FINAL

Site Investigation Report

Smoky Canyon Mine, Caribou County, Idaho

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9.0 BASELINE ECOLOGICAL RISK EVALUATION

A baseline ecological risk evaluation was conducted to characterize the risk of adverse effects to terrestrial and aquatic wildlife in the study area under current conditions. In addition to wildlife, potential effects to livestock were evaluated to assess potential reclamation needs. The framework for the evaluation was based on the Area-Wide RMP, which was developed by IDEQ as a tool to streamline assessment of risks in the Southeast Idaho Phosphate Mining Resource Area (IDEQ, 2004).

The Area-Wide RMP is based on results and conclusions of the Area-Wide HHERA (IDEQ, 2002). The Area-Wide HHERA evaluated risks to ecological receptors based on a regional scale encompassing the phosphate mining resource area. An extensive evaluation of exposure and associated risk was performed for a wide range of receptors including avian and mammalian wildlife, terrestrial vegetation, and aquatic organisms. Risks from several COPCs were evaluated including cadmium, chromium, copper, nickel, selenium, vanadium, and zinc. The overall conclusions can be summarized as follows:

- Area-wide populations of terrestrial and aquatic ecological receptors were not at risk, although “local” or “subpopulations” in the vicinity of mine sites may be affected by locally elevated COPC concentrations;

- On an area-wide basis, only risks from cadmium and selenium were potentially unacceptable;

- COPCs present in impacted riparian areas pose the highest potential for unacceptable risks to wildlife;

- Risks to aquatic biota were more highly variable, and local populations of aquatic life are most likely to be significantly affected by Site-specific conditions.

Included in the Area-Wide RMP are risk-based removal action levels for COPCs in surface water, sediment, riparian/fluvial soil, and vegetation that are judged to be protective of ecological receptors and livestock in the region. The removal action levels were developed to support a risk assessment process that is consistent with the streamlined approach described by EPA for Non-Time-Critical Removal Actions (EPA, 1993). Where applicable, the removal action levels are compared with Site-specific data for surface water, sediment, and vegetation, as presented for the nature and extent of contamination evaluations in Section 7. Those media represent the primary exposure points/media for the ecological receptors of concern cited in the Area-Wide RMP, and for the Site.

Removal action levels are not available for some environmental media that were collected for the SI. In these cases, COPC concentrations in Site samples are compared to the concentrations used in the Area-Wide HHERA. If concentrations at the Site are similar to, or lower than these regional levels, the associated risks were assumed to be similar to the results of the Area-Wide HHERA. The Area-Wide HHERA regional concentrations are based on area-weighted averages from a combination of impacted and unimpacted sites within the Southeast Idaho Phosphate Mining Resource Area. Correspondingly, unimpacted sites represented over 90 percent of the data used to estimate the regional exposures.

IDEQ excluded wide-ranging wildlife species, such as deer and elk, and small mammals from the Area-Wide RMP because they are generally abundant in the Southeast Idaho Phosphate Mining Resource Area and populations are not likely to be affected. To be consistent with the Area-Wide RMP, wide-ranging wildlife and small mammal populations are also excluded from this risk discussion. Although small mammal populations are not considered, localized risks to individual small mammals are evaluated.

The ecological risk evaluation includes all COPCs, but the discussion focuses on selenium because it is the COPC for which concentrations are most elevated at the Site. As noted in Section 7, concentrations of some other COPCs are elevated in some locations, but always in locations where selenium is also elevated and usually to a greater degree. Therefore, selenium seems to be a good indicator of mine-related effects.

