Fill:	2.6 million gallons (10 million liters) per day
Rate of Fill, 1982-1996:	5.2 million gallons (20 million liters) per day
Rate of Fill, 1996: (after the diversion of Horseshoe Bend flows to the Yankee Doodle Tailings Pond, and, in 2003, to the Horseshoe Bend Water Treatment Plant)	3.1 million gallons (12 million liters) per day
Pit Water pH*:	2.5 to 3.0 (the pH of Cola is about 2.5)
Sludge Discharged to the Pit from the Horseshoe Bend Water Treatment Plant since 2003:	211,000 gallons (800,000 liters) per day, or 160 gallons (605 liters) per minute
Pit Water Pumped for Copper Extraction:	13.2 million gallons (50 million liters) per day
Metals & Minerals Present in Pit Water:	Calcium (Ca), Magnesium (Mg), Potassium (K), Sodium (Na), Iron (Fe), Manganese (Mn), Aluminum (Al), Cadmium (Cd), Copper (Cu), Zinc (Zn), Arsenic (As), Chloride (Cl), Fluoride (F), Sulfate (SO4)
Pit Water Metal Concentration Examples:	150 mg/L Copper, 600 mg/L Zinc, 1000 mg/L Iron

***What is the pH scale?**
pH is a measure of the acidity or alkalinity of a solution. Pure or neutral water has a pH of 7.0. Acids are defined as those solutions that have a pH less than 7; while bases are defined as those solutions that have a pH greater than 7. The pH scale is logarithmic. Unlike linear scales, which have a constant relationship between the item being measured and the value reported, each individual pH unit is a factor of 10 different than the next higher or lower unit. For example, a change in pH from 2 to 3 represents a 10-fold decrease in acidity, and a shift from 2 to 4 represents a 100-fold (10 × 10) decrease in acidity.

Figure 4-13. Berkeley Pit Information (Pitwatch 2005)

4.3.3.3 West Camp/Travona Mine

The West Camp/Travona Mine Operable Unit is considered separately from the Berkeley Pit and east side underground mine workings because the ground water in this area flow to the west of the hill, not into the Berkeley Pit. Several years after the dewatering pumps were turned off, groundwater in this area flooded basements on the Butte Hill. In 1989, ARCO, under EPA supervision, constructed a pipe-and-pump system at the Travona shaft that connects to the Butte-Silver Bow sanitary sewer system (Malloy 2011). Circa 2000, this treatment stopped and at Butte-Silver Bow's request, ARCO removed all of the piping connections to the sewer system. Currently, a groundwater pumping well installed by ARCO near Centennial Avenue pumps water from the underground workings at the 600 foot level of the Travona to the Lower Area One treatment lagoons via the Lower Area One hydraulic control channel and it is discharged to Silver Bow Creek via the lagoons. The pump rate is approximately 100 gallons per minute and seasonally adjusts for infiltration from rain and snowmelt (Malloy 2011).

4.3.3.4 Lower Area One

The Lower Area One Operable unit is the former site of the Colorado Smelter and its subsequent tailings. It includes portion of Silver Bow Creek, a mine waste area known as “slag canyon,” and a series of groundwater treatment ponds. The area also included manganese ore and tailings amassed by the Department of Defense during World War II, when the Butte Reduction Works processed manganese ores in this area (Quivik 1998). Figure 4-14 shows the historic route of Silver Bow Creek through the tailings at the Butte Reduction Works.

Figure 4-14. Butte Reduction Works (World Museum of Mining 2009)

4.3.3.5 Rocker Timber Site

The Rocker Timber Operable Unit is the site of a former timber-treating plant in Rocker, Montana, approximately three miles west of Butte. The Anaconda Company operated the plant from 1909 to 1957. The plant used arsenic trioxide to treat and preserve wood. The 16-acre site contains mine waste fill in areas adjacent to and a part of the railroad bed, and in areas where wood treatment processes occurred, mine waste fill was approximately 15-18 feet deep (CDM 2011). Because the site is outside the Butte City limits, it is outside the scope of this document.

4.3.3.6 Montana Pole Plant

The Montana Pole and Treating Plant, shown in Figure 4-15, operated from 1946 to 1984 and used Pentachlorophenol (PCP) and other wood treating substances to preserve posts and poles. Hazardous wastes from these operations discharged to an adjacent ditch and eventually reached Silver Bow Creek. After a citizen complaint in 1983, The Montana Department of Environmental Health Sciences launched an investigation of the site and determined that PCP, PAHs, and dioxins/furans were present (EPA 2001).

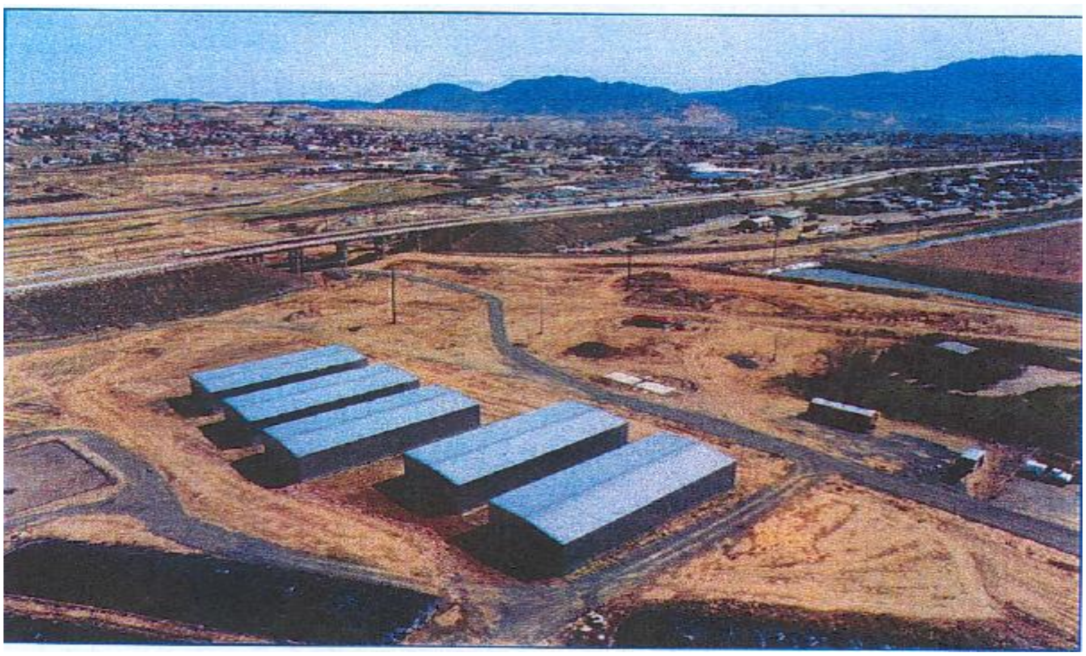

Figure 4-15. Montana Pole and Treating Plant (MDEQ 2006)

4.3.3.7 Warm Springs Ponds

The Warm Springs Ponds Operable Unit includes three tailings ponds built by the Anaconda Company between 1911 and 1959 to impound tailings and prevent their entry into the Clark Fork River. The 2,400 acre pond system is located northwest of Butte at the confluence of Silver Bow, Willow, and Warm Springs creeks. Because the ponds are outside the Butte City limits, they are outside the scope of this document.

As with the large-scale mining in Butte, environmental remediation altered the landscape extensively. Sewers became streams, dumps became parks, and the sand and barrenness were covered in clean dirt. This resurfacing came after mine closure, a deep wound to the community, and the shift in power from mining to cultural capital. This shift brought historic preservation and culture to the forefront of community ideals and resurfaced the cultural landscape of the city. The landscape was no longer viewed as a series of mining claims, a site for future expansion, or a dumping ground. It was a home where people deeply valued history and had a hope for the future.

"Earth has no sorrow that earth can not heal."
— John Muir

5.0 Environmental Remediation

There has been extensive remediation throughout the Butte Superfund sites. The following sections provide summaries of nonresidential and residential remediation and include a timeline and series of maps showing the location of contamination and remediation. This shows the extent of interaction with and alteration of the landscape. This regular alteration of the landscape is a constant in Butte history and the adaptation to these changes is consistent with the community's mining past. As seen in several of the photographs in this section, remediation has rendered many portion of the landscape less toxic and more aesthetically appealing. This chapter also includes a description of the Butte Remediation Evaluation System, an EPA tool that evaluates the integrity of reclamation in Butte. The residential remediation section includes a series of maps that illustrate the extent of lead, arsenic, and mercury contamination in residential locations as well as a map and description of residential remedial actions. The chapter concludes with a map showing both nonresidential and residential remedial action in the Butte area.

5.1 Nonresidential

The following narrative, timeline, and maps were developed from several sources, including the EPA BPSOU Proposed Plan, the EPA BSPOU Record of Decision, the Phase II Remedial Investigation and Report for the BPSOU by the PRP Group, the EPA BPSOU website, the Butte Reclamation Evaluation System (BRES) guidance documents and annual reports, Butte-Silver Bow Planning Department, and the Butte-Silver Bow GIS Department (U.S. EPA 2004, U.S. EPA 2006a, U.S. EPA 2009a, PRP Group 2002, CDM 2003, BSBGIS 2009, BSBPD 2009). Figure 5-1 provides an overview of nonresidential reclamation in the Butte area. Table 5-1 provides a historic timeline of nonresidential remediation in Butte.

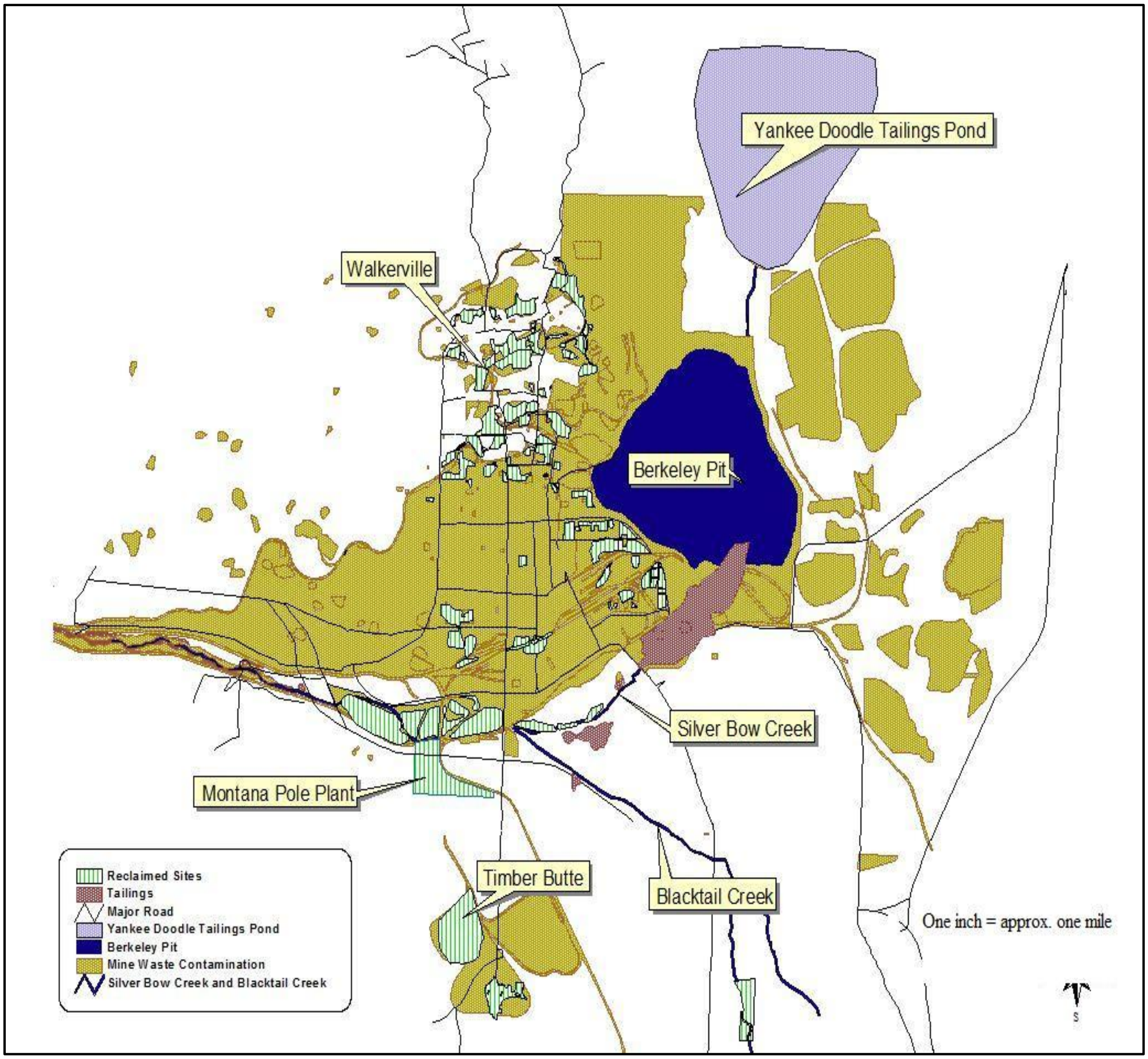

Figure 5-1. Nonresidential Remediation at the Butte Superfund Site (Map by Author)

5.1.1 Butte Priority Soils Operable Unit

ARCO-BP, the purchaser of the Anaconda Company and primary PRP, performed the first remedial actions in the Butte Priority Soils Operable Unit (BPSOU) under EPA supervision in 1988, when 300,000 cubic yards of contaminated soils were stabilized at mine waste dumps in Walkerville, a small town along the northern border of Butte (U.S. EPA 2011). This action addressed mine waste dumps and residential soils that contained greater than 2,000 ppm lead or 10 ppm mercury. This action included the following Walkerville sites: Alice Dump, Alice Mill, Paymaster Dump, Moulton Dump, Walkerville Ball field, Walkerville Playground, Upper Missoula Gulch, Blue Wing Dump, Lexington Mine and Mill, and the LaPlata Gulch (U.S. EPA 2011). That same year, four earthen basements and 23 residential yards were remediated in the Walkerville area (U.S. EPA 2011). Figures 5-2 and 5-3 show the Lexington mine and mill yard before and after remediation. In addition to contaminant removal, the remaining contaminants of concern are less bioavailable because they are capped with clean soils and vegetation.

Figure 5-2. Lexington Mine before Remediation (U.S. EPA 2004)

Figure 5-3. Lexington Mine after Remediation (U.S. EPA 2004)

The following year, ARCO moved approximately 40,000 cubic yards of contaminated soil at Timber Butte, located in the southwestern portion of the city, to a temporary on-site repository (U.S. EPA 2011). The company remediated two residential yards in this area at this time (U.S. EPA 2011).

Several additional mine dumps in the Walkerville area were capped had contaminated soils removed in 1994 (U.S. EPA 2011). These dumps included the Curry, Waste Dump #5, and the Jangula vacant lot. Several residential source areas in Walkerville and Butte were also capped or removed at this time. This action addressed nonresidential source areas with lead concentrations higher than 2,300 ppm and residential concentrations greater than 1,200 ppm (U.S. EPA 2011). In 2006, 46 residential areas in Walkerville were reclaimed. Additional removal of BPSOU source area soils occurred in 1994 and included the following sites: Venus Dump, Clark Street Dump, Missoula Mine, Mountain Con-2, and the Belle of Butte. Source area removals in 1995 included Robert Emmet Dumps, Atlantic-1, West Ruby Dump, Little Mina, Capri Motel/Arctic Dump, Ravin, Waste Dump #20 (U.S. EPA 2011). Reclamation work in 1996 included regrading and capping at the Belmont Hoist, Little Mina Adjacent Area, Blue Jay Mine, the Parrott Dump, and Parrott Mine Yard. Reclamation actions during the 1997, 1998, and 1999 construction seasons occurred at the following sites: North and South Emma Dumps, Sister Dump, New Era 1 and 2, Henriett, Waste Rock Dump, Steward Mine, Baltic Dump, Mandan Park, Girard Park, and the northern portion of the Old Lexington Mill (U.S. EPA 2011). Portions of the Butte New England Yard and Belmont Mine Yard were reclaimed in the 1999 and 2000 construction seasons (U.S. EPA 2011).

In 1990 and1991, ARCO capped or removed approximately 100,000 cubic yards of waste dumps in the BPSOU (U.S. EPA 2011). Waste dumps addressed in 1990 included: the Curry Dump, Cellar Dirt Dump, Mandan Park Play Area, Child Harold-2 Dump, Heaney Dump, Green Copper Dump, Rising Star Dumps West and East, Jasper, Rock Island Dump, Zella, Old Glory West, West Stewart Parking Lot, Alliance Dump, Tension Dump, Magna Carta Lessee Dumps, Sister Dump, Atlantic-1 Dump, Josephine Shaft, Rialto, Star West Dump, Washoe Sampling Works, Dexter Mill, Travona Dump, Mountain Con-2 Dump, Corra-2 Dumps, Eveline Dump, and Work Area 10, also known as the Day Care Center site (U.S. EPA 2011). Remedial actions also included the reclamation of a concentrate spill on a railroad bed and seven adjacent residential yards in the 800 blocks of Main, Highlands, and Colorado (U.S. EPA 2011). Additional remediation of rail road beds resumed in 1999 and continued until 2003. This work used action levels of 250 ppm arsenic for residential soils and railroad beds in residential areas and 1,000 ppm arsenic in open space areas (U.S. EPA 2011).

ARCO's 1991 remedial actions also included the removal of approximately 40,000 cubic yards of contaminated soils at the Colorado Smelter, shown in Figure 5-4, to an on-site disposal area (U.S. EPA 2011). The EPA removed 80,000 cubic yards of contaminated soils to an on-site repository at the Colorado Mill site during 1993-1998 and installed a groundwater collection system during remedial actions (U.S. EPA 2011).

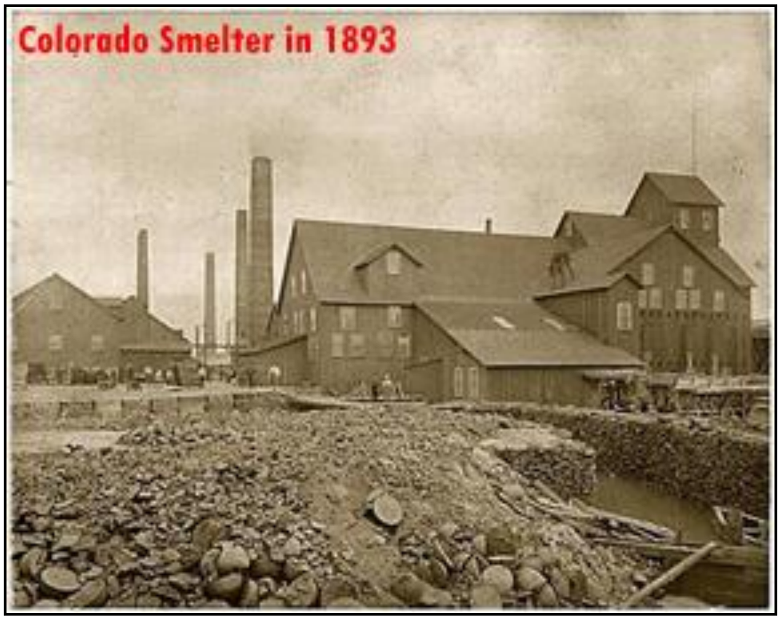

Figure 5-4. Colorado Smelter (CTEC 2009)

In 1992, ARCO removed contaminated soils and capped the Anselmo Mine Yard, Anselmo Dump, Late Acquisition Yard, and Silver Hill Dump (U.S. EPA 2011). This same year, the Defense Logistics Agency, EPA, and U.S. Bureau of Reclamation removed portions of the manganese stockpiles along Silver Bow Creek, located east of the Metro Sewage Plan and west of Montana Street (U.S. EPA 2011). The stockpile included 409,781 short tons of manganese ore and tailings amassed by the Department of Defense during World War II, when the Butte Reduction Works processed manganese ores (U.S. EPA 2011). The remedial action included the removal of 391,670 short tons of ore and tailings to a repository in Whiskey Gulch, west of the BPSOU (U.S. EPA 2011).

In 1998, the Montana Department of Environmental Quality removed approximately 700,000 cubic yards of contaminated soils from the Alice Dump and placed them in the Alice Pit (U.S. EPA 2011). This action also included grading and contouring of the slopes, construction of a storm water ditch, and cover soil with vegetation (EPA 2011). This same year, residents of Dexter Street, immediately east of Missoula Gulch, found elemental mercury in their soil and informed the EPA (U.S. EPA 2011). In response, ARCO removed 49 cubic yards of contaminated soils from two locations in this area. The BPSOU also includes surface water, including storm water runoff. A municipal storm water improvement plan was created in 2001 (U.S. EPA 2011).

Another facet of the BPSOU is the Butte Residential Metals Abatement Program, which includes a lead abatement program operated by the Butte-Silver Bow Health Department. The program remediates residences with arsenic levels greater than 250 ppm, lead levels over 1,200 ppm, or mercury levels over 147 ppm in interior dust. It also remediates yards with arsenic or lead at those same levels in soils. The lead program also remediates lead drinking water pipes and lead paint. This program is described in a subsequent section of this chapter.

5.1.2 West Camp and Travona Mine

In 1989, a piping-and-pumping system was installed to redirect the flooded mine waters in the West Camp and Travona shaft area (U.S. EPA 2011). The new system routed flood waters to the Metro Sewage Treatment plant. This action prevented basement flooding and contaminated ground water from entering the alluvial aquifer and Silver Bow Creek (EPA 2011).

Major storm water remediation projects, including the construction of cement channels and sedimentation ponds, began in 1996 (U.S. EPA 2011). Initial storm water actions occurred at the Kelly Mine Yard, Upper and Lower Missoula Gulch, and Buffalo Gulch. In 1998 and 1999, a storm water piping system and detention pond were installed in Upper Buffalo Gulch to redirect storm water from the gulch to the Berkeley Pit (U.S. EPA 2011). In 1998, storm water remedial actions at Missoula Gulch included the construction of catch basins, concrete channels, and diversions, as well as the removal of contaminated soils from Upper Missoula Gulch, Wappelo Dump, Missoula Mine, and the Garfield site (U.S. EPA 2011). Figures 5-5 and 5-6 show the western portion of Missoula Gulch before and after remediation.

Figure 5-5. West Missoula Gulch before remediation (U.S. EPA 2004)

Figure 5-6. West Missoula Gulch after remediation (U.S. EPA 2004)

5.1.3 Mine Flooding and the Berkeley Pit

The rising floodwaters in the Berkeley Pit have the potential to migrate into the alluvial aquifer and into Silver Bow Creek (U.S. EPA 2011). Major remedial actions will begin when the waters reach the critical action level of 5,410 feet. This is expected to happen in 2023 (U.S. EPA 2011). There are several remedial activities that have taken place in this area, however. In 1996, water flowing from Horseshoe Bend was diverted from the Berkeley Pit and routed to the Yankee Doodle Tailings Pond (U.S. EPA 2011).

In 1998, Montana Resources stopped heap leaching operations and began pumping water from the Berkeley Pit to their adjacent operations and extracting copper from this water. This process and the Horseshoe Bend diversion stopped in 2000 when MRI temporarily shut down the operations. In 2003, MRI resumed mining and copper extraction from the Berkeley Pit waters. The same year, MRI started a water treatment plant at Horseshoe Bend, shown in Figure 5-7, and began using these waters in mining operations. Sludge from the plant is discharged into the pit (Berkeley Pit Education Committee 2009).

Figure 5-7. Horseshoe Bend Treatment Plant and Berkeley Pit (Photo by Author)

5.1.4 Silver Bow Creek

The first five miles of Silver Bow Creek, in an immediately west of Butte, are known as Subarea 1 (U.S. EPA 2011). ARCO led remediation efforts at the Colorado Tailings, located in this area, under EPA direction from 1993 to 1998 (EPA 2011). This work included the removal of 1,200,000 cubic yards of tailings from the Silver Bow Creek floodplain (U.S. EPA 2011). It should be noted, however, that an estimated 1,000,000 cubic yards of tailings remain in the stream and floodplain beneath the Metro Sewage Treatment Plant, including the historic slag walls, and other immobile structures. The Montana Department of Environmental Quality (MDEQ) initiated remediation in the upper reaches of Silver Bow Creek in 1999, when it removed streamside tailings, reconstructed the stream channel, and began revegetation of the stream bank. The remediation of the first mile of Silver Bow Creek continued downstream the following year, and in 2001and 2002, MDEQ led efforts to reclaim Miles 2 and 3 of the stream. This remediation included an infusion of restoration grant moneys that allowed DEQ contractors to plant denser vegetation on the stream bank and floodplain. Remediation of the next two miles of Silver Bow Creek occurred in 2002 and 2003 and also included enhanced vegetation, channel reconstruction, and other restoration efforts (MDEQ 2003). Remediation of Subarea 2 of Silver Bow Creek is ongoing, and it is outside the scope of this study. Figure 5-8 shows the removal of streamside tailings from Silver Bow Creek.

Figure 5-8. Removal of Streamside Tailings (CTEC 2009)

Upstream portions of Silver Bow Creek within Butte are now referred to as the Metro Storm Drain. This drain is a man-made water conveyance used to transport storm water, mine water, and sewage. Historically, the drain was used by the Anaconda Company to convey wastewater from the Berkeley Pit. Silver Bow Creek currently begins at the confluence of the Metro Storm Drain and Blacktail Creek and becomes the headwaters of the Clark Fork River (U.S. EPA 2006a). Currently, a group of community members are petitioning the State of Montana to return the name of this water body to Silver Bow Creek and to remediate it accordingly (Silver Bow Creek Headwaters Coalition v. State of Montana 2012). This is an act of contesting history and dissenting heritage discourse while employing the authorized heritage discourse of historic preservation. It demonstrates the importance of naming and government agency hegemony in the Superfund process. So long as the Montana DEQ can designate the former creek as Metro Storm Drain, an industrial sewer, it does not have to remediate or restore the former creek. But residents that belong to the Silver Bow Creek Headwaters Coalition want the creek as a natural part of their community and environment.

5.1.5 Montana Pole and Treating Plant

The EPA Emergency Response branch removed approximately 10,000 cubic yards of contaminated soils in July of 1985 (EPA 2009). The group also installed two groundwater interception/oil recovery systems to prevent oil seepage into Silver Bow Creek at that time. EPA listed the site on the Nation Priority List (NPL) in 1987. In 1992, the EPA installed ten recovery wells to remove the light non-aqueous phase liquid. These 25-foot wells each contained two pumps, one to collect free-floating oil and one to pump contaminated groundwater to an on-site treatment facility. The treatment facility began operation in 1993. In addition to the 10 wells, the EPA also installed 890 feet of sheet piling, on the southern side of Silver Bow Creek. In 1996 and 1997, the EPA constructed a land treatment unit, soil staging, and pretreatment piles; built an addition to the water treatment plant, constructed two contaminated groundwater recovery trenches, and excavated the north side contaminated soils (EPA 2009).

In 1999 and 2000, the agency relocated sewer and water lines away from the treatment area. On-site treatment of the contaminated soils continued until 2007, when the soil staging pre-treatment piles were dismantled. In the course of remedial actions, over 200,000 cubic yards of contaminated soils were excavated from the site. Approximately 150,000 cubic yards of these soils were treated at the Land Treatment Unit and were then backfilled on-site. In addition to this, 24,000 cubic yards of soil staging pile soils were treated and backfilled. The groundwater treatment system has treated approximately 1 billion gallons of groundwater (EPA 2009).

5.1.6 Timeline of Major Nonresidential Remedial Actions

Table 5-1 provides a timeline of major nonresidential remedial actions in Butte. The timeline details the significant amounts if toxic soils removed and transferred to mine waste repositories in the Butte area, most often in the Berkeley Pit area. There are also on-site repositories in the Timber Butte and Colorado Smelter areas. The timeline also shows an initial focus on the Montana Pole Plant and Walkerville area, followed by an expanded scope across the Butte landscape. Several remedial actions involving mine flooding and storm water runoff occur throughout the timeline.

Table 5-1. Timeline of Major Non-Residential Remedial Actions in Butte

Year	Location	Remedial Action
1985	Montana Pole Plant	Removal of 10,000 cubic yards of contaminated soils containing PCP, Dioxin, and PAHs.
1988	Walkerville	Stabilization of 300,000 cubic yards of lead-contaminated soil from the following mine waste dumps: Alice Dump, Alice Mill, Paymaster Dump, Moulton Dump, Walkerville Ball field, Walkerville Playground, Upper Missoula Gulch, Blue Wing Dump, Lexington Mine and Mill, and the LaPlata Gulch.
1988	Walkerville	Remediation of four earthen basements and 23 residential yards.
1989	Timber Butte	Consolidation of 40,000 cubic yards of contaminated soil to a temporary on-site repository.
1989	Timber Butte	Remediation of two residential yards.
1989	West Camp/Travona Shaft	Piping and pumps to reroute flooded mine waters to Metro Sewer.
1990-1991	Butte	100,000 cubic yards of waste dumps in the BPSOU capped or removed at Curry Dump, Cellar Dirt Dump, Mandan Park Play Area, Child Harold-2 Dump, Heaney Dump, Green Copper Dump, Rising Star Dumps West

		and East, Jasper, Rock Island Dump, Zella, Old Glory West, West Stewart Parking Lot, Alliance Dump, Tension Dump, Magna Carta Lessee Dumps, Sister Dump, Atlantic-1 Dump, Josephine Shaft, Rialto, Star West Dump, Washoe Sampling Work, Dexter Mill, Travona Dump, Mountain Con-2 Dump, Corra-2 Dumps, Eveline Dump, and Work Area 10.
1990-1991	Butte	Concentrate spill on railroad bed reclaimed.
1990-1991	Butte	Remediation of seven residential yards.
1991	Colorado Smelter	Removal of 40,000 cubic yards of contaminated soils to an on-site disposal area.
1992	Anselmo, Silver Hill, Late Acquisition yard	Removal of contaminated soils at Anselmo Mine Yard, Anselmo Dump, Late Acquisition Yard, and Silver Hill Dump.
1992	Silver Hill	Removal of contaminated soils.
1992	Manganese Stock Piles	Removal of portions of the stockpile.
1992	Montana Pole Plant	Installation of groundwater treatment and capture wells. Installation of sheet piling south of Silver Bow Creek.
1993-1998	Colorado Tailings	Removal of contaminated soils and installation of groundwater system.
1994	Walkerville	Removal or capping of several mine dumps, including the Curry, Waste Dump #5, and the Jangula vacant lot.
1994	Butte and Walkerville	Removal or capping of several residential source areas.
1994	Butte	Removal contaminated soils at Venus Dump, Clark Street Dump, Missoula Mine, Mountain Con-2, and the Belle of Butte.
1995	Butte	Removal contaminated soils at Robert Emmet Dumps, Atlantic-1, West Ruby Dump, Little Mina, Capri Motel/Arctic Dump, Ravin, Waste Dump #20.
1996	Storm Water Sites Throughout Butte	Construction of cement channels and sedimentation ponds.
1996	Butte	Regrading and capping at the Belmont Hoist, Little Mina Adjacent Area, Blue Jay Mine, the Parrott Dump, and Parrott Mine Yard.
1996	Berkeley Pit	Water flowing from Horseshoe Bend was diverted from the Berkeley Pit and routed to the Yankee Doodle Tailings Pond.
1996-1997	Montana Pole Plant	Construction of land treatment unit, soil treatment piles, groundwater collection trench.
1997-1999	Butte	Reclamation at North and South Emma Dumps, Sister Dump, New Era 1 and 2, Henrietta Waste Rock Dump,

		Steward Mine, Baltic Dump, Mandan Park, Girard park, and the northern portion of the Old Lexington Mill.
1998	Alice Dump and Pit	Removal of 700,000 cubic yards of contaminated soils from the dump to the Berkeley Pit.
1998	Upper Buffalo Gulch Storm Water	Construction of piping and detention pond to route storm water from the gulch to the Berkeley Pit.
1998	Missoula Gulch	Construction of catch basins, concrete channels, and diversions. Removal of contaminated soils from Upper Missoula Gulch, Wappelo Dump, Missoula Mine, and the Garfield.
1998	Berkeley Pit	MRI began extracting copper from Berkeley Pit water.
1999-2000	Silver Bow Creek (First Mile)	Removal of streamside tailings, stream bank restoration, and vegetation.
1999-2000	Butte	Remediation at Butte New England Yard and Belmont Mine Yard.
1999-2000	Montana Pole Plant	Relocation of sewer and water lines.
1999-2003	Butte Railroad Beds & Yards	Removal of contaminated soil.
2000-2001	Walkerville	Remediation of 46 residential yards.
2001-2002	Silver Bow Creek (Miles 2-3)	Removal of streamside tailings, stream bank restoration, and vegetation.
2003-2004	Silver Bow Creek (Miles 2-3)	Removal of streamside tailings, stream bank restoration, and vegetation.
2003	Berkeley Pit	MRI resumed copper extraction from Berkeley Pit waters.
2003	Berkeley Pit	Horseshoe Bend Water Treatment Plant.
2007	Montana Pole Plant	Completion of soil remediation. Remedial action included 200,000 cubic yards of soils and 1 billion gallons of groundwater.

5.1.8 Butte Remedial Evaluation System (BRES)

The Butte Remediation Evaluation System (BRES) is an EPA tool that evaluates the integrity of reclamation of former mine dumps in Butte. The system evaluates whether the reclamation is maintained in a manner that provides long-term protection of human health and the environment (CDM 2003). BRES field activities began in 2007 and continue each summer field season. These activities include the evaluations of the following:

- Vegetation cover
- Erosion
- Site edge condition

- Exposed waste
- Bulk soil failure
- Barren areas
- Gullies

The evaluators then develop a logic diagram to determine whether additional reclamation work is necessary or whether the site is protective of human health and the environment. If additional work is necessary, the evaluators determine if additional evaluation or monitoring is adequate or whether an engineering assessment or reclamation improvement plan is necessary (BRES 2008). These determinations are known as trigger items and are noted on the logic diagrams in Appendix F in the following manners (BRES 2008):

- Vegetation/reclamation improvement (VI/RI)
- Engineering evaluation (EV)
- Monitor at the next BRES evaluation (M)

Appendix F contains recommendations for the trigger items found during the 2007 and 2008 field season. It also contains a table that lists trigger items from the 2009 field season. Butte Silver Bow, the EPA, and the MDEQ will use these recommendations to guide future site investigations and management. The following tables are taken directly from the BRES annual reports (BSBPD 2009a, BSBPD 2009b).

As seen in Appendix F, numerous site edges, barren areas, gullies, and areas with bulk soil failure and low pH material should be addressed throughout the BPSOU. In the 2007 and 2008 analysis of 100 sites, 57 (over half) of the sites were in need of vegetation or reclamation improvement; in the 2009 analysis of 200 sites, 47 were in need of vegetation or reclamation. There were 42 gullies in 2007 and 2008, and 25 in 2009 that should undergo an engineering evaluation. These evaluations should also be done on 14 bulk soil failure sites in the 2007-2008 investigation and 47 in the 2009 inspection. There were 60 sites with low pH material in 2007-2008 and 67 in the 2009 inspection. While just four site edges should be monitored from the 2007-2008 inspection, 117 of the site edges from the 2009 inspection should be monitored.

5.2 Residential Remediation

The Butte-Silver Bow County Lead Intervention and Abatement Program address both mining related and non-mining related sources of lead from residential properties. The program began in 1995 and since its inception there has been a significant drop in blood lead levels in area children (U.S. EPA 2009a). In 2009, no samples taken of children for blood lead were over the CDC 9.9 ug/dl action level (BSBHD 2009). There has not been a study to determine whether the remediation has lowered exposure to the other contaminants of concern.

Figure 5-9 shows the location of residential properties that were sampled by the program and contained lead levels over 1,200 ppm. As seen in this figure, elevated lead concentrations occur throughout the city but are concentrated in the uptown and Walkerville portion of the city. The majority of residential sampling has occurred in this area, and that may have affected this distribution. Figure 5-10 shows the location of residential properties that were sampled by the program and contained arsenic levels over 250 ppm. Figure 5-11 shows the location of residential properties that were sampled by the program and contained mercury levels over 146 ppm.

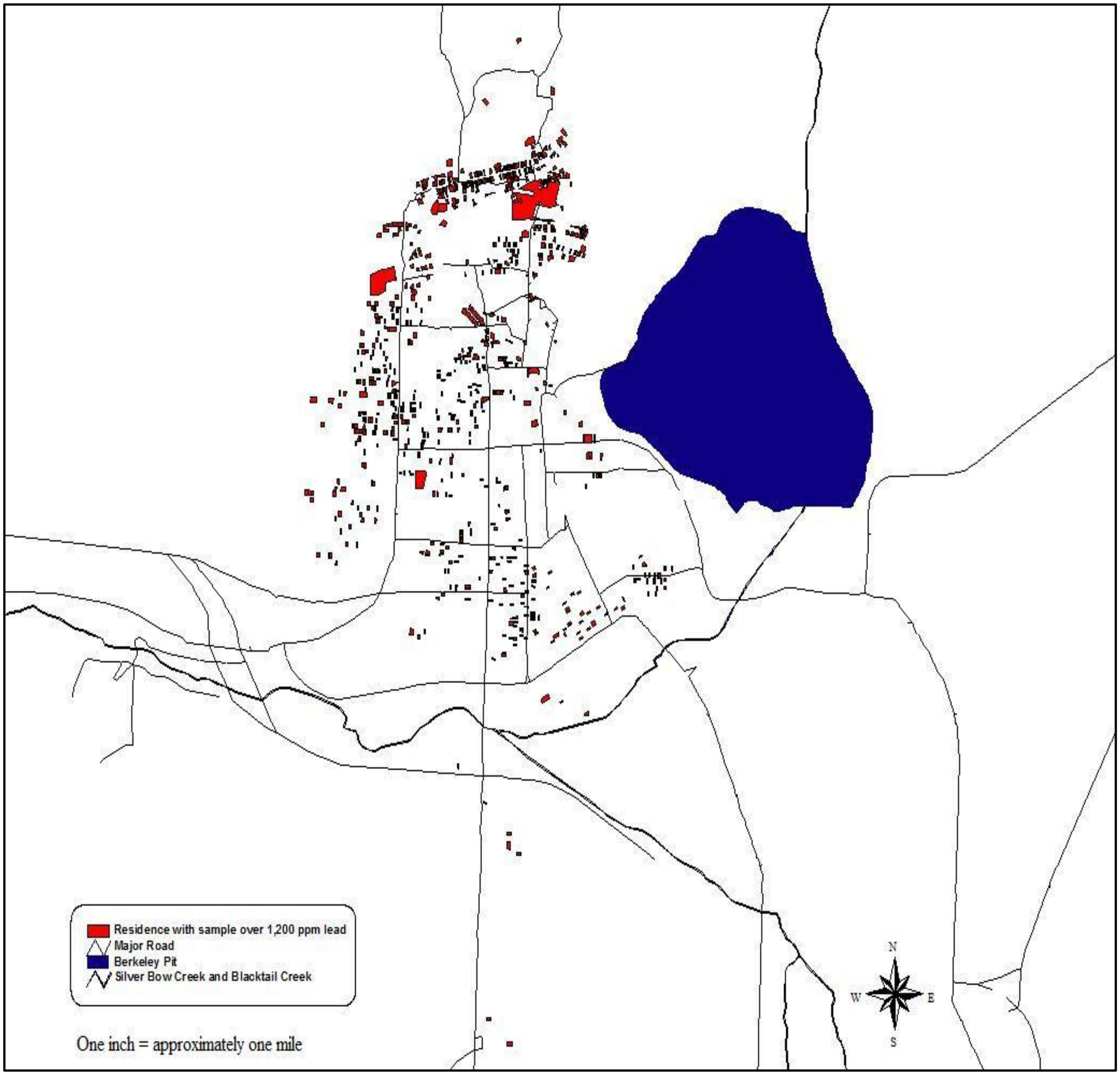

Figure 5-9. Residential Properties with Elevated Lead

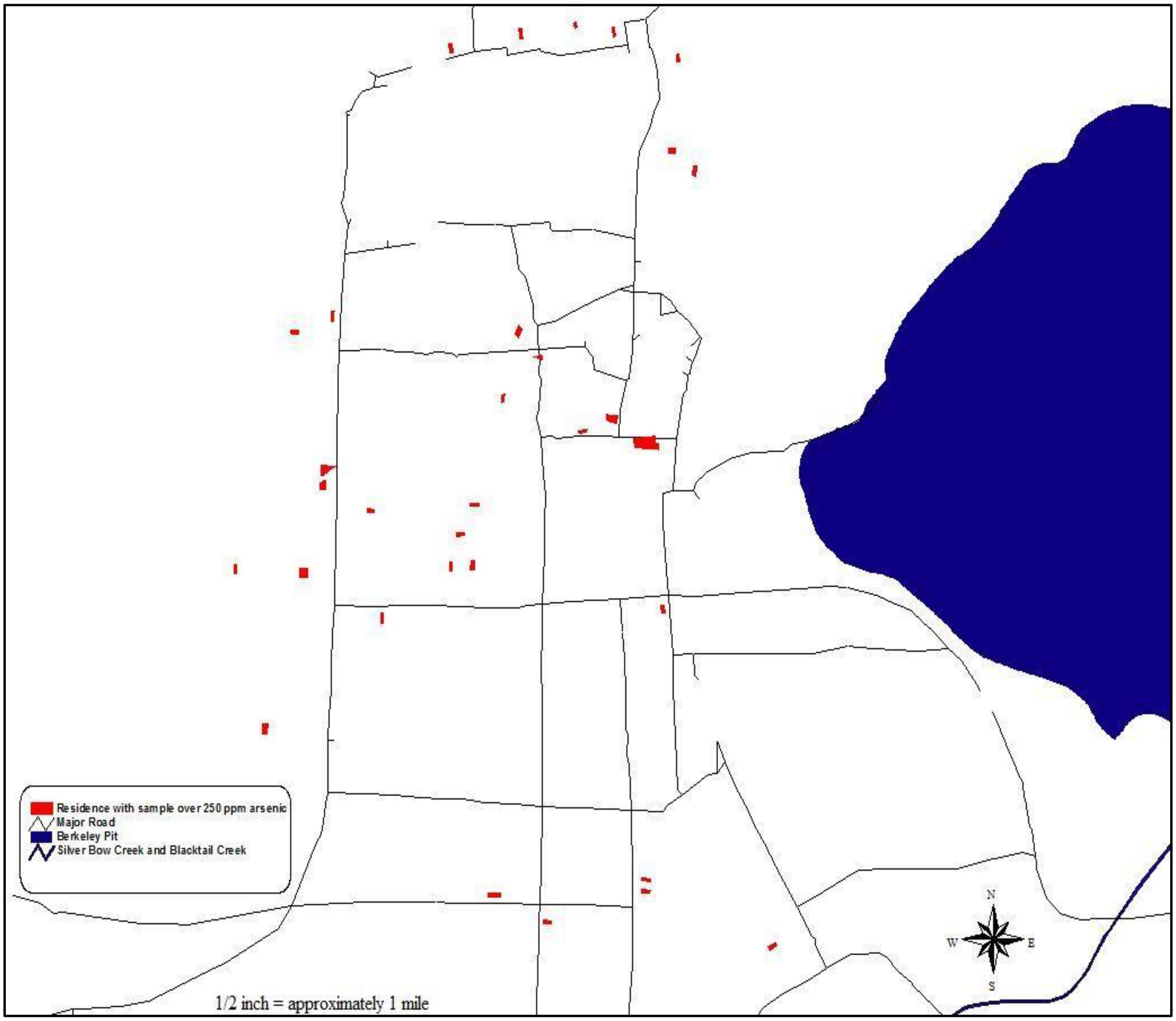

Figure 5-10. Residential Properties with Elevated Arsenic

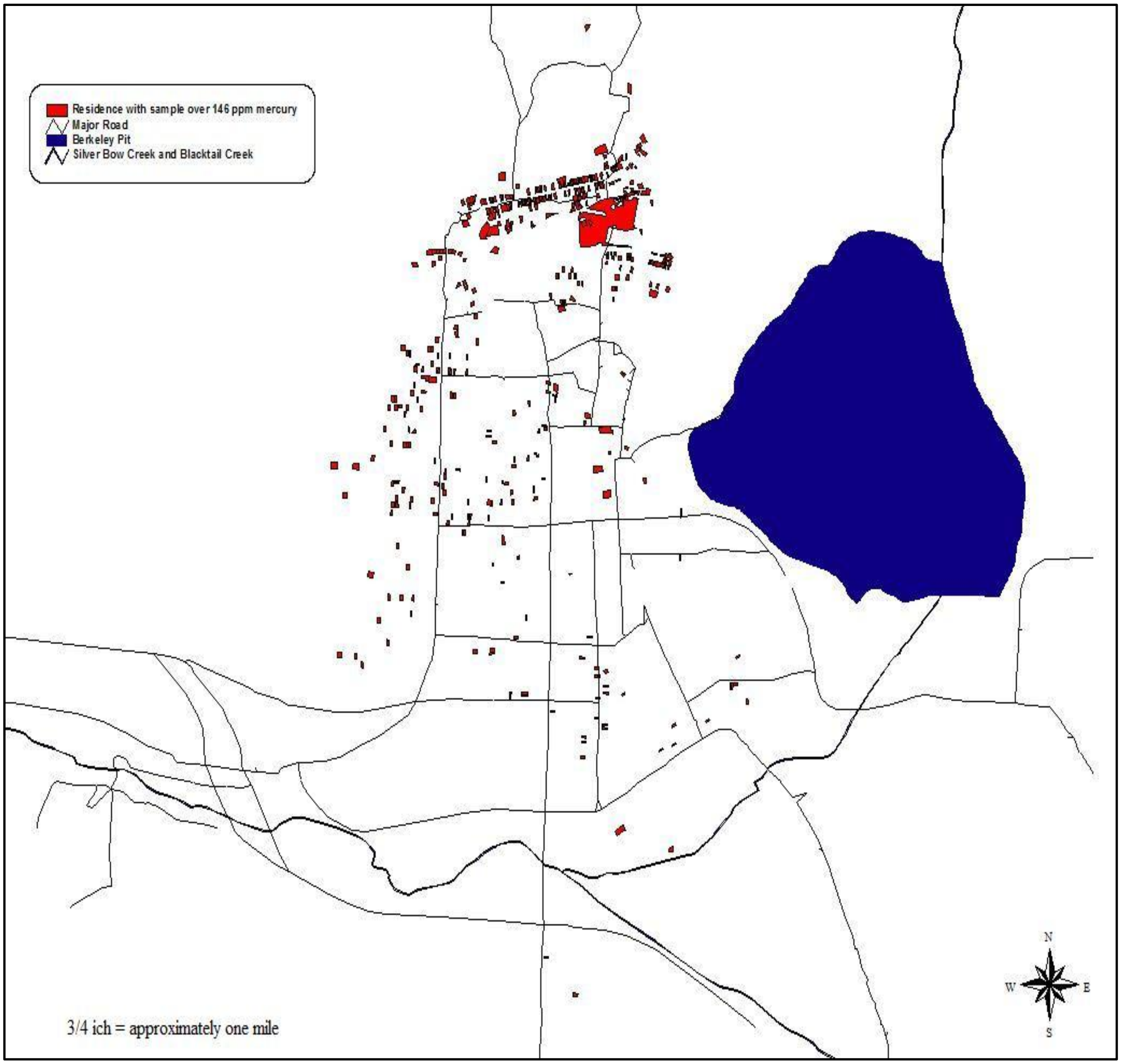

Figure 5-11. Residential Properties with Elevated Mercury

5.2.1 Residential Remediation Actions

As seen in Table 5-2, which summarizes the residential remedial actions for mining-related abatement, the number of abatements has increased each year and this is expected to continue as abatement expands beyond the BPSOU boundary (BSBHD 1995-2008). Figure 5-12 shows the location of these remedial actions. The distribution of these actions coincides with the elevated lead, arsenic, and mercury samples shown in the previous figures. Appendix F contains a summary of residential remedial actions and the maximum metals levels at the residences.

