Chapter 3. Affected Environment and Environmental Consequences

Biological Resources

Introduction

This section discusses the affected environment and environmental consequences of the proposed action and alternatives on biological resources. Biological resources include wildlife and plant populations, as well as vegetation and biophysical resources that provide suitable habitat within the analysis area. The scope of analysis encompasses potential impacts from the proposed project, taking into consideration both the spatial extent (spatial analysis area) and duration of impacts (temporal bounds of analysis). Figure 51 shows the spatial analysis area, which encompasses 145,190 acres.

The analysis area includes vegetation communities, surface water drainages, and onsite physical and topographic features (e.g., caves and mine adits/shafts, seeps and springs, stock tanks, rock outcrops, etc.) that may be directly impacted by the project. The analysis area also includes the indirect downgradient impacts on the surface water and groundwater environments that would result from the onsite diversion and impoundment of surface water and potential spills or other accidental releases;[1] the indirect impacts on springs and seeps surrounding the project footprint;[2] and the indirect impacts of noise,[3] dust,[4] and light[5] resulting from mining and transportation. Therefore, the analysis area includes the following: (1) springs and drainages that receive surface water discharge from the mine site, including Davidson Canyon wash to its confluence with Cienega Creek; (2) springs and seeps within the area of projected groundwater drawdown associated with the mine pit, including those in upper Davidson Canyon; and (3) areas adjacent to the mine site and transportation corridors that may be impacted by noise, dust, and light. The temporal analysis period includes 24 hours of light and noise for at least 20 years and the potential for groundwater drawdown for up to 1,000 years after closure of the mine.

[1] The analysis area is partially defined by a combination of the extent of the Montgomery and Associates Inc. (2010) and Tetra Tech (2010g) 5-foot drawdown contours of the 1,000-year models. See the groundwater and surface water quantity and quality sections.

[2] Ibid.

[3] The analysis area is partially defined by 50 A-weighted decibel surface blasting and 55 A-weighted decibel traffic noise contours (Tetra Tech 2009d). See the “Noise” and “Transportation/Access” sections.

[4] See the “Air Quality and Climate Change” section.

[5] See the “Dark Skies” section.

