

APPENDIX A

Vegetation Decision Unit Evaluation

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1.0 OBJECTIVES FOR PROTECTION OF GRAZING LIVESTOCK

This appendix explains how data collected during the Site Investigation (SI) were used to further evaluate the potential for livestock exposure to selenium at the Smoky Canyon Mine (the Site). The SI identified potential risks for livestock due to elevated selenium concentrations in seep water, water in the detention basins below the seeps, vegetation in the seep areas, and vegetation on the portions of the overburden disposal areas (ODAs) where the average selenium concentration in the vegetation was above the IDEQ vegetation removal action level of 5 mg/Kg.

Potential risks to livestock from the seep and detention basin waters will be addressed through the removal action. Once the potential for exposure to seep water, detention-basin water, and vegetation in the seep areas is eliminated, the remaining potential risk to grazing livestock, and wildlife, would be associated with selenium in vegetation on the ODAs.

2.0 RISK-BASED CRITERIA FOR SELENIUM IN VEGETATION

IDEQ has recently completed additional data collection and risk assessment (Area-Wide Risk Assessment, IDEQ, 2003) to support risk management decisions for the southeast Idaho phosphate resource area. The resulting Area-Wide Risk Management Plan (IDEQ, 2004) recommends a removal action level for selenium in vegetation of 5 mg/Kg (dry weight). As explained by IDEQ (2004), a mean concentration of 5 mg/Kg selenium meets the regional beneficial use goals of the land management agencies (i.e., domestic animal grazing). IDEQ (2004) indicates that cattle, and probably wildlife, may be able to tolerate short periods of feeding on vegetation with selenium concentrations higher than their regional removal action level. Livestock, and in particular sheep and horses, are generally thought to be more sensitive to selenium than wildlife. Browsing wildlife species, such as elk and deer, typically have larger range areas and more transient use of grazing areas than livestock. IDEQ established their removal action level for selenium in vegetation at a level considered protective for sensitive livestock and thus also protective for grazing wildlife.

IDEQ indicates that areas where vegetation has an average selenium concentration above 5 mg/Kg may need to be addressed to restore unrestricted grazing use, as intended by the original mine plans. Alternatively, land managers can develop grazing management practices for those areas when such practices will not shift undue management burdens to the grazing lease holders or land management agencies (IDEQ, 2004).

The USFS and BLM have developed interim guidelines that specify the acceptable selenium content of vegetation established on reclaimed areas. The interim guidelines were developed for the FMC Dry Valley Mine (USFS and BLM, 2000) but were also referenced during planning for the Panels B and C operations at the Site (BLM and USFS, 2002). The USFS/BLM vegetation guidelines, or goals, consider the potential for acute and chronic selenium exposures for wildlife and livestock that may graze on reclaimed mine areas.

The USFS/BLM reclamation goals for unrestricted grazing use are as follows:

- Fifty percent of the vegetation measured over the surface of the reclaimed mine area must contain selenium concentrations less than 5.0 mg/Kg dry weight.
- Forty-five percent of vegetation measured over the surface of the reclaimed mine area may contain selenium concentrations ranging between 5.0 and 10.0 mg/Kg dry weight.
- No more than five percent of vegetation measured over the surface of the reclaimed mine area may contain selenium concentrations greater than 10.0 mg/Kg dry weight.

- No more than 0.5 percent of the vegetation measured over the surface of the reclaimed mine area shall exceed 20 mg/Kg selenium dry weight.

Both the USFS/BLM and IDEQ guidelines are aimed at post-reclamation conditions at former mine sites. Although not specifically defined in terms of acreages, these guidelines are relevant to the large “reclaimed mine area” (i.e., hundreds of acres) typically associated with a phosphate mining operation in southeast Idaho. In particular, these guidelines are appropriate for public lands where the multiple land use goals of grazing, wildlife habitat, and mining overlap. For smaller areas of mining disturbance and/or areas under private ownership these guidelines may not be appropriate.