Table 5-2. Summary of Mining-Related Residential Remedial Actions 1995-2008

Year	Number of Residential Remedial Actions
1995	1
1996	7
1997	6 Residences, 1 Park
1998	28
1999	33
2000	29
2001	62; Walkerville Time Critical Removal
2002	23
July 2003- July 2004	22
July 2004- July 2005	28
July 2005- July 2006	27
July 2006- July 2007	28
July 2007- July 2008	30
July 2008- July 2009	32
July 2008- December 31, 2008	25
January 1 – December 31, 2009	45
January 1 – December 31, 2010	65

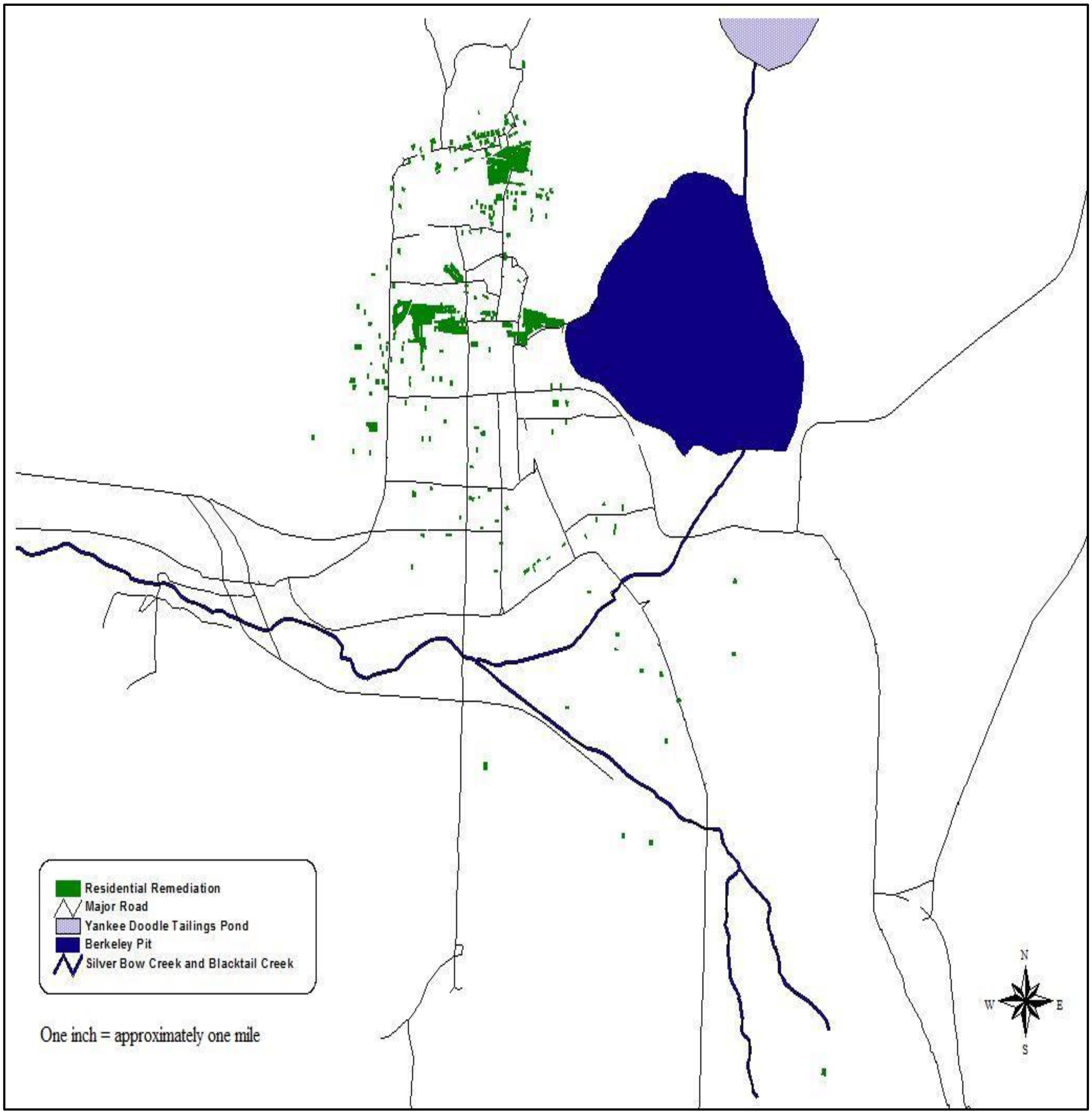

Figure 5-12. Residential Remediation Locations

Figure 5-13 illustrates both the residential and nonresidential remediation in Butte. As seen in the figure, remediation in the community is extensive and occurs chiefly in the uptown and midtown portions of the city. When the remediation is compared to the extent of mining contamination, shown previously in Figures 2-4, 5-9, 5-10 and 5-11, it is apparent that more extensive remediation is necessary to protect the public health and environment in Butte, and it is expected that remediation will continue well into the future.

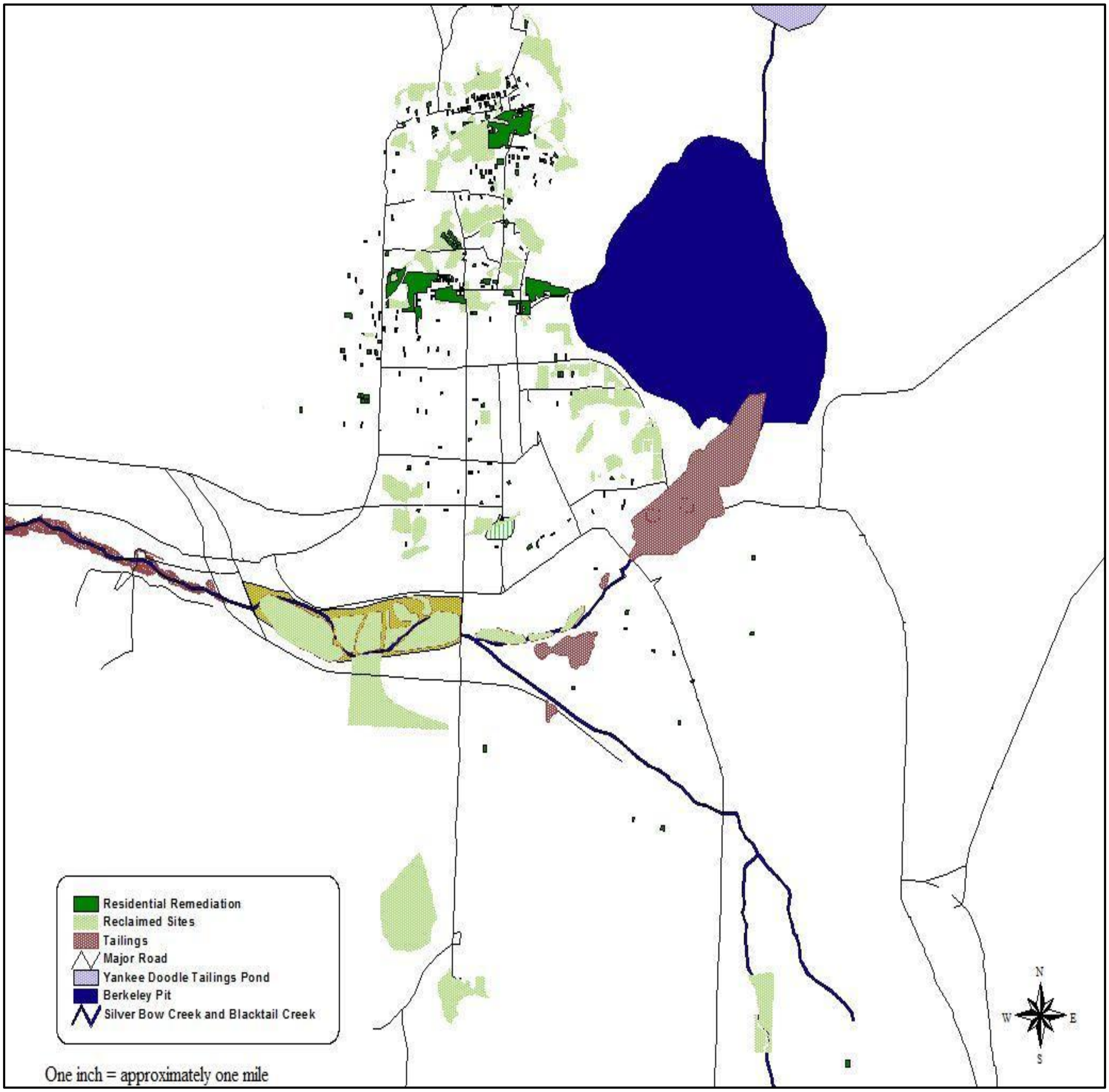

Figure 5-13. Remediation in the Butte Superfund Area

The extensive environmental remediation in Butte is consistent with the regular alteration of the landscape in mining operations, and the size and scale of environmental remediation should be considered in this light[7]. It is also important to recognize that

[7] Interested readers should refer to the National Research Council's *Superfund and Mining Megasites: Lessons from the Coeur d'Alene River Basin (NRC 2005)* for an exploration of the EPA's scientific and

there are other forms of remediation taking place in the Butte landscape. Historic preservation, designations, re-creations of historic events and places, museums, tourism, and recreation are forms of cultural remediation, as described in the following chapter.

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technical practices at Superfund mega sites, such as the Coeur d'Alene River basin Superfund site in northern Idaho. This report gives an extensive background on lead exposure and uptake models used in human health risk assessments.

"Ours is essentially a tragic age, so we refuse to take it tragically. The cataclysm has happened, we are among the ruins, we start to build up little habits, to have new little hopes. It is rather hard work: there is now no smooth road into the future: but we go round, or scramble over the obstacles. We've got to live, no matter how many skies have fallen"
~ D.H. Lawrence

6.0 Contested History and Cultural Remediation

The history of Butte is contested in many ways. To ARCO-BP and the EPA, it is a remediation success story; to environmentalists, it is an environmental disaster; to historians, it is a lusty boomtown rich with characters and wealth; to the community, it is a home, full of family history and family ties, steeped deep in hard work, resilience, and craftsmanship. To outsiders, it is a place of dereliction and decay: a violent disruption in the scenic beauty of Montana. Joseph Kinsey Howard referred to it as the "black heart of Montana" (Emmons 1990). To insiders, there is a deep sense of place in the landscape, and it is a source of pride and proof of hard work and historic significance (Dobb 1999). Because this contention is so deeply held and is a source of contrast to the authorized heritage discourse of the Montana and American ideal, the community has created its own history, stories, and ways of life. The conflict has served as a way to make culture more valuable in Butte, as predicted by Brown (2003). Acts of re-claiming history, landscape, and community are acts of cultural reclamation. The cultural values, ways of life, and landscape are not restored to the original state, which would be an act of authentic restoration, but are reclaimed in a manner deemed acceptable to the community. In some instances, such as the An Ri Rah festival of Irish heritage, acts of authentic cultural restoration do take place, such as Gaelic language classes. This mirrors the practice of environmental remediation, with selected areas of restoration occurring throughout the Butte Superfund sites, such as Silver Bow Creek. This section will provide examples of cultural remediation occurring in Butte and will provide a basis for understanding the cultural landscape. It will also discuss the historic designations that authenticated the historic landscape.

6.1 Historic Designations

In 1984, the Butte Historical Society developed a historical preservation park plan that included a park system that would connect all the mine yards, a steam-operated railroad, and underground mine tours. ARCO quickly voiced concerns and asked for a reverter clause at any leased mine yards (Montana Standard 1984a). This same year, Butte residents petitioned for an emergency ban on the removal of historic buildings to become permanent law. The petition came after rumors of a Bozeman developer's plans to purchase and move historic homes from Butte's west side (Montana Standard 1984b). The following year, the city council unanimously approved a Historic District Overlay Zone to ban removal, relocation, or demolition of any historic property in the National Historic Landmark District (Montana Standard 1985c). Soon after, ARCO representatives told the Council of Commissioners that the Historic Overlay Zone could potentially hamper future mining efforts. The company held permits for lands within the zone, and the company planned to remove existing gallows frames if new mining started. Historic Preservation Officer Janet Ore responded that if ARCO wanted to start mining ore and had to remove an old head frame, it could petition the Commission for a variance (Montana Standard 1985d). Ultimately, the Council decided to keep the gallows frames as a part of the Overlay Zone and to protect Butte's remaining frames. Butte Ironworkers Local 107 and Anaconda Local 81 supported preserving the frames, and several members reported that they built the frames (Montana Standard 1985e). The same year, the Butte Historical Society, along with Renewable Technologies, published a plan for the Butte-Anaconda Master Park Plan and ARCO agreed to donate two mine yards, the Anselmo and the Original, to the Society for park development (Montana Standard 1985f).

These are all examples of the community valuing cultural properties and going against the hegemonic discourse of a mining town. The mining company was not granted reverter clauses on structures and could not destroy historic structures for mining development. By creating a historic zone, the community laid claim to the landscape and contested the value of the landscape. It also established historic preservation as the authorized heritage discourse and shifted the power in the relationship between the mining company and the community to the community, particularly historic preservationists within the community.

Figure 6-1 illustrates the Historic Overlay Zone, gallows frame locations, mine yards, Central Business District, and the National Historic Landmark structures. As seen in the figure, there are numerous historic and culturally significant features outside of the Historic Overlay Zone, but the zone does include the Central Business District and numerous historic structures. The zone does not include the bulk of the gallows frames or mine yards, however, and this is why the council voted to protect the gallows frames as a part of the act.

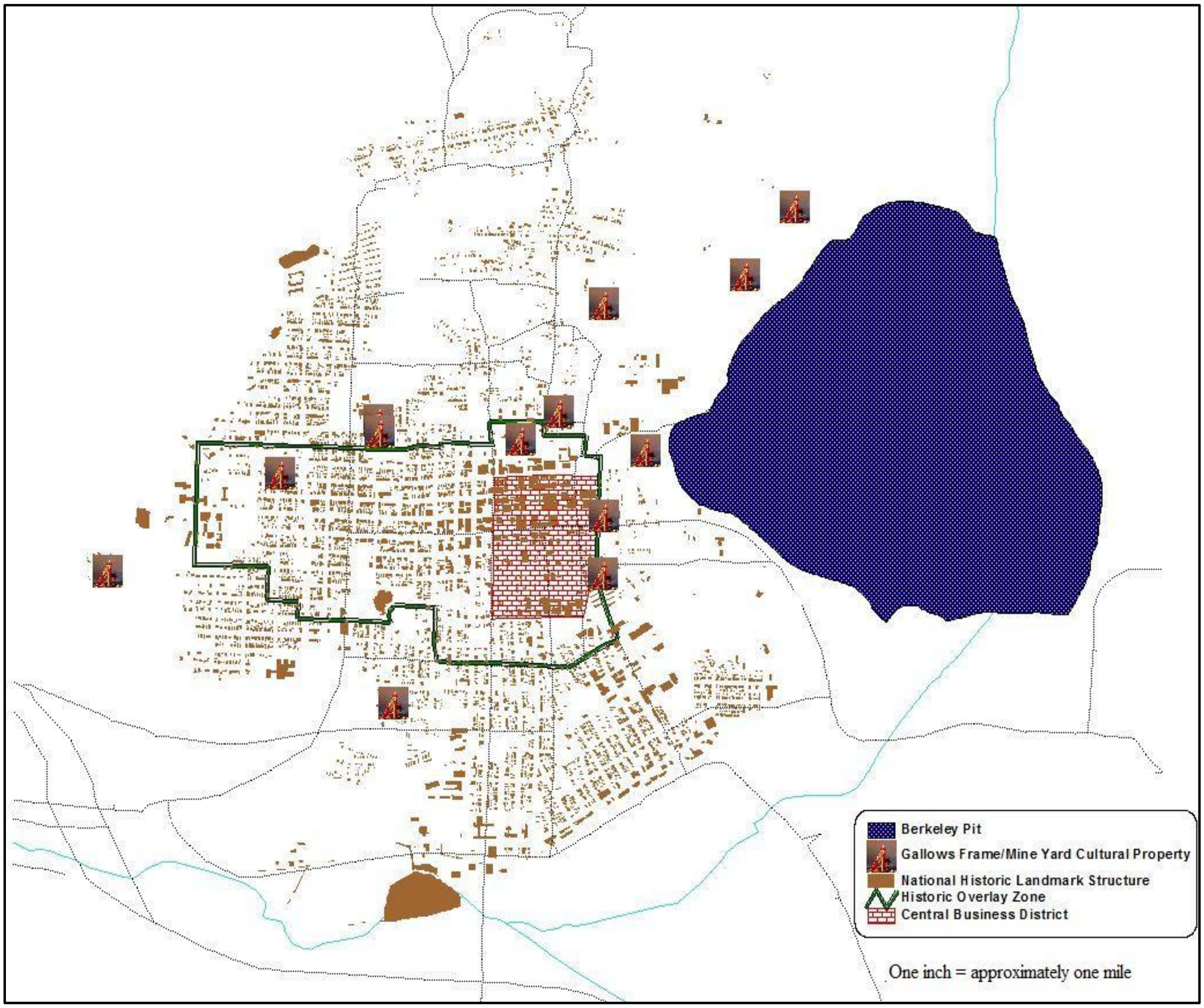

Figure 6-1. Butte Historic Districts and Structures (Map by Author)

In 1986, cultural remediation of mining structures continued, when the Butte Historical Society created a self-guided tour of the city mine yards. The tour included a map of former mine sites, gallows frames, and contemporary mining locations (Montana Standard 1986). The following year, the Butte-Anaconda Historic Park Plan received funding from the Resource Indemnity Trust Fund for renovations at the Anselmo Mine yard “to make it more usable as a tourist attraction so people can see and begin to understand the nature of mining in Butte” (Montana Standard 1987b). The Abandoned Mines Reclamation Bureau (AMR) and the Department of State Lands continued work on the Anselmo mine yard for several years. Butte-Silver Bow announced plans to take over the project after the Department of State Lands removed the asbestos, capped shafts, repaired buildings, and landscaped the site and stated that it had $150,000 in Resource Indemnity Trust Funds to complete renovations (Montana Standard 1990a). The mine yard, shown in Figure 6-2, is currently used as an interpretive site that is open to the public by appointment.

Figure 6-2. Anselmo Mine Yard (Photo by Author)

In 1990, an AMR project at the Diamond Mine stopped when historical artifacts were destroyed during reclamation. As a consequence, local preservationist Brian Shovers worked with the AMR and the State Historic Preservation Office to create a

Butte Historic Properties Management Plan. The plan detailed how reclamation should proceed at historically significant sites (Montana Standard 1990b).

Despite the efforts of the Butte Historic Properties Management Plan and the Butte-Anaconda Historic Park System plan, historians found that the EPA and local administrators did not include the preservation of industrial structures in remediation designs until the State Historic Preservation Officer intervened (Quivik 2001). The 1993 Regional Historic Preservation Plan (RHPP) reported: "… there has not been an effort to comprehensively integrate historic resources planning considerations into the Superfund investigations and clean-up actions. Rather, the Superfund process has approached the historic aspects of each site independently. The question of what to preserve is often confused by not knowing what else could be lost later. Further, the schedule of 'time-critical' response actions under Superfund are difficult to meet in the context of preservation law. This has resulted in eleventh hour attempts to save historic resources. At best, these resources have been considered only on a site by site basis through Memoranda of Agreement initiated under less than ideal circumstances. There has been no process to determine the appropriate mitigation in the larger context of the mining landscape" (RHPP 1993). This further illustrates the power relationship between the EPA and the preservation community. The clear frustration stemming from the loss of cultural resources and the lack of a comprehensive plan for historic resources show a disconnect and source of further disillusionment.

It is interesting to note, however, that the acknowledgements for Regional Historic Preservation state that ARCO funded the plan and that ARCO had agreements with Butte-Silver Bow for the development of the plan. An EPA official is listed as a staff/consultant for the project, and the plan committee included ARCO representatives and Montana Department of Environmental Quality representatives (RHPP 1993). This level of involvement with the historical plan shows the importance placed on interpreting the history of Butte and in the cultural remediation associated with this interpretation. It was obviously in ARCO's financial interest as the Primary Responsible Party for environmental remediation in Butte to interpret the historic mining landscape as something that would lose value if it was remediated. This form of cultural remediation is exactly what happened in the instance of the 100-acre area north of the Berkeley Pit. It was also in the interest of the EPA and the DEQ to limit remediation areas in Butte to match available funding. However, the EPA and DEQ have a directive to remediate lands that pose a significant health threat. These conflicting agendas have played out in differing levels of remediation, protection of health, and preservation of historic resources. According to Pat Munday, who has systematically studied and compared Superfund site remediation plans throughout the Upper Clark Fork Basin, the cost of remediation for the historic mining landscape north of the Berkeley Pit would likely have cost between 50 and 100 million dollars (Munday 2011).

In addition to faulting the Superfund process for investigating historic properties on a case by case basis, the Regional Historic Preservation Plan also faulted the community and city for focusing efforts on a few scattered sites. This approach allowed the majority of the historic structures to deteriorate. The plan concluded: "… without substantial economic investment and the demand for historic 'infrastructure', through adaptive reuse of historic structures, these losses will continue. Tourism oriented to historic and cultural resources and the opportunity to experience those resources may provide the only viable reason for their preservation" (RHPP 1993).

The largest designation of the historic culture of Butte came in 2006, when the Butte, Walkerville, and Anaconda areas were listed jointly as the Butte-Anaconda National Historic Landmark District. As described by Little (2005), this designation authenticated the national significance of the community and is a rallying point for historic preservationists who want to prevent remediation of the historic mining landscape. The 9,774- acre district contains 6,015 contributing resources, including 5,975 buildings, 37 structures, and one object (NPS 2006). As described by the National Historic Landmarks Program, the district "represents several themes discussed in the theme study, including: Marking Labor History on the National Landscape, Extractive Labor in the U.S., and American Manufacture: Site of Production and Conflict. It meets the requirements for national significance defined in the theme study. This nomination also expands the NHL district to encompass all of the nationally significant resources associated with copper production and unionism" (NPS 2006). This designation reinforces the dissenting heritage discourse of Butte. Instead of focusing on mine production, company wealth, or the Anaconda Company, the designation is based on labor and its significance in the national, not just local, landscape. It is very specific in noting conflict and unionism in the reasons for designation, again reinforcing the significance of labor and the working people of Butte. The resources associated with the district, as listed in the National Register of Historic Places Registration Form, include the following:

- Headframes, mill buildings, mines, mine yards, and industrial resources
- Granite Mountain Mine and Memorial
- Community of Walkerville
- City of Butte
- City of Anaconda
- Butte, Anaconda, & Pacific (BA&P) railroad
- Anaconda Copper Mining Company Smelter Smokestack
- Labor meeting halls
- Hennessey Building – former Anaconda Company Headquarters
- William A. Clark Mansion
- Metals Bank
- Mary MacLane House
- Myron Brinig House
- Butte Socialist Hall

This designation labels the items on the list as cultural properties or cultural markers. As seen in the list, the majority of the markers are associated with mining and labor activity in the area. Mary MacLane and Myron Brinig were well known writers discussed in the poetics sections of this study. The registration form notes the high integrity of the site and that mining and its associated contamination are still a large part of the landscape (NPS 2006). This reinforces the cultural value placed on the mining landscape, including both historic structures and contamination.

The National Historic Landmark District listing is an act of heritage preservation. By applying for, receiving, and curating the district, members of the community preserve the historic structures, as well as the communities and Butte, Walkerville, and Anaconda, and their cultures. Beyond the tangible structures, the designation preserved the intangible community values and meaning associated with mining structures, memorials, historic architecture, labor struggles, socialist politics, and community. By claiming entire cities and communities to be significant, the designation authenticates the strong sense of community and networks associated with mining culture. The designation also validates pride in craftsmanship and history and the use of the term "Butte America."

The community memories associated with these intangible items were conveyed in literature by authors such as MacLane and Brinig, whose homes are singled out in the designation. It is not the homes themselves that are deeply valued by the community: rather, it's the literature and community memories encapsulated in the author's works. As Francaviglia noted, a romanticized version of the landscape was necessary before it could be valued. Books such as Brinig's *Wide Open Town* created this romanticized version.

The authorized heritage discourse of the wildly successful mining company and the rags-to-riches Copper Kings are also part of the designation, as describe by Smith (2006). This shows the axis of variation in historic pride. The community deeply values its significance in mining history; it still promotes itself as the "Richest Hill on Earth," and the inception and rise to global significance of the Anaconda Company are a part of this memory. The success of the Anaconda Company authenticates the community's claim of significance in the mining world and venerates the craftsmanship of the miners and the sacrifices of their families. By bestowing the mining past with venerability, a sense of stability is given to the community. The mining landscape further reinforces this stability and ensures that the memories of mining culture will be passed on to future generations. It also serves to promote the area to the general population and provides a means of explanation for the landscape. By signifying the area with a National Historic Landmark designation, an acceptable discourse is created to promote tourism and interaction and preservation of the landscape.

In 2007, community members overwhelmingly supported a mill levy to pay for renovations to the Butte-Silver Bow Public Archives. The community support for this levy is a cultural remediation marker illustrating the value placed on the historic artifacts and cultural materials the archives curate. The archives are also a destination spot for tourists, as are the World Museum of Mining, Berkeley Pit, and mining structures (Butte Chamber of Commerce 2011).

Mining towns often attempt to replace mining with tourism. This practice is seen extensively in mining towns such as Butte, Bisbee, Leadville, and Deadwood (National Summit of Mining Communities 2008). Attracting tourists often involves the practice of preservation. Francaviglia sees two different motives for placing historic significance on mining towns. The first concerns the need to recognize the former greatness of the mining community and the ways it dominated nature, and the second concerns the veneration of the community's antiquity as evidenced in the decay of mining and architectural structures. It also serves as a way to promote authorized heritage discourse, legitimizing certain aspects of the past and community spokespeople. This legitimization is reinforced by creating an economy within the community. As described by Smith, this can discourage members of the current community from engaging with the present because they are consumed by curating the past.

6.2 Recreation of Columbia Gardens

Community groups and individuals continue to practice cultural remediation of the Columbia Gardens. Though the site no longer exists, structures that survived the fire were moved to Clark's Park and the Beef Trail area. The local shopping mall contains a reconstruction of the carousel horses and merry-go-round (Spirit of Columbia Gardens Carousel 2011). The future site of the reconstructed carousel is a matter of intense public debate (Butte Restoration Alliance 2007a). Re-creations of the butterfly garden can be seen at the Lexington Mine Yard gardens, shown in Figure 6-3, Clark's Park, and throughout Butte residential yards. The original entrance to the Gardens was moved to the Beef Trail area, near a former ski hill and future private housing development. Playground equipment and children's playhouses from the Gardens are now a part of the city-operated Clark's Park.

Figure 6-3. Re-creation of Columbia Gardens Butterfly Garden at the Lexington Mine Yard (Photo by Author)

In addition to these larger re-creations of the Columbia Gardens, community members have re-creations in their yards, including butterfly gardens and carousel horses. It is also common to find paintings and pictures of the Columbia Gardens displayed in Butte homes. Movies such as the documentary *Remembering the Columbia Gardens* (Ekness 1999), novels, and local histories about Butte are full of accounts of the Gardens and the deep wound left by their loss. These memories are communal acts of cultural reclamation and serve as a way for the community to cope with the loss of a valuable cultural resource. They are also a source of dissenting discourse. Claims that the Anaconda Company set fire to the Gardens to make way for the Berkeley Pit show the deep sense of betrayal felt by the community. The mining company is not seen as the good steward, as it promoted itself, but as an arsonist that destroyed the community's most valuable memories, traditional cultural properties, homes, and neighborhoods. By continuing to re-create the Gardens 40 years after their destruction, the community ensures that the Gardens and the sense of betrayal will survive in the cultural memory. They also memorialize the turning point in the community's power relationship with the mining company. The destruction of the Gardens signifies the final straw for the Butte community, and after this point cultural capital was valued over mining economic capital.

6.3 Re-Creation of The Auditor

There are several examples of the re-creation of The Auditor, the dog described in the risk perception section of Chapter 2, in Butte. This dog represents many things for the Butte community, including resilience, hope, and survival. The Auditor Foundation collected donations and funded a series of sculptures that are in the Chamber of Commerce and local shopping mall (Peterson 2011). Figure 6-4 shows a photograph of one of these statues.

Figure 6-4. Sculpture of The Auditor in Butte Shopping Mall (Woestendiek 2010)

6.4 Mine Yards

Mine yards and structures are often used for gardens, public art, social centers, community concerts, demonstration projects, memorials, and outdoor theatres, and they are the site of stages for the National and Montana Folk Festivals. Gallows frames are an integral structure in the cultural identity of Butte and are traditional cultural properties in the area.

During underground mining operations, the Anaconda Company held eminent domain over sub-surface lands as well as the associated lands where the mineshafts came to the surface (Finn 1998). These spots, marked with gallows frames, were off-limits to anyone but workers or company officials. Recently, however, several of the remaining gallows frames were returned to the city as a part of the Superfund program. In 2003, a community project known as Lighten Up Butte began to outline these gallows frames, along with others owned by private people, local businesses, and the World Museum of Mining, with red LED lights. Figure 6-5 shows the Belle Diamond gallows frame, which was lit for the first time in October of 2007.

Figure 6-5. The Belle Diamond Gallows Frame at Night (Lighten Up Butte 2007)

Currently, eight of the remaining 14 gallows frames are a part of this project, and the community plans to light the other frames in the near future. This assertion of control over land that was previously held apart from the community is a marker of cultural remediation and is a source of community pride. It is also a representation of the scale of mining in the area and the extent that mining is woven through the landscape, in ways that made Butte a vast open-air factory (Munday 2002). According to the Lighten Up Butte group, the gallows frames:

> … represent Butte's mining heritage, the submerged sacrifice of sweat, toil and tears to get the precious metals from beneath the surface that helped win wars and fuel a global economy. The copper mines beneath each headframe made widows and orphans, but their immense wealth also fed and clothed thousands of families, many of them immigrants from around the world who realized their American dreams here. They still represent the resilience of a town that stands

tall and strong and straight against the onslaught of time and the elements. They punctuate the Butte landscape like exclamation points (Lighten Up Butte 2007).

This statement highlights many mining culture values, including pride in resilience, history, family, and distrust of power. The statement is careful to include the dissenting discourse of negative health effects and risks associated with working in the mines and sacrificing for the mining economy.

In addition to these acts of cultural remediation, mine workings and gallows frames are also re-created in residential yards throughout the Butte landscape, as in the case of the Columbia Gardens. Figure 6-6 shows one such yard re-creation.

Figure 6-6 Gallows Frame in a Butte Yard (Photo by Author)

6.4 World Museum of Mining

Mining structures are a significant feature at the World Museum of Mining, located directly west of the Montana Tech campus. This museum, opened in 1965, operates an underground mining tour and is a source of dissonant labor heritage. In 2008, the museum built the Miner's Memorial Garden. This memorial is dedicated to any persons who lost their life in a mining, smelting, concentrator, or railroad accident. The memorial complements the Granite Mountain Memorial, built in 1996, which commemorates the victims of the 1917 Granite Mountain-Speculator fire, described in detail in the work *Fire and Brimstone* (Punke 2006).

In addition to mining structures, the museum curates a replica of a western American mining town. While some of the buildings at the museum are from parts of local buildings, most are reconstructed or contrived. It is interesting to note that the museum re-creation does not resemble Butte in its past or present. Much like nearby Virginia City, another faux Western frontier city and tourist destination, it is instead fashioned after an imagined frontier Main Street, with an example of several types of buildings one might encounter in an imagined Western mining camp or Western genre movie, such as an apothecary, Chinese laundry, saloon, and bordello. The structures in Virginia City also are not authentic or native to the former mining camp and contain the same type of structures (Montana Historic Preservation Committee 2011).

The practice of creating an imagined mining camp provides a simplified, sanitized version of the mining lifestyle that is easily digested by the general public[8]. The dominance of one company, the size and scale of the mining operations, bitter labor battles, poverty, ethnic conflicts, contamination, and health effects are completely ignored. It is the epitome of the romanticizing Francaviglia (1991) describes as necessary before the landscape can be appreciated. By creating a microcosm of the romanticized past, the museum distills the preservation values of the community. The museum is suspended in the boomtown years, and the historic mining landscape and structures are unreclaimed. The museum also contains a church from the Meaderville neighborhood, which was destroyed to make way for the Berkeley Pit. This is a significant act of cultural reclamation and heritage. Preservation of a sacred structure from a lost neighborhood serves as a dissenting discourse and means to keep a portion of the neighborhood and its destruction in the community memory.

As with the National Coal Mining Museum in Wakefield, England, the World Museum of Mining contains an underground tour of a mine and is a source of dissonant labor heritage, with descriptions of working class practices, conditions, community, and labor struggles. The museum also recruits local actors to engage in historical storytelling, singing, and interpretation. This, in a sense, has broken the barrier of class and gender by entering the underground through what Davies refers to as the “umbilical link” that connects the mine to the surface (Davies 1984). While it is important to acknowledge that this practice is for visitation, education, and entertainment, and is not for the actual work of mining, it is a significant act of cultural remembrance.

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[8] This is a part of the larger American culture’s romanticizing of mining. Examples include the Disneyfication of mining in the cartoon *Snow White and the Seven Dwarves* and amusement parks such as Knott’s Berry Farm, which has an imagined mining town with rides through mock mine shafts in an ore cart and gold panning activities.

The practice of creating an imagined mining camp is in line with other creations throughout the western United States as a means to promote the area for tourism. In her work *Historic Preservation and The Imagined West*, Judy Morley describes this practice and the importance of tourism in the Western economy. Morley notes that in the 1980s, historic sites attracted more visitors that natural sites, even in Western states that promoted National Parks (Morely 2006). Morley also describes the significance of preservation in Urban Renewal. The practice of combining urban renewal programs with historic preservation brought state and federal funds to revitalize Western cities such as Denver, Colorado, and Albuquerque, New Mexico. In Butte, the Urban Revitalization Agency is a significant source of funding for businesses to renovate and preserve buildings in the Central Business District.

6.6 Contamination as Recreation

In addition to tourism in the contaminated landscape, there are several other forms of recreation[9]. Because contamination is ubiquitous in the Butte landscape, it is inevitable that there is recreation in contaminated spaces. It is interesting that the use of contaminated and remediated space as recreational areas seldom contain specific reference to the contamination or remediation as a part of the cultural significance of the place.

The hundreds of acres of land west of Montana Tech (a small engineering college), stretching to Rocker and Brown's Gulch, is an example of a contaminated recreation space. This area, shown in Figure 6-7, is heavily used by walkers, joggers, dog owners, mountain bikers, motorcyclists, and gun enthusiasts. This land is not used because it is contaminated; it is used in spite of its contamination. It is the nearest available open space to many West Side and Uptown residents, particularly Montana Tech students. This area is also a part of the West Side Soils Operable Unit, but despite extensive use by the community, only one attempt has been made to minimize contact with mine waste. This is the remediation of the former railroad line leading from Butte to Rocker. This former railroad line is paved throughout Uptown Butte and is frequently used as a walking trail. In the West Side Soils area, the line is not paved, but is capped with clean soil. The walking trail begins in Uptown Butte, near the Granite Mountain Memorial, and on its course passes numerous mine yards, historic structures, and neighborhoods. The unpaved portion of the path on the West Side Soils section can be used to access the Greenway Trail which skirts the remediated and restored portions of Silver Bow Creek. This Greenway Trail currently extends to Durant Canyon and is slated to connect to the trails in the nearby city of Anaconda. This trail will be an extensive recreation system for the community and serves as a way to connect different cultural and environmental aspects of the landscape (Pioneer 1998).

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[9] Patrick Novotny's work in environmental justice, building on the work of Louis Gibbs, to redefines the environment as a place where people live, work, and play (Novotny 2000).

Figure 6-7. Contaminated Recreation Space West of Montana Tech (Photo by Author)

As described in previous sections, mine yards hold deep cultural significance to the Butte community. They are also used for community recreation, the most notable being the Original Mine site, which was environmentally reclaimed and is now used for picnics, weddings, community celebrations, and the National and Montana Folk Festivals. A future example of a environmentally remediated mine site slated for use in this capacity is the Mountain Con Mine Yard, set to open in 2012. This yard contains walking trails, gardens, picnic tables, and a covered gazebo. It also contains un-reclaimed historic mining landscape. In an article concerning the site, ARCO-BP spokespeople call the mine yard "a gift to the people of Butte" (KXLF 2010). The walking trails from the site connect to the nearby Granite Mountain Memorial, also constructed by ARCO-BP under EPA supervision. This memorial, shown in Figure 6-8, commemorates the victims of the 1917 Granite Mountain-Speculator fire and contains numerous memorial plaques that provide a history of the disaster and a speaker that plays oral histories of the disaster. This is a significant piece of cultural remediation and serves as a strong warning of the dangers and sacrifices associated with the mining way of life.


Figure 6-8. Granite Mountain Memorial (Photo by Author)

The East Park/ Mercury Street Development Area is another example of a former mine site, the Belmont, being used as a recreation and social space. The area includes the Belmont Senior Center, which contains the water tower from the Columbia Gardens (Figure 6-9) and the Mac Center, a sports complex used for local and state sporting events.

Figure 6-9. Columbia Gardens Water Tower and Belmont Senior Center (Photo by author)

The Missoula Street baseball complex is another remediated site used primarily for baseball and softball, and the Copper Mountain Complex is the former site of the city landfill, now a park and sports complex. Knob Hill Park in Walkerville is a reclaimed area used for walking and viewing the Butte Valley and surrounding mountains. The Ulrich-Schotte Walking Trail, shown in Figure 6-10, borders Blacktail and Silver Bow Creek and is heavily used by the community year round. As seen in the figure, this trail contains interpretive signage that describes restoration efforts along the creek.

Figure 6-10. Ulrich-Schotte Walking Trail

Together, these recreation places help paint the picture of a community that is active in the landscape, regardless of contamination, but one that particularly enjoys spaces where remediation has occurred. This illustrates a strong interaction and value placed on the environment but a lower value placed on the avoidance of a higher risk for potential health effects. This is due in part to the long-term nature of risk from the exposure, the chronic nature of the exposure, and the community's sense of place.

6.7 Festivals

Festivals are cultural celebrations and telling markers of important cultural issues for the community. In Butte, labor-related festivals such as Miner's Union Day are small-scale historic recreations, but the annual St. Patrick's Day celebration has continued since the early days of the city. The celebration also includes a Finnish celebration the day before, called St. Urho's Day, which celebrates the heritage of Finnish residents and is centered in the Finn Town area of Butte, particularly at the Helsinki Bar and Yacht Club, adjacent to the Berkeley Pit. Beyond celebrating Irish heritage, the community celebrates the wide-open mythology of the past, promoting excessive drinking, fighting, and mining camp bravado. This bravado is also promoted in the summer festival known as Evel Days, which incorporates automotive stunts and other risk taking behavior in celebration of the town's native son, Evel Knievel. In this act of cultural remediation, the former value placed on risk taking in mining is transferred to a value of risk taking in general. Stuntmen light themselves on fire and jump out of windows, drive motorcycles over rows of cars, and parade motorcycling equipment throughout the Commercial Business District. In the An Ri Rah festival, the cultural emphasis is also placed on Irish heritage, but the festival does not re-create or glorify mining, risk taking, or the wide open town mythology. This festival is promoted as a family event and is also based in the Commercial Business District. The festival includes acts of cultural restoration, specifically Irish culture, such as Gaelic language classes, Irish dance, Irish music, and movies and concludes with a Catholic mass, further specifying the regions of Irish heritage being re-created (Montana Gaelic Cultural Society 2011).

In 2008, Butte became the location for the National Folk Festival for a three-year period. The success of this festival led to the foundation of the Montana Folk Festival, which occurs in July at the same location and stages throughout the Central Business District. This designation authenticated the town's self-promotion as a festival city and brought with it much needed festival infrastructure as well as festival planning and promotion skills. The folk festival group built stages at former mine yards, most notably the Original Mine Yard, as seen in Figure 6-12. Figure 6-11 is a photograph of the area prior to remediation. Note the large piles of mine waste, proximity of residential structures, and child playing in the foreground. The choice of stage location further authenticates the cultural value placed on mine yards and becomes an example of cultural remediation by re-creating the yards as spaces of public celebration. Other stages are built throughout the Central Business District, which is closed to vehicle traffic throughout the festival. This also gives significance to the district as a site of cultural remediation. Local developers intend to use the festival infrastructure created by the National Folk Festival to promote Butte as the state's "Festival City." The promotion of the city in this manner is also an act of cultural reclamation of the wide-open town mythology. Butte was known to both insiders and outsiders by this moniker, and instead of subverting this mythology, the community has created a dissenting discourse of fun and festivity that minimizes the associations with fighting, violence, and prostitution and capitalizes on it in the tourism industry.

By staging all festivals in the Central Business District, previously also described as the Historic Overlay Zone, the community further authenticates the importance of this area and promotes the area to future generation and tourists. It also reaffirms the authorized heritage discourse of a contested terrain. By celebrating, designating, preserving and authenticating this area, the community ensures that it not be destroyed by mining. As with the National Historic Landmark designation, this provides an acceptable discourse for interaction with the contaminated landscape and highlights the positive aspects of the landscape. This is a significant form of cultural remediation and dissenting discourse that ensures future replication by the annual nature of the festivals.