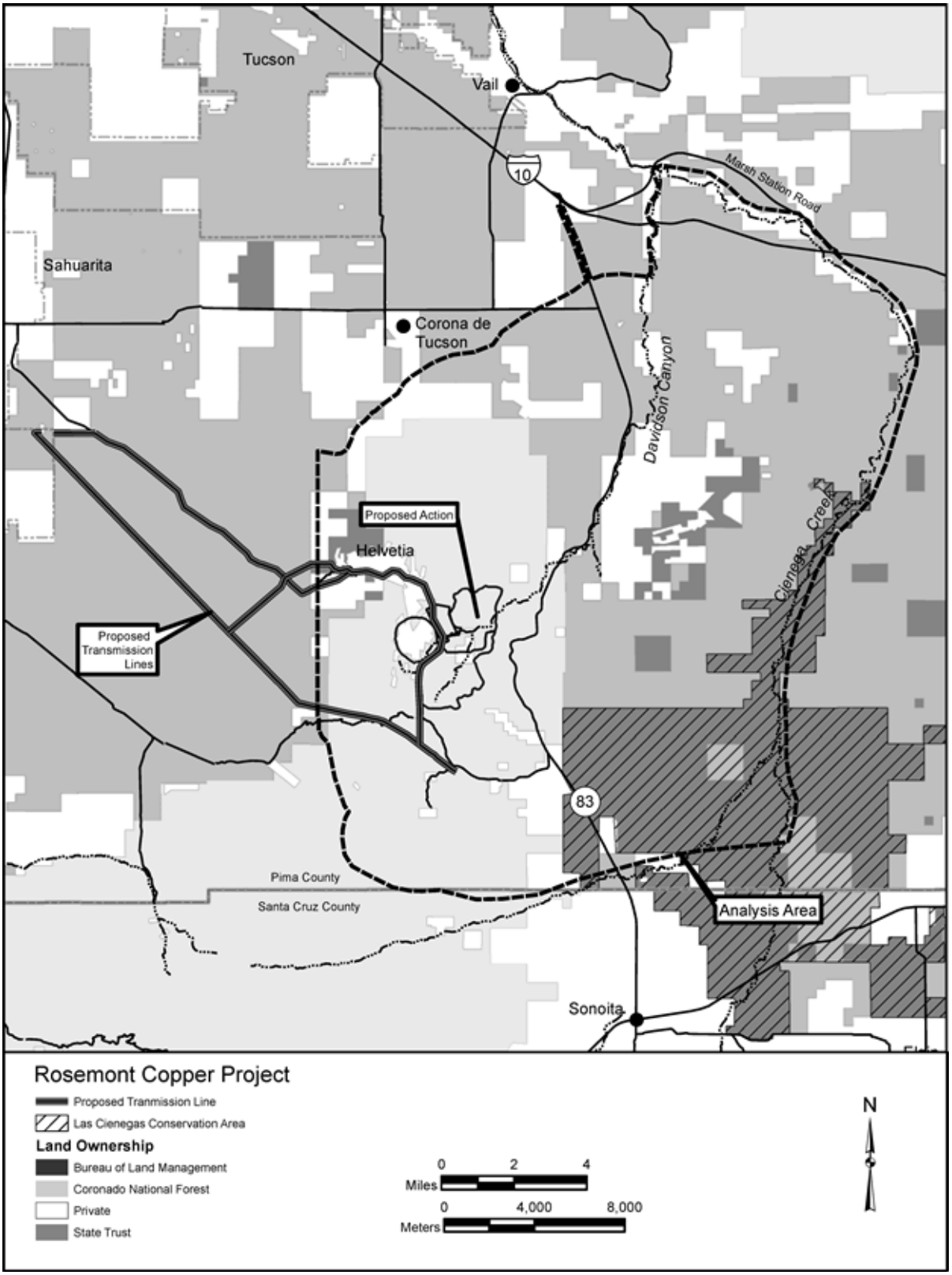


Figure 51. Analysis area for biological resources

Issues, Cause and Effect Relationships of Concern

Issue 4: Impact on Springs, Seeps, and Riparian Habitats

This issue relates to the potential impacts on riparian and wetland habitat that would result from the alteration of surface and subsurface hydrology from the pit and other operations. Potential impacts may include loss of riparian habitat and fragmentation of riparian habitat and corridors, including Cienega Creek.

Issue 4 Factors for Alternative Comparison

- Riparian habitat disturbed, unique or uncommon riparian habitat disturbed, and wildlife corridors disturbed (acres)
- Riparian habitat lost and unique or uncommon riparian habitat lost (acres)
- Seeps and springs degraded or lost (number)
- Qualitative assessment of ability to meet legal and regulatory requirements for riparian areas

Riparian issue factors that address springs and seeps as well as qualitative impacts to riparian areas are analyzed fully in the “Groundwater Quantity” section. Riparian habitat lost is analyzed fully in the “Surface Water Quality” section. Impacts are summarized in this “Biological Resources” section.

Issue 5: Impact on Plants and Animals

This group of issues focuses on effects on plant and animal populations and habitats. Many aspects of the mine operations have the potential to affect individuals, populations, and habitat for plants and animals, including special status species. Species of conservation concern may be affected. This issue includes the potential for impacts to wildlife as a result of landscape alteration and from light, noise, vibration, traffic, and other disturbance from the proposed mine operations.

Issue 5A: Vegetation

The pit, plant, tailings and waste piles, road and utility corridors, and other facilities may result in a permanent change to the vegetation, and reclamation is not expected to restore vegetation to preproject conditions.

Issue 5A Factor for Alternative Comparison

- Vegetation permanently lost or modified, by vegetation type (acres)

Issue 5B: Habitat Loss

The mine and ancillary facilities may result in a loss of habitat for numerous plant and animal species.

Issue 5B Factors for Alternative Comparison

- Habitat lost, modified, or indirectly impacted (acres)
- Qualitative assessment of impacts to aquatic habitats and surface water that supports wildlife and plants such as stock tanks, seeps, and springs

Issue 5C: Nonnative Species

The mine operations may create conditions conducive to the introduction, establishment, and/or spread of nonnative species, which may out-compete native plants and animals. Forest Service and

other Federal, State, and local laws, regulations, policies, and plans contain management direction for invasive plants.

Issue 5C Factor for Alternative Comparison

- Acres of disturbance that could create conditions conducive for invasive species

Issue 5D: Wildlife Movement

The mine operations may modify and/or fragment wildlife habitats and/or reduce connectivity between habitats. The transportation system and increased traffic could result in more wildlife roadkills.