3.0 EXISTING SITE CONDITIONS

The ODAs at the Site will be accessible to both wildlife and livestock. Area A of the Smoky Canyon Mine lies within the Caribou-Targhee National Forest, and the land is managed by the USFS for multiple uses. The long-term uses of the mine area as habitat for elk and deer as well as grazing area for livestock were identified in the SI. The Smoky Canyon Mine's planned reclamation activities are aimed at restoring vegetation that would be acceptable for both of these uses. As such, achievement of the IDEQ removal action level and the USFS/BLM interim guidelines for selenium in vegetation within the "reclaimed mine area" are appropriate removal action objectives (RAOs).

Livestock are expected to consume mainly forage vegetation, which at the Smoky Canyon Mine includes grasses, forbs, and legumes. Large wildlife species, such as elk, also consume forage and may browse on vegetation that includes woody shrubs and young trees. Both forage and browse-type vegetation is present on the ODAs within the reclaimed areas. The quantity of forage is currently higher than the quantity of browse.

Data collected during the SI indicate that even though there are individual sample locations on the A Panel, Pole Canyon, and D Panel ODAs where the selenium concentration in vegetation is higher than 5 mg/Kg, the average selenium concentrations in vegetation collected from larger areas are typically less than IDEQ's removal action level of 5 mg/Kg. The selenium concentrations in forage and browse vegetation samples collected during the SI are mapped on Figure A-1; the individual sample locations where selenium concentrations were higher than 5 mg/Kg are indicated. Forage vegetation collected from the A Panel and Pole Canyon ODAs had higher average selenium concentrations, at 11.6 mg/Kg and 10.4 mg/Kg respectively, than the average selenium concentrations in forage from the north and south halves of the D Panel ODA at 4.0 mg/Kg and 1.6 mg/Kg, respectively. The practices originally used to cover and revegetate overburden areas have changed since the A Panel and most of the Pole Canyon areas were reclaimed. The lower selenium concentrations in forage from the D Panel area reflect the beneficial effects of more recent reclamation practices in limiting selenium uptake by vegetation. Overall, the average selenium concentration in browse from the mine-disturbed areas was less than 5 mg/Kg.

Certain plant species growing in the re-vegetated overburden areas, especially the legumes, such as alfalfa, sweet clover, and astragalus, have elevated selenium concentrations relative to the other broadly-present species. The legumes are known as a selenium-accumulator species, and the legumes typically have higher selenium contents than the composite of forage vegetation taken from the same location. The inclusion of selenium-accumulator species in the multi-species forage samples contributes to the identified selenium concentrations above 5 mg/Kg in the forage.

At the Smoky Canyon Mine, the average selenium concentration in selenium-accumulator species collected from the ODAs was 29 mg/Kg, and the maximum selenium concentration measured in a selenium-accumulator species was 213 mg/Kg. Hyper-accumulator species with higher selenium concentrations (i.e., 500 to several thousand mg/Kg) have been observed on the ODAs at the Conda Mine (MFG, 2004). The forage in these areas contained species such as curly-cup gumweed and aster. No hyper-accumulator species with similar selenium concentrations were found at the Smoky Canyon Mine during the SI vegetation sampling task completed in July 2004.

When forage vegetation are compared to the USFS/BLM interim guidelines for vegetation on reclaimed mine areas, the vegetation does not currently meet all aspects of the guidelines in the reclaimed mine area. Summary statistics for the forage vegetation on the mine-disturbed area are included on Table A-1. More than 5 percent of the forage vegetation samples collected from entire mine-disturbed area within Area A have selenium concentrations greater than 10 mg/Kg and more than 0.5 percent of the forage samples have selenium concentrations above 20 mg/Kg. Therefore, additional evaluation of livestock exposures to selenium while grazing on mine-disturbed areas is warranted.

