New Mexico Wildlife and Fisheries Resource Potentially Affected by the Gold King Mine Toxic Liquid Release

New Mexico Department of Game and Fish
August 14, 2015

BACKGROUND

On August 5, 2015 approximately 3 million gallons of toxic liquid spilled from the Gold King Mine near Silverton, Colorado into Cement Creek, subsequently flowing into the Animas River. The spill resulted in immediate insult to several water quality parameters including pH, turbidity, sedimentation and toxic substances, particularly heavy metals. Metals of particular concern that were released by the spill appear to include but are not limited to arsenic, copper, lead, mercury, and selenium. The spill and its effects on water quality were conveyed down the Animas River into New Mexico, potentially impacting aquatic and terrestrial wildlife in the state.

AFFECTED AREA

The areas in New Mexico most directly affected by the Gold King Mine spill are the Animas River proper from the Colorado-New Mexico border to the Animas-San Juan River confluence, the San Juan River from the Animas River confluence downstream to the New Mexico-Utah border, and water bodies that draw water from the rivers. In general, tributaries to the Animas and San Juan rivers in New Mexico were not directly affected by the spill nor was the San Juan River upstream of the Animas River confluence, notably including the quality trout waters in the Navajo Dam Tailwater reach. Terrestrial habitat surrounding affected waters could also be impacted.

AFFECTED RESOURCES

Aquatic Wildlife

<u>Pre Spill Conditions</u>

Designated Use and Management-The Animas River designated uses are “coldwater aquatic life” from the Estes Arroyo upstream to the NM-CO line and “marginal coldwater aquatic life” from the confluence with the San Juan River upstream to Estes Arroyo (74-6-4 NMSA 1978, 20.6.4 NMAC). These reaches of the Animas River support several native and non-native fish species.

The San Juan River, from the Animas confluence downstream to the Navajo Nation Border, has designated uses of “marginal coldwater aquatic life and warmwater aquatic life” (74-6-4 NMSA

1978, 20.6.4 NMAC). This reach of river is managed for recovery of federally endangered fishes and conservation of other native fish species.

Fisheries-Several fish population surveys have been conducted throughout the entire reach of the Animas River. The most recent fish survey conducted by the Department was in 1997. During this survey eight different fish species were captured and bluehead sucker, flannelmouth sucker, and speckled dace were the most abundant. Surveys conducted from 1997 to 2007 in the Animas River resulted in capturing seventeen different fish species with bluehead sucker, flannelmouth sucker, brown trout, and rainbow trout representing most of the catch composition (Valdez, 2008). Recent surveys, as of spring 2015, indicate similar species presence and abundance as data from previous surveys. Adult razorback sucker were also captured in the lower Animas River during the spring 2015 surveys (USFWS unpublished data).

The San Juan River downstream of the Animas River is designated as critical habitat for federally endangered Colorado pikeminnow and razorback sucker. The Department, in cooperation with the U.S. Fish and Wildlife Service (USFWS) and other partners, participates in annual adult, juvenile, and larval fish surveys in the San Juan River to monitor and investigate population status of these and other species. A Range Wide Conservation Agreement for roundtail chub, bluehead sucker, and flannelmouth sucker, all found in both the San Juan and Animas rivers, was implemented and signed by several federal and state agencies, including the Department, and tribes in 2004. The agreement lays the foundation for conservation strategies for the long term persistence of the three species. Sportfish are rare in the San Juan River downstream of the Animas confluence, with the exception of channel catfish which are actively removed to facilitate the recovery of the endangered fish.

Macro-invertebrates-The Department also has macro-invertebrate survey data from the Animas and San Juan rivers that documents at least seventeen different taxa with *Tricorythodes* (mayfly) and *Hydropsyche* (caddis fly) representing the largest proportion in the Animas River.

Angler Use-The Animas River provides angling opportunity and according to the Department Angler Use database it receives an average of 3,393 angler days per year. There are three ponds in the lower Animas River watershed that also provide angling opportunity including Lake Farmington, Aztec Pond, and Tiger Park Pond. According to the database these ponds receive an average of 23,500 angler days per year combined. Based upon the National Survey of Fishing, Hunting, and Wildlife Associated Recreation of New Mexico (USFWS 2011) an angler day is valued at $60 to the state and local economy. Combining the Animas River and ponds the total average angler days per year is 26,933 and valued at about $1.6 million dollars.

Stocking-The Department stocks a two mile reach of the Animas River through Aztec, NM twice per month throughout the year with 200 to 500 catchable rainbow trout at each event. The USFWS has stocked razorback sucker and Colorado pikeminnow in the lower Animas River annually since 2011 and into the affected reach of the San Juan River routinely since the mid-1990's (Furr 2015).