Issue 5D Factors for Alternative Comparison

- Qualitative assessment of the change in movement corridors and connectivity between wildlife habitats
- Quantitative assessment of increased volume of traffic related mortality of various animal species

Issue 5E: Special Status Species or Species of Concern

The mine operations may impact habitat for species of concern. Species of concern include those afforded protection under the Endangered Species Act, Forest Service and Bureau of Land Management sensitive species, Forest Service management indicator species, migratory birds of conservation concern,[6] Arizona Game and Fish Department's wildlife of special concern in Arizona, and Sonoran Desert Conservation Plan priority vulnerable species.

Issue 5E Factors for Alternative Comparison

- Habitat lost for each species of concern (acres)
- Potential for alternative to affect the population viability of any species

Issue 5F: Animal Behavior

Mine operations, including drilling and blasting, may result in noise and vibrations, which may impact animal behavior and result in negative impacts on wildlife. Nocturnal and other animals may be adversely affected by the light glow in night skies.

Issue 5F Factor for Alternative Comparison

- Habitat impacted by noise, vibration, and light (acres)

Analysis Methodology, Assumptions, Uncertain and Unknown Information

In order to reduce the amount of uncertainty in the impacts analysis, surveys were completed in order to assess the distribution of several special status plant and animal species within portions of the analysis area. However, for many species, surveys were not conducted, and it is not known whether these species actually occur within the analysis area. Where species-specific survey data were not available, the analysis relied on extensive literature reviews, museum specimens, past survey efforts, and online locality information.

[6] Migratory birds of conservation concern includes species listed as either National Partners in Flight priority bird species or migratory nongame birds of management concern in the United States.

The wildlife and plant species addressed in this analysis were chosen from the following: (1) the 31 species listed by the U.S. Fish and Wildlife Service as either threatened, endangered, or petitioned for relisting for Pima and Santa Cruz Counties; (2) the 86 animal species and 76 plant species identified as sensitive by the regional forester for the Southwestern Region of the Forest Service (SWCA Environmental Consultants 2011a); (3) the 33 species identified as sensitive by the Bureau of Land Management for the Tucson Field Office (SWCA Environmental Consultants 2011a); (4) the 33 species and 1 group identified as management indicator species for the Coronado National Forest (SWCA Environmental Consultants 2011c); (5) the 105 species listed as either National Partners in Flight priority bird species or migratory nongame birds of management concern in the United States (SWCA Environmental Consultants 2011d); (6) the 29 species listed as priority vulnerable species by Pima County (SWCA Environmental Consultants 2011b); and (7) the four candidate species (SWCA Environmental Consultants 2011b).

Environmental surveys were conducted in the Rosemont area in the 1970s based on ANAMAX's preliminary mining plans for the area (Davis and Callahan n.d. (1977)). More recently, WestLand Resources Inc. conducted surveys in the analysis area for special status species (Buecher et al. 2010; Schmalzel and Archer 2010; WestLand Resources Inc. 2009a, 2009b, 2009d, 2010b, 2010c, 2010d, 2010e, 2011b). The surveys focused on areas of potential impact from the project, mostly around the proposed footprint. More detailed discussions of each species and important features such as stock ponds and tanks (potential habitat for Chiricahua leopard frog); mine shafts, mine adits, and natural caves (potential bat habitats); and talus slopes (potential talussnail habitat) are included in the supporting biology documents for this project.

After a series of screening processes (SWCA Environmental Consultants 2011b), it was determined that 98 special status species and one management indicator species group (table 97) would be retained for further analysis. The potential for occurrence of the species in the analysis area was based on the following: (1) documented records; (2) site-specific field surveys; (3) existing information on distribution; and (4) qualitative comparisons of the habitat requirements of each species with vegetation communities or landscape features (e.g., soils, biophysical features) within the analysis area. All special status species were first screened and analyzed within the "Biologists' Report" (SWCA Environmental Consultants 2011b) to determine which ones needed further analysis within the supporting documents. Any species listed as threatened, endangered, or petitioned for relisting within Pima and Santa Cruz Counties was screened in table 1 of the "Biologists' Report," and those deemed to potentially occur in areas to be impacted by the proposed project were carried through for detailed evaluation within the "Biological Assessment" that will be prepared and submitted to the U.S. Fish and Wildlife Service. Any species listed as sensitive by the Forest Service or Bureau of Land Management was screened in table 2 of the "Biologists' Report," and those deemed to potentially occur in areas to be impacted by the proposed project were carried through for detailed evaluation within the "Biological Evaluation" (SWCA Environmental Consultants 2011a). Any species or groups listed as management indicator species by the Forest Service was screened in table 3 of the "Biologists' Report," and those deemed to potentially occur in areas to be impacted by the proposed project were carried through for detailed evaluation within the "Management Indicator Species Report" (SWCA Environmental Consultants 2011c). Any migratory bird species on either the National Partners in Flight priority bird species or migratory nongame birds of management concern in the United States lists was screened in table 4 of the "Biologists' Report," and those deemed to potentially occur in areas to be impacted by the proposed project were carried through for detailed evaluation within the "Migratory Bird Analysis" (SWCA Environmental Consultants 2011d). Any priority vulnerable species listed by Pima County (table 5 of the "Biologists' Report") or candidate