9.1 Surface Water

The surface water evaluation is based on the IDEQ removal action levels. Two general categories of surface water were identified, regulated and non-regulated. Regulated water bodies are those that fall under regulation of the Clean Water Act and state water quality criteria. Generally, water bodies that are contiguous with streams or rivers and have designated specific beneficial uses are considered to be regulated. IDEQ's risk management decisions for these areas are based on protection of aquatic life. Non-regulated water bodies generally include closed-system ponds or impoundments designed to control sedimentation, overflow, or other function; and that do not discharge to regulated water bodies and are not intended to support aquatic life. These water bodies are generally not part of the natural landscape, nor do they affect regulated water bodies. Ecological risk evaluation for these water bodies is based on watering livestock or use by transitory wildlife that may drink from them.

9.1.1 Regulated Surface Water

Regulated surface water at the Site consists of stream segments and springs that are hydrologically connected via surface water flow pathways. The removal action levels for COPCs are consistent with the Idaho's chronic water quality standards and are intended to be

generally protective of all aquatic life including fish, invertebrates and aquatic vegetation. Therefore, comparison of surface water data to removal action levels provides a conservative assessment of risks to these receptors. For selenium, the standard is 0.005 mg/L (total) (Table 7-1). For many of the other COPCs, the standard is dependent on the hardness of the water (see Table 7-9).

Exceedances of the selenium standard were primarily focused in three areas: Pole Canyon Creek below the external overburden disposal area (LP-1 and LP), Hoopes Spring (HS, HS-1 and HS-3), and in Sage Creek in lower Sage Valley below the confluence with Hoopes Spring (LSV 4) (Table 7-10). Surface water at lower Pole Canyon Creek contained the highest selenium concentration observed, exceeding the removal action level by more than ten fold. Water quality at Pole Canyon Creek also exceeded the standards for cadmium, nickel and zinc. However, during the two years of the SI, spring flows from Pole Canyon Creek rapidly dissipated on the Sage Valley floor and was not observed to enter the north fork of Sage Creek. During the remainder of the year, most of the streambed below the overburden disposal area was dry.

In recent years, selenium concentrations in Hoopes Spring have consistently exceeded the water quality standard, but no other COPC concentrations exceed standards. Selenium concentrations in Hoopes Spring are much lower than in Pole Canyon Creek and exceeded the removal action level by approximately two-fold. In Sage Creek below the confluence with Hoopes Spring, selenium concentrations also exceed standards, but concentrations are much lower, and the frequency at which standards are exceeded is also lower (Table 7-10). As noted in Section 8, flow from Hoopes Spring contributes more than one-half of the flow in Sage Creek downstream of their confluence. Correspondingly, the observed selenium concentrations in Sage Creek are almost solely due to input from Hoopes Spring. Selenium concentrations in Crow Creek below inflow from Sage Creek did not exceed the selenium standard. These data indicate that risk to aquatic resources in Sage Creek are restricted to the section between Hoopes Spring and Crow Creek and are due to input from Hoopes Spring.

9.1.2 Non-Regulated Surface Water

Non-regulated surface water at the Site consists of overburden seeps and detention ponds constructed to capture seep water and stormwater runoff. IDEQ has established three removal action levels for selenium in non-regulated surface water, depending on habitat and use of the water. One level was established for each of the other COPCs. The most stringent selenium criterion for non-regulated surface water is the same as for regulated surface water (0.005 mg/L), and is intended for application to non-regulated water that has developed a significant riparian area beyond the intended use. None of the seeps or ponds at the Site has developed significant riparian habitat or aquatic life beyond that expected for such industrial use. Therefore, comparisons to this criterion were not applicable.

The second removal action level (0.050 mg/L) is intended to protect water for routine use, for example by livestock. Table 7-12 shows the seeps and detention ponds in Panels A, D, and E that exceed this selenium concentration. Within the Site, seeps ES-4 and ES-5, and the associated detention ponds are within the grazing lease area. Seep ES-4 and the adjacent detention pond have been fenced and made inaccessible to livestock. Seep ES-5 has also been fenced, but the associated detention pond EP-5 has not. Selenium concentrations in EP-5 range from 0.096 to 0.101 mg/L, exceeding the removal action level by two-fold. Other detention ponds in the A and D Panels are outside the grazing lease and are not fenced. Concentrations in some of these ponds (AP-2, DP-7, and DP-10) exceed the 0.05 mg/L level at some times during the year. However, the level of access by livestock to the water in these ponds it is not known.