4.0 GRAZING USE

Portions of the Smoky Canyon Mine lie within four different USFS livestock grazing allotments (Figure A-2). The allotment size, permitted types and numbers of animals, and permitted grazing dates are reported for each allotment on Table A-2. Cattle grazing is limited to the Sage Valley area on the east side of Site, including portions of the D and E Panel ODAs; other portions of the Site, including western portions of the D and E Panel areas and also the A Panel and Pole Canyon ODAs, may be grazed by sheep.

Table A-2 also reports the proportion of each allotment that has been disturbed by mining, which varies from less than 3 percent of the area within the Timber Creek allotment to approximately 40 percent in the Lower Crow Creek and Sage Valley allotment. The number of days when grazing is allowed each year varies from 60 days in the Sage Creek allotment to 121 days in the Lower Crow Creek and Sage Valley allotment.

The allotment used for cattle grazing, the Lower Crow Creek and Sage Valley allotment, has the greatest proportion of its area disturbed by mining. Allotments used for sheep grazing have between 3 and 10 percent of their areas disturbed by mining (Table A-2).

5.0 POTENTIAL LIVESTOCK EXPOSURES AT SMOKY CANYON

The existing Site data and grazing information used to further evaluate potential livestock exposure are presented below. This evaluation is focused on probable sheep exposures because sheep are the most likely sensitive receptor within the Site.

The percentage of grazing area disturbed by mining determines the daily probability (probability on any given day of the permitted grazing period) of grazing in a mine-disturbed area. For the three sheep allotment areas, there is less than a ten percent probability that sheep will graze on mine-disturbed area on any of the permitted grazing days (Table A-1). The grazing rate, or the average area grazed per day, in each allotment was estimated from the total area and number of grazing days. The estimated sheep grazing rates in these three allotments range from approximately 64 to 142 acres per day (see Table A-1). Given the estimated grazing rates within these allotment areas, sheep could be expected to graze on mine disturbed areas for approximately 1.5 days in the Timber Creek allotment, 3 days in the Sage Creek allotment, and 8 days in the Pole Canyon allotment. Cattle grazing in the Sage Valley allotment potentially graze mine-disturbed areas for up to 50 days of the 121-day annual allotment duration.

Given the size of the grazing allotments and the relatively small proportion of the allotment area that has been disturbed by mining, sheep are not expected to graze on mine-disturbed areas for long periods of time. However, the presence of hyper-accumulator species in forage from the reclaimed area remains a concern for sensitive species such as sheep. Recent experience at the Conda Mine indicates that several consecutive days of sheep grazing on reclaimed areas with selenium hyper-accumulating species, in conjunction with selenium-impacted stock watering areas, can result in acute to lethal selenium exposure, because the sheep may feed selectively on those hyper-accumulator plants (MFG, 2004). Experience at Conda indicates risk to livestock due to selenium hyper-accumulators is even higher when nearby drinking water and dietary supplements also contain selenium. Sheep fed up to 75 mg selenite daily, or approximately 1.1 mg of selenium per Kg of body weight, can experience a number of selenotoxic effects (e.g., myocardial degeneration and fibrosis, pulmonary congestion, and edema) (Eisler, 1985). Lethal effects have been observed in sheep at doses of 3.2 to 12.8 mg of selenium per Kg of body weight (Eisler, 1985). These quantities of selenium could be consumed by an average-sized sheep (70 Kg sheep consumes 1.5 to 6 Kg forage per day) grazing for one day on forage with 100 mg/Kg selenium.

As noted above, the mine-disturbed area within the Smoky Canyon Mine does not currently meet the USFS/BLM interim guidelines for forage vegetation because more than 5 percent of the forage samples collected from that area had selenium concentrations above 10 mg/Kg. However, forage vegetation on the mine-disturbed portion of one grazing allotment does meet all guidelines. Table A-1 provides summary statistics for forage samples collected from the

mine-disturbed portions of each grazing allotment. The average selenium concentrations in forage in the mine-disturbed portions are 13.4 in the Pole Canyon allotment, 1.9 mg/Kg in the Timber Creek allotment, and 13.7 mg/Kg in the Sage Valley allotment (refer to Figure A-2 for map of allotment areas). No forage samples were collected from mine-disturbed portions of the Sage Creek allotment. The forage vegetation collected from mine disturbed portions of the Timber Creek allotment, which includes a portion of the south D Panel ODA, meets all of the guideline criteria. More than 5 percent of the forage samples from the mine-disturbed portions of the Pole Canyon and Sage Valley allotments have selenium concentrations greater than 10 mg/Kg.