Acute Effects

Fisheries-The initial concern(s) for acute effects are fish kills associated with low pH and concentration of heavy metals especially copper. Typically acute exposures to low pH conditions alone do not result in fish mortality, but lethal conditions can occur in acute exposure (96 hours) when combining low pH and low concentrations of copper (Colt and Tomasso 2001). Copper and other heavy metals can bind to gill tissues and cause ionoregulatory issues that result in death. The pH levels in the Animas River through New Mexico were lowered by the plume, but remained near neutral conditions (pH 7). No acute mortality was observed in the Animas or San Juan rivers. However, it should be noted that eggs and larval fish are likely more susceptible to the types of water quality impacts caused by the spill but effects on these life stages are more difficult to observe. A Department biologist has been on site since the plume moved through New Mexico and has not observed any evidence of a fish kill. Site visits will continue to monitor for signs of fish and macro-invertebrate kills.

Macro-invertebrates- Little is known about acute toxicity of acid mine runoff and heavy metal toxicity to North American invertebrates. However, acute toxicity may reduce total abundance and richness (diversity) of the invertebrate community, especially of certain mayflies (Brinkman and Johnson 2007) and crustaceans (Levent et al. 1999). It is likely that abundance and diversity would recover from an acute exposure.

Angler Use-The Department has recommended anglers do not fish or consume fish from the Animas River and affected downstream areas. This will result in some short-term loss of angler days and expenditures in the local economy.

Stocking-The Department's next scheduled stocking is the second week of September for the Animas River. This stocking and other fall events will likely be postponed until water quality conditions return to pre-spill conditions.

Chronic Effects

Fisheries-The potential chronic effects of the spill on fish populations are the most concerning. Since fish are contained in the aquatic environment exposure is unavoidable and long term exposure to heavy metals can decrease individual fish health and population sustainability. Although at this time the long term heavy metal concentration in the Animas River is unknown, chronic exposure to heavy metals can have significant negative impacts to fish behavior (Atchison et al. 1987), gonad and embryonic development (Jezierska et al. 2009), and can cause other deleterious effects (Govind and Madhuri 2014). Heavy metals can also bio-accumulate into fish tissues and organs (Vinodhini and Narayanan 2008) and be transferred to other wildlife species that prey on fish (e.g., eagles, otters, etc.). Sedimentation from the spill may negatively impact fish habitat if not flushed from the system. Of particular concern for the endangered fishes of the San Juan River is the potential for increased levels of selenium. Selenium levels in the San Juan River prior to the spill were an existing concern (Buhl and Hamilton 2000) and continue to be investigated as a potential impediment to recovery of both Razorback Sucker and Colorado Pikeminnow in the Colorado River Basin (Buhl and Hamilton 2000, Hamilton et al. 2005). Any increase in selenium in the San Juan River as a result of the spill could exacerbate

existing concerns. Other toxic heavy metals pose similar concerns as potential impediments to recovery of endangered fish.

Macro-invertebrates- Chronic effects of acid mine runoff and heavy metal contamination may include loss or changes in distribution of certain taxa, especially mayflies, stoneflies, and beetles (Clements et al. 2000). Loss of certain taxa may impair nutrient cycling and decomposition through changes to functional feeding groups (Clements et al, 2000). Bioaccumulation of heavy metals also occurs, specifically in caddisflies, and may affect predatory organisms (Maret et al. 2003). Macro-invertebrates are also sensitive to sedimentation and mine spill materials could alter and negatively impact habitat.

Angler Use-Several of the lower Animas watershed ponds are filled with water diverted from the river. Water diversions have been closed until further notice. Pond levels will likely decrease due to evaporation and water quality could degrade beyond parameters to support fish and become unsuitable for stocking. This would result in a loss of angler days and revenue for the local economy. Depending on spill conditions and water quality recreational angling in the Animas River may be impacted long-term.

Stocking-Ongoing stocking efforts could be affected depending on the persistence of heavy metals and spill materials. Long-term assurance of water quality conditions and persistence of acceptable levels of heavy metals would be needed prior to commencing stocking efforts. In the event that fish kills occur in Lake Farmington, Aztec Pond, and/or Tiger Park Pond as a result of being disconnected from the Animas River, the fish lost would need to be replaced through stocking.

<u>Recommendations that will require additional resources</u>

- Fish health and population monitoring in the Animas and San Juan rivers including larval fish monitoring (long and short term)
- Water quality and sediment monitoring including heavy metal testing (long and short term)
- Macro-invertebrate monitoring (long and short term)
- Fish tissue testing for heavy metals (long term)
- Economic impact monitoring of angling opportunity loss (if affected long term)

Terrestrial Wildlife

<u>Pre Spill Conditions</u>

Ungulates-Mule deer and elk are both found in the affected area. It is likely that some mule deer and elk in the affected area utilize drinking water and forage resources in the San Juan/Animas riparian zone.

