Not only has mining played a significant role in the United States, but for hundreds of years mining has been a vital contributor to the economic and social development of New Mexico as early as the 1500s. One of the earliest gold deposits was in the Ortiz Mountains (Old Places district) in 1828, 21 years before the California Gold Rush in 1849. At the time the U.S. General Mining Law of 1872 was written, there was no recognition of the environmental consequences of direct discharge of mine and tailings into the nation’s rivers or streams and the impacts of the activity on the availability of drinking water supplies, and operational and aquatic habitats. Miners operating on federal lands had little to no requirement for environmental protection until the 1970s and 1970s, although the dumping of mine waste and tailings directly into the nation’s rivers was halted by an Executive Order in 1955. It is important to recognize that these early mines were not breaking any laws, because there were no laws to break. Today, there are more than 2,000 inactive or abandoned mine features in 27 districts and prospective areas (New Mexico Bureau of Geology and Mineral Resources, 2014). The New Mexico Bureau of Geology and Mineral Resources has published and updated databases on the districts, mines, deposits, occurrences, and sites since 1967. The inventory and prioritization for reclamation has not been accomplished in New Mexico. Some of these inactive or abandoned mine features can pose serious health, safety and/or environmental hazards, such as open shafts and adits (some concealed by deterioration or vegetative growth), tunnels that contain deadly gases, highwalls, encounters with wild animals, radon and metal-laden water. Some sites have the potential to contaminate surface water, groundwater and air quality. Heavy metals in mine waste or tailings and acid mine drainage can potentially impact water quality and groundwater. A recent example is the Golden King mine in Colorado where approximately 3 million gallons of acid water evolved soil and tail debris from the mine portal, pyrite rock and soil from adjacent waste rock dumps, and were deposited in Cement Creek, and ultimately, flowing downstream to the Animas and San Juan Rivers (Gibbs et al., 2015). Environmental accidents also have occurred at some New Mexico mine sites, mostly before the 1980s. In July 1979, 370,000 cubic meters of radioactive water containing 1,000 tons of contaminated sediment from a failure of the United Nuclear uranium tailings dam traveled 110 km downstream in the Pecos River in western New Mexico. Evidence of high radioactivity at the Guadalupe West waste rock site, and an adjacent water well and the Animas River was reported by Guadalupe West Mining Company in 1979, but this accident was only recognized as early as 1974, but was not evaluated until 2004.

Many mine and federal agencies have mitigated the physical safety hazards by closing these mine features, but very few of these reclamation efforts have examined the long-term chemical effects of these mine sites. There is still potential for environmental effects long after remediation of the physical hazards, as found in several areas in New Mexico (for example Terrero and Questa mine; McLemore et al., 2001, 2009, 2010). Some of these observations only come from detailed electron microscope studies that are not part of a government remediation effort (McLemore et al., 2009, 2010).

The objective of our research is to develop a better procedure to inventory and characterize inactive or abandoned mine features in New Mexico, using the Lucky Don and Little Dave uranium mines in the Chupadero mining district as an example. The hazard ranking of mine openings and features, using BLM ranking methodology will be utilized for most sites (Bureau of Land Management, 2014). Also we wish to suggest remediation activities that would manage or mitigate dangers to the environment and public health, while taking into consideration historical, cultural and wildlife issues and mineral resource potential.

### Methodology

The following methods were used during the visit to the Lucky Don mine, and the readings collected from the scintillometer mapping and the paste pH will be used to determine future work in the Lucky Don area.

#### Geologic and Scintillometer Mapping

A scintillometer is an instrument which measures naturally occurring radioactivity and displays that data as counts per second (cps). Using standard survey and mapping techniques and instruments, including the RS-111 HANDY SCINT, a lo-scope of 3 feet from the Guadalupe West waste rock site, (U.S.GS Annals, 2002), and mapping of the locations of the stabi adit and paste piles. The 16 points that can be seen on the map the locations used in mapping the paste and the most important are accompanied by scintillometer readings for that exact location. The importance of the various scintillometer readings is to provide information on radon and metal activity in the vicinity of the adits and the paste piles, and around the entire vicinity of the mine. The values from the scintillometer can be seen at each point after the dust has settled. Paste pH was recorded at the initial survey point, as well as the base and the berm of the waste rock pile.

#### Paste pH

Paste pH measurements of representative samples collected from the berms along the waste pile were determined following the procedure outlined in the U.S. Bureau of Mines Technical Service Center report, 132 p., http://www.usbr.gov/docs/goldkingminereport.pdf. To determine the paste pH of each of the paste piles, the pH and paste configuration at the location and 6 ft away from the waste pile were noted. The importance of determining the paste pH is a preliminary indication of whether material is likely to produce acidic drainage. These tests do not, however, provide any data regarding whether acidification may occur or the rates at which acid generation and neutralization reactions will ensue.

#### Summary

The Lucky Don mine cuts across a NE trending normal fault that displaces the San Andres Formation against the Yermo Formation. The Lucky Don mine is located on the upper side of the San Andres Formation and formed on the lower side on the Yermo Formation. The mine features include three shaft adits, one exploration adit, one pile, two washed-out mine roads, and one underground survey adit. The shaft adits were primarily constructed for the purpose of draining the mine, and of 4ft high and 6 ft wide. The other two adits had dimensions approximately 6 ft high and 6 ft wide. One exploration shaft adit, and one paste pipe were mapped by GPS surveying (Figure 1). The area west of the shaft adit was the top of the waste pile. One main waste pile was found at the Lucky Don mine. The waste pile is located west (below) of the four-stub adit. The shaft adits was measured to be draining at roughly 37’ west-southeast. An old wooden ore shoot still stands along the west-southeastern slope of the Lucky Don waste pile. Most of the wood appeared to be rotted, being deemed unsafe. Other mining related buildings were not observed. The only other mining feature present was a washed out road that was used during when the mine was active. The road runs east to west, just north of Lucky Don. There is evidence of several drilling holes, indicating the Lucky Don mine was not abandoned. No obvious reclamation activities were observed. The shaft adits are partially filled with sediment and rocks. The waste pile has not been reclaimed.

### Recommendations

Additional testing includes whole rock analyses and petrology of the waste rock material and estimate of volumes and tonnages of waste and rock piles. Final Hazard ranking will be determined. Determination of hydrological conditions will be made (estimate annual run-off from past hauls, depth of groundwater from State Engineers and NMBRMR data, estimate runoff, erosion rates).