Samples of the selenium-accumulator species collected from the mine-disturbed area of each allotment have average selenium concentrations of 45.5 mg/Kg in the Pole Canyon allotment, 16.7 mg/Kg in the Timber Creek allotment, and 16.3 mg/Kg in the Sage Valley allotment. Selenium-accumulator species were included in the forage vegetation samples collected in each of these areas.

In summary, although the average concentrations in vegetation across the Smoky Canyon Mine are less than the IDEQ 5 mg/Kg removal action level, comparison of the existing vegetation data to USFS/BLM guidelines indicates that selenium levels in forage vegetation on only the south D Panel area within the Timber Creek allotment are acceptable for unrestricted grazing by livestock. The existing vegetation on disturbed areas in the Pole Canyon and Sage Valley allotments, which includes the A Panel, Pole Canyon, and north and east D Panel ODAs, does not meet guidelines for unrestricted grazing. In these areas, the presence of selenium-accumulator species, in some areas of forage vegetation, results in elevated selenium concentrations.

6.0 GOAL FOR UNRESTRICTED GRAZING USE

In order to remain conservative with respect to potential risks for receptors, the USFS/BLM reclamation goals should be adopted and applied to the mine-disturbed areas within each grazing allotment. The resultant RAOs for terrestrial vegetation on the ODAs at the Site are:

- Maintain selenium concentrations at USFS/BLM reclamation-goal levels within the mine-disturbed area of each separate grazing allotment.
- Eliminate and prevent future establishment of selenium hyper-accumulators from the ODAs.

Response actions that consider these objectives will protect sensitive livestock such as sheep, other livestock such as cattle, and grazing wildlife such as elk from exposure to selenium in vegetation at levels considered a potential health risk.

The areas where actions may be required to achieve the guideline criteria are:

- A Panel external ODA¹, Pole Canyon ODA, and northern D Panel backfilled pit area within the Pole Canyon grazing allotment; and
- Eastern D Panel backfilled pit and external ODAs within the Sage Valley grazing allotment.

¹ A Panel pit is currently being backfilled and reclaimed using current BMPs and elevated selenium concentrations in vegetation are not expected post reclamation.

7.0 REFERENCES

Eisler, R., 1985. Selenium Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review, U.S. Fish and Wildlife Service Contaminant Hazard Reviews, Report No. 5, October 1985.

Idaho Department of Environmental Quality (IDEQ), 2004. Final Area-Wide Risk Management Plan: Removal Action Goals and Objectives, and Action Levels for Addressing Releases and Impacts from Historic Phosphate Mining Operations in Southeast Idaho, Selenium Area-Wide Investigation, Southeast Idaho Phosphate Mining Resource Area. February.

MFG, 2004. Analysis of Grazing Considerations, J.R. Simplot Conda Mine, Caribou County, Idaho: Prepared for the J.R. Simplot Company, Pocatello, Idaho.

USFS/BLM, 2000. Final Environmental Impact Statement, Dry Valley Mine, South Extension Project for FMC Corporation, U.S. Department of Agriculture Forest Service Caribou National Forest, Pocatello Resource Area, June 2000.

BLM and USFS, 2002. Final Supplemental Environmental Impact Statement, Smoky Canyon Mine, Panels B & C. Pocatello Field Office, Pocatello, Idaho.