Other Mammals-The Animas and San Juan river corridors provide habitat for numerous species of small mammals including carnivores (coyote, red fox, gray fox, raccoon, striped skunk, river otter, and historically mink); rodents (American beaver, muskrat, and porcupine); and other smaller species such as ground squirrels, rats, mice, and bats.

Hunter and Trapper Use-Populations of both mule deer and elk in this area are relatively stable, providing recreational opportunities. In 2014 there were 457 deer and 733 elk licenses sold in the region (Game Management Unit [GMU] 2). It is important to note that the affected area is only part of this GMU.

Non-ungulate mammal species (protected and unprotected furbearers) that are most utilized in the area by hunters and trappers are beaver, muskrat, coyote, red fox, and gray fox. River otter is present but is a non-harvestable furbearer in New Mexico.

Acute Effects

Ungulates-At this time we cannot predict with any accuracy, what the effects of the spill might be on mule deer and elk. The toxicity of contaminants depends on a variety of factors such as; the amount of contaminant absorbed, the concentration of the contaminant, whether it was a single event or chronic exposure, the route of exposure, and many other factors. Mule deer and elk are large, highly mobile species that typically do not concentrate in a localized area for long periods of time. Because of their mobility, they are less likely to experience acute or chronic effects from the spill than those species that spend their entire life in riparian zones. There is still a possibility that mule deer and elk could intake contaminated materials through ingestion of contaminated water, soil, or forage (vegetation). Excessive uptake of certain minerals can be toxic to deer and elk; however there have been no reports of immediate impacts to these species.

Other Mammals-As with ungulates, potential acute effects to other mammals in general are difficult to predict without better information on the constituents of concern that have been transported into these rivers by the spill and the extent of contamination of river water, backwaters of the river, river sediments and riparian vegetation. Three species (beaver, muskrat, and river otter) are semi-aquatic species that spend a substantial part of their life history in water, both while foraging for food and travelling. These species are most likely to come into direct contact with contaminants in river water, either through ingestion of food items and water, or by contact with eyes or nasal membranes. Other species that are entirely or primarily terrestrial, such as most carnivores, most rodents, and bats, may ingest contaminated river water. Ingestion of some metals by mammals can result in short-term health issues although this is dependent on the specific metals, their concentration, and the behavioral responses of the animals to avoid water that may be contaminated.

Chronic effects

Ungulates-If contaminants concentrate in an area used by mule deer and elk, the possibility exists for some heavy metals to accumulate in tissues of species living in the contaminated area. Because mule deer and elk are highly mobile and the contamination continues to flow downstream, severe chronic effects are not expected at this time.

Other Mammals-The long-term effects of contamination by metals is possibly detrimental to mammal populations in the affected area although as with acute effects, this depends on the metals involved and their concentrations. Some metals can bioaccumulate in certain animal and plant species and could be further concentrated in predators and browsing species that

consume them, with possible impacts to the animal's health and survival. Species that potentially could be most affected by bioaccumulation of metals include beaver (which forage on riparian and aquatic plants), muskrats (which forage on riparian and aquatic plants and mollusks and other small aquatic animals), and river otter (which forages on fish and crayfish).

Hunter and Trapper Use – Currently we have insufficient information to recommend that hunters and trappers should forego harvesting mammals in the affected area. We recommend that hunters and trappers make note of any mammals that are dead or appear sick when they are hunting and trapping and contact the Department. We will continue monitoring mule deer and elk as the situation progresses.

Recommendations that will require additional resources

- Possible tissue/hair/fecal sampling of mule deer and elk if effects are expected (long term)
- Continue monitoring population demographics of mule deer and elk (long term)
- Possible tissue and hair sampling of non-ungulate mammals that are harvested by hunters and trappers, particularly of semi-aquatic species like beaver and muskrat, for toxicity testing (long term)
- Possible tissue and hair sampling of non-consumable mammal species (e.g., mice, rats) that use the riparian zone of the affected area for toxicity testing (long term)
- Monitoring of non-ungulate mammal populations through surveys of these species and communication with local resource managers and sportsmen (short and long term)

Amphibians and Reptiles

Pre Spill Conditions

Following internal NMDGF files and Degenhardt et al. (1996), 8 amphibians and 24 reptiles (1 turtle, 12 lizards, and 11 snakes) are found in the affected area, and none are federally or state listed.