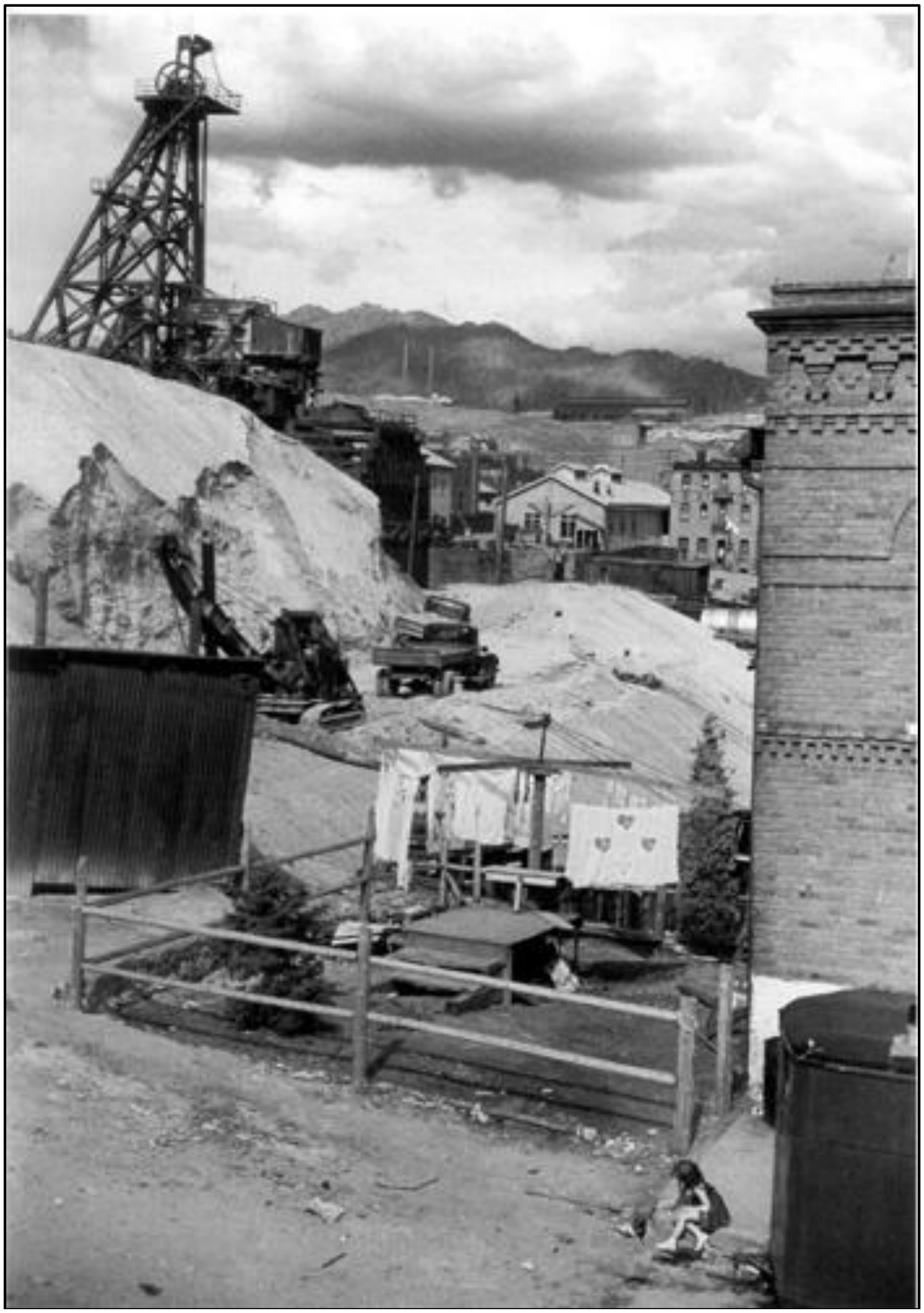

Figure 6-11. Original Mine Yard Prior to Remediation (Butte-Silver Bow Public Archives Photo Collection 2010)

Figure 6-12. Original Mine Yard at the 2008 National Folk Festival (Photo by Author)

6.8 PRP Examples

Cultural remediation is not only practiced by community members in Butte. It is also practiced by ARCO-BP and the EPA. These acts of remediation are sometimes packaged with environmental remediation, as in the case of the Mountain Con Mine Yard and the Berkeley Pit Viewing Stand, which promotes the toxic pit lake as a tourist destination.

Mining companies have the capacity to "create, destroy, modify, and interpret places of cultural heritage value, depending on criteria such as the nature of the place, economic imperatives, and historical perspectives" (Boyd, et al. 2005). This has been the case in Butte, where the current mining company, MRI, is actively interpreting heritage and practices cultural remediation throughout the city. The Washington Foundation plans to construct a mining interpretive center on land immediately west of the Berkeley Pit viewing stand. This is based on economic imperatives. The current mining operations are very lucrative, and veneration of mining history and the associated community support of mining ensure no negative political impacts to the mine's operations.

This is not the first promotion of the area as a tourist destination. The Anaconda Company began promoting the Berkeley Pit as a tourist spot after 1955. Company advertisements showed the beginnings of the pit with the caption: "See America the bountiful, visit Butte, Montana, 'The Richest Hill on Earth' and see how the Anaconda Company mines the metal so essential to the nation's economic strength" (LeCain 2006). The use of the pastoral adjective "bountiful" is an obvious attempt to liken mining to agricultural endeavors and minimize its environmental and social impacts.

In the 1970s, the Anaconda Company built a viewing stand for tourists to look over the pit, free of charge. After closing their Butte operations, Anaconda shut off the pumps that dewatered the underground mine workings, and the 675-acre pit quickly flooded (U.S. EPA 2005a). Currently, the City of Butte charges tourists an entrance fee to view the pit-lake. The city government sees the charge as means to fund a pavilion, restrooms, park, and picnic grounds near the entrance, but some community members find this use of environmental capital without mention of its toxicity disturbing (Butte Restoration Alliance 2007a). Figure 6-13 provides an example of community reaction to the promotion of the Berkeley Pit as a tourist destination.

Figure 6-13. Community Reaction to Promotion of the Berkeley Pit as a Tourist Destination (Corbett 2007)

The image depicted in figure 6-13 is a clear act of dissenting discourse. The hegemonic (authorized) government and mining company discourse promotes the pit as a place of entertainment and a celebration of the mining past and completely negates its toxic nature and its symbolism as the destruction of neighborhoods and the underground. The taped recording at the viewing stand promotes authorized heritage discourse by describing the size and scale of previous mining operations and the prominence in national and global metal markets. The recording makes no mention of the toxic nature of the waters. This irony is exemplified in the artist's rendering of a water skier and tour boat on the pit. The image is ridiculous because the water is highly acidic and toxic and because the community does not have a space for aquatic recreation like many other Montana communities. This sense of the ridiculous was also highlighted by John Stewart's *The Daily Show*, which lampooned the promotion of the toxic pit as a tourist destination. In the video segment on the Berkeley Pit, the reporter states "The city of Butte, Montana, has taken lemons and turned them into something that if you drink it could kill you" (Daily Show 2006). The reporter then interviews local resident Fritz Daily, who provides dissenting discourse when he says "We have the largest contaminated body of water in the United States sitting right in the middle of our town because the Environmental Protection Agency has allowed that to happen, and its wrong, and it should be stopped" (Daily Show 2006).

For the city government and mining companies to promote the area as a tourist attraction and seemingly harmless water body is an obvious attempt to minimize contamination extent and severity. There are differing agendas for this. In the case of the city government, it promotes the Pit as a means to drive the tourism economy and does not want to discomfort viewers. In the case of the former and current mining companies, the reclamation of the Pit is not considered a part of Superfund cleanup, and it is economically imperative that this designation remain. It also serves as a way to delegitimize claims of toxic health impacts from the landscape. By displaying the toxic pit as an attraction, the public is left to assume it is safe and the contamination does not cause harm. This is an act of cultural remediation as romanticized, sanitized history and serves as a way for the culture to value the landscape without confronting negative health and environmental consequences.

In addition to the funds collected by the city for the entrance fee, the Dennis Washington Foundation pledged $100,000 for the completion of an entrance area (Pitwatch 2005). In doing this, the Washington Corporation, which owns MRI, exercises hegemonic control over the interpretation and cultural remediation of the area. It is important to note that Washington Corporation is a potentially responsible party and could be required to pay a part of Superfund cleanup, and community opinion weighs heavily in Superfund decisions. It is economically important that the community continues to support the promotion of pollution as entertainment. The viewing stand area is shown in Figure 6-14.

Figure 6-14. Berkeley Pit Viewing Stand (Photo by author)

Additionally, a 100-acre area north of the Berkeley Pit will remain untreated after several community members petitioned to have the waste left in place as a historic mining landscape. In exchange for this 100-acre area, MRI agreed to plant a garden along a berm of the Berkeley Pit, near the viewing stand and bordering Continental Avenue, a major traffic artery (Butte Restoration Alliance 2007a). This illustrates the capacity of the mining company to use historical preservation as leverage in environmental negotiations, and it pre-empts cultural remediation controlled by the community. This reclamation is particularly interesting because it contains Celtic knot and harp patterns in the garden, which are cultural markers of the Irish mining community, and while parts of the Dublin Gulch area were consumed by the pit, the majority of neighborhoods consumed by the pit were populated by Italian, Slovenian, Austrian, Finnish, French, and English in the Meaderville, McQueen, and East Side neighborhoods. This could be interpreted as an act of cultural remediation that aims to show the dominance of the Irish over the Butte landscape, or it could show the influence of the Irish on mining activities in Butte. Whichever the case, it is not a factual marker of the ethnicities of the former neighborhoods of this area. This area is shown in Figure 6-15.

Figure 6-15. Celtic Garden at Berkeley Pit Viewing Stand Area (Photo by author)

The cultural remediation and contested history sites provide a basis for an understanding of the cultural landscape and the transitional cultural properties in Butte.

As described by Brown (2003), cultural conflict can cause cultural sites to become more valuable to the community. This is certainly the case in mine yards, neighborhoods, and the Central Business District as well as recreation spaces like the Columbia Gardens.

“We always did feel the same. We just saw it from a different point of view.”
~ Bob Dylan

7.0 Contemporary Butte

This chapter investigates the contemporary cultural landscape of Butte, including traditional cultural properties and culturally significant places and develops a list of cultural markers. The landscape and markers show a shift in power from the mining company and mining industry to the community and historical preservationists. The chapter also includes a discussion of the Butte Restoration Alliance and the Citizens Technical Environmental Committee, community groups involved with environmental, historical preservation, and health issues. A survey of the Butte medical community provides insight into contemporary community attitudes and understandings of health and environmental issues. The chapter also includes a study of poetics associated with the resilience in community literature.

7.1 Cultural Landscape

The cultural landscape provides a means to understand the interaction between the community and the landscape, highlighting places where the community members derive parts of their cultural identity, engage in heritage, and preserve and promote memory and discourse (King 2003). It also illustrates the interconnection of social, environmental, and health issues. The interconnection of themes throughout a landscape is more significant than any single salient feature (Altschul 2005). The cultural landscape includes traditional cultural properties as well as areas that hold cultural significance but are not old enough to be considered for the National Register. Some landscape features may no longer exist physically but are a part of the landscape as community memory. The cultural landscape also includes open space and park lands, which are used as recreational spaces by the community.

7.2 Traditional Cultural Properties and Places of Cultural Significance

Traditional cultural properties are places that are eligible for the National Register and are associated with the cultural practices of a living community, which are both a part of the community’s history and are important in maintaining cultural identity. By definition, traditional cultural properties contain one of the following five qualities: spiritual power, practice, stories, therapeutic quality, and remembrance (King 2003).

As described in the mine yards section, mining properties serve as traditional cultural properties throughout Butte by being places of storytelling, practice, and remembrance. The National Historic Landmark District designation, along with the use of the area as a place of practice, storytelling, and remembrance marks the structures within the district and the district itself as a traditional cultural property. Most notably, this designation encompasses the entire communities of Butte, Walkerville, and nearby

Anaconda and unifies the district as a traditional cultural landscape. The landmark designation also includes architectural aspects of the community, including buildings and mining structures. Several structures are specified in the designation for their contribution to national labor issues. This gives prominence to the dissenting discourse in Butte of labor and working class history, as opposed to middle and upper class, corporate, production, and other forms of dominant history. The former Anaconda Company headquarters are also specified in the designation, and the company's importance in local, regional, national, and international metals and industrial history should not be underestimated. It is interesting to note that the first floor of the former headquarters is now the location of a local market, as it was in the time of early Anaconda Company operations. The remaining floors are now high-end, eco-friendly apartments. This act of reclaiming the space for community use is an additional example of cultural remediation.

The ethnic neighborhoods of Butte are also traditional cultural properties. One example is the former Chinatown area, which is curated and promoted by the Mai Wah Society. This group operates a museum that contains materials found in archeological investigations as well as other historic artifacts from the neighborhood. It also hosts Chinese scholars, artists, and lectures as well as the annual Chinese New Year parade. The neighborhood also contains the Pekin Noodle Parlor, which has been open for over 100 years.

The nearby Dumas Brothel commemorates the former red-light District (Murphy 1982). The building is a former bordello that now operates as a museum. Buildings in this district are distinct in their architecture, featuring numerous windows facing the street to advertise the women who worked inside them and numerous separate entrances to the women's chambers. The Blue Range Building, shown in Figure 7-1, is an example of this architecture. There is also a parking lot that contains a memorial of this neighborhood, known as the Copper Block. This area, shown in Figure 7-2, contains silhouettes of prostitutes surrounding the alley. This is an act of dissenting discourse because it venerates prostitution and shows the value of the women, neighborhood, history, and the profession to the community.

Figure 7-1. Blue Range Building (Photo by Author)

Figure 7-2 Memorial for the Red-light District (Photo by Author)

Signage similar to this memorial occurs at the former location of the hotel that housed labor activist Frank Little[10] before he was lynched. Figure 7-3 shows two men carrying the body of Little from the boarding house before he was lynched. While his murderers were never discovered, according the community memory, Little was lynched by Anaconda Company men and hung in an area near German and Bavarian neighborhoods as a warning against labor activists (Byrnes 2003). This cultural memory has attained mythic status in Butte and while labor history is outside the scope of this study, it is important to note examples such as this as a dissenting discourse and important contribution to the cultural heritage of the city. Not knowing whether the company was responsible for the lynching is reminiscent of the Columbia Gardens and Central Business District fires. While the community memory is that of Anaconda Company arson and many feel that Anaconda had an arsonist on staff, this was never proved and charges were never filed (Ekness 1999).

Figure 7-3. Frank Little Memorial (note rope around perpetrator's neck) (Photo by Author)

[10] Frank Little was a labor activist for the Industrial Workers of the World (IWW). He came to Butte as the leader of the IWW metal miners union in 1917 to recruit for new members. Within two weeks of his arrival, unnamed men lynched Little and hung him from a railroad trestle in the smelter district. A local man found his body the following morning with a note bearing the vigilante sign 3-7-77 and a list of other labor organizers as a threat (Calvert 1988).

7.3 Additional Places of Cultural Significance

In addition to traditional cultural properties, there are several other places in Butte that are considered significant to the cultural identity of the community but could not be considered traditional cultural properties because they are not old enough to be considered eligible for the National Historic Register, no longer exist, or because they do not meet one of the five criteria set forth by King (2003). Figure 7-4 shows both traditional cultural properties and culturally significant properties in the Butte area. It is interesting to note that several of the features lie outside of the mining district and greatly expand the cultural landscape from the Butte Hill to the approximate size of the contemporary community. A large majority of these are natural features that are used for social gatherings and recreation, such as the park at Basin reservoir, the Silver Bow Creek Trail, Nine Mile, Sheep's Head, Big Butte, Thompson Park, Highlands, Beaver Ponds, Homestake/Delmo, Maud S. Canyon, East Ridge, Beef Trail, and Moulton areas. Other features serve as landmarks, such as the East Ridge, which gives direction to all location- based discussions in the community; Timber Butte; the Highlands; the Berkeley Pit; and Big Butte, also known as the Big M, which is lit at night and serves as a directional marker for Uptown Butte.

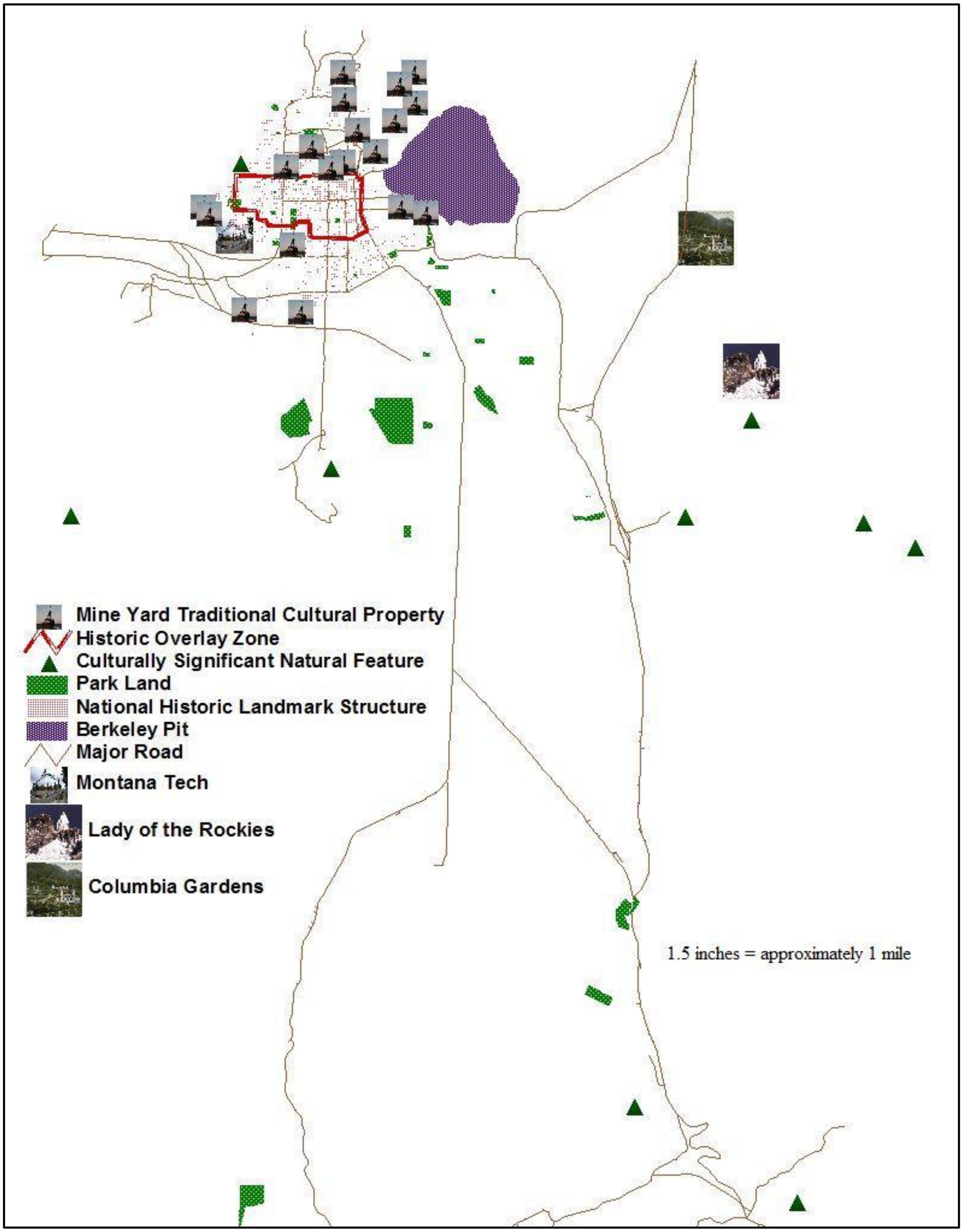

Figure 7-4. Culturally Significant Places in the Butte area

7.4 Cultural Markers

The cultural landscape of Butte includes the residential community and the surrounding visual perimeter. Community members derive different parts of the cultural identify from different parts of the landscape. As seen in Figure 7-4, the traditional cultural properties occur in the Uptown or Hill region of the landscape and natural cultural markers, parks, recreation, and open space occur on the Flats and in the nearby public land areas. This illustrates a marked difference in how the community perceived, modified, and interacted with its environment in different regions of the landscape. This disparity is a form of interconnection of themes that in a cultural landscape is more significant than a single salient feature (Altschul 2005). There is also a strong interconnection between environmental contamination and traditional cultural properties in the landscape. While environmental contamination is ubiquitous in the cultural landscape, there is a greater concentration of contamination on the Hill, where the majority of the traditional cultural properties exist. There is also an interconnection between culturally significant natural features, park lands, and open space. Together, the culturally significant places shown in Figure 7-4 are physical cultural markers and physical markers of cultural remediation in Butte. In areas where the environment was used for mining, the focus is on architecture, mining structures, and community. In areas that were not used extensively for mining, natural features and open space are valued. This shows the axis of variation in the traditional cultural properties in Butte. A nontoxic environmental landscape is valued but only in areas that are not dedicated to mining, the economy, history, or heritage.

There are also significant events that are temporal cultural markers and temporal markers of cultural remediation in the community. These temporal markers denote a cultural shift or the occurrence of a behavioral or physical cultural marker in Butte. Table 7-1 is a list of the major temporal cultural markers in Butte during the 1950-to-2010 time period. As seen in this table, the temporal cultural markers show a shift in cultural power from the Anaconda Company to historical preservationists, environmental activists, and tourism promoters. The city's decision to deny the mining company's plans to consume the historic Central Business District in 1975 marks a cultural watershed. In asserting itself, the community placed more value on cultural capital than financial capital. The table shows a clear trend of increasing community values of cultural resources and the increasing importance of historic preservation and historic designations. It also shows a trend toward the promotion of the town as a festival city and the importance of tourism. The timeline shows a strong interaction between environmental and historic preservation issues and the importance of both in the culture. Environmental issues change from mining to remediation after mine closure, and this turning point coincides with the city hiring a Historic Preservation Officer, publishing a Historic Park Plan, and the creation of the Historic Overlay Zone. This point exemplifies the shift in power from mining company to community and the strong community interest in preserving historic structures.

Table 7-1. Major Temporal Cultural Markers in Butte

1950	Greater Butte Project- numerous historic mining structures destroyed
1950	Anaconda Company donates Butte Community Hospital to City
1955	Start of Berkeley Pit. Instant promotion as tourist site
1957	Massive fire destroys Clark Park grandstand
1957	Interstate I90 bisects flats
1959	Lee Enterprises buys ACM papers
1960	Silver Bow General Hospital opened on lease from ACM
1962	Butte Airport opens
1962-1964	Massive fires in Meaderville
1962	Butte named to National Historic District list
1964	End of Meadville neighborhood as Berkeley Pit expands
1964-1978	End of McQueen neighborhood as Berkeley Pit expands
1965	World Museum of Mining Opens
1969	Model Cities Program starts in Butte
1970	Berkeley Pit viewing stand built to promote tourism
1972-1975	20 major fires in CBD 1972-1975
1973	Columbia Gardens destroyed by fire
1975	Anaconda Company announces plan to mine CBD area
1975	Closure of Mtn. Con and Steward mark end of underground mining
1975	Butte Forward approves plans to move CBD and mine the area
1976	Butte City Council rejects plans to move CBD and mine the area
1976	Butte –Silver Bow city/county consolidation
1976	Butte Heritage Cookbook published
1977	Butte Arts Foundation begins use of Arts Chateau as museum
1978	Last McQueen resident leaves; Holy Savior church buried
1979	Butte-Silver Bow establishes the Urban Revitalization Agency
1982	Berkeley Pit closed
1982	Last brothel, the Dumas, closed in Butte
1983	End of Berkeley Pit operations in Butte
1983	ARCO turns off underground pumps, begins mine flooding
1983	EPA designates Butte area as a Superfund site
1984	Butte hires a City Historic Preservation Officer
1984	Historic Park Plan published
1984	Historic inventory started in Butte
1985	Butte-Anaconda Master Park Plan
1985	Historic Overlay Zone created
1985	Our Lady of the Rockies built on the East Ridge
1985	Dennis Washington buys ARCO’s Butte operations
1986	Architectural and Historical Inventory of the National Landmark District
1987	EPA enlarges Superfund site
1990	Butte Historic Management Plan
1993	Regional Historic Preservation Plan

1995	URA begins historic landmark signs program
1995	342 Snow geese die after landing on the Berkeley Pit waters
1996	Granite Mountain Memorial
2002	Evel Days festival begins
2003	An Ri Rah festival begins in Butte
2003	Lighten Up Butte begins lighting gallows frames
2006	Butte-Anaconda National Historic Landmark District Designation
2007	Archives mill levy passes
2009	Master Park Plan
2008-2010	Mountain Con Mine Yard Plan
2008-2010	National Folk Festival at former mine yards and CBD

When considered as a whole, the physical and temporal cultural markers show a shift in cultural power from the mining industry to historical preservation, environmental remediation, and tourism industries. This shift mirrors the shift in settlement pattern of the city from the Hill, which was settled as a mining camp, to the Flats, which were settled as a suburban community. The conflict between historical preservation, environmental remediation, and mining is an important part of the culture and will continue to influence the cultural landscape well into the future.

7.5 Open Space and Park Lands

Today, parks dot the Butte landscape. As seen in Figure 7-5, the majority of park land occurs in the residential areas, with smaller parks on the Hill and larger parks on the Flats. Several large parks, such as Thompson Park, a 3,500-acre forest with walking trails, picnic areas, and a folf course and the Basin Creek Reservoir picnic grounds are adjacent to open space and National Forest lands. It is interesting to note that open space within the residential area is most often a former mine site and/or contamination site, such as the Missoula Gulch Ball Field or Copper Mountain Youth Park, and open space outside of the residential area is more often undisturbed forest. As discussed in the previous section, this shows the axis of variation in interaction with the environment.

The 2009 Master Park Plan for Butte-Silver Bow states that the objective for the trails is to connect the network of open spaces, parks, recreation areas, and mine lands. The plan states: "The park system has the potential to play a major role in interpreting the rich history of Butte-Silver Bow. As mine lands continue to evolve as park land, an interconnected preserve of open spaces, historical sites and other recreation facilities can enhance Butte-Silver Bow's notoriety as a major historical and recreational attraction" (Butte-Silver Bow 2009). The use of the word "notoriety" promotes Butte's wide open town mythology, boomtown past, and significance in the global market. It also highlights the feeling of contention between the community and outsiders. It is not celebrated for its past; it is notorious for it. This claims the landscape and its historical and recreational attraction as a dissenting discourse to the authorized American discourse. By capitalizing on dissenting discourse, the plan serves as an act of cultural remediation.

The plan also describes the interconnection of parks and historic structures through the landscape. This interconnection is more important that the singular recreation spaces and shows the progression of position of power from the mining industry to the community. The statement that the mine yards are "evolving" into remediated recreation spaces shows the belief that remediation is a more evolved and better way of interacting with the landscape. This shows a shift in environmental capital from mining to recreation, tourism, and residential use and a cultural value of nontoxic interactions.

The trails shown in Figure 7-5 show a broad loop with several smaller loops connecting these areas. The plan also describes undeveloped park lands in the area and lists approximately 2,200 acres of Superfund land in Uptown Butte as potential park lands. This land is described as remediation land that cannot be used for residential or industrial purposes and includes gallows frames and former mining equipment.

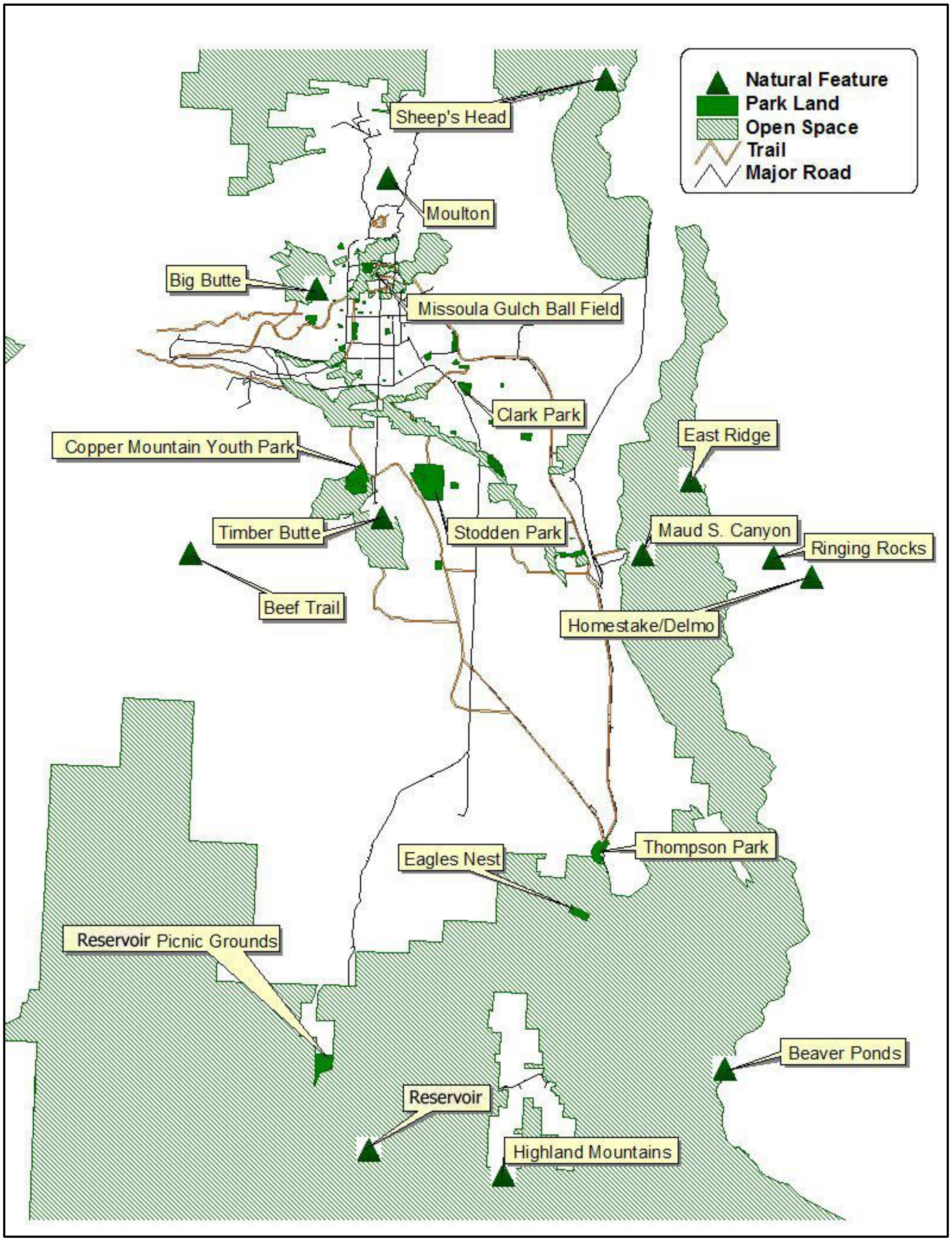

Figure 7-5. Contemporary Park Land, Trails, and Open Space in the Butte Area

7.6 Community Groups

Volunteer groups offer a window into the community. By joining and contributing to community groups, the author was able to look at the cultural values of everyday life as well as large-scale social movements. Becoming a part of the community organizations provided a better understanding of community values, social institutions, power relationships, community networks, economic arrangements, and ways in which the community takes action. The two community groups joined by the author for this research were the Butte Restoration Alliance (BRA) and the Citizens Technical Environmental Committee (CTEC). Together, these groups provided a wide exposure to community members and other groups in the Butte area. Both groups focused on environmental and health issues, and the BRA also focused on historical preservation. To determine the perceptions of the medical community regarding environmental health, remediation, and cultural influencing factors, the author conducted a confidential survey of the medical community in Butte. The results are summarized in this section.

7.6.1 Butte Restoration Alliance

The Butte Restoration Alliance is a community volunteer organization that was created by Butte-Silver Bow government leaders, including the Chief Executive and Planning Director, and citizens involved in organizations concerned with environmental restoration in the area. One aim of the group is to bring together the many volunteer organizations, such as Imagine Butte, Mainstreet Butte, Citizens for Preservation and Restoration (CPR), Montana Economic Revitalization and Development (MERDI), Greenway, Citizens Technical Environmental Committee (CTEC), the Clark Fork Watershed Education Program (CFWEP), the Chamber of Commerce, and others to form a coordinating group that would interact with Butte-Silver Bow and provide community input for the restoration and redevelopment of Butte, particularly with a focus on the expenditure of Natural Resource Damage Program restoration funds. It is important to note that the EPA was a part of the steering and planning of this group and provided funding for the steering committee, graphic design and production, public awareness, and project management (BRA 2007b).

The application process for the group was modeled after the Milltown Dam city group in Missoula County, Montana, where interested persons had to apply and be selected for membership. The Milltown Dam was located 120 miles downstream of Butte on the Clark Fork River Superfund site, and the contamination in the area originated in Butte and Anaconda. The application stated that the group was: "… created to advise the local, state, and federal governments on future restoration projects in Butte and Silver Bow County. Projects will seek a balance between environmental concerns and other more aesthetically and culturally enhancing projects that make Butte a more desirable place to live" (BRA 2007b). This shows sensitivity to cultural values beyond remediation and a healthy environment and implies an emphasis on increasing resident enjoyment of the city as well as attracting future industry and residents.

The Natural Resource Damage Program is listed as the main source of funding for restoration efforts in the area (BRA 2007b). Additional funding sources for restoration and community enhancement projects listed in the BRA background document include the Resource Indemnity Trust, Urban Revitalization Authority, Community Transportation Enhancement Program, Butte-Silver Bow Redevelopment Trust, and the Treasure State Endowment Program (BRA 2007b). The guiding principles of the group include environment responsibility, historic/cultural preservation, sustainability, accessibility, and community (BRA 2007b). The environmental guideline states that environmental responsibility should be a part of remediation, restoration, and redevelopment. These guiding principles illustrate cultural values and demonstrate the importance placed on environmental responsibility. Group meetings further illuminated a community sense of a lack of responsibility in the past and a belief that community involvement could help shape policies and decisions, thereby resulting in more environmentally responsible reclamation and restoration activities (BRA 2007a). The group created six subcommittees: environmental, recreation, historical preservation, neighborhood enhancement, infrastructure, and management. These subcommittees then created lists of projects and prioritized their importance. This provides an understanding of the “axis of variation” described by Erickson (1976), showing the diversity of opinion and more realistic understanding of cultural values and discourse.

Many members of the group, including the author, are environmental engineers who specialize in mine waste treatment, particularly in the Butte area. This is due, in part, to a now defunct program funded by the national EPA known as the Mine Waste Technology Program. This program researched and demonstrated mine waste treatment technologies and operated at both a local engineering company known as MSE, Inc. and at Montana Tech, which offered a master’s degree emphasis program, research support, and funding. Environmental engineering bachelor and master’s degree programs are offered at Montana Tech.

Several professors from Montana Tech also joined the BRA, including faculty from the environmental engineering, technical communications, political science, biology, geology, and engineering science departments. One member of group who was a part of the historical preservation subcommittee was from the Montana Bureau of Mines and Geology, which is located on the Montana Tech campus. Several additional members of the environmental subcommittee were Montana Tech graduates, particularly from the environmental engineering department, and currently work in the environmental consulting industry and are often involved in environmental remediation projects in the area. This highlights a consideration for community involvement in both the BRA and CTEC. Many members of the environmental groups were employed in the environmental remediation industry, and the groups provided a community networking opportunity, as well as an opportunity to influence and be informed of upcoming remediation work and potentially benefit from being involved in the group. While the majority of the reason for most members of the group was to have a positive impact on environmental restoration and remediation and to volunteer valuable environmental engineering, scientific, and communication skills, this additional motive did influence some group interactions, particularly in relation to power dynamics with city government and EPA officials who were potentially sources for future business contracts or employment.

The environmental subcommittee did not prioritize projects that were slated to occur under Superfund or the local health department. Projects they listed as having high importance included landscaping, particularly native landscape; natural water catchments to enhance irrigation; treatment of contaminated water for use as an irrigation source; and reduction of weeds in uptown yards; fencing and posting around hazardous areas until reclamation occurs; bringing active mining activities into the process; and performing a public health study of Butte (BRA 2007b).

A chief division between the historic and cultural preservation group and the environmental group is the stance on remediation of contamination in the mining landscape. The historic group felt that the landscape was an example of historic mining landscape that could be destroyed by remediation, and the environmental group felt that mining structures should be preserved but contaminated lands should be remediated (BRA 2007a). As described in the historic mining landscape section of Chapter 2, some members of the historic preservation community felt that environmental remediation of mining contamination in Butte is a form of historic sacrilege that would cover up all signs of former mining and would cause Butte to "look like Kansas" (Williams 1993, Wycoff 1995, St. Clair 2003). Environmental subcommittee members expressed concern that historic structures be preserved but also felt that there was little chance for the loss of mining history in Butte considering the scale of mining contamination, the number of mining structures, sites such as the Berkeley Pit, which will not be remediated because the EPA determined it is technically impracticable to do so, and areas already designated as historic mining landscape by the EPA that will never be remediated (U.S. EPA 1994, BRA 2007a).

There is a legal basis for the historic preservationists' opinions. The EPA and its Superfund programs are subject to the regulations of the Historic Preservation Act of 1966. This act requires federal agencies to consider the effect of their actions on National Register-eligible resources, but does not prohibit these agencies from having an adverse effect on the resources. It also requires that the agencies consider alternatives and mitigate negative effects (Environmental Law Institute 1982). In a study of State Historic Preservation Officers (SHPOs) and their experiences with Superfund sites that have historic resources, Fred Quivik found that the EPA often ignored opportunities to include preservation and interpretation of resources in remedial design (Quivik 2001). Quivik describes personal experiences in the Butte preservation community:

> Our hope for cooperation with the EPA was soon dashed, however, by the agency's myopic understanding of its design objectives. Local administrators seemed to see the historic copper industry as the enemy, and they saw the only design alternative for remediation to the obliteration of any historic industrial

> features that happened to be in the way of the clean-up and to cover those areas with newly planted grass. Moreover, they exhibited the attitude that their mandate was so important that nothing so relatively trivial as community or national history should hamper the completion of their mission (Quivik 2001).

According to Quivic, the Montana SHPO helped mitigate this problem and forced the EPA to comply with the National Historic Preservation Act, and consider its impacts to cultural resources in Butte and mitigate adverse effects whenever possible. After this experience, Quivik surveyed SHPOs of all 50 states and found similar adverse impacts to cultural resources in Leadville, Colorado; Virginia City/Comstock, Nevada; Bunker Hill, Idaho; and the ASARCO smelter in Tacoma, Washington (Quivik 2001).

Hardesty also investigated this topic in his article "Issues in Preserving Toxic Wastes as Heritage Sites" (Hardesty 2001). In this article, Hardesty argues that toxic wastes are artifacts produced by humans that evoke human emotions and therefore have socially redeeming values that justify their preservation. According to Hardesty: "… like other artifacts, toxic waste dumps or other hazardous landscape elements can be interpreted from a number of perspectives, but viewing them as historical documents, or commodities, or as ideas appears to be particularly useful" (Hardesty 2001).

Hardesty described a conflict between residents in the California mining community of Amador County, where one group of residents feared the negative health effects associated with arsenic-bearing mine waste dumps and another group promotes future mining efforts that include a viewing center for historic and current mining activities. Hardesty supports the pro-mining group stance and concludes: "The bottom line is how to balance the cost of mitigating the risk of preserving a hazard to ensure public safety with the hazard's value as a repository of historical information or as signs and symbols useful in interpreting the past or maintaining social and the cultural integrity of a community" (Hardesty 2001).

In a study of challenges associated with properly addressing acid mine drainage contamination, Carroll Russell describes historic preservation as one of the four main challenges. She provides the example of the Elizabeth mine in Strafford, Vermont, which contains mine waste piles that are sources of acid rock drainage. These piles are historic, and after many public hearings, the community members reached a conclusion that environment cleanup and historic preservation could work together. One example of compromise in this process is the tinting of the remediated piles to keep their historic appearance (Russell 2006).

Robertson (2006) also discusses historic preservation of the toxic landscape in Cokedale, Oklahoma. Interestingly, Robertson notes that it was newcomers to the community who most often promoted preservation of the toxic landscape (Robertson 2006).

The historic/cultural preservation guiding principle of the Butte Restoration Alliance states: "We believe that Butte has a unique history and culture that should be value and preserved" (BRA 2007b). The community principle states: "we believe in Butte's community spirit and sense of independence, and that involvement in remediation, restoration and redevelopment project can further encourage that spirit" (BRA 2007b). The historical preservation subcommittee considered the creation of historic guidelines for new construction and a viewing stand at the Berkeley Pit obvious. They ranked the stabilization of buildings in the historic landmark district; restoration of the Columbia Gardens, particularly plantings and landscaping; and cultural activities as high priorities (BRA 2007b). The cultural activities included the creation of a historical/cultural trust that would promote theatres, arts, and museums. They also suggest the creation of a museum of Butte history. The preservation of the Copper King Mansion and support of the Butte-Silver Bow archives were also listed as high priorities (BRA 2007b). Initial efforts of this group focused on mine yard renovations after reviewing the allocation agreements between Butte-Silver Bow and ARCO (BRA 2007a).

The conflict between environmental and historical preservation groups has made the viewpoints of each more valuable to like-minded members of the community. Environmental groups are as strongly determined to have the contamination remediated as the historic preservationists are to leaving the waste in place. This debate ensures that environmental and cultural remediation will remain at the forefront of the cultural identity of Butte well into the future.

The BRA and CTEC also functioned as community involvement conduits for the EPA and Montana DEQ. These organizations used the meetings as a means to inform the public about upcoming projects and sometimes as a means to gain public input. This second function is tempered by the experience of several presentations being simple statements of fact and showcases for future projects, with no changes occurring as a result of input from community members in the meeting. As described in an editorial by CTEC member John Ray: "Contrary to EPA's own policy, it limits its community involvement activities to the public information about what EPA is doing and engaging in public activities to 'sell' the public on EPA activities" (Montana Standard 2011). This tactic disenfranchised several members of the group, including the author, and posed real doubt as to the purpose and efficacy of the groups.

7.6.2 CTEC

In a study of the rhetoric of environmental activism, Kevin DeLuca (2009) described the role of groups, particularly environmental groups, in changing public consciousness in ways that are measurable in changes in cultural meaning and values and in public discourse (DeLuca 2009). One method employed by these groups is the use of antagonisms, which question and challenge the hegemonic discourse of industrialism. This is similar to dissenting discourse. Antagonisms are used in the environmental movement to question the discourse of industrialism that pollution is the "price of progress." Similarly, environmental group antagonisms to EPA cleanup policies and actions levels are seen in environment groups, as is the case in Butte. Historical preservation groups also have antagonisms for EPA practices and environmental group discourses. The medical community has its own discourse, which values health over preservation and is more in line with the environmental group discourse and is an antagonism to the historical preservation hegemony.

The Citizens Technical Environmental Committee (CTEC) is a group 10 to 15 volunteers concerned with environmental issues in the Butte area that attempts to facilitate public involvement in remediation and restoration efforts. The group consists of environmental engineers, scientists, college professors, historians, and concerned citizens. The group began in 1989 and has stopped and started with waxing and waning public interest over its tenure. The group is funded by an EPA Technical Assistance Grant (CTEC 2011).

The group had been dormant for several years when a member of the Butte-Silver Bow Planning Committee and the state EPA involvement coordinator approached members of the BRA subcommittee to re-form the group. The Technical Assistance Grant fund for the group was contingent on group activity, and members of the BRA environmental subcommittee felt that CTEC was an additional avenue to promote community involvement in environmental remediation activities. It also provided a means for community interaction, such as a website, EPA document repository, storefront office location, and part-time employee available to interact with the public.

One important issue during the period of this study was the five-year review for the Butte Priority Soils Operable Unit (BPSOU). This included the incorporation of public comment, and several members of CTEC and the BRA, including the author, were courted by the EPA contractor performing the review to be a part of this comment. The findings of this review were favorable to the EPA and its involvement with the local community. CTEC member John Ray noted:

> "This is, of course, what happens when the agency that developed the cleanup plan reviews its own work. Would a reasonable person really expect the EPA to find that it had made mistakes?...Overall, it is clear, if one reads the five year review, that public comment had little substantive impact on that review. For example, serious concerns raised by the public regarding the adequacy of data used in the health risk assessments on the Butte hill were determined to be unfounded by the same EPA personnel responsible for doing the original risk assessments" (Montana Standard 2011).

Ray concluded his editorial with a reminder that the EPA is a government organization that is funded by the public, responsible to the public. This consideration was not seen in any interactions with the EPA in CTEC or BRA meetings. Questions regarding remedial action levels, bioavailability studies, and health monitoring methods were dismissed with assurances that doctors had studied the contamination and determined that Butte arsenic and lead had a lower bioavailability than other sites in the

United States (CTEC 2008). CTEC concerns about the arsenic and lead action levels were also reported in several written communications, meetings, position papers, and letters (CTEC 2004, CTEC 2005, CTEC 2008, CTEC 2009b, CTEC 2010). The expression of these concerns had no effect on EPA decisions.