TABLES

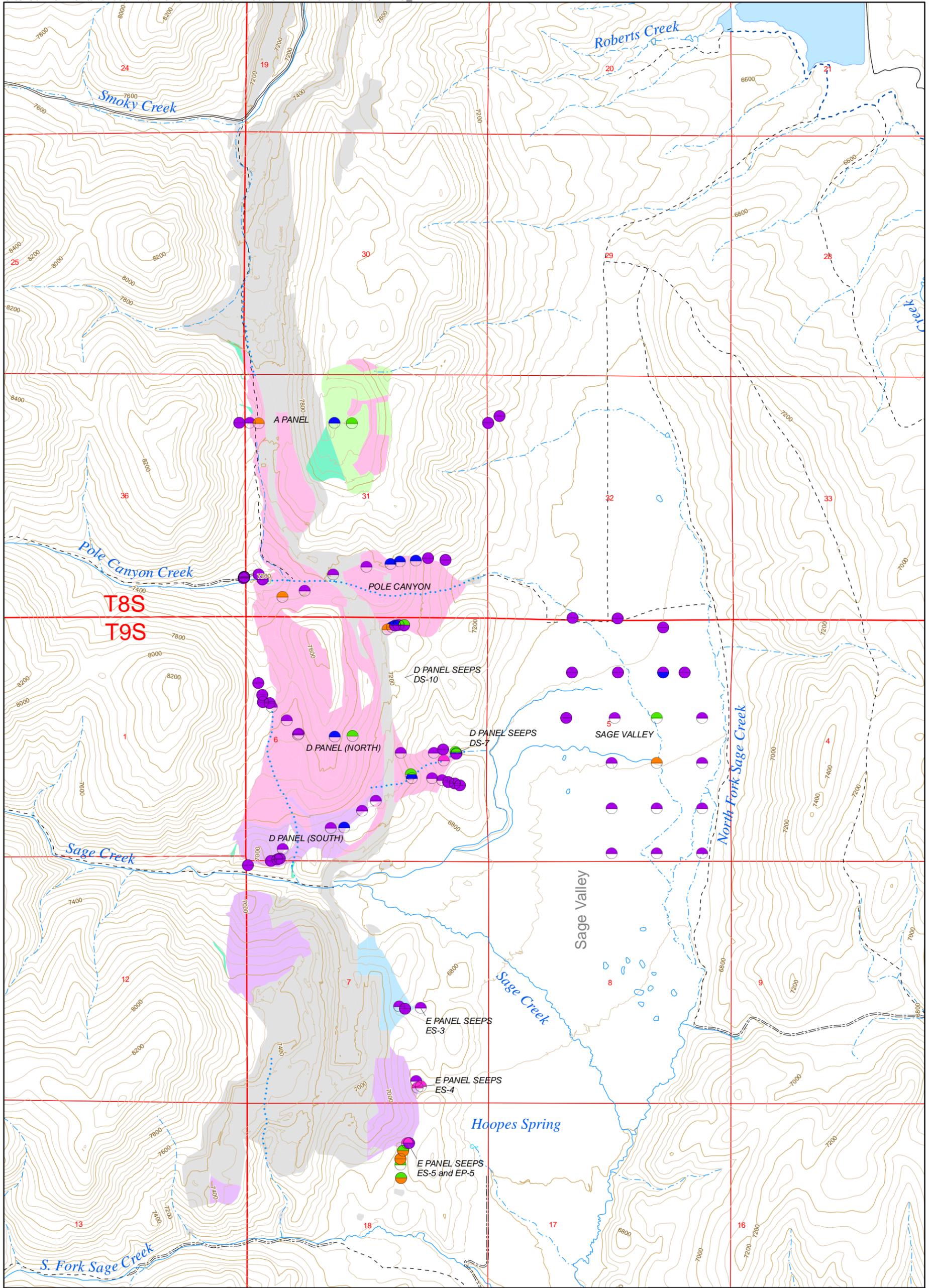
Table A-1
Descriptive Statistics for Selenium in Vegetation (mg/Kg) in Mine-Disturbed Areas within Grazing Allotments