The third removal action level (0.201 mg/L) is intended to protect transient wildlife that may use the surface water for drinking. Table 7-12 shows the seeps and detention ponds in Panels A, D, and E that exceed this concentration of selenium. As noted above, ES-4, ES-5, and EP-4 are fenced, possibly deterring entry of some of the larger wildlife species. Other seeps and ponds are not fenced, but the level to which wildlife use the ponds is unknown.

9.2 Sediment

As with surface water, IDEQ developed separate sediment removal action levels for regulated and non-regulated water bodies. Removal action levels for regulated water bodies are based on the NOAA probable effects levels (PELs), which are based on effects to aquatic life. For non-regulated water bodies, removal action levels are based on risk to wildlife that may ingest the sediment while feeding or drinking from the water body. For both regulated and non-regulated water bodies, removal action levels were set at the higher of the area background concentration and the risk-based level.

Sediments in lower Pole Canyon Creek (LP) contained COPC concentrations that exceeded area-wide background removal action levels for all COPCs except copper (Figure 7-13). Chromium, copper, vanadium and zinc each exceeded area background concentrations at lower Smoky Creek, but no COPC concentration exceeded removal action levels at any location other than LP. Therefore, Site-wide ecotoxicological risk from sediment in regulated water bodies appears to be acceptable at all locations except lower Pole Canyon Creek.

The presence of high COPC concentrations in lower Pole Canyon Creek sediments is due to the deposition of overburden slope materials in the creek during past slope failures at the toe of the overburden disposal area. The slope has since been stabilized, but residual sediments remain in the creek bed below the overburden disposal area.

Sediment COPC concentrations were higher in non-regulated surface water bodies, such as detention ponds, than in regulated surface waters. Concentrations in the non-regulated waters

exceeded area background and the removal action levels for non-regulated water bodies for all COPCs except copper (Figures 7-22, 7-23, 7-24). This is likely due to the accumulation of fine-grained materials eroded from the unreclaimed overburden areas and/or precipitation of dissolved COPCs from the collected seep waters. The detention ponds are effectively capturing these materials and preventing them from being transported to downgradient areas.

The potential use of the detention ponds by wildlife has not been characterized. Fencing at some of the ponds may prevent access by livestock and may deter some large wildlife species, but many wildlife species could access the ponds.

9.3 Terrestrial and Riparian Vegetation

Site vegetation was sampled primarily to assess the potential effects on livestock and wildlife that may ingest vegetation with elevated COPC concentrations. Vegetation was collected from the currently grazed area in northern Sage Valley, overburden disposal areas, seep areas, and riparian sampling sites. Data are presented for three types of vegetation that represent mixtures of plants that various species may ingest: browse, forage (mix of grass and forbs), and potential selenium hyperaccumulator species.

For northern Sage Valley, concentrations did not exceed removal action levels for any COPC except selenium. Selenium in two forage samples collected from the lower Pole Canyon Creek corridor exceeded the removal action level of 5 mg/Kg DW, with concentrations above 20 mg/Kg DW, but in northern Sage Valley the mean and 75 percentile concentrations for northern Sage Valley did not. Since the removal action level for selenium is meant to be compared to the mean, the results suggest acceptable risk for grazing and browsing animals in northern Sage Valley.

Selenium was also the only COPC that exceeded removal action levels in any vegetation samples from the overburden disposal areas (Figure 7-40). Concentrations in browse did not exceed the removal action level. However, mean selenium concentrations in forage samples exceeded the removal action level in unreclaimed areas of A Panel and the Pole Canyon overburden disposal area. Concentrations in the more extensively reclaimed D Panel samples were lower than or approximately equal to the removal action level. Thus, reclamation actions at D Panel have contributed to reducing risk to acceptable levels by reducing vegetation uptake of selenium from overburden.