species (table 1 of the "Biologists' Report") listed by the U.S. Fish and Wildlife Service was screened in the "Biologists' Report," and those deemed to potentially occur in areas to be impacted by the proposed project were carried through for detailed evaluation within the "Biologists' Report" (SWCA Environmental Consultants 2011b).

Table 97. Summary of special status plant and animal species that were retained for further analysis of impacts for the proposed Rosemont Copper Mine Project

Common Name	Scientific Name	U.S. Fish and Wildlife Service	Forest Service	Bureau of Land Management	State	County
Plants						
Arid Throne Fleabane	*Erigeron arisolius*		S			
Arizona Coral-Root	*Hexalectris arizonica*		S			
Arizona (=Cochise) Giant Sedge	*Carex ultra*		S	S		
Arizona Manihot	*Manihot davisiae*		S			
Bartram Stonecrop	*Graptopetalum bartramii*		S	S	SR	
Beardless Chinch Weed	*Pectis imberbis*		S			
Broad-leaf Ground-Cherry	*Physalis latiphysa*		S			
Chihuahuan Sedge	*Carex chihuahuensis*		S			
Chiricahua Mountain Brookweed	*Samolus vagans*		S			
Coleman's Coral-Root	*Hexalectris colemanii*		S	S	SR	
Huachuca Golden Aster	*Heterotheca rutteri*		S	S		
Huachuca Water Umbel	*Lilaeopsis schaffneriana* var. *recurva*	E			HS	PVS
Lemmon Milkweed	*Asclepias lemmonii*		S			
Lemmon's Stevia	*Stevia lemmonii*		S			
Lemon Lily	*Lilium parryi*		S			
Metcalfe's Tick-Trefoil	*Desmodium metcalfei*		S			
Needle-spined Pineapple Cactus	*Echinomastus erectocentrus* var. *erectocentrus*				SR	PVS
Nodding Blue-eyed Grass	*Sisyrinchium cernuum*		S			
Pima Indian Mallow	*Abutilon parishii*		S	S		
Pima Pineapple Cactus	*Coryphantha scheeri* var. *robustispina*	E			HS	PVS
San Pedro River Wild Buckwheat	*Eriogonum terrenatum*			S		
Santa Cruz Striped Agave	*Agave parviflora* ssp. *parviflora*		S		HS	
Santa Rita Yellowshow	*Amoreuxia gonzalezii*		S		HS	
Sonoran Noseburn	*Tragia laciniata*		S			
Southwestern (or Box Canyon) Muhly	*Muhlenbergia palmeri (=dubioides)*		S			
Sycamore Canyon (or Weeping) Muhly	*Muhlenbergia elongata (=xerophila)*		S			
Tumamoc Globeberry	*Tumamoca macdougalii*		S	S		PVS
Amphibians and Reptiles						
Arizona Ridge-nosed Rattlesnake	*Crotalus willardi willardi*		S, MIS		WSC	