Allotment	All Mine Disturbed Areas	20280 - Sage Creek	20289 - Pole Canyon (includes portions of A Panel, Pole Canyon, and north and east D Panel ODAs)		20291 - Timber Creek		30017 and 30018 - Lower Crow Creek and Sage Valley	
	Forage		Forage	Selenium Accumulator Species	Forage	Selenium Accumulator Species	Forage	Selenium Accumulator Species
No. of samples	33	No samples	13	15	5	11	15	9
Minimum	0.1	--	0.3	0.2	0.7	0.7	0.1	5.1
Mean	11.8	--	13.4	45.5	1.9	16.7	13.7	16.3
Maximum	125	--	62.5	213	4.5	54.5	125	50.6
5th percentile	0.5	--	0.4	1.9	0.7	0.7	0.3	5.1
Median	4.9	--	7.5	28.3	1	8.7	4.9	10.5
95th percentile	42.9	--	57.6	196	4.5	55.1	98.2	55.7

**Table A-2
Grazing-Allotment Data for the Vicinity of Smoky Canyon Mine**

Allotment	USFS Allotment Number	Total Area (acres)	Mining Disturbed Area (acres)	% Disturbed	Animal	No. Animals Permitted	Grazing Dates	No. Grazing Days	Estimated Days of Grazing Disturbed Area
Sage Creek	20280	4,164	209	5.0%	sheep	1000	7/1 to 8/30	60	3.0
Pole Canyon (includes portions of A Panel, Pole Canyon, and north and east D Panel ODAs)	20289	12,060	1,144	9.5%	sheep	1020	6/27 to 9/20	85	8.1
Timber Creek	20291	3,832	107	2.8%	sheep	1000	7/1 to 8/30	60	1.7
Lower Crow Creek and Sage Valley	30017 30018	1,146	471	41.1%	cattle	132	6/1 to 9/30	121	49.7

FIGURES



Legend

Selenium Concentrations (mg/kg dry weight) in Vegetation

Browse	Forage	Mine Disturbance Area
Selenium (mg/kg) dry wt.	Selenium (mg/kg) dry wt.	Not Reclaimed
<= 5	<= 5	90% Topsoil Cover Over Run of Mine
> 5 TO <= 10	> 5 TO <= 10	Topsoil Over Chert Cap
> 10 TO <= 20	> 10 TO <= 20	Topsoil Cover on all Chert
> 20 TO <= 100	> 20 TO <= 100	No Topsoil, No Chert, Contoured and Seeded
> 100	> 100	Miscellaneous Reclamation Type