For example, in a 2004 CTEC document presented to the Butte-Silver Bow Council of Commissioners regarding attic dust contamination and remediation CTEC questioned lead and arsenic action levels noting that Butte action levels are among the highest in the nation. The document states: "CTEC does not agree that children in Butte recreate any differently in residential yards compared to children in East Helena. Their action level is 60% lower for yards" (CTEC 2004). Regarding indoor exposure to contaminated dust: "CTEC believes it is unreasonable to assume that indoor exposure to dust and outdoor soils exposure deserve the same action levels" (CTEC 2004). Additional concerns included: "people are assumed not to go into or use their attics" and "all home renovators are assumed to get a permit prior to beginning construction work for testing and cleanup" (CTEC 2004). The document goes on to state: "it seems assumptions are used to support that the people of Butte live differently than other communities. Furthermore, Butte homes are assumed to be able to easily contain toxic waste in their attics, precluding dust from entering the breathing and living space of homes" (CTEC 2004). In a 2005 position paper regarding the proposed plan for the Butte Priority Soils Operable Unit, CTEC stated that it believed that the plan had several inadequacies, including overall protection of human health and the environment, long-term effectiveness and permanence, and reduction of toxicity, mobility or volume (CTEC 2005). This document restated CTEC concerns regarding action levels and bioavailability assumptions. Regarding arsenic:

> The proposed plan states that the remediation goal for arsenic in residential solid media of 250 mg/kg represents a 1 in 10,000 cancer risk. This is the highest cancer risk of the 3 action levels considered by the EPA. CTEC contends that the selection of the least protective remediation goal for arsenic by the EPA further puts the health of Butte citizens at risk. Arsenic remediation goals should be developed so that not one of the 24,400 Butte residents has an elevated risk of cancer from arsenic exposure. CTEC recommends that EPA perform analysis of a histogram of Butte residential arsenic levels in soils to determine an appropriate natural break in arsenic concentration distribution that will provide for a cancer risk of approximately 1 in 100,000 (CTEC 2005).

CTEC again expressed concerns regarding bioavailability, action levels, and health monitoring in a letter regarding the 5-year review of the Butte Superfund sites in 2010 (CTEC 2010). The author's concerns regarding bioavailability studies, action levels, and health monitoring can be found in the risk assessment section of Chapter 4. The author's personal interaction, as well as interaction by a Montana Tech professor who specializes in risk assessment, with the local EPA site manager on this matter were confrontational and left no room for input or suggestion (CTEC 2008). Continued suggestions for medical monitoring of chronic exposure and exposure to all contaminants of concern, not just lead, also were met with the same stance (CTEC 2008). They were noted in the five-year review, however (U.S. EPA 2011c).

There was frequent frustration within the current group regarding the lack of EPA consideration for their input, extent of studies and lack of projects as well as the difficulty of translating the studies so that they could be understood by the larger community (CTEC 2008). To combat this issue, the group has held public information fairs, became a part of the local art walk, and maintains a website with more accessible descriptions of the operable units and remedial activities. The group has shown interest in health issues and has repeatedly supported the public health study portion of this dissertation (CTEC 2008). This shows a community interest in health issues, particularly as they relate to environmental contamination and remediation.

As a side note, it is important to understand that the local EPA site manager did not support the health study portion of this dissertation and tried to suppress it (Butte-Silver Bow Health Department 2011b). This began as a debate between the Butte-Silver Bow Health Department, which funds portions of the health study, and local and state EPA officials. In this debate, the local EPA site manager demanded that the study be approved by her office and be subject to scrutiny by the CDC and ATSDR before the dissertation could be defended and presented to the public in any manner (Butte-Silver Bow Health Department 2011c). The Butte-Silver Bow Health Department contract for the health study portion of this dissertation does not stipulate rights to the study and is not beholden to the EPA (Butte-Silver Bow Health Department 2011b). Additionally, this research began long before the Health Department offered funding and a large portion of it has been done purely for the purposes of this dissertation (Barry 2006). Subsequent meetings with the state EPA legal counsel determined that the local EPA official had no right to make this claim. The state EPA endorsed the study and stated that the study is not confidential (U.S. EPA 2011b). The referenced letters from the EPA legal counsel and Butte-Silver Bow Health Department regarding this issue can be found in Appendix C.

7.6.3 Butte Medical Community Survey

To determine the perceptions of the medical community regarding environmental health, remediation, and cultural influencing factors, the author conducted a confidential survey of the medical community in Butte. The survey included questions regarding environmental health effects, incidence of health problems, perception of environmental remediation and action levels, risk perception, and cultural influences. Appendix D contains a copy of the survey questions. The University of Montana Institutional Review Board (IRB) approved this survey; documentation is included in Appendix D.

In response to the question regarding environmental contamination that could potentially increase the risk of health problems in Butte, the majority (10 of 13) listed mine waste and a smaller majority (8) specified arsenic and lead. One further specified copper, and one specified asbestos. One public health nurse did not think that there were contaminants that increased the risk of health problems in Butte.

In response to the question regarding environment health effects that stem from contamination in Butte, the majority (11 of 13) felt that there are environmental health effects that stem from environmental contamination in Butte. One was not sure and one did not think that this is the case. Of the 11 that did think there are environmental health effects, seven specified diseases. Each specification included cancer (or neoplasm), five listed multiple sclerosis, two specified autoimmune disease, and two specified pulmonary or respiratory system diseases (and correlated it to tobacco use, in addition to exposure to contamination). Thyroid disease, neurological disease, and rheumatoid arthritis all were expressed by one respondent as environmental health effects that result from exposure to contamination in Butte.

When asked if they see an increased incidence of health problems in Butte compared to other communities, four responded that they have not practiced outside of Butte. One of these respondents noted that their colleagues reported higher rates of multiple sclerosis in Butte. One respondent did not see higher rates in Butte, and one said "not yet"; this respondent has practiced in Butte for three years. Of the seven who responded that they have seen an increased incidence of health problems in Butte, five specified multiple sclerosis, four specified cancer, one specified rheumatoid arthritis, and one specified thyroid and respiratory diseases. Of this group, one thought an increased incidence of skin cancer could be associated with ethnicity and altitude, and one thought that smoking, substance abuse, poverty, and lack of health insurance also are factors.

Eight respondents did not know whether the environmental contamination is being remediated to a level that is protective of human health. Of these, two thought that they did not have enough background information to answer, and one of these thought that remaining contamination could adversely affect people with compromised immune systems. One respondent thought that the environment is being remediated to a level that is protective of the public health. Four did not think that this was the case. Of these, one specified that the mine waste, soil, water, and dust were not being remediated to a level that is protective of human health and stated: "People in Walkerville still talk about mercury coming out of the drains." Another respondent from this group felt that more needs to be done to protect human health and remediation should be "stepped up." One respondent from this group thought that the public should be educated about risks involved with contamination and remediation levels. A final member of this group did not think that the area was being remediated at all.

When asked to specify whether the remedial action level for the contaminants of concern are adequate to protect human health, eight thought that they didn't know or didn't have enough background information to answer the question. One member of this group felt that there should be public education that provides this information. One was concerned that the action levels are not adequate. One respondent thought that the remedial action levels are adequate to protect human health. Four did not think this is the case. There was little elaboration in this group, but one did think that the remedial actions should be "stepped up."

When asked whether historic preservation or environmental remediation should take precedence in instances of a historic landscape or historic structure, there was a high percentage of comments, which will be summarized here. Of the 12 respondents, 11 thought that the environment should take precedence. One felt that both should take precedence. None thought that historic landscapes or structure should take precedence. The comments beyond yes or no are included below:

"Environmental remediation should take precedence. I feel very strongly about this."

"Environmental remediation should be more important for the health of the public over rotting old buildings."

"Human health is priority one. I think historic landscape and structures should be preserved/restored when contamination or risk is removed."

"Historic preservation is also important, especially economically, but in the long run environmental remediation is also economically important, i.e. health care costs, and undesirable safety factors."

When asked if they felt that there is a diminished perception of risk in the Butte community, there was also a large number of comments. Of the 13 respondents, seven felt that there is a diminished perception of risk, two were not sure, one answered perhaps, one did not feel there is a diminished perception of risk, and one did not answer unequivocally either way. One respondent answered no, but appeared to interpret the question as whether there is a perception by persons outside the community that Butte has a higher risk from environmental contamination. The comments from this question are summarized below.

"Yes. The community as a whole does not have enough insight regarding the risks of environmental contamination."

"Yes. People act as if they are indestructible. They party like they are nineteen until they have a heart attack in their forties. Also, several state they used to play and now let their kids play with mercury in Walkerville. Most don't believe the pit has any real danger to water or air quality."

"Yes. Especially people originally from Butte feel that Butte is the best place in the world and are in denial of what is going on in the environment."

"No. I think that it is probably that there is a higher perception of risk, that does not pan out when you look at the actual numbers." The respondent did not provide a reference to what these numbers represent.

“Yes. I think people in Butte are used to hard times and are proud of how tough they are, but I also feel the community needs to be better informed as to the contamination risks in our community.”

“Perhaps. We are leaving it up to the environmental engineers to decide.”

“Yes. Because now the environmental damage is not as evident as it once was with some of the remediation that has already been done, but much more is needed.”

“No. As an outsider, that is mostly what I was warned about when moving here. The perception is still strong that Butte has toxic qualities including the water.”

“Yes. I feel that we should all be more proactive in searching out this information, becoming more self-educated, better informed.”

“People are not always educated as to the risk in our environment.”

“Don’t know. Maybe just benign neglect and lack of evidence.”

When asked if there are cultural influences that affect health issues in Butte, eight felt that there are cultural influencing factors. Three respondents were not sure or did not know. Two said perhaps or maybe. There were no respondents who thought that there are no cultural influencing factors that affect health issues in Butte. Their responses are summarized below.

“Yes, especially regarding risk taking behavior.”

“People are in denial of what is going on in the environment.”

“I think the ‘tough living’ type belief causes some people to not seek healthcare when needed, and I think this also plays into people not buying into preventative measures or life styles.

“I feel these are small in comparison to the risk of the environmental contamination in the community.”

“Acceptance of drinking in excess. Smoking is decreasing but many are still addicted and youths are starting.”

“I think historic preservation may be influenced or is the same as cultural preservation. Butte is a community rich in history and culture and we take great pride in that and take great measures to preserve that history. Structures that may be contaminated or pose a risk may be preserved for historic or cultural value and remediation becomes a lower priority.”

"Many people have lived here all their lives and think that things are the way they are and can't be changed. This attitude needs to change."

The majority of the answers and comments from this survey show a concern for the environment and health effects associated with contamination, particularly mine waste, arsenic, lead, copper, and asbestos. But most did not know if the remediation is at a level that is protective of human health or if the action levels are adequate. Several did not think the remedial actions or action levels are adequate. Many respondents specified diseases such as cancer, multiple sclerosis, autoimmune disease, respiratory disease, thyroid disease, neurological conditions, and rheumatoid arthritis.

The majority also felt strongly that environmental remediation should take precedence over historic preservation. This shows the axis of variation for this issue. Not only do people in the environmental community want the landscape remediated and think it should take precedence over the historic landscape, so does the medical community.

Many also thought that there is a diminished perception of risk in Butte, and of these, several though this perception led to negative health consequences from interactions with the environment. This shows a cultural influencing factor for health issues and the way the community interacts with the environment. Several specific mining culture values were present in the comments from this question, specifically pride in resilience and toughness and romanticizing the environment. The question regarding cultural influencing factors also described several mining culture values as influencing health issues, particularly risk taking, toughness, historic pride, and romanticizing the past.

It also included reference to the antagonistic cynicism seen in mining communities. The comment that residents think that "things are the way they are and can't be changed" speaks to this feeling and the feeling of powerlessness in environment issues. Several comments also concerned the need for public education and for the public to seek out this information. This would indicate that community involvement by the EPA DEQ, city, BRA, and CTEC are not reaching the entire community and more could be done to solicit involvement, communicate, and/or educate.

The comment stating that the community is leaving it up to the environmental engineers to decide whether the area is being adequately remediated shows that the environmental engineers serve as the community spokespeople in environmental and health issues. It is telling that government agencies and the mining companies are not mentioned in any comments; the focus is consistently on other community members.

These comments, along with the actions of the BRA and CTEC, indicate a strong interest in environmental and health issues. This interest is tempered by antagonistic cynicism and a feeling of frustration in affecting change and getting input incorporated into remedial actions. The fact that these groups have endured shows their resilience and essential alignment with Butte culture.

Butte literature also illuminates the value of resilience to the Butte community. Characters overcome poverty, abuse, and contamination. The town itself is resilient and survived the flood of the underground city and the rising waters of the Berkeley Pit. The community resurrects and preserves the portions of the town that didn't survive; the neighborhoods, mine yards, and Gardens in memory, especially in literature, where they are crystallized for future community members to experience, value, and pass on.

7.7 Poetics of Resilience

After the fires and after whole neighborhoods were consumed by the ravenous pit, the mining company abandoned the Underground and shut off the pumps that de-watered the mines. A flood filled the underground city, made its way through thousands of miles of tunnels, and erupted into the pit. Lahey described the impending flood poignantly (Lahey 1983):

"The shafts will be covered
the pit will become a lake
and the old miner with the silky
dead hair will return home."

In Lahey's poem, the water is seen as purification, washing the dead miner from the shaft and returning him to the community. The Pit becomes a mountain lake, not the flooding toxic pit of reality. This speaks to a cultural desire to retrieve the community from the Underground before it is lost forever and a wish for a clean environment. The yearning for cultural reclamation of the Underground is also seen in re-creations of the Underground at the World Museum of mining and in the planning of underground tours of the underground ventilation structures in the Central Business District. These re-creations, along with re-creations of the Columbia Gardens and gallows frames, are a form of resilience in the Butte community. While the structures and physical landscapes were lost, literature, the cultural memory, and nostalgia allow them to endure. Resilience and endurance are important aspects of a mining culture, and both can be found throughout Butte literature.

In *Buster Midnight's Café* (Dallas 1998), May Anna fought her way from poverty, an abusive childhood, and prostitution to a successful career. Her love interest literally fought his way to success as a boxer. Insurmountable odds are constantly overcome in Butte stories. Rags-to-riches motifs dot the literary landscape. From the prostitute turned movie star, to MacLane's rise to prominence in the pre-feminist movement, to the professor turned mining magnate in *Perch of the Devil* (Atherton 1914, these stories echo the rags-to-riches stories of Butte's mining barons, Marcus Daly and William Clark, and exemplify the American dream. The story of Butte's copper kings and the community desire for mineral wealth and the gamble associated with mining are played out in its literature. These stories reinforce the community value of resilience, hard work, and faith in the profitability of mining and mining cultural values. The boxer in *Buster Midnight's Cafe* did not give up when he encountered adversity; he instead redoubled his effort and fought his way back to prominence. The mine owner's wife did not abandon her marriage in *Perch of the Devil;* she instead climbed into his mine and searched through the tunnels for a connection to him. Roddy does not resign himself to muteness in *Wide Open Town* (Brinig 1931), he instead digs deeper inside himself and creates new words with deep meaning.

Stories of resilience also come in the form of interactions with contamination. Dallas revels in the contaminated waters of Butte. In describing a happy childhood memory, she describes a pond used by local children:

> "It wasn't much of a pond because it was mostly filled with water from the mines, but the boys liked it because it was dangerous and they'd been told if they ever drowned, their bodies would be lost forever. Whippy Bird claimed that was because the pond was really a glory hole, and it went down a thousand feet. Maybe even to China, May Anna said. The boys also liked that pond because it was used as a garbage dump, it stank to high heaven, which kept most people away. Kids had to be tough to go there" (Dallas 1998).

Not only was the pond contaminated by mining, it had the extra contamination of a garbage dump. Some of the most tainted waters in town were the playground of Butte children. Beyond repeating the pride and resilience in overcoming contamination, the passage shows the fear associated with the unknown, with death and the depth of the pond. It is untouchable, not because it is pure, but because it is poison. This created a sort of mystery and magic in the pond, suitable to a child's imagination. It does not matter to Dallas that the imaginings of the children are dark; imagination has an absolute value. This has a telling cultural implication. As a town that prides itself on grandiosity, calling itself the "richest hill on earth", etc., the extent of contamination also may have an absolute value to the community. It is not viewed as negative or positive, it is instead valued for its size and scope and the associated amount of resilience to live within it and to create it in the first place.

MacLane takes poison to enlarge herself: "The poisoning of my soul-the passing of my unrest-would rouse my mental power. My genius would receive a wonderful impetus from it" (MacLane 1902). She does this to kill the lesser parts of herself and make room for the resilient. By selecting for strength, she fortifies and cultivates her self-proclaimed genius. Brinig, too sees pain as a source of enlargement: "Pain enlarges me. I grow vast in my pain and my understanding knows no limits" (Brinig 1931). Together, these observations illuminate the Butte value of poison, pain, and harsh reality. These conditions toughen and enlarge the personality and are a source of strength, not just a source of illness and death.

Lahey also praises the contamination and vilifies attempts to clean the landscape. In his poem "Dr. Butte" (Lahey 1983):

"We were cured of blight
of dirty sky, of brown buildings,
cured of the late twentieth
century.
Dr. Butte provided the glue
so we could go on
so our fingers could work
and our graves would wait
undug in the green cemetery."

Lahey does not see the greening of the community or the return of the Gardens; instead he sees the greening of the cemetery, the death of the town. This exemplifies an adversarial stance against valuing environmental remediation and health issues over the mining landscape and mining itself. It also speaks to the longer life expectancy associated with remediation. Instead of finding rest and peace in death, the community must continue working.

In contrast, Reif Larsen's *The Selected Works of T.S. Spivet* (Larsen 2010) expresses the contemporary view of the contaminated waters of Butte in a manner consistent with people outside the community. In this novel, the narrator, a young genius, attends Butte middle schools while his mother studies entomology in the nearby forest. The narrator expresses sympathy for local residents who do not want to talk about the toxic water in their backyard: "Butte hit national headlines every other year right around Earth Day as a symbolic warning of what could go so wrong in humanity's tenuous relationship with the land. It got to be psychologically wearisome to live in the poster town of environmental catastrophe." Indeed, it is. But he thought the local science teachers should see the poisoned waters "as a treasure trove of projection analyses and case studies and extended metaphors" (Larsen 2010). He then imagined remaining frozen in time for 25 years until the pit has filled with water and could not carry any more: "… eventually there would be a great rumbling and then the door of the science room would burst open and behind it a biblical swirl of red poison water would instantly soak our posters on mass and gravity and chicken eggs." This metaphor is common in articles about Butte waters. They are dire in their prediction, seeing biblical floods of poison shaking the citizens awake from their perceived unnatural relationship with the toxic landscape. This is not unexpected for a town known as the Perch of the Devil, the Black Heart of Montana, and Poisonville. It is important to understand that the outsider's perception of the community's relationship with the landscape and its accompanying health issues are subjective and are not the only valid viewpoint, however. The familiarity of the town with the toxic landscape has made it accept and embrace the dark waters as well as the sand and barrenness.

The Berkeley Pit is not the only poisoned water in the city. As Dallas described, the city is riddled with toxic ponds, pits, and streams. To the Butte community, clean waters come from elsewhere. Long ago, the mining company created water lines to carry clean water from the nearby mountain streams and lakes, the unreachable places of purity described in *Wide Open Town* (Brinig 1931). This vision of the divided environment has persisted since Brinig's time. The local landscape was contaminated and profitable and the mountains were a place of purity and escape. Larsen places his narrator's home at the source of the community's pure water, in the rural community of Divide. This gives the perfect vantage point for watching the flood waters rise. When the torrent does happen, he is safe in his position as an outsider.

These reflections show the conflicted nature of the relationship with the environment in Butte and the resilience required to endure. While the environment is the source of employment, heritage, and life, it is also the source of poison and death. Miners continue to pull ore from earth and, although the air is now relatively pure, the toxic dust of the past continues to settle and stir in the wind. The fires of class warfare have long since died out and are now the fires of pyromania and insurance collection. Neighborhoods are not reborn from these fires; they are boarded up, demolished, or hauled to a museum. The underground city was lost in the flood, its poisoned waters rising in the unfathomable pit and spilling into the creeks and ponds. To outsiders like Larsen, the toxicity is condemnable and the people dumb for living beside it. To insiders, it is their heritage, and it is a badge of honor to overcome and float on these waters. As Lahey says:

"Druidic celebrations, people, flow,
tolerance and patience.
I am initiated and I know."

"Dying is an art, like everything else."
~ Sylvia Plath

8.0 Health Study

One way to investigate the health issues in a community is to gain an understanding of its disease rates. It is extremely difficult to track disease occurrence rates, because of the Health Insurance Portability and Accountability Act (HIPAA) privacy laws, however, so this study instead focused on mortality rates, which are reported to the Centers for Disease Control (CDC). These data are reported on a county level. This assures that the data are valid, do not contain bias, and that personal identities are kept confidential. By determining the mortality rates in Butte and then comparing these rates to the mortality rates for the State of Montana and the United States as a whole, it is possible to gain an understanding about the effect living in the Butte area has on the health of the community. This line of reasoning is consistent with environmental epidemiology methods that attempt to correlate environmental exposure to disease incidence and mortality. It is important to note that while some conclusions can be made based on toxicological information, these conclusions are correlations and cannot prove causation. Cultural influencing factors, also discussed in this section, must be considered as contributing factors to elevated or decreased mortality rates.

This chapter provides a toxicological description of the chemicals of concern in the Butte environment. This description includes routes of exposure, target organs, interactions, and potential health effects associated with the chemicals. The chapter also includes the results of the author's longitudinal epidemiology of Butte for the years 1978-2007. The investigation then correlates the mortality rates from to the toxicology of the chemicals of concern. The chapter closes with a consideration of the cultural influencing factors and their influence on the longitudinal epidemiology study's mortality rates.

8.1 Chemicals of Concern

The Record of Decision for the Butte Priority Soils Operable Unit of the Butte Superfund site (U.S. EPA 2006a) lists the following metals found to be in elevated quantities in Butte soil, air, water, or house dust: aluminum, arsenic, cadmium, copper, iron, lead, mercury, silver, zinc. Additionally, the Montana Pole Plant Superfund Site, located in southwest Butte, contains several polycyclic aromatic hydrocarbons (PAHs), chlorophenols, dioxin/diobenzofurans, and metals, all listed in table 8-1 (MDEQ 2006). In a study of domestic dogs as biosamplers of mining contamination in Butte, the following eight elements were identified as elements of concern (Peterson 2007): aluminum, arsenic, boron, lead, lithium, manganese, molybdenum, selenium.

To ensure all chemicals of concern in Butte are addressed in this toxicology study, the author conducted an interview with Butte-Silver Bow Reclamation Manager Tom Malloy in March of 2008. Mr. Malloy suggested the addition of asbestos and nitrates to the lists of chemicals of concern. Asbestos is present uptown Butte buildings, structures, and pipelines, and nitrate contamination occurs in south Butte and Silver Bow Creek (Malloy 2008). The list of chemicals of concern was then sent to the Butte Health Department and was approved by the director (Larson 2008). Based on the aforementioned investigations and discussions, the chemicals in Table 8-1 are considered to have a potential health effect on Butte residents.

Table 8-1. Butte Chemicals of Concern

Metals	**Polycyclic Aromatic Hydrocarbons (PAHs)**
Aluminum	2,4-dinitrotoluene
Arsenic	Acenaphthene
Boron	Anthracene
Cadmium	Benzo(b)fluoranthene
Chromium	Benzo(e)fluoranthene
Copper	Benzo(ghi)perylene
Iron	Benzo(k)fluoranthene
Lead	Benzo(e)fluoranthene
Lithium	Benzo[a]anthracene
Manganese	Benzo[a]pyrene
Mercury	Chrysene
Molybdenum	Dibenzo(a,h)anthracene
Selenium	Fluoranthene
Silver	Fluorene
Zinc	Indeno(1,2,3-cd)pyrene
Dioxins/dibenzofurans	Naphthalene
2,3,7,8-tetrachlorodibenzofuran (TCDF)	Phenanthrene
2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)	Pyrene
Chlorophenols	**Other**
2,4,6-trichlorophenol	Asbestos
2,4-dichlorophenol	Nitrates
2,4-dinitrophenol	
2-chlorophenol	
4-chloro-3-methylphenol	
Pentachlorophenol	

8.2 Toxicology of the Chemicals of Concern

Toxicology studies describe the following effects resulting from chronic exposure to each of the contaminants of concern. The chemicals are grouped into five categories: metals, PAHs, dioxins/dibenzofurans, chlorophenols, and others. Toxicity, as described in this report, encompasses adverse impacts such as degeneration, alteration, mutation, or necrosis. The manner of toxicity, particularly in the case of carcinogenicity, is specified wherever possible.

8.3 Routes of Exposure

The routes of exposure are divided into inhalation, dermal, and oral routes. The inhalation route, for example, includes toxins that are absorbed through the lungs and bronchial, olfactory, and mucociliary passageways, while dermal exposure indicates that the toxin is absorbed through the skin. The oral route of exposure includes food, drinking water, and ingestion of soil or dust. The exact manner of potential exposure is indicated wherever possible.

8.4 Target Organs

The target organ is the organ that receives the highest toxic effect or receives severe damage from a toxicant. A toxicant, or chemical, can have several target organs, and several chemicals can have the same target organ.

8.5 Interactions of the Chemicals of Concern

There is limited information regarding the toxicology of chemical mixtures. However there is a wide variety of known interactions between the chemicals of concern in Butte. Typically, chemical compounds elicit an additive effect when administered together. In an additive interaction, the toxic effects of a mixture are approximately equal to the sum of the exposure levels, weighted for potency (U.S. Department of Health and Human Services 2004a). However, synergistic or antagonistic reactions can also occur. In a synergistic interaction, the effects of the mixture are greater than the effects that would result in an additive interaction. In an antagonistic interaction, the effects of the mixture are less than the effects expected from an additive interaction (U.S. Department of Health and Human Services 2004a).

8.6 Metals

While little is known about the toxicity of chemical mixtures, there have been several investigations into the toxicology of metals as a group. Recent studies correlated metals exposure to immune system toxicity (Stejskal 1999, Carey 2006). One of these studies showed a correlation between metals exposure and immune system toxicity and an increased incidence of rheumatoid arthritis, ALS (Amyotrophic lateral sclerosis, often referred to as Lou Gehrig's Disease), and multiple sclerosis (Stejskal 1999). The study points to clusters of multiple sclerosis in metal-contaminated areas as further incidence of metals correlation to increased incidence. The paper also describes the effects of chronic low-dose exposure to metals and suggests that longitudinal studies are the best way to measure these effects. It attributes four mechanisms in metal-induced toxicity: free-radical formation, local toxic effects, inflammation, and calcification.

While approximately 10% of ALS cases are attributed to genetic predisposition, the study also points to environmental factors. An epidemiology study of 170 twin pairs found that only two pairs had both twins develop ALS, indicating a strong role of environmental factors. Several other studies have shown ALS disease clusters in metal-contamination areas (Sienko 1990, Provinciali 1990, Mitchell 1987). An additional study of Parkinson's Disease mortality rates in Michigan showed correlation to metals exposure from industrial processes (Benjamin 2004).

8.6.1 Aluminum

Chronic exposure to excessive amounts of aluminum is toxic to the pulmonary, musculoskeletal, and central nervous systems. Because aluminum alters calcium metabolism in organ systems, including the brain, studies have found a relationship between aluminum exposure and Alzheimer's Disease, Dementia, ALS, and Parkinson's Disease (Brown et al, 2005; Walton et al 2009; Percy et al 2001; Rondeau et al , 2009; Shaw et al, 2009; Kawahara et al, 2011).

Aluminum is seldom absorbed through the dermal route and is not readily absorbed in either oral or inhalation exposure routes. Inhalation of particulate aluminum can, however, result in direct transfer of aluminum to the brain tissue via the olfactory system. The highest concentrations of aluminum in the human body are found in the bone and lung. Aluminum can affect the absorption of other elements in the intestinal tract and can alter intestinal function. Aluminum inhibits calcium, iron, and fluoride absorption and alters calcium metabolism in several organs, including the brain (Drago, et al, 2008; Nday et al, 2010; Klaassen 2001).

Aluminum has several interactions with other metals and essential elements such as calcium, magnesium, manganese, and zinc. Aluminum has an inhibitory effect on calcium in the liver and spleen, an inhibitory effect on magnesium in the bone, and an inhibitory effect on manganese in the brain. Absorption of aluminum is greatly increased in the gastrointestinal system when citrate, a common food component, is ingested with the aluminum (ATSDR 2008b). In a human population in the western Pacific, a combination of calcium and magnesium deficient diet along with high concentrations of aluminum and manganese in drinking water were considered factors in the increased incidence of amyotrophic lateral sclerosis and Parkinson's-like dementia (Goyer 1997). A calcium, iron, or magnesium deficient diet can increase aluminum absorption and toxicity.

8.6.2 Arsenic

Arsenic is classified as a human carcinogen by the EPA. Carcinogenic effects include internal organ cancers and skin cancer from drinking water exposure and lung cancer from inhalation exposure (Smith, et al. 1992). Chronic arsenic exposure in drinking water can cause bladder cancer (Szymańska-Chabowska et al, 2002; Smith, et al., 1997, Hopenhayn-Rich, 1996; Tsuji et al., 2004; U.S. EPA 2006c).

Chronic arsenic exposure can cause neurotoxicity of both the peripheral and central nervous systems. Chronic exposure can result in liver injury that first manifests as jaundice and then progresses to cirrhosis and ascites. There is an increased incidence of cardiovascular disease in cases of chronic exposure to arsenic in drinking water.

Chronic oral exposure can also result in hyperpigmentation, keratosis, and vascular effects (Ferreccio et al., 2006; Watson et al., 2007; Kapaj et al., 2006; Tchounwou et al., 2006; Tsuji et al., 2004; Szymańska-Chabowska et al., 2002; Klaassen 2001; U.S. EPA 2006c).

Using EPA's Soil Screening Guidance (U.S. EPA 2006b), the risk-based soil screening levels (SSLs) for arsenic are: 1) 23.5 ppm to protect against noncarcinogenic health effects, 2) 3.82 ppm to protect against cancer effects, and 3) 0.426 ppm to protect against cancer effects when adjusted for age to account for increased exposure as a child. Based on this, the average soil sample for arsenic in the Butte Priority Soils database is nine times higher than the SSL for non-cancer effects and 500 times higher than the SSL for age-adjusted cancer effects. The maximum soil sample is 500 times higher than the SSL for noncancer effects and 27,900 times higher than the SSL for age-adjusted cancer effects. Epidemiologic studies of a populations exposed to arsenic in Taiwan, Bangladesh, and Sweden showed an increased risk of diabetes mellitus (Tseng et al, 2000; Rahman, et al, 1999; Teseng, et al 2002, Chen, et al, 1995).

Arsenic and ethanol co-exposure can elicit synergistic reactions. Co-exposure to lead can also cause greater than additive neurological toxicity (U.S. Department of Health and Human Services 2004b). Malnutrition can also increase the toxic effects of chronic arsenic poisoning (ATSDR, 2007a). Selenium also has an antagonistic effect on the toxic effects of arsenic. This is believed to be related to the formation of an arsenic-selenium complex than can be metabolized and excreted from the body more rapidly than either chemical alone. Human studies on arsenic-selenium interactions have not shown significant decreases or increases in arsenic toxicity. There have been lung cancer studies of copper-smelter workers in which workers with lung cancer showed lower levels of selenium in their tissues than workers who did not develop lung tumors (ATSDR 2007a).

8.6.3 Boron

Boron is used in glass manufacturing, fire retardants, leather tanning, soaps, fuels pesticides, and wood preservatives. Copper smelting can cause the release of small amounts of boron (Lottermoser, 2000; Beavington, 1970; ATSDR 2007b). Routes of exposure to boron include ingestion of food, such as fruits and vegetables that contain boron; surface and groundwater; and products such as laundry soap, pesticides, or wood preservatives that contain boron. The inhalation route is not a common exposure route for the general population but can occur in industrial work, such as borax mining and boric acid manufacture.

Boron is vascular toxic and can cause vascular hemorrhage, edema, an increase in microvascular permeability of the lung, and pulmonary edema (Kot 2009; Klaassen 2001). Human studies have shown that boron can influence functions in the bone, brain, and kidneys (U.S. EPA 2004a). Boron can also cause decreased fetal weight in humans. The EPA and the Department of Health and Human Services have not evaluated boron for human carcinogenicity. There are only limited data regarding boron's interaction with other chemicals. However, boron and calcium are known to have several potential toxic interactions, including cell membrane alteration and hormone-action modification.

8.6.4 Cadmium

The kidney is the target organ in cadmium exposure. Damage to the renal cortex can disrupt calcium metabolism processes and lead to musculoskeletal damage. Chronic cadmium exposure can also lead to lung and prostate cancer, anemia, discoloration of the teeth, and anosmia (Satarug, et al., 2010; Menke, 2009; Singh 2009; Pius, 2009; ATSDR 1999a). Chronic cadmium exposure can lead to cadmium accumulation in several other parts of the body, and this accumulation can lead to toxic effects. Areas where cadmium is known to accumulate include the pancreas, thyroid, adrenal glands, bone, lungs, testis, and central nervous system. Impaired kidney function can cause increased kidney damage from cadmium exposure. Diabetes is known to cause kidney damage, and this can put diabetics at greater risk for cadmium toxicity (Nordberg 2009). Contemporary studies also link cadmium exposure to diabetes (Edwards, 2009; Haswell-Elkins, 2007). The EPA considers cadmium to be a probable human carcinogen. This classification is based on an increase in lung cancer in laboratory animals and in humans (EPA 1991). The United States Department of Health and Human Services has determined that cadmium and cadmium compounds are carcinogens. The International Agency for Research on Cancer has determined that cadmium is carcinogenic to humans (ATSDR 1999).

The chief anthropogenic sources of cadmium include mining, smelting, electroplating, fuel combustion, metal-product disposal, waste incineration, phosphate fertilizers, and sewage sludge. Cadmium can be absorbed via inhalation, ingestion, and dermal exposure. While the inhalation route of exposure is much more favorable to cadmium absorption, gastrointestinal tract absorption of cadmium ranges from 3-8%. Dermal exposure to cadmium is not as common but can become significant in chronic exposures.

Municipal sewage sludge and phosphate fertilizers are an important source of cadmium in the soil. As the soil pH lowers, the cadmium precipitates and is more bio-available. This cadmium then accumulates in plants and animals and increases in the human diet. Cadmium occurs naturally in soil at levels of approximately 250 ppb. Cadmium is persistent in the environment and is known to bio-accumulate in the food chain, but it does not bio-magnify (Otero-Muras 2009; Barhoumi, 2009; ATSDR 1999a).

Cadmium is inhaled in small particles in fumes or in larger particles of dust. The depositional extent is dependent upon particle size. Approximately 50% of the particles sized 1.0 micrometers are deposited in the lung, while only 10% of 5 micrometer particles are deposited. Approximately 25% of the deposited proportion is systemically absorbed. The absorption rate of inhaled cadmium in smokers is elevated, ranging between 10 and 50% (U.S. DHHS 2002). Inhalation exposure can cause impaired lung functioning, fibrosis, emphysema, and pneumonia. While these effects are pronounced, the kidney is the target organ in chronic inhalation exposure.

In persons who do not smoke, the greatest exposure to cadmium comes from the ingestion of food. The typical person in the United States eats approximately 30 ug of cadmium per day, but only absorbs 1-3 ug through the gastrointestinal tract. Smoking greatly increases cadmium uptake. A single cigarette contains as much as 2 ug of cadmium, over half of which readily enters the body through the lung (ATSDR 1999a). Oral exposure can also occur through the mucociliary clearance of inhaled cadmium (ATSDR 1999a). The kidney and gastrointestinal tract are the target organs for acute oral exposure to cadmium. Target organ effects include ulcers, hemorrhage, and gastrointestinal epithelium necrosis. Kidney damage is usually the first observed chronic effect. The kidney is the target organ for both intermediate and chronic duration cadmium ingestion (U.S. DHHS 2002).

Using the EPA's Soil Screening Guidance (U.S. EPA 2006b), the risk-based soil screening levels (SSLs) for cadmium is 78.2 ppm to protect against noncarcinogenic health effects. Based on this, the mean of the soil samples for cadmium in the Butte Priority Soils database is below the SSL for noncancer effects at 69.5 ppm. The maximum soil sample is 717 times higher than the SSL for noncancer effects for cadmium at 56,100 ppm.

Cadmium toxicity can be increased in humans when there are dietary deficiencies in calcium, iron, zinc, protein, or vitamin D (Goyer 1997, ATSDR 1999a). Cadmium interferes with calcium metabolism as well as vitamin D metabolism in the kidney. Cadmium can alter calcium metabolism directly by toxicity to the bone and skeletal system or indirectly from renal toxicity (Goyer 1997). Iron deficiency, or anemia, can also increase the gastrointestinal absorption of cadmium. Co-exposure to zinc can decrease cadmium absorption in the gastrointestinal system (ATSDR 1999a). Selenium co-exposure can reduce the cadmium toxicity in bone marrow and in the cardiovascular system (ATSDR 1999a).

8.6.5 Chromium

Hexavalent chromium toxicity includes kidney damage from chronic low-level exposure, ulceration of the skin, and asthma (Shelnutt 2007, Dayan 2001, Cossta 1997, Klaassen 2001). Respiratory effects were observed in laboratory animals after exposures to hexavalent chromium dust. It is classified by the EPA as a known human carcinogen when exposure occurs through the inhalation route. Carcinogenicity by the oral route of exposure was not determined.

Chromium exposure can occur through the oral route by drinking chromium-contaminated water or eating chromium-contaminated food; through the inhalation route, by breathing chromium-contaminated air; or via the dermal route by skin contact with chromium compounds. The respiratory tract is the target organ for chromium toxicity as a result of inhalation exposure. The gastrointestinal system is the target organ in cases of oral exposure. Additional target organs include the hematological system, liver, and kidneys (Dayan 2001, Cossta 1997, ATSDR 2008). The International Agency for

Research on Cancer considers hexavalent chromium compounds carcinogenic to humans. Occupational inhalation of hexavalent chromium has been shown to cause lung cancer. Humans exposed to hexavalent chromium in drinking water have had an increased incidence of stomach tumors (Sedman 2006, Costa 1997, Cohen 1993, ATSDR 2008).

Hexavalent chromium is known to have increased mutagenic effects in the presence of other chemicals. Arsenic and chromium can lower blood cholesterol levels, and animal studies have shown a change in organ weight after co-administration. Co-administration of chromium and arsenic can cause increased arsenic levels in red blood cells, kidney, liver, spleen, and the heart, but it can also cause reduced levels of arsenic in lung and hair tissues (ATSDR 2008a).

8.6.6 Copper

Copper exposure occurs mainly through the oral route via drinking water and food and through the inhalation route via airborne particulates. The gastrointestinal system and hepatic systems are the target organs for copper toxicity. Copper toxicity also includes kidney and hematological effects (Tchounwou 2008, Gaetke 2003, ATSDR 2004). Wilson's Disease is a genetic condition in which copper is not metabolized correctly and copper accumulates in the liver, kidneys, cornea, and brain (Mufti 2006, Walker 2007). Copper has not been evaluated for human carcinogenicity by the EPA. The U.S. Department of Agriculture recommended daily allowance is 900 μg/day (ATSDR 2004).

Zinc can interfere with copper absorption, and a diet with high zinc concentrations can lead to a copper deficiency. This effect has been used therapeutically for the treatment of Wilson's Disease. Ferrous iron and tin can interfere with copper absorption. Cadmium can decrease copper absorption, and molybdenum exposure also can decrease copper uptake and, consequently, copper toxicity (Walker 2007, ATSDR 2004).

8.6.7 Iron

Iron is a naturally occurring element, and small amounts are necessary for proper nutrition. Chronic exposure to excess iron can lead to disturbance in liver function, diabetes mellitus, endocrine disruption, and cardiovascular effects (Brewer 2010, Weinberg 2009, Swaminathan 2007). Iron is not considered carcinogenic. The oral and inhalation routes are the most common routes of exposure to iron. The liver is the target organ in iron toxicity.

Iron deficiency can increase the gastrointestinal absorption of cadmium (ATSDR 1999a). It is the most common nutritional deficiency in the United States and worldwide. Ferrous iron and tin can interfere with copper absorption (ATSDR 2004). Lead absorption in the gastrointestinal system is greatly influenced by iron levels. Nutritional deficiencies in iron are known to increase lead uptake, and this effect can be pronounced in lower socioeconomic children. Iron supplementation is known to decrease lead absorption, particularly in cases of iron-deficiency anemia (ATSDR 2007c). Vitamin C is known to increase iron absorption.

Iron deficiency is also known to increase the absorption of manganese. A study of anemic subjects showed an increase in manganese uptake from 3% for normal subjects to 7.5% for anemic subjects (ATSDR 2008b). This interaction occurs only between manganese and non-heme iron, and an increased intake of non-heme iron has been shown to reduce manganese absorption. Iron can also decrease zinc absorption. A human study of subjects receiving iron supplementation showed significantly lower zinc-absorption percentages (U.S. EPA 2005b).

8.6.8 Lead

Target organs for lead toxicity include the neurological, gastrointestinal, reproductive, hematological, renal, and cardiovascular systems (Mobo 2008, Stewart 2006, Alissa 2011, Navas-Acien 2007, Hu 2007, Klaassen 2001). Additional health effects associated with exposure to lead include developmental delays, hypertension, impaired hearing acuity, impaired hemoglobin synthesis, and male reproductive impairment (Hu 2007, Wright, 2006, Navas-Acien 2007, U.S.EPA 2004b). Lead toxicity can also lead to a suppression of the immune system and immunotoxicty as well as lead-induced anemia and can disrupt calcium metabolism (Mishra 2009, Kahn 2010, Mushak 2011). Lead is considered a probable human carcinogen by the International Agency for Research on Cancer.

Recently, there have been several studies that correlate lead exposure and criminal behavior. One cohort study in Philadelphia showed childhood lead poisoning as the strongest predictor of adult criminal behavior (Denno 1990). A study of adjudicated (processed in the judicial system) juveniles in Pennsylvania showed eleven times higher bone concentration in adjudicated delinquents, compared to the control group. Importantly, bone lead is an indicator of chronic lead exposure (Needleman 2002). A longitudinal study of 195 children showed correlation between low-level pre-natal and childhood exposure to lead and delinquent and anti-social behaviors, including alcohol and drug abuse (Dietrich 2001). A subsequent study of 250 children showed correlation between pre-natal and childhood blood lead concentrations and arrests for violent crimes (Wright 2008). A 2001 study of homicides across counties of the United States showed correlation between homicide rates and air lead pollution (Stretesky 2001).

In addition to food sources of lead exposure, there are several environmental routes of exposure, including lead in dust from environmental sources, contaminated drinking water, paint, combustion of lead containing industrial emissions, soils, and lead in water from industrial or environmental sources. The oral and inhalation routes are the most common form of exposure, and hand-to-mouth activities of children are a route for dermal and oral exposures. Approximately 90% of lead particles deposited in the lungs from the ambient air are small enough to be absorbed (Klaassen 2001).

Lead toxicity in children is a significant public health concern. The EPA concluded that it was inappropriate to develop an oral reference dose because “changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development may occur at blood lead levels as low as to be essentially without a threshold” (U.S.EPA 2004b).

The Centers for Disease Control set 10 µg/dL as the blood lead level of concern for children. Because health effects have been identified below 10 µg/dL, the CDC convened an advisory committee, but did not change the level of concern, based on the following (CDC 2004):

- "No effective clinical interventions are known to lower blood lead levels for children with levels less than 10 µg/dL or to reduce the risks for adverse developmental effects."
- "Children cannot be accurately classified as having blood lead levels above or below 10 µg/dL because of the inaccuracy inherent in laboratory testing."
- "Finally, there is no evidence of a threshold below which adverse effects are not experienced. Thus, any decision to establish a new level of concern would be arbitrary and provide uncertain benefits."

Recent studies provide a rationale for lowering the blood lead level of concern to 2 µg/dL (Gilbert 2006, Bellinger 2004). These studies show that children experience cognitive and behavioral deficits at blood lead levels less than 10 µg/dL (Chiodo 2004, Fulton 1987, Landrigan, 2000 Schwartz 1994, Schwartz 1991, Selevan 2003, Walkowiak 1998, Wasserman 2000). In general, every 1 µg/dL in blood lead equates to an increase in 0.87 IQ points (Canfield 2003). The 2 µg/dL goal is attainable because it is now possible to measure blood lead levels of 2 µg/dL in laboratory testing. It is also possible to reduce environmental exposure to this point, which would eliminate the need for clinical interventions. While requiring a zero blood lead level would be ideal, it is not technically attainable.

There are several dietary influences in lead absorption. Calcium deficiency is known to increase lead absorption. Lead in water or liquid is more readily absorbed than lead in food. An increased frequency of food intake has been shown to decrease lead absorption (Klaassen 2001). Nutritional deficiencies in iron are known to increase lead uptake, and this effect can be pronounced in lower socioeconomic children (ATSDR 2007d). Iron-deficient adults have been shown to absorb lead at a rate two to three times greater than control subjects with average iron levels (ATSDR 2007c). The Centers for Disease Control recommend adequate dietary iron and calcium supplementation to prevent childhood lead toxicity (Goyer 1997). Phosphorus supplementation is known to decrease lead absorption, as is supplementation with calcium or iron, particularly in cases of iron-deficiency anemia. Copper and zinc can decrease lead absorption. Human studies have shown lower vitamin D levels in children with elevated blood lead levels (ATSDR 2007b). Cadmium has been shown to have a synergistic effect on lead in neurological toxicity and an antagonistic effect on testicular, renal, and hematological toxicity (U.S. Department of Health and Human Services 2004b). Co-exposure to arsenic can also cause synergistic neurological toxicity (U.S. Department of Health and Human Services 2004b). Co-exposure to manganese can have a synergistic neurological toxicity (U.S. Department of Health and Human Services 2004c).