Common Name	Scientific Name	U.S. Fish and Wildlife Service	Forest Service	Bureau of Land Management	State	County
Chiricahua Leopard Frog	*Lithobates chiricahuensis*	T			WSC	PVS
Desert Box Turtle	*Terrapene ornata luteola*					PVS
Giant Spotted Whiptail	*Aspidoscelis burti stictogrammus*		S	S		PVS
Gila Monster	*Heloderma suspectum*		S			
Great Plains Narrow-mouthed Toad	*Gastrophryne olivacea*		S		WSC	
Green Ratsnake	*Senticolis triaspis*		S			
Lowland Leopard Frog	*Lithobates yavapaiensis*		S		WSC	PVS
Mountain Skink	*Plestiodon (Eumeces) callicephalus*		S			
Northern Mexican Gartersnake	*Thamnophis eques megalops*	C	S		WSC	PVS
Slevin's Bunchgrass Lizard	*Sceloporus slevini*		S			
Sonoran Desert Tortoise	*Gopherus agassizii* (Sonoran population)	C	S	S	WSC	
Western Barking Frog	*Craugastor augusti cactorum*		S, MIS		WSC	
Birds						
Abert's Towhee	*Pipilo aberti*		S			PVS
American Peregrine Falcon	*Falco peregrinus anatum*		S, MIS		WSC	
Arizona Grasshopper Sparrow	*Ammodramus savannarum ammolegus*		S			
Baird's Sparrow	*Ammodramus bairdii*		S, MIS		WSC	
Bell's Vireo	*Vireo bellii*		MIS			PVS
Broad-billed Hummingbird	*Cynanthus latirostris*		S			
Buff-collared Nightjar	*Caprimulgus ridgwayi*		S			
Cactus Ferruginous Pygmy-Owl	*Glaucidium brasilianum cactorum*		S		WSC	PVS
Common Black-Hawk	*Buteogallus anthracinus*		S		WSC	
Elegant Trogon	*Trogon elegans*		S, MIS		WSC	
Golden Eagle	*Aquila chrysaetos*	Eagle Act				
Gould's Wild Turkey	*Meleagris gallopavo mexicana*		S, MIS			
Lucifer Hummingbird	*Calothorax lucifer*		S			
Mexican Spotted Owl	*Strix occidentalis lucida*	T			WSC	PVS
Montezuma Quail	*Cyrtonyx montezumae*		MIS			
Northern Beardless-Tyrannulet	*Camptostoma imberbe*		S, MIS			
Northern Goshawk	*Accipiter gentilis*		S		WSC	
Northern Gray Hawk	*Buteo nitida maximus*		S, MIS		WSC	

Common Name	Scientific Name	U.S. Fish and Wildlife Service	Forest Service	Bureau of Land Management	State	County
"Primary and Secondary Cavity Nesters," Used Here as a "Guild;" Some Individual Species Treated Elsewhere			MIS			
Rufous-winged Sparrow	*Aimophila carpalis*					PVS
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	E			WSC	PVS
Swainson's Hawk	*Buteo swainsoni*					PVS
Varied Bunting	*Passerina versicolor*		S			
Violet-crowned Hummingbird	*Amazilia violiceps*		S		WSC	
Western Burrowing Owl	*Athene cunicularia hypugaeae*			S	WSC	PVS
Western Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*	C	S		WSC	PVS
Whiskered Screech-Owl	*Megascops trichopsis*		S			
Fish						
Gila Chub	*Gila intermedia*	E	MIS		WSC	PVS
Gila Topminnow	*Poeciliopsis occidentalis occidentalis*	E	MIS		WSC	PVS
Longfin Dace	*Agosia chrysogaster*		S	S		PVS
Invertebrates						
Cestus Skipper	*Atrytonopsis cestus*		S			
Rosemont Talussnail	*Sonorella rosemontensis*	C				PVS
Santa Rita Mountains Chlorochroan Bug	*Chlorochroa rita*			S		
Sonoran Talussnail	*Sonorella magdalenensis*					PVS
Mammals						
Allen's Big-eared Bat	*Idionycteris phyllotis*		S	S		PVS
Arizona Shrew	*Sorex arizonae*		S		WSC	PVS
Big Free-tailed Bat	*Nyctinomops macrotis*			S		
Black Bear	*Ursus americanus*		MIS			
California Leaf-nosed Bat	*Macrotus californicus*		S		WSC	PVS
Cave Myotis	*Myotis velifer*			S		
Cockrum's Desert Shrew	*Notiosorex cockrumi*		S			
Fringed Myotis	*Myotis thysanodes*			S		
Fulvous Harvest Mouse	*Reithrodontomys fulvescens*		S			
Greater Western Mastiff Bat	*Eumops perotis californicus*		S			
Hooded Skunk	*Mephitis macroura milleri*		S			
Jaguar	*Panthera onca*	E			WSC	PVS
Lesser Long-nosed Bat	*Leptonycteris yerbabuenae*	E			WSC	PVS
Merriam's (or Mesquite) Mouse	*Peromyscus merriami*		S			PVS
Mexican Long-tongued Bat	*Choeronycteris mexicana*		S		WSC	PVS
Northern Pygmy Mouse	*Baiomys taylori ater*		S			
Ocelot	*Leopardus pardalis*	E			WSC	PVS