Acute Effects

Amphibians may be impacted directly by the mining spill, given they use their skin to breathe and to absorb water, and because of their close association with water (Duellman and Trueb 1986). The impact of such metals as aluminum on amphibians is complex, being dependent upon the hardness and pH of the water, as well as the particular physiology of a species of amphibian (Freda 1991). Amphibians most likely to encounter the effects of the spill would be tiger salamander, northern leopard frog, and Woodhouse's toad. Reptiles do not breathe or drink through their skin and therefore may not be quite as at-risk as amphibians. However, the single turtle known from the area, painted turtle, is one that is highly aquatic and therefore would have a high probability of being impacted by the spill through direct acute contact.

Chronic Effects

A primary concern is bioaccumulation of toxic materials, either directly from the sediment, or by way of linkages in the food chain (e.g., amphibians eating invertebrates with accumulated toxic materials, snakes eating amphibians with accumulated toxic materials). Another concern is alteration of water chemistry in the affected areas, which can have negative impacts on amphibians, such as acidification of the system (Lannoo 2005). Amphibians most likely affected over the long-term would be tiger salamander, northern leopard frog, Woodhouse's toad, and, because it is both highly aquatic and a significant predator of small invertebrates and animals, American bullfrog. Reptiles most likely to be affected would be painted turtle and black-necked gartersnake, the latter because it preys upon invertebrates, small fish, and frogs and toads.

Recommendations that will require additional resources

- Walking surveys for signs of sick or dead amphibians, particularly at the tadpole stage (short term)
- Dip-netting surveys for signs of sick or dead amphibians, particularly at the tadpole stage (short term)
- Tissue sampling of amphibians at various life history stages for signs of bioaccumulation (long term)
- Tissue sampling of gartersnakes for signs of bioaccumulation (long term)

Birds

Pre Spill Conditions

Waterfowl-Annual aerial waterfowl surveys are conducted along the Animas and San Juan rivers once a month from October through January. This area is an important migratory stopover point for waterfowl and holds thousands of geese and hundreds of ducks through the winter. The area also has a resident breeding population of Canada geese and dabbling ducks.

Shore birds-Great blue herons use both rivers, primarily during migration and winter.

Raptors and Corvids-The Animas and San Juan rivers provide year-round habitat for several species that would be expected to consume fish and waterfowl, including great horned owls, golden eagles, red-tailed hawks, turkey vultures, and common ravens. This is an important wintering area for bald eagles. Osprey have been reported breeding along these rivers and are known to use the area during migration. The state threatened peregrine falcon has been reported rarely in and around Aztec and Farmington, NM.

Other Avian Species-The San Juan River near the confluence with the Animas River is proposed critical habitat for the federally threatened yellow-billed cuckoo. The federally endangered southwest willow flycatcher has also been reported along these rivers. In addition, Rio Grande wild turkey occurs along both rivers and Merriam's wild turkey occurs north of Aztec, NM.

Hunter Use-The Animas and San Juan rivers provide some waterfowl hunting opportunity in San Juan County. During the 2014-2015 hunting season, voluntary hunter harvest reports totaled 89 ducks, 5 Canada geese, and 10 American coots harvested in the county.

Acute Effects

The initial concern for acute effects was mortality from toxicity related to sludge-covered waterfowl. Acute effects from heavy metal exposure are uncommonly reported in free-ranging birds (USGS 2013). The affected area has been surveyed by helicopter and on the ground since the plume moved into New Mexico. There has been no evidence of avian mortality.

Hunter Use - The Department is not currently recommending any changes in hunter use of harvested birds.

Chronic Effects

Direct exposure to contaminated water and sediment, ingestion of contaminated vegetation, fish, invertebrates, and wildlife at a higher trophic level can lead to chronic exposure and bioaccumulation. Heavy metal contamination can directly impact exposed birds through an increased susceptibility to predation and disease, feather damage leading to hypothermia, emaciation, and a variety of sublethal effects that lead to death (Cristol et al. 2008, Cristol et al. 2012 , Iko et al. 2009, USGS 2013). It can also cause indirect effects such as decreased reproductive success and behavioral changes in offspring (Heinz 1979, Blus et al. 1985, Cristol et al. 2012). Heavy metals can also impact predatory birds such as raptors and herons through bioaccumulation in wildlife tissues and organs (Wood et al. 1996, Hopkins et al. 2007, Cristol et al. 2008).

Hunter Use - Currently, there are no anticipated impacts to hunter use. Detections of high levels of heavy metals in edible portions of waterfowl may result in guidelines regarding harvest and ingestion of certain body parts.

Recommendations that will require additional resources

- Waterfowl tissue testing for heavy metals (short and long term)
- Avian influenza testing- recommended because heavy metal toxicity may mimic avian influenza symptoms (long term)

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