8.6.9 Lithium

Chronic exposure to lithium, even in low or therapeutic doses, can lead to kidney toxicity, including necrosis and interstitial nephritis (Grandjean 2009, Markowitz 2000, Batlle 2008). Cardiovascular and nervous system effects are attributed to the competitive relationship between potassium and lithium, which can cause a disruption in intracellular metabolism. The therapeutic dose for lithium is 0.6-1.5 meq/L (Klaassen 2001). Lithium is not considered carcinogenic.

The main route of exposure for lithium is the oral route, where it is readily absorbed by the gastrointestinal tract. Lithium is used in medications and can also be used in industrial applications, such as alloy production, as a lubricant, and as a catalytic agent. Lithium can compete with sodium in certain organs, such as the renal system. It can also compete with potassium and create the potential to elicit toxic effects in the cardiovascular and nervous systems (Aral 2008, Grandjean 2009, Klaassen 2001).

8.6.10 Manganese

Manganese is essential to proper nutrition, but elevated exposure can lead to toxic effects. Manganese exposure can occur through food and water through the oral route, or through dust via the inhalation route. Inhalation of manganese from mines, mills, and other industrial sources is the most common cause of manganese toxicity (Klaassen 2001). Inhalation toxicity targets the central nervous system and lungs. Lung toxicity includes pneumonitis and respiratory diseases. Central nervous system toxicity includes a condition known as manganism, which is a neuropsychiatric disorder that initially manifests with irritability, difficulty walking, compulsive behavior, and speech disturbances (Roth 2011, Huang 2007, Robert 2009, Klaassen 2001). As manganism progresses, symptoms closely resembling Parkinson’s Disease occur, including a mask-like face, retropulsion or propulsion, and degeneration of the basal ganglia. Liver cirrhosis is also commonly observed in manganism. Oral toxicity targets the liver and gastrointestinal system. The EPA reference dose for oral ingestion of manganese is 0.14 mg/kg-day and the reference concentration for inhalation is 5E-5mg/ cubic meter (U.S.EPA 1991b). The Food and Nutrition Board of the National Research Council set 2 to 5 mg/day of manganese as the adequate and safe amount for ingestion by adults (ATSDR 2001b). Manganese is not classified as a human carcinogen.

A low iron level, or iron deficiency, is known to increase the absorption of manganese. A study of anemic subjects showed an increase in manganese uptake from 3% for normal subjects to 7.5% for anemic subjects (ATSDR 2008b). This interaction occurs only between manganese and non-heme iron, and an increased intake of non-heme iron has been shown to reduce manganese absorption. Manganese and iron also compete for absorption at the blood-brain barrier. Manganese can decrease cadmium absorption and has been used as a pretreatment to reduce cadmium toxicity. Cadmium also has an antagonistic effect on manganese uptake. High levels of phosphorus and calcium in the diet can decrease manganese absorption. Manganese can also increase the synthesis of metallothionine, a metal-binding protein (ATSDR 2008b).

8.6.11 Mercury

Mercury is a naturally occurring element that exists in three oxidation states: elemental mercury, mercurous mercury, and mercuric mercury. The routes of exposure for mercury can be through inhalation, ingestion, and dermal exposure; however, the significance of the routes of exposure varies, depending on the form of mercury. The kidney and central nervous system are the main target organs for metallic mercury toxicity. Chronic exposure to mercury can be toxic to the neurological, renal, cardiovascular, respiratory, gastrointestinal, hepatic, immunologic, reproductive, and developmental systems (Zahir 2005, Holmes 2009, Crespo-López 2009, Klaassen 2001, U.S.EPA 1997b)**.** The EPA has determined that elemental mercury as not classifiable as to human carcinogenicity, based on inadequate evidence in humans and animals. Mercury is known to be immunotoxic and can cause hypersensitivity and autoimmunity (Carey 2006, Holmes 2009, Zhir 2005).

Elemental mercury is lipid soluble and is able to penetrate biological membranes, such as the placental and blood brain barriers (Klaassen, 2001). In addition, the metabolism of mercury to other forms of mercury can occur in the tissues of the body. For example, elemental mercury can be oxidized to its inorganic form (Hg^{2+}). After elemental mercury crosses blood-brain barriers and oxidizes, it can be retained in the tissues of the brain. Elemental mercury vapors can be readily absorbed in the lungs, then dissolve in the blood stream and diffuse to the body tissues. In human studies the body absorbed approximately 75 to 85% of the inhaled dose of elemental mercury vapor (U.S. EPA, 1997b).

Selenium is known to decrease the gastrointestinal absorption of mercury toxicity. In one human study, selenium levels negatively correlated with mercury levels in brain tissues (ATSDR 1999d). While selenium has a protective effect, it is also associated with higher whole-body retention of mercury and does not cause increased mercury excretion. Zinc deficient individuals can have altered mercury absorption in the kidneys, leading to a greater toxicity with less mercury accumulation (ATSDR 1999d).

8.6.12 Molybdenum

Chronic molybdenum exposure can result in elevated uric acid levels, gastrointestinal effects, anemia, and retarded growth (Klaassen 2001). Molybdenum has an adverse effect on hematological copper homeostasis. This can effect copper distribution and copper metalloenzyme function. This is thought to be a critical component in the development of gout-like symptoms when subjects are exposed to high molybdenum levels (U.S. EPA 1992). Animal studies have shown fatty degeneration of the liver and kidney after chronic oral ingestion. The EPA oral reference dose for molybdenum is 0.005 mg/kg-day/ (U.S. EPA 1992).

Molybdenum exposure can occur through drinking water, diet, and inhalation of molybdenum-bearing dust. The typical amount of molybdenum in the American diet is 120-240 ug/d. Molybdenum levels greater than 8 ug/day in public water supplies can result in toxicity. Oral exposure to molybdenum targets the kidney, liver, skeletal, and hematopoietic systems. Inhalation exposure targets the lung and skeletal systems (ORREP, 1993).

8.6.13 Selenium

Selenium is a naturally occurring trace mineral that is also found in sulfur-containing pollution discharged to the air (Das 2011, Klaassen 2001). While small amounts are necessary for proper nutrition, chronic exposure to high levels of selenium can result in neurological toxicity and the disease selenosis. This disease is typified by neurological toxicity, such as numbness in extremities, hair loss, and brittle nails (Zwolak 2011, Kunli 2004, ATSDR 2003). The central nervous system is the target organ in selenium toxicity (Zwolak 2011, Klaassen 2001).

Selenium has several interactions with a broad spectrum of elements and chemical mixtures. Selenium is known to decrease the toxicity of numerous metals, including arsenic, cadmium, copper, lead, mercury, and silver. In general, arsenic interacts with selenium and has an antagonistic effect on selenium toxicity. However, there are two methylated selenium metabolites, trimethylselenonium ion and dimethyl selenide, that can cause a pronounced synergistic toxicity (ATSDR 2003). While selenium is known to decrease silver absorption, high doses of sodium selenite or selenium oxide can cause the development of silver selenide and result in an increased deposition of insoluble silver salts throughout body tissues, causing a condition known as argyria (ATSDR 1990).

In Vitamin E deficient subjects, selenium has been shown to reduce the toxicity of metals. Vitamin E is also antagonistic to selenium toxicity, and supplementation with Vitamin E can decrease the toxic effects of selenium exposure. Selenium also has an antagonistic effect on cadmium toxicity and mercury toxicity. However, this effect causes higher whole body retention of mercury and does not increase mercury excretion. Vitamin C supplementation can increase the absorption of selenium and result in greater toxic effects in humans (ATSDR 2003).

8.6.14 Silver

Silver is toxic to the gastrointestinal system, kidneys, lungs, and skin (Panyala 2008, Kim 2009, Foldbjerg 2011). It can also result in arteriosclerosis. In skin absorption of excessive silver, the tissues form an insoluble complex of silver sulfide and selenium, resulting in a condition known as Argyria. Argyria can occur on the skin or in the conjunctive of the eye (Alexander 2009, Kim 2008, Chang 2006). The EPA oral reference dose for silver is .005 mg/kg-day (U.S.EPA 1991e). Silver is not considered a human carcinogen. Silver exposure can occur through the oral, inhalation, and dermal routes. Silver accumulates in the liver and nervous system and readily crosses the blood-brain barrier.

Selenium is known to decrease silver absorption and thereby have an antagonistic effect on silver toxicity. However, high doses of selenium, such as sodium selenite or selenium oxide, can cause the development of silver selenide and result in an increased deposition of insoluble silver salts throughout body tissues causing Argyria. An individual with a selenium-deficient diet who is exposed to high amounts of silver can have liver toxicity, including liver necrosis (ATSDR 1990). Silver can also disrupt copper metabolism (Zimnika 2007).

8.6.15 Zinc

Zinc is a naturally occurring element, and small amounts are necessary for proper nutrition. Chronic exposure to high levels of zinc can cause gastrointestinal effects, anemia, and disruption of cholesterol levels (Andriollo-Sanchez 2008, Uyemura 2010, ATSDR 2005). Zinc is not considered to be a human carcinogen.

Zinc exposure can occur through the oral route, through drinking water and dietary intake, or through the inhalation route when exposed to zinc dust. Inhalation exposure can occur in the following industries: construction, painting, automobile mechanics, mining, smelting, welding, alloy manufacture, galvanized metal production, machine part manufacture, and rubber production and in plants producing paint, linoleum, oilcloths, batteries, glass, ceramics, and dyes. Oral exposure to zinc targets the kidneys, pancreas, gastrointestinal, and immunological systems. In inhalation exposure, zinc targets the respiratory system (Andriollo-Sanchez 2008, Uyemura 2010, ATSDR 2005).

Using the EPA's Soil Screening Guidance (U.S. EPA 2006b), the risk-based soil screening level (SSL) for zinc is 23,500 ppm, to protect against noncarcinogenic health effects. Based on this, the mean soil sample value for zinc in the Butte Priority Soils database is below the SSL for non-cancer effects at 2,597 ppm. The maximum soil sample is 13.4 times higher than the SSL for non-cancer effects for zinc at 315,000 ppm.

Several studies show an antagonistic relationship between lead and zinc. Zinc can also be antagonistic to copper toxicity when the levels of zinc exposure are much greater than copper levels (Plum 2010, Andriollo-Sanchez 2008). This principle is used in the treatment of Wilson's Disease. Cadmium can change the distribution of zinc in the body, causing an accumulation of zinc in the kidney and liver, possibly causing a deficiency in other organs. Zinc can increase cadmium toxicity in the kidney and can also cause an increase in metallothionein synthesis, which inhibits cadmium toxicity (U.S. EPA 2005b, ATSDR 2005). Zinc is also antagonistic in calcium absorption. Iron can decrease zinc absorption. A human study of subjects receiving iron supplementation showed significantly lower zinc absorption percentages (U.S. EPA 2005b).

8.7 Polycyclic Aromatic Hydrocarbons (PAHs)

The following PAHs present at the Montana Pole Plant Superfund Site are considered as a group in this profile:

- 2,4-dinitrotoluene
- Acenaphthene
- Anthracene
- Benzo(b)fluoranthene
- Benzo(ghi)perylene
- Benzo(k)fluoranthene
- Benzo(e)fluoranthene
- Benzo[a]anthracene
- Benzo[a]pyrene
- Chrysene
- Dibenzo(a,h)anthracene
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- Naphthalene
- Phenanthrene
- Pyrene

Polycyclic aromatic hydrocarbons (PAHs) have varying carcinogenic potentials. PAHs are associated with skin and organ cancers in humans and animals. PAH chemicals accumulate in cell membranes and interrupt cell functions and are considered mutagenic. PAHs are also considered an immunosuppressant and can cause vascular toxicity (Gerlofs-Nijland 2009, Lee 2011, Allan 2010, Jurgen 2008).

The Department of Health and Human Services considers benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, dibenz[a,h]anthracene, and indeno[1,2,3-c,d]pyrene animal carcinogens. The EPA has determined that benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, and indeno[1,2,3-c,d]pyrene are probable human carcinogens (ATSDR 1996).

Polycyclic aromatic hydrocarbons (PAHs) exposure can occur through the oral, dermal, or inhalation route. Dietary exposure is less common, except in cases where food is grown in a contaminated area. PAH exposure most commonly occurs in mixtures of the PAH chemicals, rather than in an individual PAH exposure. It should be noted that several experiments have shown that most PAH mixtures are considerably less potent than individual PAHs. While this can often be the case, other studies have shown that PAH mixture by-products at a manufactured gas plant were over 700 times more toxic than expected (ATSDR 1996). If the compounds compete for a deactivating pathway, they can increase the toxicity of other PAHs.

Co-exposure to PAH airborne particles can affect the pharmacokinetics of PAHs and can increase their carcinogenicity. For example, animal tests showed that co-exposure of benzo[a]pyrene and particles containing hematite (Fe_2O_3) and arsenic trioxide (As_2O_3) can greatly increase respiratory tract tumors. PAHs bound to particles can increase exposure time to the PAHs in the lungs and can increase the risk for lung cancer (ATSDR 1996).

There are also compounds that are antagonistic to PAH toxicity, including selenium, molybdenum, nitrates, and enzyme-inducing compounds such as antioxidants, plant flavonoids and phenols, vitamin A, garlic oil, turmeric extracts, and, interestingly, soy sauce. In an animal study of the effect of nitrite in drinking water and soy sauce in food on stomach tumors caused by benzo[a]pyrene, the combination resulted in a significant reduction in the number of tumors. When administered separately, nitrite and soy sauce did not affect the carcinogenicity benzo[a]pyrene. The mechanisms of the antagonistic effect of the combination is not understood (ATSDR 1996).

8.8 Dioxins/Dibenxofurans

Dioxin is a broad term used to describe a family of 75 chlorinated dioxin congeners. Dioxins are hydrophobic in nature and resist metabolism. Because of this, dioxins tend to persist in the environment and are known to bioaccumulate in fatty tissue (Gianfranco 2011, Ruzzin 2010). Dioxins are commonly found in complex chemical mixtures that contain the dioxin-like compounds, such as chlorinated dibenzofurans. These compounds are known as dioxin-like because they elicit a similar toxicity and occur in similar environments. The dioxins present at the Montana Pole Plant Superfund site include TCDF, TCDD, and dibenzofuran.

The liver is a target organ of dioxin exposure, with differences in severity in different type of dioxin (Rose 2010, Walker 2006). Chloracne is a commonly observed effect of dioxin exposure (Passarini 2010, Liu 2011). It is characterized by follicular hyperkeratosis on the face and neck that occurs both with and without cysts or pustules. It can also extend to the back, chest, upper arms, abdomen, and outer thighs. The chloracne can lead to disfiguration and lesions that can last over 30 years from initial onset. Lesions can heal and reappear over the lifetime of the person exposed to dioxin. Chloracne lesions have been observed in humans, cattle, rhesus monkeys, mice, and rabbits.

Human studies of chronic exposure to dioxin showed an increased incidence of cancer mortality and development of soft-tissue sarcoma after a long latency period. Animal studies of chronic oral exposure have shown an increased cancer incidence. Additional chronic effects observed in animal tests showed hepatic effects, developmental effects, behavioral effects, and immunological effects (Ruzzin 2010, Bock 2009, ATSDR 1999b).

Human and animal studies have shown that dioxins have an additive effect when administered simultaneously. This is important because several forms of dioxin can exist in one area, as at the Montana Pole Plant site. Dioxins also have an additive effect with chlorinated dibenzofurans, which are also known to occur in similar environments, as is the case in Butte. Several other compounds also have a synergistic effect when administered with TCDD, including oral retinoic acid, subcutaneous hydrocortisone, and subcutaneous benzo(a)pyrene (Taratini 2011, Murphy 2007, ATSDR 1999b).

Workers exposed to TCDD reported several neurological effects for up to 10 years following exposure, such as sensory impairment, peripheral neuropathy, orthostatic collapse, and symptoms of neurotoxicity, such as weakness in the lower limbs, lassitude, loss of appetite, headaches, increased perspiration, metal disorders, and muscular pain. Animal studies have shown that dioxins can be immunosuppressive. The administration of TCDD in animal tests induced thymic atrophy or weight changes in the thyroid. Bone marrow degeneration was observed in oral TCDD administration tests. Rodents exposed to intermediate duration of TCDD showed suppressed cell-mediated and humoral immunity. Several studies have shown reproductive and developmental effects in humans and animals after dioxin exposure. Both human and animal studies have shown that dioxin can cross the placental barrier and that it is excreted in milk (Alvarez-Pedrerol 2007, Carreira 2011, ATSDR 1999b).

The EPA drinking water standard for children is 1 nanogram of dioxin per liter of water per day. Long-term exposure limits for children's drinking water is set at no more than 0.01 ng/L per day. In adults, long-term drinking water exposure should not exceed 0.04 ng/L (ATSDR 1999b). The Food and Drug Administration recommends that fish and shellfish be consumed only if the dioxin level is less than 50 ppt. Because of this, 21 states have issued over 60 health advisories to restrict the consumption of fish and wildlife that contain elevated levels of dioxin (ATSDR 1999b).

Dioxin is typically filtered from drinking water in the United States, but persons that obtain drinking water from a well may be exposed to dioxin. The use of chlorinated pesticides and herbicides can also lead to dioxin exposure. Contact with soil, PCP treated wood, and transformer fluids that contain PCB can lead to dioxin exposure. Dioxin is present in higher levels in industrialized areas, ranging from 0.001 to 0.01 ppb, particularly near waste incineration sites. Wood burning and pesticide application can lead to high dioxin levels in rural areas. Cigarette smoke is an additional source of dioxin exposure. Second hand smoke can lead to dioxin exposure. Studies of lifetime alcohol consumption and dioxin interaction have shown a significant interaction and a greatly increased risk of TCDD absorption and retention. This would increase the risk to dioxin toxicity (ATSDR 1998). Dioxin is consistently present in blood and adipose tissue samples taken from non exposed individuals, indicating that it exists at background levels in the environment (ATSDR 1999b).

Occupational exposure to dioxin typically occurs through dermal contact and inhalation of contaminated air. Workers who handle chlorinated phenols, such as 2,4,5-

TCP and PCP, or chlorinated pesticides and herbicides, such as Silvex, hexaclorophene, 2,4-D and 2,4,5-T, have a much larger risk of exposure to dioxin. The wood products industry also has a potential for dioxin exposure. Workers who pressure treat wood with PCP or handle PCP wood products have elevated dioxin exposure levels. Pulp and paper mills also have elevated dioxin levels in chlorination processes. Waste incinerators, both municipal and hazardous, can have elevated dioxin exposure.

8.9 Chlorophenols

The following chlorophenols present at the Montana Pole Plant Superfund Site are considered as a group in this profile:

- 2,4,6-trichlorophenol
- 2,4-dichlorophenol
- 2,4-dinitrophenol
- 2-chlorophenol
- 4-chloro-3-methylphenol
- Pentachlorophenol.

The primary exposure route for chlorophenols is the oral route, particularly through the ingestion of drinking water from wells containing chlorophenols. Exposure can also occur through the dermal route when there is contact with treated wood or contaminated soils or through the inhalation route when chlorophenols are present in the air. The target organs are the liver and immune system (Michałowicz 2010, Limaye 2008) The International Agency for Research on Cancer (IARC) has determined that chlorophenols are possibly carcinogenic to humans. In addition to cancer and immune toxicity, exposure to pentachlorophenol can result in thyroid and reproductive system toxicity (Boas 2006, Orton 2009, Michałowicz 2010). There is little data regarding the interaction of chlorophenols with other chemical substances. Because chlorophenols are toxic to the liver, they could cause an increased toxic effect when administered with another compound that elicits liver toxicity (ATSDR 1999c).

8.10 Other

8.10.1 Asbestos

Asbestos is considered a human carcinogen by the EPA (U.S.EPA 1988). Asbestos toxicity is chiefly associated with the inhalation route of exposure. The lungs are the primary target organ in asbestos toxicity. Human studies have consistently shown an increased incidence of lung cancer, mesothelioma, and gastrointestinal cancer as a result of chronic exposure to asbestos (Heintz 2009, Toyokuni 2009, Pintos 2009, Clin 2009, U.S.EPA 1988). Asbestos is also associated with immunotoxicity (Klaassen 2001).

Asbestos and cigarette smoke can have a synergistic effect in lung toxicity, particularly lung cancer (Valavanidis 2009, Kamp 2009, ATSDR 2001c). The surface properties of asbestos fibers can influence toxicity. If there is iron on the surface of the fibers, interaction in the lung between the iron and oxygen can lead to the formation of hydrogen peroxide and hydroxyl radicals, which are associated with asbestos toxicity (Turci 2011, Klaassen 2001).

8.10.2 Nitrate

The vascular and hepatic systems are the target organs for nitrate toxicity (Camargo 2006, Klassen 2001). The chief route of exposure to nitrate is through drinking water (U.S.EPA 1991c). Nitrate is a vascular toxic agent that causes degeneration of the coronary arteries and is associated with repeated vasodilatation. The toxicity associated with nitrate is primarily a result of the conversion to nitrite, which is mediated by bacteria in the gastrointestinal system. This conversion can also occur in the stomach if gastric fluid is above pH 5. Adults with diseases such as achlorhydria or atrophic gastritis are at risk for this reaction. Infants also have an increased risk because their gastrointestinal systems normally have a high pH, which favors the growth of nitrate-reducing bacteria. Infants aged 0-3 months are the subpopulation most susceptible to nitrate-induced methemoglobinemia, or blue baby syndrome (Curseau 2011). This risk is much higher in infants who are exposed to bacteria-contaminated water because this tends to promote high concentrations of bacteria in the stomach and intestines. Nitrates can be antagonistic to PAH toxicity (ATSDR 1996).

8.11 Toxicology Findings

Based on the toxicity information provided above, several adverse health effects could occur in Butte as a result of environmental exposure to the chemicals of concern. Table 8-2 lists the adverse health effects associated with the chemical groups. The toxicity noted in this list includes adverse effects such as degeneration, mutation, necrosis, and cancer.

Table 8-2. Health Effects Associated with Butte Chemicals of Concern

Metals	**Polycyclic Aromatic Hydrocarbons (PAHs)**
Neurotoxicity	Immune toxicity
Circulatory toxicity	Vascular toxicity
Respiratory toxicity	Dermal toxicity
Hepatic toxicity	Gastrointestinal toxicity
Renal toxicity	Neoplasms
Gastrointestinal toxicity	**Dioxins/dibenxofurans**
Hematological toxicity	Neurotoxicity
Musculoskeletal toxicity	Renal toxicity
Dermal toxicity	Internal organ toxicity
Immune toxicity	Musculoskeletal toxicity
Endocrine disruption	Hematological toxicity
Neoplasms	Immune toxicity
Diabetes Mellitus	Endocrine disruption
Internal organ toxicity	Neoplasms
Genitourinary System	Genitourinary System
Chlorophenols	**Asbestos**
Hepatic toxicity	Respiratory toxicity
Leukemia	Gastrointestinal toxicity
Immune toxicity	Immune toxicity
Endocrine disruption	**Nitrates**
Neoplasms	Circulatory toxicity
Genitourinary System	Hepatic toxicity

By combining the health effects for each group of chemicals, the following list of target systems associated with toxicity from exposure to the chemicals of concern in Butte is produced:

- Circulatory System
- Digestive System
- Endocrine System
- Genitourinary System
- Musculoskeletal System
- Nervous System
- Respiratory System

Table 8-3 is a list of chemicals that elicit a synergistic or antagonistic response; all other interactions are assumed to be additive and are not listed. Additionally, the table contains lists of nutritional-element deficiencies that promote toxicity in other chemicals.

Table 8-3. Synergistic, Antagonistic, and Nutritional Deficiency Toxicity Reactions

Chemical	Synergistic chemicals	Antagonistic chemicals	Deficiency of the following chemicals can promote toxicity
Metals			
Aluminum		Calcium, Magnesium, Manganese, Silicon	
Arsenic	Lead, Ethanol, Trimethylselenonium Dimethyl Selenide	Selenium	
Boron	Calcium		
Cadmium	Cigarette smoke	Zinc, Selenium	Calcium, Protein, Vitamin D, Iron, Zinc
Chromium	Arsenic in red blood cells, kidney, liver, spleen, and the heart	Arsenic in lung	
Copper		Cadmium, Iron, Molybdenum, Tin, Zinc	
Iron		Copper, Zinc	
Lead	Arsenic, Cadmium, Manganese	Phosphorus, Copper, Zinc, Calcium, Iron	Calcium, Iron, Vitamin D
Lithium		Sodium, Potassium	
Manganese		Cadmium, high levels of calcium and phosphorus	Iron, Calcium
Mercury		Selenium	Zinc
Molybdenum			
Selenium	Silver	Arsenic, Cadmium, Copper, Lead, Mercury, Silver	
Silver	Selenium, Copper	Selenium	Selenium
Zinc		Calcium, Copper, Iron, Zinc	
Other			
Polycyclic Aromatic Hydrocarbon	PAHs, particulates, hematite particulate, arsenic trioxide	Selenium, Molybdenum, Nitrates	
Asbestos	Iron		

The toxicology of the chemicals of concern show the potential for toxicity and, consequently, elevated rates of a plethora or diseases in Butte. To see if the toxicology is an indicator of disease rates, the author undertook a study of mortality rates in Butte-Silver Bow.

8.12 Longitudinal Epidemiology Study Results

This is the first comprehensive public health study for the Butte area. It is the author's intention for this study to bring actual data to the environmental health arena in Butte. By understanding what the mortality rates are in Butte and how they compare to Montana and the United States, the community can make better informed decisions about its relationship with the environment and it priorities in the remediation and preservation of the landscape.

To compile and interpret the mortality statistics in Butte-Silver Bow County, this study developed standardized mortality ratios (SMR) for all diseases. The data were obtained from the Centers for Disease Control (CDC) WONDER database. The SMRs were developed by the following equation (Merrill 2008):

$$SMR = \text{Observed Mortality Rate} / \text{Expected Mortality Rate}$$

where the observed rate is the Butte mortality rate. The expected rate was determined by the following equation, also based on Merrill:

$$\text{Expected Mortality Rate} = \text{Observed Population} \times \text{Comparison Mortality Rate}$$

where the observed population is the population of Butte-Silver Bow County, and the comparison mortality rate is the national mortality rate or the State of Montana mortality rate, depending on which group is serving as the comparison group. Because there is a large amount of data, the results are summarized in tables in Appendix A. A brief, pared down sample set of this data is provided in this chapter in tables 8-4 to 8-11. The sample shows the SMRs for all diseases for the years 1999-2007 for the Butte compared to the United States dataset. These tables include the upper and lower 95% confidence intervals. As seen in tables 8-4 to 8-11, all SMR values fall between the lower and upper confidence intervals, indicating that they are statistically reasonable values. Because the results show a clear increase in mortality rates for all disease in both time periods the reader is sincerely encouraged to reference the appendix to gain an understanding of the gravity of the data. The SMR values greater than one are indicated in bold. In the 1999-2007 dataset, the SMR values greater than one are indicated in bold, and the rates that have increased compared to the 1978-1998 data are highlighted in yellow.

For brevity and because datasets with fewer than 20 data-points deaths are not considered statistically significant, the following tables were filtered to only show diseases with greater than 20 deaths. To obtain the best quality of data possible, the genders were combined in this data. By combining the groups, a larger number of cases (Observed N) was possible, making the data more statistically significant. This is an additional reason for grouping the years together. In a larger population, a year-by-year epidemiologic study might be possible, but because the Butte population is relatively small, a statistically sound study showing both genders for yearly data is not possible. For those interested in seeing a breakdown of gender in the same time groupings, Appendix B shows the SMRs for both genders with greater than 10 data-points. Caution should be taken with data, however, since many of the datasets have fewer than 20 data points and are not considered statistically significant. The diseases reported by CDC WONDER that have greater than 20 data points in Silver Bow County fall under the following classifications:

- Circulatory System
- Digestive System
- Endocrine System
- Genitourinary System
- Mental and Behavioral Disorders
- Musculoskeletal
- Neoplasm
- Nervous System
- Respiratory System

The SMR values that are greater than one, indicating that the mortality rate in Butte-Silver Bow is higher than Montana or the United States, are shown in bold. SMR values that increase from the 1979-1998 dataset, shown in Appendix A, are highlighted.

8.12.1 1999-2007, Butte Compared to the United States, Greater than 20 Data Points

Table 8-4. Diseases of the Circulatory System 1999-2007, Butte Compared to US

Cause of Death	SMR	Lower CI	Upper CI
Atherosclerotic heart disease	**1.76**	1.59	1.94
Acute myocardial infarction, unspecified	0.91	0.78	1.06
Stroke, not specified as hemorrhage or infarction	**1.83**	1.55	2.13
Atherosclerotic cardiovascular disease, so described	**2.15**	1.81	2.51
Congestive heart failure	**2.41**	2.02	2.84
Cardiomyopathy, unspecified	**2.15**	1.55	2.85
Essential (primary) hypertension	**2.55**	1.76	3.50
Endocarditis, valve unspecified	**4.97**	3.21	7.11
Intracerebral hemorrhage, unspecified	**1.42**	0.91	2.04
Atrial fibrillation and flutter	**1.83**	1.12	2.72

Table 8-5. Diseases of Digestive System 1999-2007, Butte Compared to US

Cause of Death	SMR	Lower CI	Upper CI
Other and unspecified cirrhosis of liver	**1.88**	1.24	2.66
Gastrointestinal hemorrhage, unspecified	**3.31**	2.16	4.71
Alcoholic cirrhosis of liver	**2.63**	1.65	3.84

Table 8-6. Diseases of Endocrine System 1999-2007, Butte Compared to US

Cause of Death	SMR	Lower CI	Upper CI
Unspecified diabetes mellitus, without complications	**1.80**	1.43	2.23

Table 8-7. Diseases of Genitourinary System 1999-2007, Butte Compared to US

Cause of Death	SMR	Lower CI	Upper CI
Unspecified renal failure	**1.19**	0.74	1.75
Urinary tract infection, site not specified	**2.26**	1.56	3.1

Table 8-8. Mental & Behavioral Disorders 1999-2007, Butte Compared to US

Cause of Death	SMR	Lower CI	Upper CI
Unspecified dementia	**1.26**	0.96	1.60

Table 8-9. Neoplasms 1999-2007, Butte Compared to US

Cause of Death	SMR	Lower CI	Upper CI
Bronchus or lung, unspecified	**1.53**	1.35	1.73
Colon, unspecified	**1.95**	1.57	2.38
Breast, unspecified	**1.30**	0.98	1.67
Pancreas, unspecified	**1.47**	1.08	1.92
Malignant neoplasm of prostate	**1.39**	1.01	1.84
Malignant neoplasm without specification of site	**1.20**	0.83	1.65
Bladder, unspecified	**2.05**	1.35	2.90
Esophagus, unspecified	**1.74**	1.10	2.52

Table 8-10. Diseases of the Nervous System 1999-2007, Butte Compared to US

Cause of Death	SMR	Lower CI	Upper CI
Alzheimer's Disease, unspecified	**1.72**	1.41	2.07
Parkinson's Disease	**1.16**	0.72	1.71
Multiple Sclerosis	**3.94**	2.09	6.37

Table 8-11. Diseases of the Respiratory System 1999-2007, Butte Compared to US

Cause of Death	SMR	Lower CI	Upper CI
Chronic obstructive pulmonary disease, unspecified	**2.67**	2.37	3.00
Pneumonia, unspecified	**1.23**	0.96	1.55
Emphysema, unspecified	**2.15**	1.48	2.94

8.13 Interpretation of Health Study Results

To interpret the SMR results, it is worth viewing the data as a complete set first. By viewing the dataset as a whole, it can be seen that the majority of the diseases have SMR values over one. This result is as important as the individual disease rates because it points to a systemic increased incidence of mortality for all causes in Butte-Silver Bow

County compared to both the State of Montana and the United States for both time periods. Clearly, there is an increased risk of mortality in Butte-Silver Bow County. As noted previously, causation cannot be proved, but correlation to the toxicity of the contaminants of concern will be examined in this section.

When compared to Montana rates, all of the diseases of the circulatory system, with the exception of congestive heart failure and unspecific causes, were greater than 1, indicating a higher rate of mortality for these causes in Silver Bow County than the State of Montana. The majority of the SMR values ranged between 1 and 2, with coronary atherosclerosis having double the State of Montana rate.

“Other” and “unspecified rheumatic heart disease” had an SMR value of 3.75. When compared to the national rates, all of the diseases, with the exception of congestive heart failure, unspecific causes, and unspecified cerebral artery occlusion were greater than 1. Generalized and unspecified atherosclerosis, pulmonary embolism and infarction, cerebral atherosclerosis, and unspecified heart failure had SMR values over double the national rate. “Other” and “unspecified rheumatic heart disease” had an SMR value of 6.14. Toxicology of arsenic shows an increased incidence of cardiovascular disease in cases of chronic exposure. Exposure to lead, mercury, and iron can cause cardiovascular toxicity.

The digestive system mortality rates were all greater than 1 when compared to Montana and national rates. Notably, colon, acute vascular insufficiency of intestine and cirrhosis of the liver without mention of alcohol were over 2 in the Montana and national comparisons. This is an important finding because arsenic toxicology indicates that arsenic exposure is correlated to liver toxicity, including cirrhosis. In the national comparison, hemorrhage of the gastrointestinal tract and unspecified intestinal obstruction were also over 2. From a cultural perspective, it is interesting to note that alcoholic cirrhosis of the liver is 1.02 when compared to Montana and 1.12 when compared to national, indicating a potential cultural influencing factor. Arsenic is also known to be toxic to the gastrointestinal system, as is chromium, lead, mercury, asbestos, and PAH compounds.

The only disease of the endocrine system with greater than 20 cases is diabetes mellitus, without mention of complication. Silver Bow County had a rate of 1.65 when compared to the Montana and 1.61 when compared to national, indicating a consistently higher rate of mortality from this cause. This is significant because toxicological information for arsenic shows a correlation between arsenic exposure and an increased risk of diabetes mellitus. Chronic exposure to elevated levels of iron is also correlated to diabetes mellitus.

The SMRs for the diseases of the genitourinary system differ slightly in the Montana and national comparisons. In the Montana comparison, urinary tract infection mortality occurs in Silver Bow County at 2.66 when compared to the Montana rate, but renal failure occurs at a rated that is less than the state rate, with an SMR of 0.98. In the national comparison, urinary tract infection mortality occurs in Silver Bow County at 1.48 times the national rate, and renal failure occurs at 1.01 times the national rate. This indicates that the State of Montana has a slightly higher incidence of renal failure, compared to the United States. Of the contaminants of concern, arsenic, cadmium, chromium, lead, mercury, and dioxins are associated with renal toxicity.

The mental and behavioral disorders pre-senile dementia and alcohol-dependence syndrome are both greater than 1 when compared to Montana and are 3.16 and 2.6, respectively, when compared to national. The elevated rates of alcohol-dependence syndrome indicate a cultural influencing factor, particularly considering the elevated alcoholic cirrhosis of the liver SMRs. Dementia can be associated with neurotoxicity. Aluminum toxicity has been correlated to dementia, and arsenic, lead, manganese, and mercury are known to be neurotoxic.

The SMR values for rheumatoid arthritis are significantly elevated in both the Montana (2.79) and national (5.16) comparisons. There is extensive research into causes for rheumatoid arthritis. Exposure to environmental toxins is suspected of triggering the activation of the immune system and causing the disease in susceptible individuals. As discussed in the metal toxicology section, there is correlation between metals exposure and rheumatoid arthritis. Infectious agents have been suspected, but there is no supporting evidence. It is suspected that rheumatoid arthritis could be hereditary and this is a broad topic of research. Tobacco use is also suspected to potentially play a role in causing rheumatoid arthritis.

All of the neoplasm (cancer) SMR values are greater than 1 in both the Montana and national comparisons, with the exception of unspecified stomach neoplasms. Neoplasms of the bronchus and lung, colon, breast (female), prostate, ovary, bladder, rectum, multiple myeloma, brain, esophagus, kidney, and skin had SMRs that ranged between 1 and 2, and larynx was 2.9 when compared to Montana and 2.62 when compared to national. Both chronic and acute neoplasms were greater than 1 in both comparisons, and chronic was 1.98 in the national comparison, indicating a significantly elevated rate of chronic neoplasms. This dataset shows an elevated incidence of cancer in Silver Bow County from the viewpoint of a state and national comparison. These findings are significant considering the known carcinogenic properties of arsenic, cadmium, chromium, PAH, dioxin, and asbestos. Specifically, bladder and skin cancer are known correlates to arsenic exposure.

For diseases of the nervous system, all SMR values are greater than 1 in both the Montana and national comparisons. Notably, multiple sclerosis had an SMR of 2.25 when compared to Montana and 4.35 when compared to national. Alzheimer's Disease and Motor Neuron Disease SMR values are both more than double the national rate.

These findings are significant because several of the contaminants of concern are known to be neurotoxic. Elevated exposure to aluminum has been correlated to an increased risk for Alzheimer's, ALS, and Parkinson's Disease (reported in this table as

Paralysis Agitans). Arsenic, lead, manganese, and mercury are also known to be neurotoxic. It is also an important finding considering previous toxicology studies showing correlations between Parkinson's Disease, Multiple Sclerosis, and ALS clusters in metal contaminated areas.

All of the disease of the respiratory system had SMR values greater than 1 in the Montana comparison. In the national comparison, all of the diseases had SMR values greater than 1, with the exception of bronchopneumonia, which had an SMR of 0.99. The asthma values are particularly interesting, having rates of 2.21 compared to Montana and 3.16 compared to the United States. Elevated exposure to chromium is known to have asthma as a potential toxic effect. Additionally, arsenic, boron, cadmium, and asbestos are also known to elicit pulmonary toxicity. The increased mortality rate for emphysema (1.19 Montana and 1.43 national) indicates a potential cultural influencing factor of tobacco use.

The 1999 to 2007 data contain mortality rates for the time in Butte associated with environmental reclamation throughout the city, particularly on the Butte Hill and Silver Bow Creek. The majority of these SMR values are also over one.

All of the diseases of the circulatory system have SMR values greater than 1 in the Montana comparison; in the national comparison, all but unspecified acute myocardial infarction were greater than 1. In the Montana comparison, cardiomyopathy and essential hypertension had values over 3, and atherosclerotic cardiovascular disease, atherosclerotic heart disease and endocarditis had SMR values greater than 2. In the national comparison, endocarditis had an SMR value of 4.97, and atherosclerotic cardiovascular disease, congestive heart failure, cardiomyopathy, and essential hypertension had SMR values over 2.

When comparing these rates to the 1978-1998 rates, the majority of the diseases showed a decreased SMR value. Congestive heart failure rates increased in both the state and national comparison, as did intracerebral hemorrhage in the national comparison. Atherosclerotic heart disease, atherosclerotic cardiovascular disease, and cerebral hemorrhage showed an increased rate in the Butte-to-Montana rate and congestive heart failure and intracerebral hemorrhage showed an increased rate in the Butte-to-national correlation.

All of the digestive system mortality rates were greater than 1 in when compared to Montana and National rates. Unspecified cirrhosis of the liver and gastrointestinal hemorrhage had values greater than twice the Montana rate, and gastrointestinal hemorrhage had an SMR value over three times the national rate. Alcoholic cirrhosis of the liver had a rate of 1.82 when compared to Montana and 2.63 when compared to national, indicating a potential cultural influencing factor. This is a particularly interesting finding because the values increased from the earlier dataset. It is also important to note that all of the SMRs for the diseases of the digestive system increased in the 1999-2007 data.

The only disease of the endocrine system with greater than 20 cases is diabetes mellitus, without mention of complication. Silver Bow County had a rate of 1.72 when compared to the Montana and 1.82 when compared to national. Both of these rates show a higher incidence in the 1999-2007 data.

Of the genitourinary system diseases, urinary tract infection mortality occurs in Silver Bow County greater than twice the Montana and national rates. Renal failure occurs at less than the Montana rate (0.96) but greater than the national rate (1.19). In both cases, the SMRs are higher in the 1999-2007 data.

Unspecified dementia is the only mental and behavioral disorder with greater than 20 cases in Silver Bow County. It occurred at a lower rate than the state of Montana (0.9) but at a higher rate than national (1.26). These results show a decrease in SMR values in the 1999-2007 data.

As with the 1979-1998 data, all of the neoplasm SMR values are greater than one, with the exception of malignant neoplasm without specification of site in the Montana comparison. In the national comparison this SMR is 2.05. In the Montana comparison, all of the neoplasms SMRs increased in the 1999-2007 dataset, with the exception of malignant neoplasm without specification of site. In the national comparison, bronchus or lung, colon, breast, prostate, and bladder neoplasm rates increased.

In the nervous system dataset, Alzheimer's Disease had an SMR greater than 1 in both the Montana and national comparisons, and the Parkinson's Disease SMRs were less than the Montana rate (0.97) but greater than the national rate (1.16). When investigating the nervous system mortality rates, the decision to include Multiple Sclerosis rates, despite there being fewer than 20 cases, stemmed from a community interest in the disease, as expressed in the medical community survey. When surveyed about health issues in Butte, several respondents noted an increased incidence or concern about an increased incidence of Multiple Sclerosis. Because the number of deaths is less than 20, caution should be taken when interpreting this result because it is not as statistically significant as a sample size that is greater than 20. The SMR for Multiple Sclerosis is 1.97 compared to the Montana rate and 3.94 times the national rate. All of the SMR values for neurological disease decreased in the 1999-2007 dataset.

All of the diseases of the respiratory system had SMR values greater than one in both the Montana and national comparisons. Of these, chronic obstructive pulmonary disease and emphysema showed increased mortality rates in both the Montana and national comparisons in the 1999-2007 dataset.

8.14 Correlation to Target Systems

As seen in the previous SMR tables, the mortality rates in Butte-Silver Bow County are greater than the Montana and national rates for disease in all of the target systems. Table 8-12 provides a visual interpretation of these results, with the addition of mental and behavioral disorders because they correlate to the nervous system and were reported by the CDC separately. The highlighted Xs indicate that the mortality rates increased from the 1979-1998 dataset.

Table 8-12. Standardized Mortality Rates

Target System	SMRs over 1 Butte Compared to Montana 1979-1998	SMRs over 1 Butte Compared to National 1979-1998	SMRs over 1 Butte Compared to Montana 1999-2007	SMRs over 1 Butte Compared to National 1999-2007
Cardiovascular	X	X	X	X
Digestive	X	X	X	X
Endocrine	X	X	X	X
Genitourinary	X	X	X	X
Mental & Behavioral	X	X		X
Musculoskeletal	X	X	Fewer than 20	Fewer than 20
Neoplasm	X	X	X	X
Nervous	X	X	X	X
Respiratory	X	X	X	X

8.15 Validity of Data

Appendix A contains the full set of data for the summarized results presented in section 8.12.1. These tables contain the number of observed mortality cases, expected number of cases, and the upper and lower 95% confidence intervals. Together, these values provide an indication of the validity of data. Because p values are correlated to sample size, in cases of small sample size such as this study, confidence intervals are a better indication of validity (Merrill 2008). Confidence intervals provide the range of reasonable values in which the population of data resides. In other words, the value of the SMR should fall between the lower and upper confidence interval to be considered a reasonable value. The tables in Appendix A show that this is the case for all of the data in this study.

8.16 Inference on the Efficacy of Remediation

The data are presented in two time periods primarily because that is the way they are reported by the CDC. To attain the highest sample size (and validity) possible for the Butte population, these two groups are looked at as a whole, rather than on a year-by-year or gender basis. This allows for an investigation into whether the rates change over time. This is an interesting opportunity because the second set of data occurs well after remediation began in earnest in Butte.

This dataset shows a decrease in mortality rates for mental and behavioral disorders, potentially correlating to the lead remediation program. It also shows a decrease in neurological disease rates. This could potentially correlate to the remediation of metals, including the neurotoxins arsenic, aluminum, lead, manganese, and mercury. It also showed a decrease in several cardiovascular diseases. It should be noted, however, that some of the cardiovascular diseases for the 1999-2007 data do not correlate because of the change in ICD coding by the CDC.

Unexpectedly, the dataset shows an increase in mortality rates for several diseases. All of the diseases of the digestive system in both the Montana and national comparisons show an increase in mortality rates. Diabetes mellitus also shows an increase in both cases. Unspecified renal failure shows an increase in both cases also, but in the comparison of the Butte rate to the Montana rate the SMR is less than one.

The neoplasm, or cancer, data is perhaps most interesting. In the Butte to Montana comparison, all cancer mortality rates increase, with the exception of "malignant neoplasm without specification of site." In the Butte to national comparison, pancreas, esophagus, and malignant neoplasm without specification of site mortality rates also decreased. All other rates increased. This would indicate that remediation activities have not had an impact on cancer mortality rates. This is important because several of the contaminants, including arsenic, cadmium, chromium, PAH, dioxin, and asbestos are carcinogenic. The 1999-2007 respiratory disease rates show a decrease in pneumonia mortality in both the state and national comparisons but show an increase in chronic obstructive pulmonary disease and emphysema.