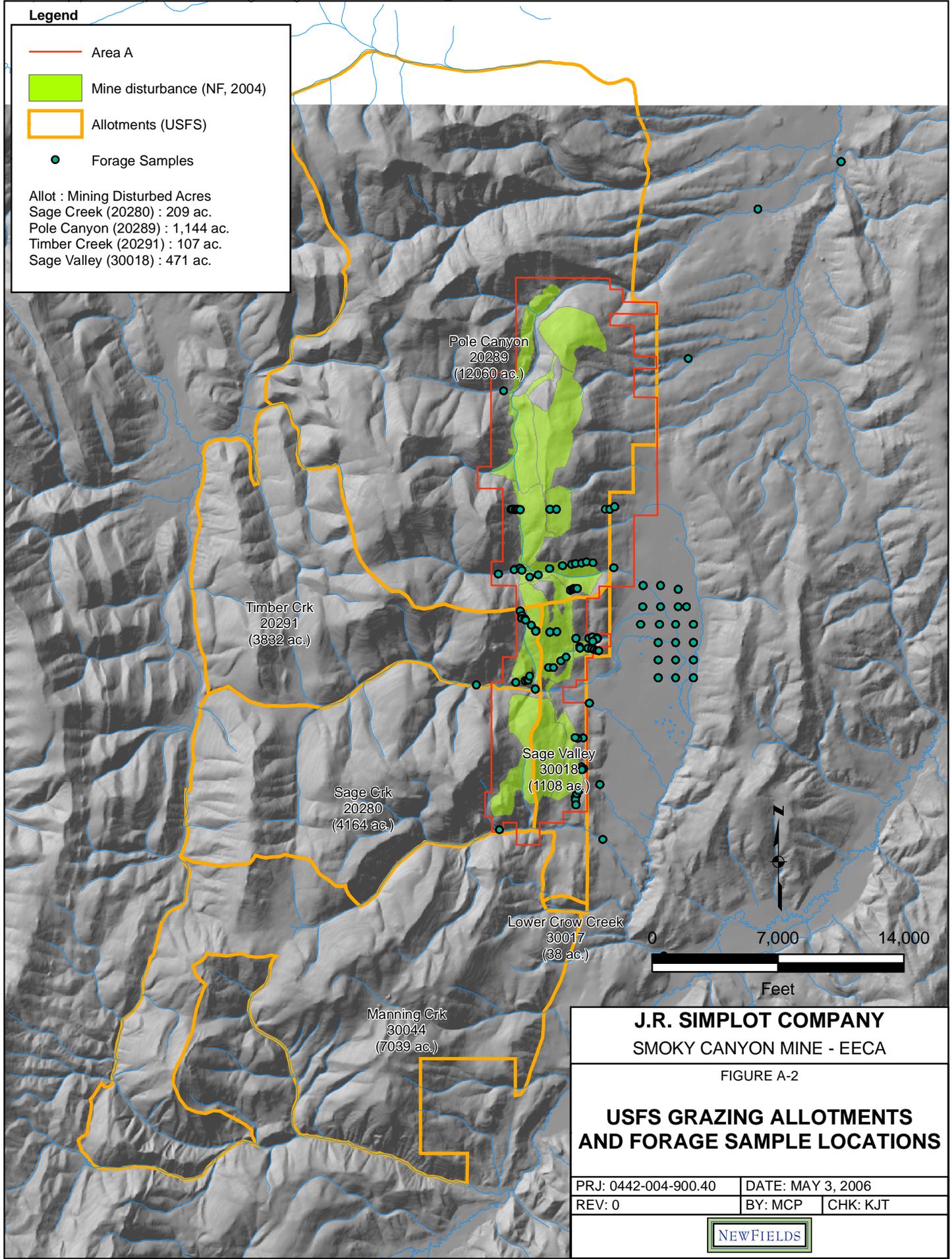
Notes: 5 mg/kg is reclamation goal for vegetation.
Topographic surface reflects 2004 conditions in mine disturbance areas.

0 2,000 4,000
Feet

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SMOKY CANYON MINE - EECA

FIGURE A-1
**TOTAL SELENIUM
(MG/KG DRY WEIGHT)
IN TERRESTRIAL VEGETATION
(JULY 2004)**

PRJ: 0442-004-900.40	DATE: MAY 3, 2006
REV: 0	BY: JMP CHK: KJT



Legend

- Area A
- Mine disturbance (NF, 2004)
- Allotments (USFS)
- Forage Samples

Allot : Mining Disturbed Acres
 Sage Creek (20280) : 209 ac.
 Pole Canyon (20289) : 1,144 ac.
 Timber Creek (20291) : 107 ac.
 Sage Valley (30018) : 471 ac.

Pole Canyon
 20239
 (12060 ac.)

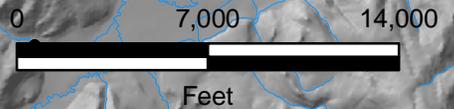
Timber Crk
 20291
 (3832 ac.)

Sage Crk
 20280
 (4164 ac.)

Sage Valley
 30018
 (1108 ac.)

Lower Crow Creek
 30017
 (38 ac.)

Manning Crk
 30044
 (7039 ac.)



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 SMOKY CANYON MINE - EECA

FIGURE A-2

**USFS GRAZING ALLOTMENTS
 AND FORAGE SAMPLE LOCATIONS**

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