Selenium was the only COPC exceeding the removal action level in vegetation at overburden seep areas. Concentrations in vegetation exceeded the Area-Wide removal action level at all overburden seeps except EP-3, which appeared to have only minimally affected water quality. For each of the affected seep areas, vegetation growing in or near the seep margins contained substantially elevated selenium levels, with concentrations ranging up to 100 mg/Kg DW (Figure 7-46). Thus, animals feeding in the immediate proximity to the seeps may experience elevated

selenium exposure. Although it is unlikely that animals would feed exclusively at the limited seep areas, individual small mammals that live in close proximity to the seep may experience elevated selenium exposure. Selenium concentrations in vegetation in surrounding areas that would comprise a significant part of an animal's diet are below 5 mg/Kg DW.

Riparian vegetation contained selenium concentrations above the removal action level at only lower Pole Canyon Creek (Figure 7-50). Remaining areas did not contain problematic levels of selenium or any other COPCs.

Livestock are generally thought to be more sensitive to selenium than wildlife. IDEQ (2004) indicates that cattle, and probably wildlife, may be able to tolerate short periods of feeding on vegetation with concentrations higher than the selenium removal action level. However, the most sensitive species, such as horses and sheep, may be more affected. For those areas exceeding the criterion, risk management actions that reduce the selenium uptake into plants, reduce the areal extent of plants with elevated selenium concentrations, or that reduce extent to which livestock or wildlife feed on forage plants growing in the overburden would reduce the potential for unacceptable exposure.

9.4 Fish

Data from fish tissue analyses indicate that, except for selenium, COPC concentrations are not elevated due to Site conditions. Concentrations of some COPCs were higher than the regional background concentrations represented by the Area-Wide HHERA exposure point concentrations (Figure 7-54). However, in many cases, the concentrations in fish from locations that are upgradient of the overburden areas (e.g., US-3, US-4) were similar to downgradient samples suggesting that the local background may be higher than the regional background. Therefore, risk from the COPCs does not seem to be increased by the Site.

Selenium concentrations in fish were highest at Hoopes Spring, ranging from 14.1 to 31.8 mg/Kg DW, with an average concentration of 23.5 mg/Kg DW (Figure 7-54). Concentrations at lower Sage Valley were lower, ranging from 13.5 to 19.3 mg/Kg DW, with an average of 16.1 mg/Kg DW. Concentrations at other sampling locations did not exceed 8.1 mg/Kg DW in any given sample, and mean concentrations did not exceed 5.8 mg/Kg DW.

Background concentrations, as reported in the Area-Wide HHERA for unimpacted areas, were approximately 8.3 mg/Kg DW. EPA (2002) identified a general threshold level of 7.9 mg/Kg DW selenium as being protective of most fish species, and EPA is currently considering the use of this value as a risk-based standard for protection of cold-water biota in surface waters. EPA also characterizes this draft threshold as protective of piscivorous avian carnivores such as kingfishers and waterfowl. Regional background concentrations, as represented by the range of EPCs used in the Area-Wide HHERA, are above 7.9 mg/Kg DW, but within the range of concentrations protective of salmonids. Salmonid species, including rainbow and cutthroat

trout, appear to be somewhat less sensitive, with protective concentrations ranging from approximately 9.5 to 15 mg/Kg DW (EPA, 2002), with some measures above 40 mg/Kg DW.

Selenium concentrations in all locations except Hoopes Spring and lower Sage Valley sites appear to at or below background and the various thresholds cited above for toxicity. Risk to fish due to selenium transport from the Site appears to be only of concern at Hoopes Spring, and Sage Creek downstream of its confluence with Hoopes Spring (i.e., lower Sage Valley). The mean concentration in fish from Hoopes Spring (23.5 mg/Kg DW) exceeds the protective ranges cited above. The mean concentration in lower Sage Creek (16.1 mg/Kg DW) is just above a range that is considered protective of salmonids (approximately 9.5 to 15 mg/Kg DW [EPA, 2002]).