Overall, these results show a potential positive impact for several diseases but do not indicate that remediation has had a positive impact on mortality rates. Table 8-13 contains a summary of findings in the longitudinal epidemiology study, based on the original study hypotheses.

Table 8-13. Longitudinal Study Questions and Hypotheses Accepted

Question	Hypotheses Accepted
1. What are the mortality rates in the Butte Superfund area, and how do they compare to Montana and the United States?	H_1: The majority of mortality rates in Butte are greater than Montana and the United States.
2. Do the two time periods have different mortality rates in Butte?	H_1: Mortality rates in Butte fluctuate over time.
3. Can remediation be correlated to a decrease in mortality rates?	Mortality rates in Butte both decrease and increase after remediation.
4. Is there a correlation between the target systems of concern in Butte and the cause of mortality?	H_1: Mortality rates in Butte do correlate with the target systems of concern.

8.17 Cultural Influencing Factors

There are several cultural influencing factors to consider as potential mechanisms of influence when interpreting the longitudinal epidemiology data. A Behavioral Risk Factor Surveillance system collected for the state of Montana showed that Butte-Silver Bow has a high rate of overweight people but a lower number of obese people and a higher number of smokers and heavy drinkers than the rest of the state (Butte-Silver Bow Health Department 2011a). These findings could correlate with elevated rates of diabetes mellitus and emphysema. However, Butte-Silver Bow has the same diabetes rate as the state of Montana.

The Behavioral Risk Factor System also reported that Butte has a higher rate of drug abuse, including alcohol, and this could correlate to the elevated rates of alcoholic cirrhosis of the liver. According to the Butte Community Needs Assessment, authored by the local hospital and Butte-Silver Bow Health Department, "The culture of alcohol abuse is well known among Butte citizens and the community's reputation throughout Montana as a hard drinking town is not without merit.…The DUI crime rate was 20% higher than the rate for Montana overall … perhaps the most alarming is that 35% of those convictions are repeat offenders" (Butte-Silver Bow Health Department 2011a).

In a further description of substance abuse, this needs assessment correlated substance abuse to the mining culture of Butte. "Butte-Silver Bow has a deeply rooted culture of substance abuse that presents a risk to public health. This culture must be understood within Butte's origins as a mining camp … its mining legacy lives on. For many, over eighty years of economic depression have resulted in multi-generational poverty that is highly entrenched and seemingly intractable. In addition, values and behaviors known to evolve in mining settlements continue to be woven into the social fabric of Butte, not the least of which is cultural acceptance of alcohol abuse" (Butte-Silver Bow Health Department 2011a).

A 2011 report from the State of Montana Department of Health and Human Services Addictive and Mental Disorders Division listed the number of clients in treatment in Butte-Silver Bow and statewide (Montana Department of health and Human Services 2011). There were 106 in treatment for alcohol addiction in Butte and 5,009 statewide. There were two in treatment for amphetamine in Butte and 51 statewide; there were three in treatment for cocaine/crack in Butte and 80 statewide. There were 29 in treatment for MDMA/ecstasy and 1,557 statewide, and there were 23 in treatment for methamphetamine and 569 statewide. There were 12 in treatment for other opiates or synthetics and 688 statewide (Montana Department of health and Human Services 2011). Overall, this does not paint the picture of Butte-Silver Bow as having a disproportionate amount of drug addiction.

In a table of key indicators of public health included in the Community Needs Assessment, which compared Butte-Silver Bow to Montana, there is a higher number of disabled persons in Butte Silver Bow. Importantly, there is a lower number of persons with health insurance (79.7% in Butte-Silver Bow and 84.65% in Montana). This could correlate to a lack of medical care and early diagnosis as well as potential for negative health effects.

Like the SMR data, the key indicators of the public health table also shows an increased incidence of asthma in Butte-Silver Bow (11% compared to 8.8% in Montana). While this is not a cultural influencing factor, it is important to restate the elevated incidence of this disease rate because there are also elevated mortality rates for this disease.

This study also shows a lower cancer incidence rate in Butte-Silver Bow (321.9 per 100,000) compared to Montana (455.5 per 100,000). This is an interesting finding because the majority of mortality rates for Butte-Silver Bow are higher than Montana rates. This could indicate a difference in aggressiveness of cancer, a difference in patient care, or a future decrease in Butte-Silver Bow cancer mortality rates.

There is a higher suicide rate in Butte than Montana but a lower motor vehicle unintentional death rate. Of these, Butte had a higher percentage of motor vehicle crashes that involve alcohol. One disturbing finding is the elevated non-motor vehicle unintentional death rate of 84.3 per 100,000 compared to six per 1000,000 in Montana. No explanation is given for this rate in the report. It is potentially related to Butte-Silver Bow having the highest crime rate of all of the major counties in Montana. There is also a potential correlation between lead exposure and violent crimes. As discussed in the toxicology section, lead exposure has been correlated to increased incidence of violent crime, including murder, juvenile delinquency, and antisocial behavior, including alcohol and drug use.

There is a perception that the majority of the population in Butte is geriatric. In fact 16.5% of the population are senior citizens, indicating that 83.5% are not elderly. The Butte-Silver Bow population average 41.6 years of age, which is higher than the Montana average of 36.7. This increase in age could correlate to an increased rate of geriatric disorders, such as Alzheimer’s disease.

“When we tug at a single thing in nature, we find it attached to the rest of the world.”
― John Muir

9.0 Summary and Conclusions

Butte is a small city in southwest Montana profoundly shaped by over a century of mining and smelting activities. These activities resulted in widespread environmental contamination and elevated health threats, as well as economic prosperity and cultural vitality. Today, Butte is a post-industrial city that is the focal point of America’s largest Superfund site as well as the nation’s largest National Historic District.

The environment, health, and culture are interconnected in Butte. Environmental issues such as contamination have social ramifications in the way the contamination affects the health, positions of power, economy, perception, and beliefs in the community. It also influences heritage issues in the spaces where the cultural landscape is threatened by change from environmental degradation or remediation. Cultural preservation can, in turn, influence this remediation or degradation and consequently have an impact on environmental and health issues. Environmental remediation is necessary to limit toxic exposure and health risks.

There are two types of remediation occurring in Butte: environmental and cultural. Environmental remediation occurs throughout the city, most notably at the operable units of the Butte Superfund sites. Contaminants of concern at the site include arsenic, cadmium, copper, iron, lead, manganese, mercury, sulfate, zinc, and others (U.S. EPA 2006a). A database developed for the remedial investigation report for the Butte Priority Soils Operable unit reports concentrations as high as 11,900 ppm arsenic; 56,100 ppm cadmium; 217,000 ppm copper; 67,100 lead; and 62,800 ppm zinc. This remediation does not restore the environment to its original state but instead reclaims it to a level of risk deemed acceptable by the EPA. Critics question whether these levels are protective of human health and the environment (Ray 2009).

Much like environmental remediation, cultural remediation is a practice where community members re-claim history, landscape, and community. This is seen in the Berkeley Pit Viewing Stand and garden; the historic mining landscape; re-creations of Columbia Gardens; the city council vote against relocation of the CBD; the historic overlay zone designation; Our Lady of the Rockies; the Granite Mountain Memorial; the World Museum of Mining; National Historic Landmark District work; conversion of the mine yards to parks, gardens, memorials, and community centers; illuminating gallows frames; festivals at former mine yards and in CBD; and the passage of an archives mill levy. The cultural values, ways of life, and landscape are not restored to some original state, which would be an act of restoration, but are reclaimed in a manner deemed acceptable to the community. In some instances, such as the An Ri Rah festival of Irish heritage, acts of cultural restoration do take place, such as Gaelic language classes. This mirrors the practice of environmental remediation, with selected areas of restoration occurring throughout the landscape.

To understand the current interrelationship between the environment, health, and culture in Butte, it is necessary to understand the cultural foundations. Butte is a mining town with a mining culture. Mining cultures are marked by a fuzzy set of characteristics, including physical and/or cultural isolation; pride in resilience, toughness, and craftsmanship; strong sense of community and kin networks; distrust of institutions, politics, and position of power; historic pride and romanticizing the past; and gender division. These cultural values are at the core of Butte's culture and heritage. Cultural isolation has led to subversive uses of heritage, as seen in conflicts between the perception of those inside and outside of the community. An example is the sense of place valued by the community and the judgment of the industrial landscape by outsiders. This is a function of societal discomfort with the price of industrialization and modern comforts and with a disruption of the pastoral ideal. It also stems from societal desire to perform environmental remediation in toxic landscapes and reduce health risks. This desire is seen both inside and outside the community. The conflict between this value and the value of the historic mining landscape shows the axis of variation in the Butte community. It also shows a variation in the cultural values regarding health issues. By ignoring the toxic aspects of the landscape, assuming all heritage is innately good, the authorized heritage discourse of historic preservation stifles community members that are concerned about health issues. This is very important considering the nature and extent of contamination, the toxicity of the contaminants of concern, and the elevated incidence and mortality rates described in this study.

Other aspects of mining culture, such as a distrust of institutions, politics, and positions of power, stemmed from and were reinforced by interactions with the mining company and government entities such as the EPA. There is little trust left in the community after years of labor disputes, lost neighborhoods, lost resources, lost livelihoods, and extensive contamination. This distrust also played out in health issues: from early smoke pollution correlating to extremely high levels of respiratory disease and the mining company's claims that the smoke did not cause harm, to current elevated mortality rates with no monitoring or reporting (until this study). The EPA and PRPs claim that that the remediation is adequate and the historic mining landscape does not pose a health risk. In meetings with the community group CTEC, the EPA was widely perceived as using the meetings as a platform to sell the community on its plans as faits accomplis, not a sincere effort to incorporate input from community members.

The condemnation of the mining landscape by outsiders can lead to cultural isolation and condemnation of the people living inside it, described as a "derelict land mentality" by Robertson. This was seen in Butte literature in the works of MacLane, Brinig, Atherton, and Dallas. The Community Needs Assessment (2001), for example, attributed alcoholism, drug abuse, poverty, blight, and violent crimes to the mining culture of Butte. While the mining culture does play a role in these negative aspects of the community, widespread pollution also is a source. Lead exposure, for instance, is correlated to increased incidence of violent crimes and drug abuse (Denno 1990, Needleman 2002, Dietrich 2001, Wright 2008, Stretesky 2001). Poverty is also a condition created by the mining economy and the nature of Superfund sites. It is difficult to attract new business or residents to a contaminated landscape, particularly if the landscape is not aesthetically appealing and is part of the largest Superfund site in the country. The majority of Butte residents who are below the poverty level live in the oldest part of town, which also contains the highest level of contamination (Butte-Silver Bow Health Department 2001).

There is a difference in the perception of the mining landscape between the internal and external viewpoint. As Robertson theorized, much of the perception from the external viewpoint represents the "mining imaginary," which represents boomtown nostalgia, dereliction, decay, and a sense that persons residing inside the landscape suffer from derelict land mentality. This sentiment is summed up perfectly by MacLane: "The entire herd is warped, distorted, barren, having lived in smoke cured Butte" (MacLane 1902). This condemnation of people and place serves as a means to devalue the industrial landscape as a home and community and promotes the authorized heritage discourse of American suburban aesthetics and pastoral ideals. The landscape serves as a constant physical reminder of heritage, family history, and community memory. The harsh landscape is a physical reflection of the cultural value of toughness, resilience, and historic pride.

Mining cultures also value resilience, toughness, strength, and craftsmanship. This value has ramifications in the health of the community and the environment. As seen in the "too tough to die" motto, people in mining cultures believe they possess the ability to overcome risks, both in mining work and in the toxic landscape. This belief was expressed in the Medical Community Survey and throughout Butte literature. Stories of resilience are a common theme in Butte literature. Characters overcome poverty, oppression, pollution, and poison and achieve love, wealth, friendship, and understanding. Narrators blend resilience with resignation and create an ideal mix of fortitude to endure the Butte landscape. In truth, people within a mining community respond to toxins the same as other members of the human race. This is seen in higher levels of respiratory illness during periods of intense air contamination and in the elevated incidence and mortality rates described throughout this study. This is also a form of romanticizing the past and remembering only certain parts of history. In the mythic stories of Butte's past, tuberculosis clinics and cancer rates are ignored and are replaced with stories of the largest producer of copper in the world. Hundreds of acres of mine waste are traded for Copper Kings, boomtown success, and the Columbia Gardens. A toxic pit lake is turned into a roadside attraction. The majority of Butte literature is set in this romanticized past, further encapsulating community memory and selecting the stories passed on to future generations.

The transition from underground mining to open pit mining proved devastating for the Butte community. Neighborhoods, historic structures, and the Columbia Gardens were destroyed, many by fire, during the expansion of the Berkeley Pit. Community members felt a deep sense of betrayal and loss during this time and eventually changed the power dynamic with the mining company, placing more value on cultural capital than on economic capital. Because the community is part of a culture that values strength, resilience, hard work, strong social ties, and the ability to overcome and thrive in harsh physical, economic, and emotional conditions, it was well suited to endure mine closure.

In changing the power dynamic, the community adopted a heritage discourse for uptown Butte. This is seen in the National Landmark District Listing, Historic Overlay Zone, Urban Revitalization Agency, and Regional Historic Preservation Plan. These designations, organizations, and plans show a community desire to preserve historic structures and community. By asserting these plans and designations, the community created an authorized heritage discourse of historic preservation over mining development and appointed historians and preservationists as community spokespeople.

The community authentication of heritage value came during a time of crisis. In 1982, the mining company announced it would close its Butte operations and devastated the local economy. This was a deep blow to Butte's mining town identity. The company left millions of cubic yards of toxic waste throughout the landscape, and the city did not have the financial, political, or technical means to remediate it. The following year, the EPA designated the Silver Bow Creek area a Superfund site and expanded the site to include the Butte area in 1987. These designations authenticated the extent and severity of contamination in Butte and reinforced the outsider view of the landscape as one of dereliction and decay. Residents continued viewing the landscape as their home and held a deep sense of place within the landscape. As with many cultural values, the conflict between the two viewpoints served as a means to enhance the cultural value.

Community and kin networks were vital to community survival. The construction of Our Lady of the Rockies showcased the extent and impact of these networks. This statue holds deep cultural meaning in Butte, and many attribute its placement on a mountain overlooking the town as the reason mining operations resumed two months later under a different company. It is also interesting to note that community members built the statue in response to a story of cancer survival. This sheds light on the statue's function as a testament to resilience and a talisman against health effects from the landscape.

The Superfund designation brought many heath issues to the surface in Butte. The authentication of the toxic nature of the landscape and the contaminants of concern, such as arsenic, left no room for doubt that there are potential health consequences to interaction with the environment. Just as the community once relied on the Anaconda Company for economic health, it relies on the EPA, DEQ, ARCO-BP, and the Butte-Silver Bow Health Department to determine whether the environment poses excessive health risks. The EPA is the chief source of this discourse because it is responsible for setting remedial action levels and is a main source of funding.

The EPA set the remedial action levels for the Butte operable units based on lead and arsenic risk assessments studies. They did not consider the other contaminants of concern, however, namely aluminum, cadmium, copper, iron, manganese, mercury, silver, and zinc. They also ignored synergistic, additive, and antagonistic toxicological interactions.

There are several troubling issues in the lead and arsenic risk assessment studies and the risk assessment process in general. First, Butte is categorized as an industrial area, when in fact it is a town of approximately 30,000, well within the U.S. Census bureau designation for a rural community. It is also important to note that much of the city is in a densely populated area. Second, the EPA did not perform an ecological risk assessment at the site. Third, the risk assessment studies were not intended to be used to set action levels, as the authors specified. Additional, these studies did not test chronic exposure impact; the tests lasted just 15 days and they looked at metal concentrations in internal organs, which are usually indicative of chronic exposure. The small sample sizes of the studies (all below 20) make the studies statistically insignificant, and there was a chronic problem with sample contamination and widespread variability in the data. Despite community questioning of the risk assessments and action levels, the EPA kept the action levels the same throughout remediation (CTEC 2004, CTEC 2005, CTEC 2008, CTEC 2010, Montana Standard 2011). This has created an authorized discourse of non-response to community input and has disenfranchised the community in environmental matters.

There are also portions of the community that accept the remedial action levels. This acceptance is often self-serving. To attract new businesses, retain home and business property values, and ensure community survival, the town needs to at least appear remediated and non-toxic. By rejecting notions of excessive risk associated with unremediated spaces that are promoted as tourist attractions, such as the Berkeley Pit and the historic mining landscape, community members exhibit the "too tough to die" mining culture value. This value isn't shared by all community members, however. Members of the Butte Restoration Alliance and CTEC showed intense concern for environmental health issues, and many were armed with the scientific education necessary to wade through the techno-speak of the remedial world. Members of the medical community also show concern for environmental health issues and believe the contamination has caused elevated disease rates. These groups are a part of the axis of variation complemented by the preservationists who do not want the landscape remediated. It is worth noting that preserving the historic mining landscape is the cheapest alternative for the EPA and ARCO-BP, and their support of the historic mining landscape option should be considered in this light.

Debate about risk levels and the consequences of leaving the landscape in this toxic state do not provide answers regarding health issues in the community, however. By remaining unaware of disease rates, the community and those in positions of power are left with only opinions. As a remedy, this study set out to investigate mortality rates in Butte and compare them to the state of Montana and the United States. It also investigated previous health studies performed in the area.

While there have been several historic studies of disease in the Butte area, previous studies focused on one type of disease, such as cancer or ALS, and generally focused on one limited time period. This did provide a background for the current longitudinal epidemiology study, however. The Riggan study of cancer rates and trends for the years 1950-1979 showed that Silver Bow County had significantly higher cancer rates than expected for all cancers, internal organs, soft tissue, and other systems, as well as secondary sites in the 1950-1979 data. This study shows clear negative health issues in the community, ranking Butte as having the eighth highest cancer rate in the country in 1950 and the 15th highest in 1960. These elevated rates are consistent over time, indicating a chronic cause, and are seen in both genders, indicating a source other than exposure in industrial mining work, which was performed almost exclusively by men.

A later study of elevated lung cancer rates in Butte-Silver Bow and Deer Lodge counties stated that these counties had twice the national rate of lung cancer incidence. A longitudinal epidemiology study of workers exposed to arsenic trioxide at the Anaconda Company's Washoe Smelter from 1925-1977 showed respiratory cancer mortality rates at levels ranging from two to nine times expected. These rates increased in direct proportion to the amount of exposure. This illustrates the bioavailability of the arsenic released from the Washoe smelter, which reached the Butte valley and is a large source of contaminated dust and aerial deposition. This is in sharp contrast to the EPA claim that the arsenic in Butte is not as bioavailable as typical arsenic compounds. The EPA used this claim to reduce bioavailability rates and increase the arsenic action levels allowed at residential, commercial, and industrial sites in Butte.

The National Cancer Institute showed elevated cancer incidence and mortality rates for Silver Bow County in the 2001-2005 reporting period. The elevated incidence rates included total cancer, bladder, kidney, renal, pelvis, leukemia, pulmonary, pancreas, prostate, and skin. The elevated mortality rates included total cancer, bladder, leukemia, pulmonary, pancreas, and prostate. This correlates to the elevated cancer mortality rates in the current health study.

A study of ALS rates in Butte showed an increased incidence ranging from 1.93 to 4.84 times the national rates, with incidence rates increasing dramatically over the 1943-1993 time-span. These are interesting data because it correlates to the elevated ALS mortality rates in the longitudinal epidemiology portion of the study.

This current longitudinal epidemiology study occurs in two time periods: 1978-1998 and 1999-2007. By analyzing mortality data in terms of standardized mortality rates for two distinct time periods, it was possible to see potential connections between mortality rates and environmental exposure to contaminants and see the public health effects of the widespread remediation occurring at the site. It also provided a mechanism to evaluate the efficacy of remediation in relation to the protection of human health.

This study asked several questions:

- What are the mortality rates in the Butte Superfund area, and how do they compare to Montana and the United States?
- Do the two time periods have different mortality rates in Butte?
- Can remediation be correlated to a decrease in mortality rates?
- Is there a correlation between the target organs of concern in Butte and the cause of mortality?

The clear health impacts from living in the Butte landscape are illuminated by principles of epidemiology. Environmental epidemiology studies focus on the difference in disease rates between comparison populations in an attempt to discover what effect the environment has on the health of the study population. This study compares the disease rates in Butte to the rates in Montana and the United States and determines whether the rates in Butte are less than, equal to, or greater than Montana and the United States. By using Montana as a comparison, rural healthcare issues, latitude, climate, elevation, and ethnicity can be discounted as reasons for elevated rates because these issues are similar throughout Montana. What is different is the contaminated environment and the culture. By comparing Butte to the United States, a broader population is given for comparison and the study is normalized for industrial impacts and nonagricultural cultures and landscapes seen throughout the US. The findings show that living in the Butte landscape leads to higher mortality rates for all diseases for both time periods and both comparison populations and that this difference is indicative of environmental contamination and cultural influencing factors.

To interpret the mortality study results, it is worth viewing the data as a complete set first. By viewing the dataset as a whole, it can be seen that the majority of the diseases in Butte have standardized mortality rates that are higher than one. This result is as important as the individual disease rates because it points to a systemic increased incidence of mortality for all causes in Butte-Silver Bow County, compared to both the State of Montana and the United States, for both time periods.

As noted previously, causation cannot be proved, but there is correlation to the toxicity of the contaminants of concern. Specifically, the toxicology of arsenic, lead, mercury, and iron show a correlation to cardiovascular toxicity. Arsenic exposure is also correlated to liver toxicity, including cirrhosis. There is a distinction in the mortality reporting between alcoholic and nonalcoholic cirrhosis; both have standardized mortality rates higher than Montana and the U.S. in both time periods. The increased incidence of alcoholic cirrhosis of the liver is presumably correlated to the cultural influencing factor of excessive alcohol use in Butte.

Arsenic and cadmium exposure are also known correlates for diabetes mellitus, another elevated mortality rate. There is correlation between metals exposure and rheumatoid arthritis, which has significantly elevated rates for all comparisons. The neoplasm, or cancer, rates are also significantly elevated for all comparisons. These findings are significant considering the carcinogenic properties of arsenic, cadmium, chromium, PAH, dioxin, and asbestos. Specifically, bladder and skin cancer are known correlates to arsenic exposure, and the mortality rates are elevated in Butte.

The majority of respiratory disease rates are also higher in Butte for all comparisons. Contaminants of concern that are correlates to pulmonary toxicity include arsenic, boron, cadmium, chromium, and asbestos. The increased incidence of emphysema indicates a cultural influencing factor of tobacco use.

Neurological diseases also correlate to metals exposure, and previous toxicology studies show correlations between Parkinson's Disease, Multiple Sclerosis, and ALS clusters in metal contaminated areas   All of the diseases of the nervous system have standardized mortality rate values over 1 in both the Montana and national comparisons in the 1979-1998 data. Notably, multiple sclerosis had a standardized mortality rate of 2.25, when compared to Montana and 4.35 when compared to national. Alzheimer's Disease and motor neuron disease standardized morality rates are both more than double the national rate. These findings are significant because several of the contaminants of concern are known to be neurotoxic. Elevated exposure to aluminum has been correlated to an increased risk for Alzheimer's Disease, ALS, and Parkinson's Disease.

The 199-2007 dataset shows a decrease in mortality rates for mental and behavioral disorders, potentially correlating to the lead remediation program. It also shows a decrease in neurological disease rates. This could potentially correlate to the remediation of metals, including the neurotoxins arsenic, aluminum, lead, manganese, and mercury. It also showed a decrease in several cardiovascular diseases. It should be noted, however, that some of the cardiovascular diseases for the 1999-2007 data do not correlate because of the change in ICD coding by the CDC.

Unexpectedly, the 1999-2007 dataset shows an increase in mortality rates for several diseases. All of the diseases of the digestive system in both the Montana and national comparisons show an increase in mortality rates. Diabetes mellitus also shows an increase in both cases. Unspecified renal failure shows an increase in both cases also, but in the Silver Bow County compared to Montana rate, it is under one.

The neoplasm, or cancer, data is perhaps most interesting. In the Silver Bow County to Montana comparison, all cancer mortality rates increase, with exception of "malignant neoplasm without specification of site." In the Silver Bow County to national comparison, pancreas, esophagus, and malignant neoplasm without specification of site mortality rates also decreased. All other rates increased. This would indicate that remediation activities have not had an impact on cancer mortality rates. This is important because several of the contaminants, including arsenic, cadmium, chromium, PAH, dioxin, and asbestos are carcinogenic.

This study showed that the majority of the mortality rates in Butte are greater than those in the state of Montana and United States rates and that mortality rates fluctuate over time. It also showed that mortality rates correlate with the target organs of concern, but it did not show a clear reduction in mortality rates after remediation. Several diseases, such as neurological disease, did decrease, and this potentially correlated to the extensive lead abatement program in the city. The results show remediation had a potential positive impact for several diseases but do not indicate that remediation has had a positive impact on mortality rates.

The health data must also be interpreted considering cultural influencing factors. The mining cultural values are the strongest cultural influencing factors in Butte health issues. As several of the respondents in the medical community survey reported, community members act as if they are too tough to be affected by health issues. This again echoes the "too tough to die" mining culture credo. This self-styled toughness and pride in resilience, coupled with a high percentage of people without health insurance, could lead to a lack of proper medical care and early diagnosis for treatment diseases.

Substance abuse, particularly alcohol abuse, is an important cultural influencing factor. Current and former residents romanticize the conception of Butte as a "wide open town." This throwback to the boomtown years of the city endures for several reasons. First, it is promoted in literature, tourism, histories, festivals, celebrations, and community memory. The signage directing tourist to Butte on Interstate I15, shown in Figure 9-1, states: "she still drinks her liquor straight." Clearly, this is a strongly embedded cultural marker that does not show signs of fading.

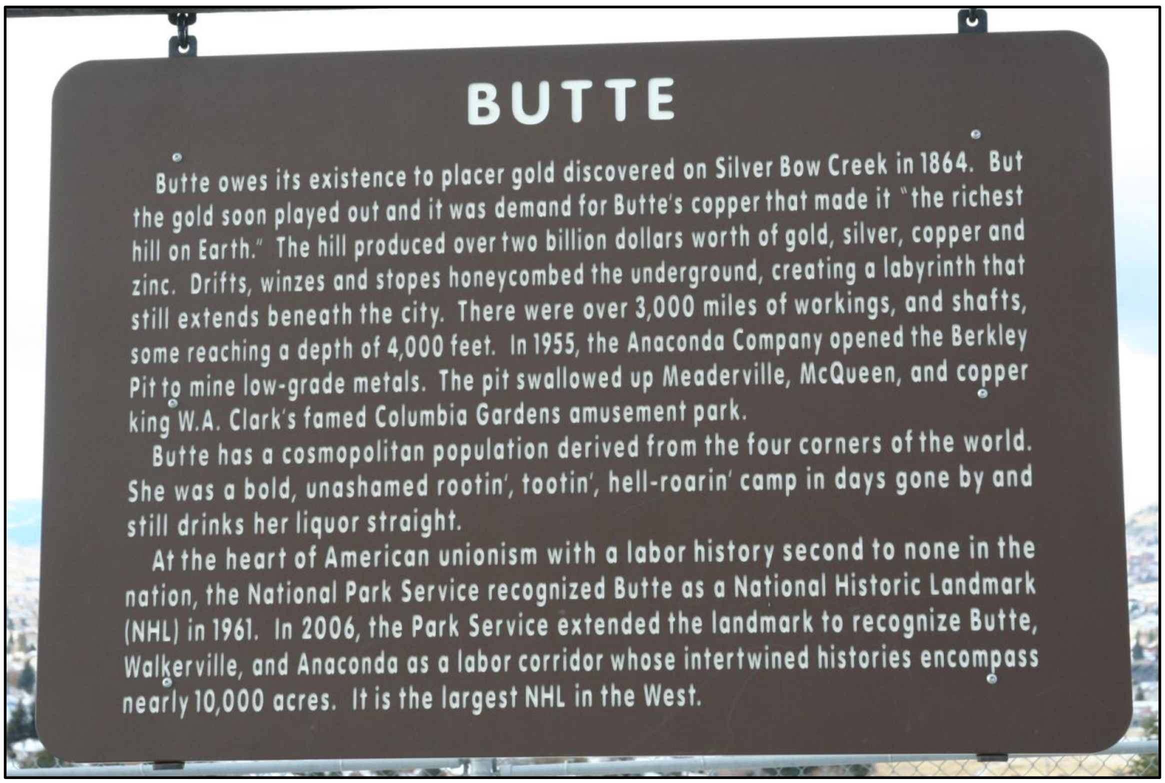

Figure 9-1. Signage on Interstate 15, Northeast of Butte (Photo by author)

Many respondents in the medical community survey also describe historic pride and romanticizing of the past as influencing factors of risk perception and interaction with the toxic landscape. By dismissing the discourse of health effects and toxicity in favor of historic pride, community members risk exposing themselves to elevated levels of contaminants and create a greater risk for health effects.

Ultimately, a balance between environmental remediation and cultural preservation that increases the overall health of the community is needed. There is no easy solution, but the community is attempting to find this balance in groups like the

Butte Restoration Alliance. Elevated mortality rates indicate that more extensive remediation is necessary. This could encroach on the historic mining landscape, but it would need not affect historic structures if the remediation follows the guidelines in the Historic Preservation Plan (1993). One potential remedy is a stronger focus and funding for remediation of residential structures and lands surrounding these structures. Programs such as the attic dust and yard remediation programs could be expanded and implemented throughout the community at more stringent remedial action levels.

Comparing the remediation, cultural, and mortality rate time-lines further illuminates some of the interactions of the environment, health, and culture. The city of Butte hired a historic preservation officer within a year of mine closure and Superfund designation. The preservation community quickly issued a Historic Park Plan and developed a historic inventory, Master Park Plan, and Historic Overlay Zone. By 1988, when the EPA began reclamation in Walkerville, the preservation community had completed an architectural and historical inventory of the National Landmark District. As remediation efforts intensified in the early 1990s, the preservation community responded with the Butte Historic Management Plan and the Regional Historic Preservation Plan.

Disease rates during this time were higher than those in the state of Montana and the United States for all disease groups. This indicates a clear community health issue, but until this study, this information was not made available to the public. This calls into question whether ignorance of health issues benefitted portions of the community in some way. This information is publically available, but a lack of knowledge allows a greater manipulation of risk assessment and exposure assumptions. By acknowledging greater than expected mortality rates, all members of the community must understand that there are health issues that should be addressed.

The Granite Mountain Memorial, built in 1996, is an example of a partnership between environmental remediation and historic preservation. EPA, ARCO-BP , and Butte-Silver Bow employed this tactic again at the Mountain Con Mine Yard, which will open in 2012. This shift shows the influence of the historic preservation community in environmental remediation, and it also shows an awareness by EPA and the PRPs of the ability to trade cultural items, such as the memorial and the Berkeley Pit garden, for large acreages of land that will not be remediated but labeled historic mining landscape. This is the cheapest remedial option and preservation community support of this option weighs heavily in EPA decisions.

The period from the later 1990s to the current time saw the start of the promotion of Butte are a "festival city." Festivals like the National and Montana Folk Festival base out of reclaimed mine yards and showcase historic structures in a nontoxic landscape. Residential remedial action began in this time period and complemented the extensive remediation of contaminated soils, streamside tailings, and storm water systems. The National Historic Landmark District designation of 2006 marked a major authentication of the historic significance of Butte, Anaconda, and Walkerville. This designation also authenticated the value of the historic mining landscape to the preservation community.

The majority of mortality rates during the 1999-2007 time period did not decrease, as one would expect to be the case. In fact, many mortality rates increased. This indicates environmental and cultural influences are fostering a health crisis in Butte. The extensive remediation is possibly not protective enough, and cultural values such as toughness, distrust of authority, and wide open town mythologies promote disease and interfere with proper medical care.

Beyond a balance between the historic preservation and environmental communities, the entire community must face what the mortality rates bring to the surface. It must process and treat this information with the care and respect the dead deserve. These numbers represent the death of parents, sisters, husbands, and children. If the community truly intends to survive, it must incorporate health values into the culture. It is part of community history, heritage, and memory to protect and defend its family and friends. By claiming this value, the community can transform the poison and create a resilient, enduring culture.

In a town that is startling in its uniqueness, surely there are discourses that can embrace culture, remediation, history, and health. Perhaps the town must dig deeper, into the sprawling world beneath the surface to find the connection between these veins. But they are there, shining like ore in the crosscuts and drifts; waiting. This would be a legacy fitting of Butte. A community rich in relations: always digging, and always bringing more connections to light.

10.0 Recommendations for Further Study

There are a multitude of studies that could be conducted in association with this dissertation. By lengthening the longitudinal epidemiology study to 1875, the approximate origin of Butte, the study would gain statistical strength and would show possible fluctuations in disease rates over time. An environmental health monitoring system that tracks disease incidence would also increase the understanding of public health and would provide a better mechanism to assess diseases such as asthma, which might not be listed as a primary cause of death but could be the result of an environmental agent. Additionally, health monitoring that tracks chronic exposure, such as hair or fingernail testing, would be a very effective way to assess chronic exposure. This type of testing would also provide results for all of the metals that are chemicals of concern. Currently, the blood-lead testing of children measures acute exposure and is the only health monitoring available to the community.

Because there is little characterization of the active mining area, an in-depth study of this area would be very informative. This could include environmental characterization, oral histories of current miners, former residents, and current residents of neighboring areas. A study of the Yankee Doodle Tailings Pond would also contribute greatly to the environmental history of Butte.

It would be worthwhile to compare Butte to other mining cities, looking at the environment, health, and culture to see whether similar cultural values are held and whether similar mortality rates occur. It would be interesting to compare mining communities in the Western United States, Appalachia, Pennsylvania, Oklahoma, with mining communities in Africa, China, Greece, Russia, South America, Australia, and Germany. This would provide a national and global perspective and would greatly add to the body of knowledge concerning mining community and culture. Finn's work *Tracing the Veins* (1998) is an example of a cultural comparison of Butte and its sister mining city Chuquicamata, and it would be interesting to look at disease rates in this sister city as a way to further explore community connections. Likewise, studies of disease rates in Dawdon, England, the location of Pattison's study of a mining culture, also would provide a deeper understanding of these connections. Because there is little literature, history, or cultural studies relating to mine closure, it would be worthwhile to investigate the effects of this phenomenon. This research could be conducted on a regional, national, and global platform.

It would also be worthwhile to compare the mining culture in Butte to an industrial city, such as Youngstown, Ohio, to see if there are cultural, environmental, and health similarities. This would help illuminate the impacts of industrialization and poverty on a city and would further define the role mining plays in cultural importance. Likewise, comparisons of mining communities to Third World nations, where the local economy is based on export by one corporation that does not leave wealth within that economy, would also be a worthwhile scholastic endeavor.

An investigation that expands the scope of this study to the entire Clark Fork River Basin could compare and contrast pollution extent, type, mortality rates, and cultural studies. This would further illuminate the connection between the environment, health, and culture in the Superfund area, and these results could be extrapolated to other contaminated areas worldwide. It would also be worthwhile to investigate other Superfund communities to look for correlations to the Butte community. From this, a foundation for the study of Superfund community culture, or Super Culture, could be formed.

A study of the poetics of mining would further illuminate the meaning and value of mining as well as the topic of environmental poetics as a whole. Additionally, the groundwork laid by the poetics of poison section in this dissertation could be used as a starting point for a broader investigation into the poetics of poison in all literature. The poetics of transformation and resilience sections could also serve as a jumping off spot for future studies of resilience and transformation.

A study of other forms of mining community artistic endeavors also could inform the cultural understanding of these communities. Appalachian folk music, for instance, contains many mining motifs and could be a wealth of information regarding community perceptions of the mining way of life. Likewise, Robert McManners' study of mining art in the great northern coalfields of England could prove a valuable starting place for an interpretation of paintings and visual interpretations of mining culture (McManners 2002).

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Appendix A. Health Data, Genders Combined, with Greater than 20 Data Points

BUTTE COMPARED TO MONTANA GREATER THAN 20 CASES, 1979-1998

Table A-1. Diseases of the Circulatory System 1979-1998, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Acute myocardial infarction	1114	620.9	**1.79**	1.69	1.90
Coronary atherosclerosis	664	331.05	**2.00**	1.86	2.16
Acute, but ill-defined, cerebrovascular disease	379	262.65	**1.44**	1.30	1.6
Chronic ischemic heart disease, unspecified	281	176.86	**1.59**	1.40	1.78
Cardiovascular disease, unspecified	199	136.57	**1.46**	1.26	1.67
Cardiac arrest	182	115.82	**1.57**	1.35	1.80
Generalized and unspecified atherosclerosis	145	79.22	**1.83**	1.54	2.14
Congestive heart failure	95	124.5	0.76	0.62	0.92
Other primary cardiomyopathies	58	33.16	**1.75**	1.33	2.23
Pulmonary embolism and infarction	56	29.73	**1.89**	1.42	2.41
Aortic valve disorders	54	27.37	**1.97**	1.48	2.53
Intracerebral hemorrhage	54	40.55	**1.3**	1.00	1.7
Cerebral thrombosis	44	28.01	**1.57**	1.14	2.07
Cerebral atherosclerosis	41	20.62	**1.99**	1.42	2.64
Heart failure, unspecified	31	29.38	**1.05**	0.72	1.46
Other and unspecified rheumatic heart diseases	29	7.73	**3.75**	2.51	5.24
Unspecified	28	33.52	0.83	0.55	1.17
Abdominal aneurysm, ruptured	27	22.17	**1.21**	0.80	1.72
Cerebral artery occlusion, unspecified	26	20.32	**1.28**	0.83	1.82
Unspecified	26	16.32	**1.59**	1.04	2.26
Other specified forms of chronic ischemic heart disease	23	19.21	**1.2**	0.76	1.74

Table A-2. Diseases of Digestive System 1979-1998, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Cirrhosis of liver without mention of alcohol	58	28.10	**2.06**	1.57	2.63
Hemorrhage of gastrointestinal tract, unspecified	37	20.28	**1.82**	1.28	2.46
Acute vascular insufficiency of intestine	32	15.64	**2.05**	1.40	2.82

Alcoholic cirrhosis of liver	26	25.39	**1.02**	0.67	1.46
Colon	23	8.94	**2.57**	1.63	3.73
Unspecified intestinal obstruction	21	11.30	**1.86**	1.15	2.74

Table A-3. Diseases of Endocrine System 1979-1998, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Diabetes mellitus without mention of complication	158	95.79	**1.65**	1.40	1.92

Table A-4. Diseases of Genitourinary System 1979-1998, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Urinary tract infection, site not specified	42	15.76	**2.66**	1.91	3.53
Renal failure, unspecified	32	32.43	0.98	0.67	1.35

Table A-5. Mental & Behavioral Disorders 1979-1998, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Presenile dementia	42	24.53	**1.71**	1.23	2.27
Alcohol dependence syndrome	35	19.55	**1.79**	1.25	2.43

Table A-6. Diseases of the Musculoskeletal System 1979-1998, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Rheumatoid arthritis	23	8.25	**2.79**	1.79	4.04

Table A-7. Neoplasms 1979-1998, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Bronchus and lung, unspecified	405	327.44	**1.24**	1.12	1.36
Colon, unspecified	174	110.49	**1.57**	1.35	1.82
Breast (female), unspecified	128	106.67	**1.20**	1.00	1.42
Malignant neoplasm of prostate	108	103.66	**1.04**	0.85	1.25
Pancreas, part unspecified	105	69.47	**1.51**	1.24	1.81
Other	99	82.74	**1.20**	0.97	1.44
Ovary	58	36.09	**1.61**	1.22	2.05
Other lymphomas	46	42.06	**1.09**	0.80	1.43
Bladder, part unspecified	44	32.56	**1.35**	0.98	1.78
Rectum	36	21.31	**1.69**	1.18	2.29
Multiple myeloma	33	23.84	**1.38**	0.95	1.90

Stomach, unspecified	32	32.39	0.99	0.68	1.36
Brain, unspecified	29	26.89	**1.08**	0.72	1.51
Esophagus, unspecified	27	21.44	**1.26**	0.83	1.78
Kidney, except pelvis	27	26.38	**1.02**	0.67	1.45
Larynx, unspecified	26	8.98	**2.90**	1.89	4.12
Melanoma of skin, site unspecified	23	16.97	**1.36**	0.86	1.97
Chronic	20	11.60	**1.72**	1.05	2.56
Acute	20	15.38	**1.30**	0.79	1.93

Table A-8. Diseases of the Nervous System 1979-1998, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Alzheimer's disease	95	55.80	**1.70**	1.38	2.06
Paralysis agitans	32	24.66	**1.30**	0.89	1.79
Motor neuron disease	24	12.42	**1.93**	1.24	2.78
Multiple sclerosis	22	9.79	**2.25**	1.41	3.28

Table A-9. Diseases of the Respiratory System 1979-1998, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Chronic airway obstruction, not elsewhere classified	395	247.06	**1.60**	1.45	1.76
Pneumonia, organism unspecified	241	165.95	**1.45**	1.27	1.64
Emphysema	63	53.14	**1.19**	0.91	1.50
Asthma, unspecified	39	17.66	**2.21**	1.57	2.96
Postinflammatory pulmonary fibrosis	27	18.86	**1.43**	0.94	2.02
Obstructive chronic bronchitis	22	9.97	**2.21**	1.38	3.23
Bronchopneumonia, organism unspecified	21	18.00	**1.17**	0.72	1.72

BUTTE COMPARED TO NATIONAL GREATER THAN 20 CASES, 1979-1998

Table A-10. Diseases of the Circulatory System 1979-1998, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Acute myocardial infarction	1114	720.01	**1.55**	1.46	1.64
Coronary atherosclerosis	664	494.13	**1.34**	1.24	1.45
Acute, but ill-defined, cerebrovascular disease	379	240.88	**1.57**	1.42	1.74
Chronic ischemic heart disease, unspecified	281	198.81	**1.41**	1.25	1.58
Cardiovascular disease, unspecified	199	200.87	0.99	0.86	1.13

Cardiac arrest	182	92.50	**1.97**	1.69	2.26
Generalized and unspecified atherosclerosis	145	57.70	**2.51**	2.12	2.94
Congestive heart failure	95	98.62	0.96	0.78	1.17
Other primary cardiomyopathies	58	51.02	**1.14**	0.86	1.45
Pulmonary embolism and infarction	56	27.77	**2.02**	1.52	2.58
Aortic valve disorders	54	21.92	**2.46**	1.85	3.16
Intracerebral hemorrhage	54	53.81	**1.00**	0.75	1.29
Cerebral thrombosis	44	32.48	**1.35**	0.98	1.78
Cerebral atherosclerosis	41	16.74	**2.45**	1.76	3.26
Heart failure, unspecified	31	12.95	**2.39**	1.63	3.31
Other and unspecified rheumatic heart diseases	29	4.72	**6.14**	4.11	8.58
Unspecified	28	63.76	0.44	0.29	0.62
Abdominal aneurysm, ruptured	27	18.15	**1.49**	0.98	2.10
Cerebral artery occlusion, unspecified	26	28.05	0.93	0.60	1.32
Unspecified	26	13.65	**1.90**	1.24	2.71
Other specified forms of chronic ischemic heart disease	23	32.31	0.71	0.45	1.03

Table A-11. Diseases of Digestive System 1979-1998, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Cirrhosis of liver without mention of alcohol	58	36.06	**1.61**	1.22	2.05
Hemorrhage of gastrointestinal tract, unspecified	37	16.39	**2.26**	1.59	3.04
Acute vascular insufficiency of intestine	32	12.44	**2.57**	1.76	3.54
Alcoholic cirrhosis of liver	26	23.14	**1.12**	0.73	1.60
Colon	23	8.75	**2.63**	1.66	3.81
Unspecified intestinal obstruction	21	8.30	**2.53**	1.56	3.73

Table A-12. Diseases of Endocrine System 1979-1998, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Diabetes mellitus without mention of complication	158	97.91	**1.61**	1.37	1.88

Table A-13. Diseases of Genitourinary System 1979-1998, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Urinary tract infection, site not specified	42	28.41	**1.48**	1.07	1.96
Renal failure, unspecified	32	31.78	**1.01**	0.69	1.39

Table A-14. Mental & Behavioral Disorders 1979-1998, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Presenile dementia	42	13.29	**3.16**	2.28	4.19
Alcohol dependence syndrome	35	13.49	**2.60**	1.81	3.53

Table A-15. Diseases of the Musculoskeletal System 1979-1998, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Rheumatoid arthritis	23	4.45	**5.16**	3.27	7.49

Table A-16. Neoplasms 1979-1998, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Bronchus and lung, unspecified	405	372.84	**1.09**	0.98	1.19
Colon, unspecified	174	123.27	**1.41**	1.21	1.63
Breast (female), unspecified	128	116.80	**1.10**	0.91	1.29
Malignant neoplasm of prostate	108	84.08	**1.28**	1.05	1.54
Pancreas, part unspecified	105	67.42	**1.56**	1.27	1.87
Other	99	83.40	**1.19**	0.96	1.43
Ovary	58	34.88	**1.66**	1.26	2.12
Other lymphomas	46	41.66	**1.10**	0.81	1.45
Bladder, part unspecified	44	29.61	**1.49**	1.08	1.96
Rectum	36	18.76	**1.92**	1.34	2.60
Multiple myeloma	33	24.30	**1.36**	0.93	1.86
Stomach, unspecified	32	38.06	0.84	0.57	1.16
Brain, unspecified	29	26.38	**1.10**	0.74	1.54
Esophagus, unspecified	27	26.84	**1.01**	0.66	1.42
Kidney, except pelvis	27	26.74	**1.01**	0.66	1.43
Larynx, unspecified	26	9.91	**2.62**	1.71	3.73
Melanoma of skin, site unspecified	23	15.33	**1.50**	0.95	2.18
Chronic	20	10.12	**1.98**	1.20	2.94
Acute	20	15.15	**1.32**	0.80	1.96

Table A-17. Diseases of the Nervous System 1979-1998, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Alzheimer's disease	95	33.86	**2.81**	2.27	3.40
Paralysis agitans	32	20.73	**1.54**	1.06	2.12
Motor neuron disease	24	9.91	**2.42**	1.55	3.49
Multiple sclerosis	22	5.05	**4.35**	2.72	6.36

Table A-18. Diseases of the Respiratory System 1979-1998, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Chronic airway obstruction, not elsewhere classified	395	168.21	**2.35**	2.12	2.59
Pneumonia, organism unspecified	241	159.75	**1.51**	1.32	1.71
Emphysema	63	43.94	**1.43**	1.10	1.81
Asthma, unspecified	39	12.34	**3.16**	2.25	4.23
Postinflammatory pulmonary fibrosis	27	14.77	**1.83**	1.20	2.58
Obstructive chronic bronchitis	22	6.12	**3.59**	2.25	5.25
Bronchopneumonia, organism unspecified	21	21.26	0.99	0.61	1.46

BUTTE COMPARED TO NATIONAL GREATER THAN 20 CASES, 1999-2007

Table A-19. Diseases of the Circulatory System 1999-2007, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Atherosclerotic heart disease	380	165.69	**2.29**	2.07	2.53
Acute myocardial infarction, unspecified	158	140.74	**1.12**	0.95	1.30
Stroke, not specified as hemorrhage or infarction	154	99.28	**1.55**	1.32	1.81
Atherosclerotic cardiovascular disease, so described	146	50.00	**2.92**	2.47	3.41
Congestive heart failure	132	90.85	**1.45**	1.22	1.71
Cardiomyopathy, unspecified	42	12.67	**3.31**	2.39	4.39
Essential (primary) hypertension	33	10.57	**3.12**	2.15	4.28
Endocarditis, valve unspecified	25	9.52	**2.63**	1.70	3.76
Intracerebral hemorrhage, unspecified	24	17.60	**1.36**	0.87	1.96
Atrial fibrillation and flutter	20	14.88	**1.34**	0.82	2.00

Table A-20. Diseases of Digestive System 1999-2007, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Other and unspecified cirrhosis of liver	27.00	12.38	**2.18**	1.44	3.08
Gastrointestinal hemorrhage, unspecified	26.00	11.41	**2.28**	1.49	3.24
Alcoholic cirrhosis of liver	22.00	12.06	**1.82**	1.14	2.67

Table A-21. Diseases of Endocrine System 1999-2007, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Unspecified diabetes mellitus, without complications	78.00	45.33	**1.72**	1.36	2.12

Table A-22. Diseases of Genitourinary System 1999-2007, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Unspecified renal failure	21.00	21.91	0.96	0.59	1.41
Urinary tract infection, site not specified	33.00	12.20	**2.70**	1.86	3.71

Table A-23. Mental & Behavioral Disorders 1999-2007, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Unspecified dementia	61	67.602	0.90	0.69	1.14

Table A-24. Neoplasms 1999-2007, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Bronchus or lung, unspecified	247.00	172.06	**1.44**	1.26	1.62
Colon, unspecified	90.00	46.71	**1.93**	1.55	2.35
Breast, unspecified	56.00	41.86	**1.34**	1.01	1.71
Pancreas, unspecified	47.00	33.60	**1.40**	1.03	1.83
Malignant neoplasm of prostate	43.00	39.21	**1.10**	0.79	1.45
Malignant neoplasm without specification of site	33.00	34.54	0.96	0.66	1.31
Bladder, unspecified	27.00	15.71	**1.72**	1.13	2.43
Esophagus, unspecified	23.00	16.04	**1.43**	0.91	2.08

Table A-25. Diseases of the Nervous System 1999-2007, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Alzheimer's disease, unspecified	106	76.04	**1.39**	1.141	1.67
Parkinson's disease	21	21.62	0.97	0.600	1.43

Multiple sclerosis	13	6.59	**1.97**	1.046	3.19

Table A-26. Diseases of the Respiratory System 1999-2007, Butte Compared to MT

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Chronic obstructive pulmonary disease, unspecified	277.00	153.42	**1.81**	1.60	2.02
Pneumonia, unspecified	67.00	59.13	**1.13**	0.88	1.42
Emphysema, unspecified	33.00	21.33	**1.55**	1.06	2.12

BUTTE COMPARED TO NATIONAL GREATER THAN 20 CASES, 1999-2007

Table A-27. Diseases of the Circulatory System 1999-2007, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Atherosclerotic heart disease	380	215.99	**1.76**	1.59	1.94
Acute myocardial infarction, unspecified	158	173.00	0.91	0.78	1.06
Stroke, not specified as hemorrhage or infarction	154	84.28	**1.83**	1.55	2.13
Atherosclerotic cardiovascular disease, so described	146	67.92	**2.15**	1.81	2.51
Congestive heart failure	132	54.80	**2.41**	2.02	2.84
Cardiomyopathy, unspecified	42	19.56	**2.15**	1.55	2.85
Essential (primary) hypertension	33	12.93	**2.55**	1.76	3.50
Endocarditis, valve unspecified	25	5.03	**4.97**	3.21	7.11
Intracerebral hemorrhage, unspecified	24	16.96	**1.42**	0.91	2.04
Atrial fibrillation and flutter	20	10.94	**1.83**	1.12	2.72

Table A-28. Diseases of Digestive System 1999-2007, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Other and unspecified cirrhosis of liver	27	14.35	**1.88**	1.24	2.66
Gastrointestinal hemorrhage, unspecified	26	7.84	**3.31**	2.16	4.71
Alcoholic cirrhosis of liver	22	8.36	**2.63**	1.65	3.84

Table A-29. Diseases of Endocrine System 1999-2007, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Unspecified diabetes mellitus, without complications	78	43.26	**1.80**	1.43	2.23

Table A-30. Diseases of Genitourinary System 1999-2007, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Unspecified renal failure	21	17.65	**1.19**	0.74	1.75
Urinary tract infection, site not specified	33	14.60	**2.26**	1.56	3.1

Table A-31. Mental & Behavioral Disorders 1999-2007, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Unspecified dementia	61	48.35	1.26	0.96	1.60

Table A-32. Neoplasms 1999-2007, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Bronchus or lung, unspecified	247	161.31	**1.53**	1.35	1.73
Colon, unspecified	90	46.09	**1.95**	1.57	2.38
Breast, unspecified	56	43.00	**1.30**	0.98	1.67
Pancreas, unspecified	47	32.00	**1.47**	1.08	1.92
Malignant neoplasm of prostate	43	30.88	**1.39**	1.01	1.84
Malignant neoplasm without specification of site	33	27.46	**1.20**	0.83	1.65
Bladder, unspecified	27	13.16	**2.05**	1.35	2.90
Esophagus, unspecified	23	13.23	**1.74**	1.10	2.52

Table A-33. Diseases of the Nervous System 1999-2007, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Alzheimer's disease, unspecified	106	61.56	**1.72**	1.41	2.07
Parkinson's disease	21	18.14	**1.16**	0.72	1.71
Multiple sclerosis	13	3.30	**3.94**	2.09	6.37

Table A-34. Diseases of the Respiratory System 1999-2007, Butte Compared to US

Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Chronic obstructive pulmonary disease, unspecified	277	103.61	**2.67**	2.37	3.00
Pneumonia, unspecified	67	54.27	**1.23**	0.96	1.55
Emphysema, unspecified	33	15.37	**2.15**	1.48	2.94

Appendix B. Health Data for Both Genders with Greater than 10 Data Points

BUTTE COMPARED TO MONTANA

Table B-1. Diseases of the Circulatory System 1979-1998, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Acute myocardial infarction	Male	685	379.90	1.80	1.67	1.94
Acute myocardial infarction	Female	429	239.00	1.80	1.63	1.97
Coronary atherosclerosis	Female	381	162.93	2.34	2.11	2.58
Coronary atherosclerosis	Male	283	167.97	1.68	1.49	1.89
Acute, but ill-defined, cerebrovascular disease	Female	248	160.58	1.54	1.36	1.74
Chronic ischemic heart disease, unspecified	Male	141	102.51	1.38	1.16	1.61
Chronic ischemic heart disease, unspecified	Female	140	73.94	1.89	1.59	2.22
Acute, but ill-defined, cerebrovascular disease	Male	131	102.77	1.27	1.07	1.50
Cardiovascular disease, unspecified	Female	110	68.67	1.60	1.32	1.92
Generalized and unspecified atherosclerosis	Female	95	45.12725	2.11	1.70	2.55
Cardiac arrest	Male	94	63.68	1.48	1.19	1.79
Cardiovascular disease, unspecified	Male	89	67.87	1.31	1.05	1.60
Cardiac arrest	Female	88	51.96	1.69	1.36	2.07
Congestive heart failure	Female	57	72.5	0.79	0.60	1.00
Generalized and unspecified atherosclerosis	Male	50	34.21	1.46	1.08	1.89
Congestive heart failure	Male	38	52.23	0.73	0.51	0.98
Cerebral atherosclerosis	Female	33	13.49	2.45	1.68	3.35
Pulmonary embolism and infarction	Female	29	15.36	1.89	1.26	2.64
Other primary cardiomyopathies	Female	29	12.62	2.30	1.54	3.21
Intracerebral hemorrhage	Female	29	21.93	1.32	0.88	1.85
Other primary cardiomyopathies	Male	29	20.43	1.42	0.95	1.98
Cerebral thrombosis	Female	28	18.36	1.52	1.01	2.14
Aortic valve disorders	Male	28	12.85	2.18	1.45	3.06
Pulmonary embolism and	Male	27	14.37	1.88	1.24	2.65

infarction						
Aortic valve disorders	Female	26	14.53	1.79	1.17	2.54
Intracerebral hemorrhage	Male	25	18.65	1.34	0.87	1.92
Other and unspecified rheumatic heart diseases	Female	22	5.78	3.80	2.38	5.56
Unspecified	Female	19	21.72	0.87	0.53	1.31
Heart failure, unspecified	Female	19	13.36	1.42	0.85	2.13
Abdominal aneurysm, ruptured	Male	18	15.81	1.14	0.67	1.72
Cerebral artery occlusion, unspecified	Female	16	12.14	1.32	0.75	2.04
Unspecified	Female	16	9.57	1.67	0.95	2.59
Cerebral thrombosis	Male	16	9.75	1.64	0.94	2.54
Other specified forms of chronic ischemic heart disease	Male	15	11.87	1.26	0.71	1.98
Heart disease, unspecified	Male	14	7.93	1.77	0.96	2.81
Unspecified	Female	12	5.74	2.09	1.07	3.44
Late effects of cerebrovascular disease	Female	12	11.92	1.01	0.52	1.66
Heart failure, unspecified	Male	12	15.98	0.75	0.39	1.24
Atrial fibrillation and flutter	Female	11	8.44	1.30	0.65	2.19
Subarachnoid hemorrhage	Female	11	13.01	0.85	0.42	1.42
Other and unspecified mitral valve diseases	Female	10	4.74	2.11	1.00	3.62
Cerebral artery occlusion, unspecified	Male	10	8.22	1.22	0.58	2.09
Unspecified	Male	10	6.78	1.47	0.70	2.53
Endocarditis, valve unspecified	Female	9	7.00	1.28	0.58	2.26

Table B-2. Diseases of Digestive System1979-1998, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Cirrhosis of liver without mention of alcohol	Male	37	15.86	2.33	1.64	3.15
Cirrhosis of liver without mention of alcohol	Female	21	12.18	1.72	1.07	2.54
Acute vascular insufficiency of intestine	Female	19	9.97	1.91	1.15	2.86
Hemorrhage of gastrointestinal tract,	Female	19	11.10	1.71	1.03	2.57

unspecified						
Hemorrhage of gastrointestinal tract, unspecified	Male	18	9.20	1.96	1.16	2.96
Unspecified intestinal obstruction	Female	16	7.96	2.01	1.15	3.11
Colon	Female	16	5.87	2.72	1.55	4.22
Alcoholic cirrhosis of liver	Female	15	9.18	1.63	0.91	2.56
Acute vascular insufficiency of intestine	Male	13	5.72	2.27	1.20	3.67
Alcoholic cirrhosis of liver	Male	11	16.11	0.68	0.34	1.15

Table B-3. Diseases of Endocrine System1979-1998, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Diabetes mellitus without mention of complication	Female	93	54.70	1.70	1.37	2.06
Diabetes mellitus without mention of complication	Male	65	41.25	1.58	1.22	1.98

Table B-4. Diseases of Genitourinary System1979-1998, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Urinary tract infection, site not specified	Female	22	9.53	2.31	1.44	3.37
Urinary tract infection, site not specified	Male	20	6.27	3.19	1.94	4.74
Renal failure, unspecified	Male	19	17.17	1.11	0.66	1.66
Renal failure, unspecified	Female	13	15.23	0.85	0.45	1.38

Table B-5. Mental & Behavioral Disorders 1979-1998, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Presenile dementia	Female	31	17.36	1.79	1.21	2.47
Alcohol dependence syndrome	Male	26	14.20	1.83	1.19	2.60
Unspecified psychosis	Female	11	13.40	0.82	0.41	1.38

Presenile dementia	Male	11	7.29	1.51	0.75	2.53

Table B-6. Diseases of the Musculoskeletal System 1979-1998, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Rheumatoid arthritis	Female	13	5.87	2.21	1.17	3.58
Rheumatoid arthritis	Male	10	2.42	4.14	1.97	7.10

Table B-7. Neoplasms 1979-1998, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Bronchus and lung, unspecified	Male	257	206.59	1.24	1.10	1.40
Bronchus and lung, unspecified	Female	148	119.63	1.24	1.05	1.44
Breast (female), unspecified	Female	128	108.05	1.18	0.99	1.40
Malignant neoplasm of prostate	Male	108	102.30	1.06	0.87	1.26
Colon, unspecified	Female	97	54.09	1.79	1.45	2.17
Colon, unspecified	Male	77	56.34	1.37	1.08	1.69
Ovary	Female	58	36.55	1.59	1.20	2.02
Other	Male	56	43.29	1.29	0.98	1.65
Pancreas, part unspecified	Female	53	35.64	1.49	1.11	1.91
Pancreas, part unspecified	Male	52	33.83	1.54	1.15	1.98
Other	Female	43	39.38	1.09	0.79	1.44
Bladder, part unspecified	Male	30	23.19	1.29	0.87	1.80
Other lymphomas	Male	27	22.13	1.22	0.80	1.72
Stomach, unspecified	Male	20	19.76	1.01	0.62	1.50
Rectum	Male	20	12.25	1.63	1.00	2.43
Malignant neoplasm of uterus, part unspecified	Female	19	8.83	2.15	1.29	3.23
Other lymphomas	Female	19	19.89	0.96	0.57	1.43
Larynx, unspecified	Male	18	7.16	2.51	1.49	3.81
Multiple myeloma	Male	18	13.31	1.35	0.80	2.05
Esophagus, unspecified	Male	17	16.20	1.05	0.61	1.61

Rectum	Female	16	9.01	1.78	1.01	2.75
Melanoma of skin, site unspecified	Male	16	9.79	1.63	0.93	2.53
Brain, unspecified	Male	16	15.73	1.02	0.58	1.58
Kidney, except pelvis	Female	15	9.14	1.64	0.92	2.58
Multiple myeloma	Female	15	10.49	1.43	0.80	2.25
Female genital organ, site unspecified	Female	14	0.22	64.34	35.05	102.46
Brain, unspecified	Female	13	11.10	1.17	0.62	1.89
Upper lobe, bronchus or lung	Male	13	4.07	3.19	1.69	5.17
Stomach, unspecified	Female	12	12.53	0.96	0.49	1.58
Cervix uteri, unspecified	Female	12	11.14	1.08	0.55	1.77
Liver, primary	Male	12	5.77	2.08	1.07	3.43
Kidney, except pelvis	Male	12	17.13	0.70	0.36	1.15
Chronic	Male	12	7.08	1.69	0.87	2.79
Acute	Male	12	7.80	1.54	0.79	2.53
Sigmoid colon	Male	11	2.46	4.47	2.22	7.51
Esophagus, unspecified	Female	10	5.09	1.96	0.94	3.37

Table B-8. Diseases of the Nervous System 1979-1998, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Alzheimer's disease	Female	58	36.47	1.59	1.21	2.03
Alzheimer's disease	Male	37	19.54	1.89	1.33	2.55
Paralysis agitans	Male	18	13.14	1.37	0.81	2.08
Multiple sclerosis	Female	16	6.14	2.61	1.49	4.04
Paralysis agitans	Female	14	11.49	1.22	0.66	1.94
Motor neuron disease	Female	13	5.83	2.23	1.18	3.61
Motor neuron disease	Male	11	6.57	1.67	0.83	2.81
Anoxic brain damage	Male	7	1.91	3.67	1.45	6.89
Multiple sclerosis	Male	6	3.69	1.63	0.59	3.19

Table B-9. Diseases of the Respiratory System 1979-1998, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Chronic airway obstruction, not	Male	208	148.00	1.41	1.22	1.60

elsewhere classified						
Chronic airway obstruction, not elsewhere classified	Female	187	98.35	1.90	1.64	2.18
Pneumonia, organism unspecified	Female	128	84.03	1.52	1.27	1.80
Pneumonia, organism unspecified	Male	113	81.91	1.38	1.14	1.65
Emphysema	Male	46	33.49	1.37	1.01	1.80
Asthma, unspecified	Female	23	9.88	2.33	1.47	3.38
Emphysema	Female	17	19.45	0.87	0.51	1.34
Asthma, unspecified	Male	16	7.80	2.05	1.17	3.18
Pneumoconiosis due to other silica or silicates	Male	16	1.02	15.73	8.96	24.37
Postinflammatory pulmonary fibrosis	Male	16	10.90	1.47	0.84	2.28
Obstructive chronic bronchitis	Female	12	3.57	3.36	1.73	5.53
Pneumonia due to other specified organism	Male	12	0.04	283.05	145.55	465.85
Postinflammatory pulmonary fibrosis	Female	11	7.92	1.39	0.69	2.33
Obstructive chronic bronchitis	Male	10	6.36	1.57	0.75	2.70

<u>BUTTE COMPARED TO NATIONAL</u>

Table B-10. Diseases of the Circulatory System 1979-1998, Butte Compared to National

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Acute myocardial infarction	Male	685	404.04	1.70	1.57	1.82
Acute myocardial infarction	Female	429	316.58	1.36	1.23	1.49
Coronary atherosclerosis	Female	381	263.77	1.44	1.30	1.59
Coronary atherosclerosis	Male	283	230.22	1.23	1.09	1.38
Acute, but ill-defined, cerebrovascular disease	Female	248	146.53	1.69	1.49	1.91
Chronic ischemic	Male	141	109.00	1.29	1.09	1.52

heart disease, unspecified						
Chronic ischemic heart disease, unspecified	Female	140	89.94	1.56	1.31	1.83
Acute, but ill-defined, cerebrovascular disease	Male	131	94.07	1.39	1.16	1.64
Cardiovascular disease, unspecified	Female	110	101.87	1.08	0.89	1.29
Generalized and unspecified atherosclerosis	Female	95	35.58	2.67	2.16	3.23
Cardiac arrest	Male	94	46.52	2.02	1.63	2.45
Cardiovascular disease, unspecified	Male	89	99.01	0.90	0.72	1.10
Cardiac arrest	Female	88	45.99	1.91	1.53	2.33
Congestive heart failure	Female	57	59.11	0.96	0.73	1.23
Generalized and unspecified atherosclerosis	Male	50	22.05	2.27	1.68	2.94
Congestive heart failure	Male	38	39.40	0.96	0.68	1.30
Cerebral atherosclerosis	Female	33	11.05	2.99	2.05	4.09
Pulmonary embolism and infarction	Female	29	14.92	1.94	1.30	2.72
Other primary cardiomyopathies	Female	29	20.14	1.44	0.96	2.01
Intracerebral hemorrhage	Female	29	29.34	0.99	0.66	1.38
Other primary cardiomyopathies	Male	29	30.94	0.94	0.63	1.31
Cerebral thrombosis	Female	28	20.60	1.36	0.90	1.91
Aortic valve disorders	Male	28	10.18	2.75	1.83	3.86
Pulmonary embolism and infarction	Male	27	12.84	2.10	1.38	2.97
Aortic valve disorders	Female	26	11.73	2.22	1.45	3.15
Intracerebral hemorrhage	Male	25	24.45	1.02	0.66	1.46
Other and unspecified rheumatic heart diseases	Female	22	3.32	6.63	4.15	9.69
Unspecified	Female	19	36.40	0.52	0.31	0.78

Heart failure, unspecified	Female	19	6.75	2.82	1.69	4.23
Abdominal aneurysm, ruptured	Male	18	13.27	1.36	0.80	2.06
Cerebral artery occlusion, unspecified	Female	16	15.86	1.01	0.58	1.56
Unspecified	Female	16	8.47	1.89	1.08	2.93
Cerebral thrombosis	Male	16	11.82	1.35	0.77	2.10
Other specified forms of chronic ischemic heart disease	Male	15	19.89	0.75	0.42	1.18
Heart disease, unspecified	Male	14	4.40	3.18	1.73	5.07
Unspecified	Female	12	7.42	1.62	0.83	2.66
Late effects of cerebrovascular disease	Female	12	10.91	1.10	0.57	1.81
Heart failure, unspecified	Male	12	6.20	1.94	1.00	3.19
Atrial fibrillation and flutter	Female	11	6.43	1.71	0.85	2.87
Subarachnoid hemorrhage	Female	11	12.34	0.89	0.44	1.50
Other and unspecified mitral valve diseases	Female	10	2.96	3.37	1.61	5.79
Cerebral artery occlusion, unspecified	Male	10	12.17	0.82	0.39	1.41

Table B-11. Diseases of Digestive System1979-1998, Butte Compared to National

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Cirrhosis of liver without mention of alcohol	Male	37	21.99	1.68	1.18	2.27
Cirrhosis of liver without mention of alcohol	Female	21	14.12	1.49	0.92	2.19
Acute vascular insufficiency of intestine	Female	19	7.87	2.41	1.45	3.62
Hemorrhage of gastrointestinal tract, unspecified	Female	19	8.69	2.19	1.31	3.28

Hemorrhage of gastrointestinal tract, unspecified	Male	18	7.70	2.34	1.38	3.54
Unspecified intestinal obstruction	Female	16	5.50	2.91	1.66	4.51
Colon	Female	16	5.99	2.67	1.52	4.14
Alcoholic cirrhosis of liver	Female	15	6.33	2.37	1.32	3.72
Acute vascular insufficiency of intestine	Male	13	4.55	2.86	1.51	4.62
Alcoholic cirrhosis of liver	Male	11	16.88	0.65	0.32	1.09

Table B-12. Diseases of Endocrine System1979-1998, Butte Compared to National

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Diabetes mellitus without mention of complication	Female	93	55.84	1.67	1.34	2.02
Diabetes mellitus without mention of complication	Male	65	42.00	1.55	1.19	1.95

Table B-13. Diseases of Genitourinary System1979-1998, Butte Compared to National

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Urinary tract infection, site not specified	Female	22	18.43	1.19	0.75	1.74
Urinary tract infection, site not specified	Male	20	9.93	2.01	1.23	2.99
Renal failure, unspecified	Male	19	15.55	1.22	0.73	1.83
Renal failure, unspecified	Female	13	16.24	0.80	0.42	1.30

Table B-14. Mental & Behavioral Disorders 1979-1998, Butte Compared to National

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Presenile dementia	Female	31	8.95	3.46	2.35	4.79
Alcohol dependence	Male	26	10.55	2.46	1.61	3.50

syndrome						
Unspecified psychosis	Female	11	8.35	1.32	0.65	2.21
Presenile dementia	Male	11	4.32	2.55	1.26	4.28

Table B-15. Diseases of the Musculoskeletal System 1979-1998, Butte Compared to National

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Rheumatoid arthritis	Female	13	3.28	3.97	2.10	6.42
Rheumatoid arthritis	Male	10	1.17	8.57	4.08	14.71

Table B-16. Neoplasms 1979-1998, Butte Compared to National

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Bronchus and lung, unspecified	Male	257.00	244.70	1.05	0.93	1.18
Bronchus and lung, unspecified	Female	148.00	128.87	1.15	0.97	1.34
Skin, site unspecified	Female	128.00	0.47	274.59	229.08	324.22
Malignant neoplasm of prostate	Male	108.00	84.59	1.28	1.05	1.53
Colon, unspecified	Female	97.00	62.82	1.54	1.25	1.87
Colon, unspecified	Male	77.00	60.45	1.27	1.01	1.57
Ovary	Female	58.00	34.68	1.67	1.27	2.13
Other	Male	56.00	43.33	1.29	0.98	1.65
Pancreas, part unspecified	Female	53.00	34.02	1.56	1.17	2.01
Pancreas, part unspecified	Male	52.00	33.40	1.56	1.16	2.01
Other	Female	43.00	40.09	1.07	0.78	1.42
Bladder, part unspecified	Male	30.00	20.15	1.49	1.00	2.07
Other lymphomas	Male	27.00	21.54	1.25	0.83	1.77
Stomach, unspecified	Male	20.00	22.39	0.89	0.54	1.33
Rectum	Male	20.00	10.23	1.95	1.19	2.90
Malignant neoplasm of uterus, part unspecified	Female	19.00	8.38	2.27	1.36	3.40
Other lymphomas	Female	19.00	20.13	0.94	0.57	1.42

Larynx, unspecified	Male	18.00	8.05	2.24	1.32	3.39
Multiple myeloma	Male	18.00	12.41	1.45	0.86	2.20
Esophagus, unspecified	Male	17.00	20.07	0.85	0.49	1.30
Rectum	Female	16.00	8.54	1.87	1.07	2.90
Melanoma of skin, site unspecified	Male	16.00	9.35	1.71	0.98	2.65
Brain, unspecified	Male	16.00	14.48	1.10	0.63	1.71
Kidney, except pelvis	Female	15.00	10.29	1.46	0.81	2.29
Multiple myeloma	Female	15.00	11.90	1.26	0.70	1.98
Bladder, part unspecified	Female	14.00	9.52	1.47	0.80	2.34
Brain, unspecified	Female	13.00	11.91	1.09	0.58	1.76
Upper lobe, bronchus or lung	Male	13.00	2.40	5.41	2.87	8.75
Stomach, unspecified	Female	12.00	15.72	0.76	0.39	1.26
Cervix uteri, unspecified	Female	12.00	12.93	0.93	0.48	1.53
Liver, primary	Male	12.00	7.50	1.60	0.82	2.63
Kidney, except pelvis	Male	12.00	16.49	0.73	0.37	1.20
Chronic	Male	12.00	5.90	2.03	1.05	3.35
Acute	Male	12.00	8.15	1.47	0.76	2.42
Sigmoid colon	Male	11.00	2.11	5.20	2.58	8.73
Esophagus, unspecified	Female	10.00	6.85	1.46	0.70	2.50

Table B-17. Diseases of the Nervous System 1979-1998, Butte Compared to National

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Alzheimer's disease	Female	58	21.56	2.69	2.04	3.43
Alzheimer's disease	Male	37	12.25	3.02	2.13	4.07
Paralysis agitans	Male	18	11.96	1.50	0.89	2.28
Multiple sclerosis	Female	16	3.18	5.03	2.87	7.80
Paralysis agitans	Female	14	8.79	1.59	0.87	2.54
Motor neuron disease	Female	13	4.70	2.77	1.47	4.47
Motor neuron disease	Male	11	5.22	2.11	1.05	3.54

Table B-18. Diseases of the Respiratory System 1979-1998, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI

Chronic airway obstruction, not elsewhere classified	Male	208	99.18	2.10	1.82	2.39
Chronic airway obstruction, not elsewhere classified	Female	187	69.23	2.70	2.33	3.10
Pneumonia, organism unspecified	Female	128	84.29	1.52	1.27	1.79
Bronchopneumonia, organism unspecified	Male	113	10.58	10.68	8.81	12.75
Emphysema	Male	46	27.30	1.68	1.23	2.21
Asthma, unspecified	Female	23	7.54	3.05	1.93	4.43
Emphysema	Female	17	16.71	1.02	0.59	1.56
Asthma, unspecified	Male	16	4.79	3.34	1.91	5.18
Pneumoconiosis due to other silica or silicates	Male	16	0.40	39.83	22.70	61.74
Unspecified pleural effusion	Male	16	0.85	18.93	10.79	29.35
Obstructive chronic bronchitis	Female	12	2.48	4.84	2.49	7.97
Bronchopneumonia, organism unspecified	Male	12	10.58	1.13	0.58	1.87
Postinflammatory pulmonary fibrosis	Female	11	6.90	1.59	0.79	2.68
Obstructive chronic bronchitis	Male	10	3.65	2.74	1.30	4.70

Table B-19. Diseases of the Circulatory System 1999-2006, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Atherosclerotic heart disease	Male	179	87.26	2.05	1.76	2.36
Atherosclerotic heart disease	Female	153	61.69	2.48	2.10	2.89
Stroke, not specified as hemorrhage or infarction	Female	99	56.55	1.75	1.42	2.11
Atherosclerotic cardiovascular disease, so described	Male	79	25.32	3.12	2.47	3.85
Congestive heart failure	Female	75	48.46	1.55	1.22	1.92
Acute myocardial infarction, unspecified	Male	73	77.45	0.94	0.74	1.17
Acute myocardial	Female	70	53.61	1.31	1.02	1.63

infarction, unspecified						
Atherosclerotic cardiovascular disease, so described	Female	58	16.90	3.43	2.61	4.37
Stroke, not specified as hemorrhage or infarction	Male	46	34.59	1.33	0.97	1.74
Congestive heart failure	Male	39	32.78	1.19	0.85	1.59
Cardiomyopathy, unspecified	Male	21	7.06	2.97	1.84	4.38
Endocarditis, valve unspecified	Female	19	5.11	3.72	2.24	5.58
Cardiomyopathy, unspecified	Female	19	4.63	4.10	2.47	6.16
Essential (primary) hypertension	Female	16	5.95	2.69	1.53	4.17
Intracerebral hemorrhage, unspecified	Female	15	9.30	1.61	0.90	2.53
Aortic (valve) stenosis	Female	12	8.16	1.47	0.76	2.42
Atrial fibrillation and flutter	Female	12	8.74	1.37	0.71	2.26
Sequelae of stroke, not specified as hemorrhage or infarction	Female	11	7.97	1.38	0.68	2.32
Hypertensive heart disease with (congestive) heart failure	Female	10	4.67	2.14	1.02	3.68

Table B-20. Diseases of Digestive System 1999-2006, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Alcoholic cirrhosis of liver	Male	16	6.70	2.39	1.36	3.70
Other and unspecified cirrhosis of liver	Male	14	6.16	2.27	1.24	3.62
Disease of digestive system, unspecified	Male	13	0.04	358.88	190.30	580.48
Gastrointestinal hemorrhage, unspecified	Female	12	5.69	2.11	1.08	3.47
Other and unspecified cirrhosis of liver	Female	11	4.89	2.25	1.12	3.78

Table B-21. Diseases of Endocrine System 1999-2006, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Unspecified diabetes mellitus, without complications	Male	37	19.74	1.87	1.32	2.53
Unspecified diabetes mellitus, without complications	Female	33	21.05	1.57	1.08	2.15

Table B-22. Diseases of Genitourinary System 1999-2006, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Urinary tract infection, site not specified	Female	24	7.57	3.17	2.03	4.57
Unspecified renal failure	Male	12	9.71	1.24	0.64	2.03

Table B-23. Mental & Behavioral Disorders 1999-2006, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Unspecified dementia	Male	35	38.39	0.91	0.63	1.24
Unspecified dementia	Male	18	17.06	1.06	0.62	1.60

Table B-24. Diseases of the Musculoskeletal System 1999-2006, Butte Compared to Montana

Gender	Cause of Death	Observed N	Expected	SMR	Lower CI	Upper CI
Female	Arthrosis, unspecified	11	1.25	8.81	4.37	14.78

Table B-25. Neoplasms 1999-2006, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Bronchus or lung, unspecified	Male	119	83.86	1.42	1.18	1.69
Bronchus or lung, unspecified	Female	100	68.93	1.45	1.18	1.75
Breast, unspecified	Female	52	37.81	1.38	1.03	1.77
Colon, unspecified	Male	46	21.66	2.12	1.55	2.78
Colon, unspecified	Female	39	20.65	1.89	1.34	2.53
Malignant neoplasm of prostate	Male	39	35.06	1.11	0.79	1.49
Pancreas, unspecified	Male	22	15.25	1.44	0.90	2.11

Pancreas, unspecified	Female	20	14.66	1.36	0.83	2.03
Bladder, unspecified	Male	17	9.82	1.73	1.01	2.65
Malignant neoplasm without specification of site	Male	16	14.82	1.08	0.62	1.67
Malignant neoplasm of ovary	Female	14	15.47	0.91	0.49	1.44
Testis, unspecified	Male	14	0.40	35.14	19.14	55.95
Malignant neoplasm without specification of site	Female	13	16.50	0.79	0.42	1.27
Esophagus, unspecified	Male	13	10.83	1.20	0.64	1.94

Table B-26. Diseases of the Nervous System 1999-2006, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Alzheimer's disease, unspecified	Female	69	48.13	1.43	1.12	1.79
Alzheimer's disease, unspecified	Male	26	19.67	1.32	0.86	1.88
Parkinson's disease	Male	11	10.47	1.05	0.52	1.76

Table B-27. Diseases of the Respiratory System 1999-2006, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Chronic obstructive pulmonary disease, unspecified	Female	125	67.57	1.85	1.54	2.19
Chronic obstructive pulmonary disease, unspecified	Male	123	67.85	1.84	1.51	2.15
Pneumonia, unspecified	Male	34	24.23	1.4	0.97	1.91
Pneumonia, unspecified	Female	31	29.28	1.05	0.72	1.46
Emphysema, unspecified	Male	15	10.22	1.47	0.82	2.31
Emphysema, unspecified	Female	12	9	1.33	0.69	2.19

BUTTE COMPARED TO NATIONAL

Table B-28. Diseases of the Circulatory System 1999-2006, Butte Compared to National

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Atherosclerotic heart disease	Male	179	97.09	1.84	1.58	2.12
Atherosclerotic heart disease	Female	153	99.23	1.54	1.31	1.80
Stroke, not specified as hemorrhage or infarction	Female	99	47.84	2.07	1.68	2.50
Atherosclerotic cardiovascular disease, so described	Male	79	33.06	2.39	1.89	2.95
Congestive heart failure	Female	75	30.19	2.48	1.95	3.08
Acute myocardial infarction, unspecified	Male	73	84.20	0.87	0.68	1.08
Acute myocardial infarction, unspecified	Female	70	74.93	0.93	0.73	1.17
Atherosclerotic cardiovascular disease, so described	Female	58	28.63	2.03	1.54	2.58
Stroke, not specified as hemorrhage or infarction	Male	46	28.76	1.60	1.17	2.10
Congestive heart failure	Male	39	18.96	2.06	1.46	2.75
Cardiomyopathy, unspecified	Male	21	9.95	2.11	1.30	3.11
Endocarditis, valve unspecified	Female	19	2.68	7.09	4.26	10.64
Cardiomyopathy, unspecified	Female	19	7.78	2.44	1.47	3.67
Essential (primary) hypertension	Female	16	7.36	2.17	1.24	3.37
Intracerebral hemorrhage, unspecified	Female	15	8.39	1.79	1.00	2.81
Aortic (valve) stenosis	Female	12	6.05	1.98	1.02	3.26
Atrial fibrillation and flutter	Female	12	6.13	1.96	1.01	3.22
Sequelae of stroke, not specified as hemorrhage or infarction	Female	11	5.38	2.04	1.01	3.43
Hypertensive heart disease with (congestive) heart failure	Female	10	5.86	1.71	0.81	2.93

Table B-29. Diseases of Digestive System 1999-2006, Butte Compared to National

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Alcoholic cirrhosis of liver	Male	16	5.51	2.90	1.65	4.50
Other and unspecified cirrhosis of liver	Male	14	7.72	1.81	0.99	2.89
Gastrointestinal hemorrhage, unspecified	Male	13	3.22	4.04	2.14	6.53
Gastrointestinal hemorrhage, unspecified	Female	12	3.85	3.11	1.60	5.13
Other and unspecified cirrhosis of liver	Female	11	5.13	2.15	1.06	3.60

Table B-30. Diseases of Endocrine System 1999-2006, Butte Compared to National

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Unspecified diabetes mellitus, without complications	Male	37	18.60	1.99	1.40	2.68
Unspecified diabetes mellitus, without complications	Female	33	20.28	1.63	1.12	2.23

Table B-31. Diseases of Genitourinary System 1999-2006, Butte Compared to National

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Other diseases of urinary system	Female	24	8.93	2.69	1.72	3.87
Renal failure	Male	12	7.63	1.57	0.81	2.59

Table B-32. Mental & Behavioral Disorders 1999-2006, Butte Compared to National

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Unspecified dementia	Female	35	28.28	1.24	0.86	1.68
Unspecified dementia	Male	18	11.97	1.50	0.89	2.28

Table B-33. Diseases of the Musculoskeletal System 1999-2006, Butte Compared to National

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI

Arthrosis, unspecified	Female	11	0.59	18.61	9.24	31.23

Table B-34. Neoplasms 1999-2006, Butte Compared to National

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Bronchus or lung, unspecified	Male	119	83.36	1.43	1.18	1.70
Bronchus or lung, unspecified	Female	100	61.16	1.64	1.33	1.97
Breast, unspecified	Female	52	37.95	1.37	1.02	1.77
Colon, unspecified	Male	46	20.59	2.23	1.64	2.93
Colon, unspecified	Female	39	20.94	1.86	1.32	2.49
Malignant neoplasm of prostate	Male	39	27.99	1.39	0.99	1.87
Pancreas, unspecified	Male	22	14.01	1.57	0.98	2.29
Pancreas, unspecified	Female	20	14.32	1.40	0.85	2.08
Bladder, unspecified	Male	17	8.07	2.11	1.22	3.23
Malignant neoplasm without specification of site	Male	16	12.25	1.31	0.74	2.02
Malignant neoplasm of ovary	Female	14	13.30	1.05	0.57	1.68
Malignant neoplasm of kidney, except renal pelvis	Male	14	6.91	2.03	1.10	3.23
Malignant neoplasm without specification of site	Female	13	12.42	1.05	0.55	1.69
Esophagus, unspecified	Male	13	9.16	1.42	0.75	2.29

Table B-35. Diseases of the Nervous System 1999-2006, Butte Compared to National

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Alzheimer's disease, unspecified	Female	69	37.70	1.83	1.42	2.29
Alzheimer's disease, unspecified	Male	26	15.79	1.65	1.07	2.34
Parkinson's disease	Male	11	9.18	1.20	0.59	2.01

Table B-36. Diseases of the Respiratory System 1999-2006, Butte Compared to Montana

Cause of Death	Gender	Observed N	Expected	SMR	Lower CI	Upper CI
Chronic obstructive pulmonary disease,	Female	125	46.83	2.67	2.22	3.16

unspecified						
Chronic obstructive pulmonary disease, unspecified	Male	123	45.35	2.71	2.25	3.21
Pneumonia, unspecified	Male	34	21.70	1.57	1.08	2.14
Pneumonia, unspecified	Female	31	27.58	1.12	0.76	1.55
Emphysema, unspecified	Male	15	7.32	2.05	1.14	3.22
Emphysema, unspecified	Female	12	6.70	1.79	0.92	2.95

Appendix C. EPA and Butte-Silver Bow Health Department Letters Concerning Health Study

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 8, MONTANA OFFICE

FEDERAL BUILDING, 10 W. 15th STREET, SUITE 3200

HELENA, MONTANA 59626

Ref: 8MO

August 26, 2011

Dr. Daniel Harrington, D.D.S.	Theresa Hocking, R.N.
Chairperson, Board of Health	Director, Public Health
Butte Silver Bow County	Butte Silver Bow County
25 West Front Street	25 West Front Street
Butte, MT 59701	Butte, MT 59701

RE: Butte Silver Bow County health study by Ms. Stacie Barry

Dear Dr. Harrington and Ms. Hocking:

In a letter dated August 16, 2011, you and the Butte Silver Bow County Public Health Department (BSBCPHD) voiced concerns about EPA statements regarding the confidentiality regarding an upcoming human health study funded by the BSBCPH and authored by Ms. Stacie Barry and its underlying data. I would like to assure you that EPA in no way intended to criticize the study or interfere with your public health authorities and responsibilities.

After further discussion internally at EPA and with BSBCPHD, we agree with BSBCPHD that the study (in draft or final form) and its underlying data are not confidential under Butte Site consent decree orders or any other provision or law. I apologize for any confusion we may have caused as a result of our misunderstanding.

The letter also characterizes the Barry public health study as a study required of Butte Silver Bow County and other respondents under the EPA-approved Residential Metals Abatement Plan (April 2010) (RMAP). The RMAP, and the recently issued CERCLA section 106 Unilateral Administrative Order for the Butte Site remedial action (UAO), require the production of a human health study every five years for a period of thirty years for the BPSOU/Butte Site. The Partial Remedial Action Work Plan, attached to the UAO, requires the submittal of a draft work plan for conduct of public health study[1] for review and comment by EPA in consultation with DEQ. The purpose of this requirement is to ensure appropriate federal and state public health agency and EPA review of the work plan for such studies before those studies are conducted, and to provide for EPA and DEQ review of draft versions of these studies before they are finalized.

Because the current Barry public health study is being done without the benefit of the required Public Health Study Remedial Design Work Plan preparation or EPA or other agency review,

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[1] The Partial Remedial Action Work Plan, at page 11, describes this requirement as a "Medical Monitoring Program Remedial Design Work Plan". As explained at the August 17, 2011 Opportunity to Confer conference on the UAO, this was an unintended mistake, and the reference at page 11 should state "Public Health Study Remedial Design Work Plan".

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EPA now recognizes that the Barry public health study is not the required RMAP five year public health study. We hope to work with the Group 1 Respondents on such a work plan over the next year (the UAO and its Partial Remedy Implementation Work Plan require the work plan to be completed by November 30, 2012), and to then oversee the production of the RMAP required public health studies after that[2].

The Barry public health study may produce useful and helpful information for the Butte Silver Bow County Board of Health and Health Department. I would like to reiterate that EPA is not criticizing the Barry public health study. We are instead clarifying and confirming that it is not the public health study required under the UAO and RMAP.

Please contact me if you have any remaining questions. Thank you for your continued work on the RMAP and the protection of human health.

Sincerely,

Joseph Vranka, P.E.
Superfund Branch Chief

cc: Sara Sparks, EPA
Julie DalSoglio, EPA
Joe Griffin, DEQ
Larry Scusa, DEQ
Group 1 Respondent Representatives

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[2] Public health studies required under the RMAP would be subject to statistical review and federal government norms for such studies.

BUTTE-SILVER BOW HEALTH DEPARTMENT

Theresa R. Hocking, R.N./C.I.C./M.S.N.

Director of Public Health/ Health Officer

August 16, 2011

Ms. Julie DalSoglio, Director

U.S. EPA, Montana Office

Baucus Federal Building

10 W. 15th Street

Suite 3200

Helena, Montana 59626

RE: Health Studies via Residential Metals Program; Butte-Silver Bow Board of Health.

Dear Ms. DalSoglio:

Recent events concerning the on-going health study via the Residential Metals Programs have raised concerns from the Butte-Silver Bow Board of Health.

It is our understanding that EPA officials associated with the Butte Priority Soils Operable Unit have stated that the health study currently being done is somehow under the auspices of Consent Decree negotiations and that any data associated with the study is court ordered protected and not available for release to the general public.

<u>Current Health Study</u>

In 2008, the Butte-Silver Bow Board of Health approved the current, on-going study with Ms. Stacie Barry, who is a doctoral candidate with the University of Montana Applied Health Sciences Program through Montana Tech. Monies associated with the study were provided through the Allocation Agreement signed by Atlantic Richfield and Butte-Silver Bow in 2006. Ms. Barry was retained as an independent contractor to complete and perform the duties below:

- Compile and interpret toxicology information for the Butte area.
- Compile and interpret mortality statistics for Butte as an epidemiological study.
- Compile and interpret health studies for Butte.
- Compile and interpret influencing factors; e.g. environmental or cultural, for mortality rates in Butte.

The health study will apply a statistical analysis based on data from the Butte area and compare those results with state and national rates. The results of the study, when completed in December 2011, will be distributed to any and all agencies, the general public, and other interested parties. In addition, these results may show where further studies are necessary.