Elevated selenium in fish from Hoopes Spring and lower Sage Creek appears to be directly correlated with surface water concentrations in these stream reaches. Dietary sources may also contribute as concentrations in aquatic invertebrates were slightly elevated with respect to background. However, sediment at Hoopes Spring did not exceed removal action levels or background.

9.5 Aquatic Invertebrates

Risk to aquatic invertebrates is generally based on COPC concentrations in sediments, and IDEQ removal action levels for sediments in regulated water bodies are based on sediment quality guidelines intended to protect the benthic macroinvertebrate community. As described above, only sediments in lower Pole Canyon Creek exceeded the removal action levels. Selenium concentrations in aquatic invertebrates were elevated at Hoopes Spring, lower Sage Creek, and lower Pole Canyon Creek. All other COPCs were also elevated in invertebrates from lower Pole Canyon Creek, probably reflecting the contribution of both water quality and sediments from lower Pole Canyon Creek. Therefore, risk to aquatic invertebrates appears to be acceptable in all areas except the lower Pole Canyon Creek area.

9.6 Conclusions

The results of this risk analysis are largely consistent with the conclusions of Area-Wide HHERA regarding ecological risk. Among the COPCs, risk from selenium was the most widespread and elevated. For all media, concentrations of other COPCs exceeded removal action levels at a limited number of locations, but usually in locations where selenium also exceeded risk criteria and usually to a greater extent. The media that contribute most to elevated selenium risk appear to be surface water and vegetative uptake of selenium directly from overburden.

Hoopes Spring and lower Pole Canyon Creek are the primary sources of selenium risk to aquatic life. Hoopes Spring is the main source of risk from selenium downstream in Sage

Creek. Pole Canyon Creek was not connected by surface flow to Sage Creek during the SI and lower Pole Canyon Creek was dry during large portions of the year. Outside of these stream reaches, risk from selenium does not appear to be unacceptable in regulated surface waters. Sediment does not appear to contribute to aquatic risk outside of lower Pole Canyon Creek, where a portion of the stream bed contains overburden materials. No other locations exhibit sediment concentrations exceeding removal action levels.

Selenium risk in aquatic biota appears to be correlated with surface water quality. Selenium concentrations in fish are elevated above regional EPCs only at Hoopes Spring and lower Sage Creek. In addition these are the only locations at which selenium concentration in fish exceeds EPA's draft threshold concentration (7.9 mg/Kg DW) (EPA, 2002).

The risk-based removal action level for selenium in vegetation is based on risk to grazing livestock, which comprise the most sensitive group of potential terrestrial-feeding receptors. Risk from selenium in vegetation appears to be primarily restricted to sections of the overburden disposal areas that are not fully reclaimed or were reclaimed prior to more recently developed reclamation practices. Vegetation immediately adjacent to contaminated seeps also poses a limited risk. Vegetation from D Panel, which has been reclaimed, contained selenium that was below or approximately equal to acceptable levels. The mean selenium concentrations in vegetation from A Panel and Pole Canyon overburden disposal area, exceeded the removal action level. The elevated mean selenium concentration in these areas was due largely to a few locations with exceptionally high concentrations.

In summary, ecological risk at Area A appears to be primarily due to elevated selenium concentrations in surface water from discharge at Hoopes Spring and vegetation on overburden materials. Unacceptable risks were also identified along the lower Pole Canyon Creek corridor, but the ephemeral nature of the stream limits exposure. Selenium transport to downgradient media, such as soils and sediments, is limited. Elevated selenium is evident in aquatic biota from some downgradient locations, but ecological risk is relatively low, and would be largely alleviated by improvement of water quality from the source areas.