Important Notes:

- **All of the data collected is existing data available to the general public; most of which can be found on the internet. No data is confidential in nature.**
- **Ms. Barry's thesis committee has approved her thesis project and has emphatically stated there are no confidential components involved.**
- **Any statistical analysis associated with the data is directly referenced and applied to CDC and ATSDR protocols.**

The Butte-Silver Bow Board of Health strongly endorses the health study currently being done. It is the charge of public health agencies to investigate, study, interpret, and analyze results from these approved types of studies to further the goal of protecting public health. Any deviation from this is unacceptable.

In addition, please consider the following:

1. Upon review of the Record of Decision, personnel could not find any reference to these kinds of "Health Studies" in the document.

2. "Health Studies" were not identified in the Explanation of Significant Differences (ESD) document.

3. "Health Studies" were not identified in the Unilateral Administrative Order (UAO) document.

4. Health Studies were funded through the Allocation Agreement with Atlantic Richfield (AR) and Butte-Silver Bow.

5. EPA officials and AR representatives were aware of the health study since its inception in 2008.

If you have any questions or would like to discuss the matter in depth, please feel free to contact the Butte-Silver Bow Health Department at (406) 497-5020.

Sincerely,

Dan Harrington, DDS

Dr. Daniel Harrington, D.D.S., Chairperson

Butte-Silver Bow Board of Health

CC: Paul Babb, BSB Chief Executive

Butte-Silver Bow Board of Health

Terri Hocking, BSB Health Director

Jon Sesso, BSB Planning Director

Eileen Joyce, BSB County Attorney

Mollie Maffei, BSB Deputy County Attorney

Henry Elsen, Esq., EPA

Joe Vranka, EPA

Sara Sparks, EPA

Holly Peterson, Mt. Tech

Julie Hart, Mt. Tech

Stacie Barry

Appendix D. Health Professional Survey Form and IRB Approval Form

Butte Medical Professional Survey

1. How long have you been a medical professional in Butte and what type of medical profession do you currently practice?

2. Have you received training in environmental medicine?

3. What, if any, environmental contaminants in the Butte area do you think could potentially increase the risk of health problems in Butte?

4. Do you think that there are environmental health effects that stem from the environmental contamination in the Butte Superfund Sites? Please elaborate.

5. Do you see an increased incidence of health problems in Butte compared to other communities you have practiced in? Please elaborate.

6. Do you think that the environmental contamination is being remediated to a level that is protective of human health? Please elaborate.

7. 7. Do you think that the remedial action levels for the contaminants are adequate to protect human health?

8. Butte is part of a National Historic District. In instances of a historic landscape or historic structures, should historic preservation or environmental remediation take precedence? Please elaborate.

9. 9. Do you think that there is a diminished perception of risk in the Butte community? Please elaborate.

10. Do you think there are cultural influences that affect health issues in Butte? Please elaborate.

Form RA-108
(Rev. 8/10)

VP RESEARCH & DEV. JUL 12 2011 THE UNIV. OF MONTANA

THE UNIVERSITY OF MONTANA-MISSOULA
Institutional Review Board (IRB)
for the Use of Human Subjects in Research
CHECKLIST / APPLICATION

IRB Protocol No.: 134-11

At The University of Montana (UM), the Institutional Review Board (IRB) is the institutional review body responsible for oversight of all research activities involving human subjects outlined in the U.S. Department of Health and Human Services Office of Human Research Protection (www.hhs.gov/ohrp) and the National Institutes of Health, Inclusion of Children Policy Implementation (http://grants.nih.gov/grants/funding/children/children.htm).

Instructions: A separate registration form must be submitted for each project. IRB proposals are approved for three years and must be continued annually. **Faculty members** may email the completed form as a Word document to *IRB@umontana.edu*. **Students** must submit a hardcopy of the completed form to the Office of the Vice President for Research & Development, University Hall 116.

1. Administrative Information

Project Title: The Environment, Health and Culture in Butte, Montana	
Principal Investigator: Stacie Barry	Title: Operations Director, Energy Services, National Center for Appropriate Technology
Email address: stacieb@ncat.org	
Work Phone: 406-533-6658	Cell Phone: 406-490-3082
Department: Interdisciplinary PhD Department	Office location: Butte, Montana

2. Human Subjects Protection Training *(All researchers, including faculty supervisors for student projects, must have completed a self-study course on protection of human research subjects* ***within the last three years*** *(http://www.umt.edu/research/complianceinfo/IRB/) and be able to supply the "Certificate(s) of Completion" upon request. Add rows to table if needed.*

NAME and DEPT.	PI	CO-PI	Faculty Supervisor	Research Assistant	DATE COMPLETED Human Subjects Protection Course
Stacie Barry, IIP	☒	☐	☐	☐	6/20/11
Pat Munday	☐	☐	☒	☐	7/11/11
	☐	☐	☐	☐	
	☐	☐	☐	☐	

3. Project Funding

Is grant application currently under review at grant funding agency? ☐Yes *(If yes, cite sponsor on ICF if applicable)* ☒No			Has grant proposal received approval and funding? ☐Yes *(If yes, cite sponsor on ICF if applicable)* ☐No	
Agency	Grant No.	Start Date	End Date	PI

Is this part of your thesis or dissertation?	If **yes**, date you successfully presented your proposal to your committee:
☒Yes ☐No	Before beginning the program in Spring of 2007

For UM-IRB Use Only

IRB Determination:

✓ Approved Exempt from Review, Exemption # 2 *(see memo)*
_____ Approved by Expedited/Administrative Review *(see* ***Note to PI***)*
_____ Full IRB Determination
_____ Approved *(see* ***Note to PI***)*
_____ Conditional Approval *(see memo)* - IRB Chair Signature/Date: __________
_____ Conditions Met *(see* ***Note to PI***)*
_____ Resubmit Proposal *(see memo)*
_____ Disapproved *(see memo)*

*** Note to PI:** Study is approved for one year. Use any attached IRB-approved forms (signed/dated) as "masters" when preparing copies. If continuing beyond the expiration date, a continuation report must be submitted. Notify the IRB if any significant changes or unanticipated events occur. Notify the IRB in writing when the study is terminated

Final Approval by IRB Chair: [signature] Date: 7/13/2011 Expires: __________

1

Appendix E. Residential Remedial Actions and Maximum Metals Levels

Table E.1 Summary of Residential Remedial Actions and Maximum Metals Levels

SUMMARY OF SOILS REMEDIATED UNDER MOU – 114 (Based on Soil Lead Concentrations)			
	Location	**Year**	**Maximum**
			Metals Level
			(mg/kg)
1	Colorado Stamp Mill	1995	2400
2	210 W. Woolman	1996	11600
3	1036 S. Utah	1996	3450
4	79 Bennett	1996	3340
5	917 W. Broadway	1996	2930
6	315 W. Broadway (basement)	1996	1540
7	109 Belle Street	1996	2030
8	109 Belle Street (basement)	1996	2720
9	929 Hornet	1997	3000
10	1028 S. California	1997	3010
11	1619 N. Main	1997	1800
12	246 W. Daly (demolished home)	1997	21000
13	31 Missoula	1997	3990
14	36 W. Center	1997	1360
15	Girard Park	1997	2630
16	1802 A Street	1998	5880
17	3 Bennett	1998	12400
18	105 E. Center	1998	2690
19	640 S. Clark	1998	1920
20	Christmas Source Area	1998	2450
21	912 Emma	1998	2610
22-24	Nightingale Source Area (3 yards)	1998	14100
25	1629 N. Main	1998	1980
26-37	Tullamore Addition (12 yards)	1998	3510
38	806 S. Washington	1998	2100
39	806 1/2 S. Washington (House Demo)	1998	2100
40	4 Bennett	1999	33300
41	8 Bennett	1999	5570
42	21 W. Center	1999	1450

43	118 W. Copper	1999	3940
44	131 W. Copper	1999	1260
45	Vacant Lot West of 131 W. Copper	1999	1260
46	905 W. Copper	1999	1540
47	924 S. Colorado	1999	1920
48	213 S. Dakota	1999	1290
49	238 S. Dakota	1999	1610
50	123 W. Daly (basement)	1999	3020
51	244 W. Daly (demo.)	1999	Elevated Pb,Hg
52	532 Edison	1999	3600
53	601 W. Galena	1999	1340
54	1011 Michigan	1999	1410
55	723 N. Montana	1999	1730
56-64	Nightingale Source Area (9 yards)	1999	14100
65	636 Placer	1999	3950
66	115 W. Quartz	1999	1990
67	217 W. Virginia	1999	2380
68	855 W. Quartz	1999	1430
69	305 W. Virginia	1999	1430
70	405 W. Virginia	1999	2530
71	505 S. Washington	1999	2050
72	1019 W. Woolman	1999	3890
73	131 W. Copper	1999	1220
74	301 N. Alabama	2000	1980
75	602 N. Alaska	2000	1840
76	519 W. Aluminum	2000	3500
77	717 W. Broadway	2000	1290
78	23 W. Center	2000	3620
79	25 W. Center	2000	1290
80	108 E. Center	2000	3620
81	935 W. Copper	2000	1510
82	421/423 N. Excelsior	2000	1650
83	413 E. First	2000	1190
84	Immaculate Conception Park	2000	5490
85	17 W. LaPlatta	2000	1680
86	19 W. LaPlatta	2000	1490
87	57 W. LaPlatta	2000	1270
88	406 E. Mercury	2000	1400

89	430 S. Montana	2000	1760
90	521 N. Montana	2000	1780
91	1042 S. Nevada	2000	1310
92	North Anselmo Timber Slope	2000	Source Area
93	207 E. Pacific	2000	4140
94	Lot E. of 207 E. Pacific	2000	1520
95	128 Pearl	2000	6670
96	Lot – 107 W. Quartz	2000	1250
97	111 W. Quartz	2000	4050
98	849 W. Quartz	2000	1800
99	920 W. Quartz	2000	1570
100	102 Sutter	2000	1840
101	103 Sutter	2000	1640
102	411 W. Virginia	2000	7100
103	417 W. Virginia	2000	2460
104	8 Bennett (basement)	2001	5570
SUMMARY OF SOILS REMEDIATED UNDER THE WALKERVILLE EMERGENCY TIME CRITICAL REMOVAL ACTION (Based on Soil Lead Concentrations)			
	Location	**Year**	**Maximum**
	-	-	**Metals Level**
	-	-	**(mg/kg)**
105	1409 B Street	2001	>3000
106	4 Bennett (basement)	2001	>3000
107	9 Bennett	2001	>3000
108	15 Bennett	2001	>3000
109	25 Bennett	2001	>3000
110	27 Bennett	2001	>3000
111	29 Bennett	2001	>3000
112	55 Bennett	2001	>3000
113	Capitol Hill Source Area	2001	>3000
114	120 E. Daly	2001	>3000
115	47 W. Daly	2001	>3000
116	51 W. Daly (yard)	2001	>3000
117	51 W. Daly (basement)	2001	>3000
118	52 W. Daly	2001	>3000
119	107 W. Daly	2001	>3000
120	115 W. Daly (basement)	2001	>3000

121	115 W. Daly (flower bed)	2001	>3000
122	117 W. Daly (yard)	2001	>3000
123	117 W. Daly (basement)	2001	>3000
124	125 W. Daly	2001	>3000
125	149 W. Daly	2001	>3000
126	221 W. Daly (basement)	2001	>3000
127	242 W. Daly (basement)	2001	>3000
128	304 W. Daly (basement)	2001	>3000
129	306 W. Daly	2001	>3000
130	521 W. Daly (yard)	2001	>3000
131	521 W. Daly (basement)	2001	>3000
132	618 W. Daly	2001	>3000
133	726 W. Daly (basement)	2001	>3000
134	11 Lexington Terrace	2001	>3000
135	980 N. Main (yard)	2001	>3000
136	980 N. Main (basement)	2001	>3000
137	1516 N. Main	2001	>3000
138	1608 N. Main	2001	>3000
139	1614 N. Main (yard)	2001	>3000
140	1614 N. Main (basement)	2001	>3000
141	718 North St. (basement)	2001	>3000
142	107 O'Neil (basement)	2001	>3000
143	825 17th St. (basement)	2001	>3000
144	905 17th St. (basement)	2001	>3000
145	Tennis Court Source Area	2001	>3000
146	Toboggan Source Area	2001	>3000
147	508 Transit	2001	>3000
148	512 Transit	2001	>3000
149	23 W. Daly (basement)	2001	>3000
151	618 W. Daly (basement)	2001	>3000

SUMMARY OF YARDS, ATTICS & BASEMNETS REMEDIATED UNDER MOU – 135 (Based on Metals Concentrations)

	Location	**Year**	**Maximum**
	-	-	**Metals Level**
	-	-	**(mg/kg)**
152	226 W. Aluminum	2001	1230
153	23 E. Center	2001	3900

154	120 E. Daly (Basement)	2001	1300
155	23 W. Daly	2001	2000
156	47 W. Daly (Basement)	2001	2200
157	123 W. Daly	2001	4340
158	127 W. Daly (Attic)	2001	6730
159	155 W. Daly (basement)	2001	9880
160	417 E. Galena	2001	1980
161	973 N. Main	2001	1710
162	34 Missoula	2001	1770
163	205 E. Pacific	2001	2100
164	403 Transit (yard)	2001	1500
165	403 Transit (basement)	2001	1500
166	415 W. Virginia	2001	3860
167	1407 5th St.	2002-2003	3200
168	1608 1st St. (yard)	2002-2003	2900
169	1608 1st St. (basement)	2002-2003	2900
170	1611 6th St. (yard)	2002-2003	1410
171	1611 6th St. (basement)	2002-2003	1410
172	40 Blue Wing	2002-2003	1500
173	114 Blue Wing	2002-2003	1400
174	20 W. Center	2002-2003	2870
175	129 W. Daly	2002-2003	5950
176	135 W. Daly	2002-2003	2900
177	619 W. Daly (Attic)	2002-2003	25700
178	621 W. Daly	2002-2003	1400
179	333 E. Galena	2002-2003	1600
180	341 E. Galena	2002-2003	2300
181	864 S. Main	2002-2003	1320
182	1615 N. Main	2002-2003	1600
183	733 N. Montana	2002-2003	1210
184	7 O'Neil (yard)	2002-2003	2910
185	7 O'Neil (basement)	2002-2003	2910
186	405 E. Park	2002-2003	1240
187	109 W. Porphyry	2002-2003	1480
188	618 W. Quartz	2002-2003	3440
189	305 W. Virginia (basement)	2002-2003	2260
190	709 N. Wyoming (basement)	2002-2003	1410
191	1514 B Street	2003-2004	1600

192	59 Bennett	2003-2004	1240
193	65 Bennett	2003-2004	1400
194	79 Bennett	2003-2004	1300
195	79 Bennett (basement)	2003-2004	1340
196	939 W. Broadway	2003-2004	257 As
197	18 W. Copper	2003-2004	1320
198	43 W. Daly	2003-2004	1500
199	43 W. Daly (attic)	2003-2004	6020
200	310 W. Daly	2003-2004	1200
201	316 W. Daly	2003-2004	1400
202	332 W. Daly	2003-2004	1400
203	401 W. Daly	2003-2004	1500
204	410 W. Daly	2003-2004	1500
205	6 Gladstone Terrace	2003-2004	1600
206	724 W. Granite	2003-2004	1530
207	724 W. Granite (basement)	2003-2004	3510
208	3750 Green Lane	2003-2004	1290
209	314 S. Jackson (attic)	2003-2004	1380 Pb, 1030 As
210	117 O'Neil	2003-2004	1400
211	1409 Schley	2003-2004	3480
212	18 Toboggan	2003-2004	1200
213	620 W. Quartz	2004-2005	1190
214	39 Missoula	2004-2005	1870
215	39 Missoula Source Area	2004-2005	5300
216	117 O'Neil Source Area	2004-2005	4540
217	114 O'Neil	2004-2005	1400
218	27 E. Center	2004-2005	1700
219	809 Travonia	2004-2005	470 As
220	724 W. Granite (attic)	2004-2005	5950
221	803 W. Copper	2004-2005	2310
222	Butte Archives Lot	2004-2005	1540
223	133 E. Center	2004-2005	1110
224	13 Sun View Terrace	2004-2005	1700
225	354 E. Galena	2004-2005	1390
226	922 W. Copper	2004-2005	1220
227	1117 W. Broadway	2004-2005	243 As
228	943 W. Caledonia (attic)	2004-2005	2000
229	1508 N. Main	2004-2005	1880

230	820 N. Main	2004-2005	1810
231	66 W. Park (interior dust)	2004-2005	12700 Pb & 263 As
232	1027 W. Porphyry (attic)	2004-2005	2950
233	1108 W. Broadway (basement)	2004-2005	1250
234	1108 W. Broadway (attic)	2004-2005	3780
235	1110 W. Broadway (attic)	2004-2005	1220
236	1110 W. Broadway (yard)	2004-2005	1260
237	1031 California (W. Lot)	2004-2005	2530
238	410 W. Granite	2004-2005	1880
239	815 Thirteenth	2004-2005	1380
240	609 N. Wyoming Lot	2004-2005	258 As
241	410 W. Granite (basement)	2005-2006	4860
242	102 W. Daly (yard)	2005-2006	1800
243	102 W. Daly (attic)	2005-2006	1510
244	114 W. Daly (yard)	2005-2006	1500
245	114 W. Daly (attic)	2005-2006	3990 Pb & 381 As
246	1305 E Second (yard)	2005-2006	1710 Pb & 276 As
247	1001 W. Park (yard)	2005-2006	1200
248	24 W. Woolman (yard)	2005-2006	3480
249	326 Curtis (yard)	2005-2006	2670
250	131 W. Daly (yard)	2005-2006	1530
251	921 W. Broadway (yard)	2005-2006	1490
252	27 N. Excelsior (yard)	2005-2006	3780
253	126 W. Daly (yard)	2005-2006	1300
254	1617 N. Main (yard)	2005-2006	1900
255	107 Academy (yard)	2005-2006	1800 Pb & 330 As
256	75 Bennett (yard)	2005-2006	1400
257	141 W. Daly (yard)	2005-2006	280 As
258	240 W. Daly (yard)	2005-2006	3310
259	734 W. Park (yard)	2005-2006	1460
260	205 Toboggan (yard)	2005-2006	330 As
261	107 W. Daly (attic)	2005-2006	9490 Pb & 408 As
262	123 W. Daly (attic)	2005-2006	4340 Pb & 558 As
263	518 W. Granite (attic)	2005-2006	3610 Pb & 1910 As
264	1015 N. Henry (attic)	2005-2006	370 As
265	625 N. Main (attic)	2005-2006	2730 Pb & 1280 As
266	405 E. Park (attic)	2005-2006	1790 Pb & 993 As
267	604 Travonia (attic)	2005-2006	4160

268	95 Blue Wing (yard)	2006-2007	343 As
269	12 W. Clark (yard)	2006-2007	1400 Pb
270	32 E. LaPlatta (yard)	2006-2007	1350 Pb
271	542 Colorado (yard)	2006-2007	1440 Pb
272	109 O'Neil (yard)	2006-2007	1300 Pb
273	1059 Porphyry (attic)	2006-2007	1830 Pb & 325 As
274	730 W. Park (attic)	2006-2007	1990 Pb & 1250 As
275	1129 Lewisohn (attic)	2006-2007	3160 Pb & 280 As
276	728 S. Washington (attic)	2006-2007	3550 Pb & 604 As
277	332 Boardman (attic)	2006-2007	7290 Pb & 664 As
278	909 Empire (attic)	2006-2007	1480 Pb & 457 As
279	734 W. Park (attic)	2006-2007	476 As
280	1109 W. Broadway (attic)	2006-2007	3240 Pb & 280 As
281	62 W. Daly (yard)	2006-2007	1800 Pb
282	43 W. LaPlatta (yard)	2006-2007	1440 Pb
283	1125 Farrell (yard)	2006-2007	1230 Pb
284	1245 Farrell (yard)	2006-2007	1400 Pb
285	1221 E. First (attic)	2006-2007	1830 Pb & 294 As
286	536 W. Mercury (attic)	2006-2007	316 As
287	421 W. Iron (attic)	2006-2007	3950 Pb & 365 As
288	1512 N. Main (attic)	2006-2007	5980 Pb & 497 As
289	58 Missoula (attic)	2006-2007	1270 Pb & 258 As
290	858 S. Main (attic)	2006-2007	2030 Pb & 850 As
291	107 Missoula (attic)	2006-2007	2090 Pb & 579 As
292	858 S. Main (yard)	2006-2007	1870 Pb
293	896 N. Main (yard)	2006-2007	1210 Pb
294	1100 W. Copper (yard)	2006-2007	13200 Pb
295	632 S. Clark (yard)	2006-2007	1630 Pb
296	43 W. Daly (yard)- previous failure	2007-2008	1500Pb
297	826 Empire (storm water site)	2007-2008	FSUA
298	Caledonia Drop Inlet(storm water site)	2007-2008	FSUA
299	625 N. Main (yard)	2007-2008	2030 Pb
300	37 W. Center (yard)	2007-2008	1350 Pb
301	413 Boardman (storm water site)	2007-2008	FSUA
302	33 Missoula (storm water site)	2007-2008	6030 Pb FSUA
303	1511 N. Main (yard)	2007-2008	1560 Pb
304	659 Maryland (attic)	2007-2008	2050 Pb & 857 As
305	522 W. Silver (attic)	2007-2008	1430 Pb & 673 As

306	410 W. Granite (attic)	2007-2008	12600 Pb & 646 As
307	833 S. Main (attic)	2007-2008	1670 Pb & 819 As
308	519 N. Montana (attic)	2007-2008	335 As
309	1125 Porphyry (attic)	2007-2008	1750 Pb & 890 As
310	527 Edison (attic)	2007-2008	1740 Pb & 630 As
311	633 W. Quartz (attic)	2007-2008	405 As
312	15 W. Woolman (attic)	2007-2008	1650 Pb & 505 As
313	403 W. Mercury (attic)	2007-2008	5110 Pb & 1220 As
314	17 Wells	2007-2008	1610 Pb
315	103 W. Center (soil/basement)	2007-2008	1580 Pb/3110 Pb
316	47 E. Center (attic/soil)	2007-2008	16,600 Pb /1190 Pb
317	1039 Antimony (attic)	2007-2008	3520 Pb & 334 As
318	1122 Lewisohn (attic)	2007-2008	7640 Pb& 324 As
319	21 Bennett (soil)	2007-2008	1400 Pb, 1500 Pb, 2100 Pb
320	19 O'Neil (soil)	2007-2008	1980 Pb
321	125 W. Copper	2007-2008	1260 Pb
322	111 W. Copper (soil)	2008	1770 Pb
323	409 N. Alaska (soil)	2008	3020 Pb
324	905 N. Main (soil)	2008	2030 Pb& 1510 Pb
325	1035 Caledonia (soil)	2008	1400 Pb
326	1122 W. Quartz (attic/soil)	2008	7340 Pb, 1450 As/1350 Pb
327	23 Wells (attic/soil)	2008	2660 Pb, 839 As/1660 Pb
328	413 Virginia (soil)	2008	1410 Pb
329	1001 Lewisohn (attic)	2008	330 As
330	415 Broadway (attic/indoor dust)	2008	3540 Pb, 927 As/ 4140 Pb
331	713 N. Montana (attic)	2008	1780 Pb & 611 As
332	1010 W. Granite (attic)	2008	1350 Pb & 941 As
333	426 N. Wyoming (attic/basement)	2008	2120 Pb, 658 As/1390 Pb, 1420 Pb
334	734 S. Main (attic/soil)	2008	2510 Pb, 600 As/ 1300 Pb
335	2615 Edwards (attic)	2008	1280 Pb & 357 As
336	Boardman St. (Storm water site)	2008	acidic pH
337	Kelley Mine Enterance (SWS)	2008	Mine Waste
338	North Wyoming Street (SWS)	2008	Mine Waste

339	13 Sun View Terrace (attic)	2008	
340	117 W. Daly (attic)	2008	5240 Pb & 742 As
341	413 Boardman (soil)	2008	FSUA
342	423 W. Aluminum (attic)	2009	1250 Pb & 705 As
343	1123 Farrell (attic)	2009	2310 Pb & 555 As
344	2020 Utah (attic)	2009	1440 Pb
345	212 N. Crystal (attic)	2009	1400 Pb & 892 As
346	2121 Walnut (attic)	2009	301 As
347	2521 Princeton (attic)	2009	672 As
348	117 E. Center (attic)	2009	2340 Pb & 1230 As
349	356 E. Mercury (attic)	2009	1860 Pb & 773 As
350	1929 S. Arizona (attic)	2009	2420 Pb & 554 As
351	325 W. Gold (attic)	2009	1870 Pb & 530 As
352	829 W. Park (attic)	2009	2100 Pb & 514 As
353	1750 Grand Ave. (attic)	2009	1430 Pb & 775 As
354	1621 Dewey (attic)	2009	1590 Pb & 274 As
355	811 Galena (attic)	2009	4170 Pb & 980 As
356	41 E. Center (soil)	2009	1560 Pb
357	621 Galena (soil)	2009	1740 Pb
358	918 W. Gold (soil)	2009	1320 Pb
359	829 W. Park (soil)	2009	1270 Pb
360	635 S. Clark (soil)	2009	1200 Pb
361	212 N. Crystal (soil)	2009	3790 Pb
362	514-522 N. Wyoming (5-Attics)	2009	2500 Pb & 1090 As
363	514-522 N. Wyoming (5-soils)	2009	2940 Pb
364	235 E. Granite (attic)	2009	2250 Pb & 523 As
365	235 E. Granite (soil)	2009	4970 Pb
366	683 S. Alabama (soil)	2009	260 As
367	23 1/2 W. Woolman (soil)	2009	2020 Pb
368	417 Virginia (attic)	2009	2920 Pb & 903 As
369	1129 Caledonia (attic)	2009	1220 As
370	1131 W. Park (attic)	2009	412 As
371	604 W. Broadway (attic)	2009	2010 Pb & 444 As
372	1503 First St. (attic)	2009	4840 Pb
373	318 S. Jackson (attic)	2009	617 As

Appendix F. BRES Findings

Table D.1 2007 and 2008 BRES Findings

Vegetation/reclamation improvement (VI/RI)
Engineering evaluation (EV)
Monitor at the next BRES evaluation (M)

			Trigger Items						
			Polygon Specific		Site Specific				
Site Name	**Site ID**	**Polygon ID**	**Vegetation**	**Erosion**	**Site Edges**	**Low pH Material**	**Bulk Soil Failure**	**Barren Areas**	**Gullies**
Minnie Irvine	2	A						VI	EV
		B							
Amy Dump	4	A			M	EV	EV		EV
Alice Dump	5	A						VI	
Belle of Butte	8	A	VI		M	EV		VI	EV
		B							
Clark Street Dump	9	A							
Magna Charta Lessee Dumps	11	A			M	EV		VI	
		B							
Rising Star Dumps West	15	A	VI	EV	M	EV		VI	EV
Rising Star Dumps East	15E	A							
Curry	16	A				EV		VI	
Paymaster	17	A					EV		
Walkerville Ballfield	18	A				EV			
		B	VI						
Blue Wing Dump	19	A							
Walkerville Playground	20	A	VI		M	EV		VI	
Twilight East	24	A							EV
Venus Dumps	25	A				EV		VI	
Cripple Dump	26	A							
Wappello Dump	27	A	VI	EV		EV		VI	EV
Lexington Dump	29	A			M	EV		VI	EV
		B	VI						
		C	VI	EV					
Atlantic-1	30	A			M	EV		VI	EV
Waste Dump #5	31	A	VI					VI	
Corra 2 Dump	32	A			M	EV		VI	
		B	VI						
		C	VI	EV					
Eveline Dump	34	A			M	EV		VI	
		B	VI						
Eveline East	34E	A				EV			

Del Monte	35	A							
La Platta	36	A			M	EV	EV	VI	EV
Josephine Shaft	37	A			M	EV			
		B							
Sisters Dump	38	A						VI	EV
		B							
West Gray Rock	41	A			M	EV		VI	EV
		B	VI	EV					
Garfield	45	A						VI	EV
Missoula Mine	46	A			M	EV		VI	EV
		B							
Old Glory West	48	A							
Old Glory	49	A	VI		M			VI	
Zelia	50	A	VI		M	EV			
Moscow Dump	52	A			M	EV		VI	EV
		B							
Poulin Dump	53	A	VI		M	EV		VI	EV
Spence Dump	54	A			M				
Kennedy Dump	55	A	VI					VI	
Buffalo Dump	56	A	VI	EV		EV	EV	VI	EV
Little Mina	59	B		EV	M	EV		VI	EV
		A	VI						
		C	VI						
West Ruby Dump	66	A							
		B							
Silver Hill Dump	67	A			M			VI	
Anselmo Dump	70	A			M		EV	VI	
Anselmo Mine Yard	71	A	VI	EV	M	EV		VI	
		B							
		C							
Anselmo - Timber Yard Slope	71N	A	VI			EV	EV	VI	EV
		B	VI						
New Era 1 & 2 - Downey Shafts	72	A		EV	M				EV
Donkey Hill	72S	A			M				
Jasper Dump	73	A	VI			EV			
West Gagnon Dump	74	A			M	EV		VI	EV
National Dump	75	A			M	EV		VI	
Waste Dump #20	76	A	VI		M	EV	EV	VI	EV
		B	VI						
Late Acquisition	79	A			M	EV		VI	EV
West Steward Parking Lot	80	A			M	EV			
Clear Grit Dump	81	A			M	EV	EV		
Cellar Dirt Dump	82	A			M	EV		VI	
Mandan Park Play Area	84	A							
Waste Dump #37	90	A			M			VI	EV

		B	VI						
Robert Emmett Dumps	91	A							
Soudan - Gold Hill	93	A	VI			EV		VI	EV
		B							
Rialto Dump	94	A	VI		M	EV			
Washoe Dump	96	A	VI		M	EV			EV
Parrot Shop South Slope	97S	A	VI		M	EV		VI	
		B	VI	EV					
		C	VI						
Capri Motel - Artic Dump	100	A							
Blue Jay Mine	101	A						VI	
Emma Shaft	114	A							
Butte New England	115	A			M	EV	EV	VI	EV
		B							
Belmont Mine Yard	116	A			M	EV			EV
		B	VI						
Anderson Shaft NE	117E	A	VI	EV	M	EV		VI	EV
Anderson Shaft	117	A				EV		VI	EV
Bonanza Dump	120	A			M	EV		VI	EV
		B							
		C							
Travona Dump	121	A			M	EV			EV
		B		EV					
Otisco Dump	123	A			M	EV		VI	EV
Child Harold - 2 Dump	125	A	VI					VI	
Tension Dump	127	A				EV		VI	
Heaney Dump	129	A							
Emma Dump	132	A			M	EV	EV		
		B	VI						
Dexter Mill	133	A			M	EV		VI	
Star West Dump	134	A			M	EV	EV	VI	EV
		B							
Ophir Dump	136	A	VI			EV		VI	EV
Charlie Judd Park	142	A							
Colorado Smelter	150	A			M	EV			EV
Colorado Smelter North	150N	A			M	EV	EV	VI	
Montana St. and I-90	152	A			M		EV	VI	
		B							
Clark Tailings	155	A			M	EV		VI	
		B							
Timber Butte Mill	156	A			M			VI	EV
		B		EV					
		C							
Waste Rock Dump	158	A	VI		M	EV			

NW Syndicate Pit	159	A			M	EV			
NE Syndicate Dump - Oro Butte Shaft	160	A			M				
Blaine Center	171	A			M			VI	EV
Caldonia Triangle	172	A			M	EV		VI	
Garden Street Area	173	A			M			VI	
		B							
Buffalo South	174	A				EV		VI	EV
		B		EV					
		C							
Upper Missoula Gulch	175	A	VI		M	EV	EV	VI	EV
		B	VI	EV					
North Alice Culvert	177	A	VI		M	EV			
Leathers Property	178	A							
Ralph Sr.	179	A			M				
Tullamore Dumps	180	A			M				EV
Mountain Con - 3	181	A				EV			EV
Hornet Addition	1503	A							
La Platta Street	1511	A			M				
Black Bird	1625	A			M	EV		VI	
		B	VI						
		C	VI						

VI = Vegetation/Reclamation Improvement
EV = Engineering Evaluation
M = Monitor at the next BRES evaluation

Table D.2 BRES Polygons and Trigger Items 2009

			Trigger Items						
			Polygon Specific		**Site Specific**				
Site Name or Site Description	**Site ID**	**Polygon ID**	**Vegetation**	**Erosion**	**Site Edges**	**Low pH Material**	**Bulk Soil Failure**	**Barren Areas**	**Gullies**
Syndicate Pit Dumps	51	A	RI			X	X	X	
Little Mina 1	57	A			X	X	X		
Mountain Con - 2 Dump	58	A	RI		X	X			
Little Mina 2	68	A			X				X
		B	RI						
PA020 Dump	77	A			X	X	X	X	
		B	RI						
Original Mine Yard	78	A			X	X		X	
		B	VI	X					

Steward Mine Yard	83	A			X	X		X	
		B	RI						
Colorado Stamp Mill	92	Butte/Silver Bow Jail							
Lizzie Shaft	105	A	RI		X	X		X	X
		B	RI						
Hoy - Hickey Shafts	106	C&C Service Building							
Belmont Hoist	116	A			X			X	
Green Copper Dump	126	residences, alley, and parking			X	X			
Alliance Dump	128	residential area and alley			X			X	
Washoe Sampling Works	135	A			X				
2nd and Nevada	138	A			X				
Concentrate Spill	139	railroad track			X	X			
Fools Concentrator (FC) and FCA	153		RI		X	X		X	
Syndicate Pit Dumps	160S	A	VI		X	X		X	X
Christmas	1501	A	RI		X			X	X
Nightengale	1519	paved driveway			X				
Henriett	1539	A							
Maryland Ave and Iron St.	1656	parking lot			X			X	
Field of George St. and Kaw Ave	1796	A	VI		X	X		X	
		B							
walking trail from behind minning museum to grizzly trail	2000	walking trail			X	X			
Sites along trail section 2000	2001	rock rip rap			X				
Sites along trail section 2000	2002	rock covered			X				
Sites along trail section	2003	rock rip rap							

2000									
Sites along trail section 2000	2004	concrete ditch							
Sites along trail section 2000	2005	rock rip rap							
Sites along trail section 2000	2006	rock rip rap							
Sites along trail section 2000	2007	rock rip rap							
Sites along trail section 2000	2008	A	VI						
Sites along trail section 2000	2009	rock rip rap				X		X	
Sites along trail section 2000	2010	rock rip rap			X	X			
Walking trail to west of section 2000	2011	gravel walking path			X			X	
Site along trail section 2011	2012	rock barrier						X	
Site along trail section 2011	2013	rock/gravel Slope			X			X	
Sites along trail section 2000	2014	concrete ditch							
Sites along trail section 2000	2015	concrete culvert/ditch							
Sites along trail section 2000	2016	rock rip rap							
Sites along trail section 2000	2018	A	VI						
Sites along trail section 2000	2019	A			X				
Sites along trail section 2000	2020	culvert and rip rap							
Sites along trail section 2000	2021	gravel border				X			

Sites along trail section 2000	2022	A	VI						
Sites along trail section 2000	2023	rock rip rap						X	
Sites along trail section 2000	2024	culvert and rip rap							
Sites along trail section 2000	2025	A	VI		X				
Sites along trail section 2000	2026	rock rip rap							
Sites along trail section 2000	2027	A	VI		X				
Sites along trail section 2000	2028	rock rip rap							
Along Buffalo St. between MT St. and Main St.	2029	A			X				
Walking trail between Caledonia St. and Bell St.	2030	walking trail			X	X			X
Site along trail section 2030	2031	A	VI		X				
Site along trail section 2030	2032	A			X	X			
N of Tullamore and W of MT	2033	A			X				X
Rock Rip Rap on S side of Buffalo St.	2035	rock rip rap							
Rock Rip Rap on N site of Buffalo St.	2036	rock rip rap and drain							
Gravel Road N of site 2033	2037	gravel road				X			

Site along trail section 2000	2038/2039/2099	A	VI		X	X			
Site along trail section 2000	2040	rock slope			X	X			
Site along trail section 2000	2041/2065	A	VI	EV	X				
Site along trail section 2000	2043	rock drainage							
Site along trail section 2000	2045	rock slope				X			
Site along trail section 2000	2047	rock rip rap							
Site along trail section 2000	2048	drainage ditch			X				
Site along trail section 2000	2049	A	VI		X				
Site along trail section 2000	2050	drainage channel							
Site along trail section 2000	2051	rock rip rap				X			
Site along trail section 2000	2052	rock slope							
Site along trail section 2000	2053	cement water channel			X				
Site along trail section 2000	2054	rock rip rap				X			
Site along trail section 2000	2055	rock lined ditch			X				
Site along trail section 2000	2057	A	VI		X				
Site along trail section 2000	2059	rock lined			X	X			
Site along trail section 2000	2060	A	VI		X	X			
Site along trail section 2000	2062	A	VI		X	X			

Site along trail section 2000	2066	A	VI		X				
Off Excelsior Ave along walking trail section 2117	2067	dirt area			X			X	X
Off Excelsior Ave along walking trail section 2117	2068	A	VI					X	
Site along trail section 2030	2069	rock lined path to gate							
Site along trail section 2030	2070	rock lined ditch			X	X			
Site along trail section 2030	2071	A	RI		X				
		B	RI						
Site along trail section 2030	2072	A	RI					X	
		B							
Site along trail section 2030	2073	A	RI		X	X		X	
Site along trail section 2030	2074	A	RI		X	X		X	
Site along trail section 2030	2075	rock lined drainage ditch			X	X			
Site along trail section 2030	2076	rock covered			X	X			
Site along trail section 2030	2077	A	VI		X			X	
Site along trail section 2030	2078	rock			X	X			
Site along trail section 2030	2079	rock ditch			X	X			
Site along trail section 2030	2080	rock			X	X			
Site along trail section 2030	2081	drainage ditch			X				
Site along trail section	2082	A	RI			X		X	X

2030									
Site along trail section 2030	2083	A	VI		X	X			X
Site along trail section 2109	2084	A							
Site along trail section 2109	2085	A	RI						
Site along trail section 2109	2086	A							
Site along trail section 2109	2087	A			X				
Site along trail section 2109	2088	A	VI						
Site along trail section 2109	2089	A							
Site along trail section 2000	2090	A	VI		X				
Site along trail section 2109	2091	A						X	X
Site along trail section 2109	2092	A							X
Site along trail section 2109	2093	A	VI						
Site along trail section 2109	2094	gravel road							
Site along trail section 2109	2095	A	VI		X				X
Site along trail section 2109	2096	A			X				
Site along trail section 2109	2097	A			X				
Site along trail section 2000	2098	rock covered							
Site along trail section 2000	2100	rock lined ditch							
walking trail connected to	2101	A	VI		X				

section 2109									
Site along trail section 2109	2102	A			X				
Site along trail section 2000	2103	culvert							
Site along trail section 2101	2105	A	VI						
Site along trail section 2101	2106	rock rip rap drainage							
Site along trail section 2109	2107	A							
Site along trail section 2109	2108	A B	 VI		X			X	
Walking trail from Steel St. to Park St.	2109	walking trail							
Site along trail section 2109	2110	A							
Site along trail section 2109	2111	A							
Site along trail section 2000	2115	rock rip rap							
Section of walking trail along Western Ave	2116	walking trail							
Walking trail off of Excelsior Ave	2117	walking trail							
Site along site 2125	2119	A			X				
Site along site 2123	2120	A							
Site along site 2124	2121	A							
Section of walking trail along Western Ave	2122	A	RI						
Section of walking trail	2123	walking trail			X	X			

between Western Ave and Emmet Ave.									
Section of walking trail along Western Ave	2124	walking trail							
Section of walking trail off Copper St and grass section	2125	walking trail			X				
North side of Buffalo St. east of Main St.	2126	A	RI		X			X	
		B	RI						
Site North of Anaconda Road	2136	A			X				
Site North of Anaconda Road	2140	A		X	X		X		X
Site North of Anaconda Road	2143	A			X	X		X	
		B	RI	X					
South slope of the MAC parking lot	2145	A	VI		X	X			X
Field south of MAC	2146	A	VI	X	X				X
North of Iron St. W of Shield Ave	2150	A	RI	EV	X	X		X	X
		B							
Railroad track from Arizona St to Shields Ave	2152	RR tracks			X	X			X
Paved Parking lot N of Iron St. and E of Shield Ave.	2156	paved parking lot			X				
South of Paved Parking Lot (site 2156)	2157	A	RI	X	X				X
Old Railroad track E of Arizona St. and S of	2165	rock covered			X	X			

Aluminum St.									
South of Iron Street E of Warren Ave.	2166	barren area		X		X		X	X
Along railroad track section 2152	2169	rock covered			X	X			
Along railroad track section 2152	2172	rock lined ditch			X	X			
Along railroad track section 2152	2173	A	RI		X			X	
Rock covered drainage areas E of Arizona St. and North of Iron St.	2174/2177	rock covered drainage area							
East of Arizona St and North of 3rd St.	2176	A B	RI		X	X		X	
East of Arizona St. and North of 3rd St.	2175/2183	drainage ditch and newly (2008) reclaimed South edge			X	X			
East of Arizona St. and S of Iron St.	2178	rock lined ditch			X				
East of Arizona St. S of Aluminum St. and N of Iron	2179	concrete wall and dirt							
North of railroad track section 2152	2180	A	VI		X	X			
East of Arizona St. S of Aluminum St. and N of Iron	2181	rock covered			X	X			

East of Arizona St. S of Aluminum St. and N of Iron	2182	A	RI						
Along railroad track section 2152	2184	rock covered				X			
Along railroad track section 2152	2186	rock covered			X	X			
Along railroad track section 2188	2187	rock covered							
Railroad Track section off of 2152 to the South	2188	railroad track				X			
Along railroad track section 2188	2189	Lime rock next to railroad tracks			X	X			
Along railroad track section 2188	2190	rock covered			X	X			
Along railroad track section 2152	2192	rock covered				X			
Along railroad track section 2152	2195	A	RI	EV	X	X		X	X
Section of railroad track south of 2nd St. W of Shield Ave.	2203	rock covered							
	2204	RR track in alley			X	X			
Site along railroad track E of Shield Ave	2205	A	VI			X			
Section of railroad track West of Shield	2206	Lime rock covered area				X			

Ave., S of 2nd St.									
Site along railroad track east of Shield Ave	2207	rock covered				X		X	
Railroad track in alley	2208	rock coved RR track							
Along railroad track section 2211 and 2203	2210	A			X			X	
Section of railroad east of Harrison Ave. and South of 1st St.	2211/2224	rock covered							
Along railroad track section 2211	2212	gravel, dirt and lime rock along railroad			X				
corner of 3rd and Nevada	2213	railroad track							
N of Civic Center Rd., S Shield Ave. by Baseball field	2214	A			X				X
N of Civic Center Rd., S Shield Ave. by Baseball field	2216	A	VI		X				
N of Farrell St.	2217	rock covered							
Base of rock slope 2217	2221	A	VI					X	
Corner of 3rd and Nevada	2222	A	RI		X	X		X	
East of Warren Ave by Railroad track	2226	A	RI					X	
Railroad track N of 3rd St. W of Nevada Road	2227	bed of active Railway							

Railroad track N of 3rd St. W of Nevada Road	2228	slope of railway, mainly rocks							
Along site 2235	2234	Lime rock barrier next to RR							
Railroad track S of Iron St. from Montana St. to SW edge of Granite Mtn. Road	2235	railroad track							
Along site 2235	2236	lime rock along RR							
Along site 2235	2238	A	VI		X	X			
Along site 2235	2240	south side railroad mainly rocks			X				
Along site 2235	2245	A	VI		X				
Along site 2235	2248	A			X				
Along site 2235	2249	A	VI		X				
Along site 2235	2251	A	VI		X				
Along site 2235	2253	A	VI		X	X			
Along site 2235	2256	A	VI		X				X
South Side of railroad track by Centennial Ave.	2259	A B	 VI	 X	X				X
Along Railroad St West of Utah St	2267	A	RI		X			X	
Along Railroad St West of Utah St	2268	A	RI		X			X	
North of Centennial Ave along Lower Missoula Gulch	2269	A	VI	X	X	X	X		
Along Railroad St West of	2270	A	RI		X			X	

Utah St									
By corner of Railroad St. and Delaware Ave.	2272	A	RI						
By corner of Railroad St. and Delaware Ave.	2273	rip rap drain							
By corner of Railroad St. and Delaware Ave.	2276	A	RI		X			X	
By west end of Metro Storm Drain (Site 2310)	2288	A	VI						
Corner of Grizzly Trail and Lynx Trail	2302	gravel parking lot						X	
Metro Strom Drain	2310	A			X	X		X	X
203 Missoula	2322	alley and private property			X				
Corner of Platinum St. and Excelsior Ave.	121NW	A B	RI		X			X	
Catch Basin 08	CB08	A	VI		X		X	X	X
Catch Basin 09	CB09	A			X	X		X	