Common Name	Scientific Name	U.S. Fish and Wildlife Service	Forest Service	Bureau of Land Management	State	County
Pale Townsend's Big-eared Bat	*Corynorhinus townsendii pallescens*		S			PVS
Plains Harvest Mouse	*Reithrodontomys montanus*		S			
Pocketed Free-tailed Bat	*Nyctinomops femorosaccus*		S			
Western Red Bat	*Lasiurus blossevillii*		S		WSC	PVS
Western Yellow Bat	*Lasiurus xanthinus*		S		WSC	PVS
White-nosed Coati	*Nasua narica*		S			
White-tailed Deer	*Odocoileus virginianus couesi*		MIS			
Yellow-nosed Cotton Rat	*Sigmodon ochrognathus*		S			

Status Key:

U.S. Fish and Wildlife Service (U.S. Department of the Interior)

C – Candidate. Plant and animal taxa considered for possible addition to the List of Endangered and Threatened Species. These are taxa for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threat(s) to support issuance of a proposal to list, but issuance of a proposed rule is currently precluded at present by higher priority listing actions.

E – Endangered. Any species that is in danger of extinction throughout all or a significant portion of its range.

Eagle Act – Bald and Golden Eagle Protection Act. Recently (September 11, 2009), there was a final rule (50 Code of Federal Regulations Parts 13 and 22) regarding permit requirements for the nonpurposeful "take" of bald and golden eagles.

T – Threatened. Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Forest Service (U.S. Department of Agriculture, Southwestern Region)

MIS – Management Indicator Species. Species managed by the Forest Service because of the following: (1) their population changes are believed to indicate the effects of management activities; (2) they are monitored during forest plan implementation in order to assess the effects of management activities on their populations and the populations of other species with similar habitat needs which they may represent; and (3) their population trends will be monitored, in cooperation with state fish and wildlife agencies to the extent practicable, and relationships to habitat changes determined.

S – Sensitive. Those taxa occurring on national forests in Arizona that are considered sensitive by the regional forester.

Bureau of Land Management (U.S. Department of the Interior)

S – Sensitive. Those taxa occurring on Bureau of Land Management field office lands in Arizona that are considered sensitive by the Arizona State Office.

State (Arizona Native Plant Law, Arizona Department of Agriculture)

HS – Highly Safeguarded. No collection allowed.

SR – Salvage Restricted. Collection only with permit.

State (Wildlife of Special Concern in Arizona, Arizona Game and Fish Department)

WSC – Wildlife of Special Concern in Arizona. Species whose occurrence in Arizona is or may be in jeopardy, or with known or perceived threats or population declines, as described by the Arizona Game and Fish Department's listing of wildlife of special concern in Arizona (Arizona Game and Fish Department 1996)

County (Priority Vulnerable Species, Pima County Sonoran Desert Conservation Plan)

PVS – Priority Vulnerable Species. Species that are being considered and analyzed as potentially covered species under the Pima County Sonoran Desert Conservation Plan. These species were chosen through a process of scientific review of more than 100 species that are already listed as threatened or endangered or recognized by the Federal Government as imperiled, extirpated species, and a much larger number of species that are in decline and potentially on the way toward Endangered Species Act listing.

Summary of Effects by Issue Measures by Alternative

Table 98 provides a comparison of the impacts for each issue measure by alternative.

Table 98. Summary of effects

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
4. Riparian habitat disturbed (acres)*	None	Cienega Creek: 490.4 hydroriparian/ mesoriparian; Davidson Canyon: 471.2 xeroriparian, 17.2 to 204.7 mesoriparian; Empire Gulch: 58.3 hydroriparian/ mesoriparian; Gardner Canyon: 139.6 hydroriparian/ mesoriparian	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
4. Qualitative assessment of ability to meet legal and regulatory requirements	None	Biological, hydrologic, and geomorphic impacts to Davidson Canyon; Biological and hydrologic impacts to Cienega Creek, Empire Gulch, and Gardner Canyon	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
5A: Vegetation – Loss of vegetation communities†	None	6,380 to 6,461 acres lost or converted	6,278 to 6,359 acres lost or converted	7,014 to 7,095 acres lost or converted	7,014 to 7,095 acres lost or converted	7,363 to 7,444 acres lost or converted
5B: Habitat Loss – Acres of habitat†	None	6,380 to 6,461 acres lost or converted	6,278 to 6,359 acres lost or converted	7,014 to 7,095 acres lost or converted	7,014 to 7,095 acres lost or converted	7,363 to 7,444 acres lost or converted
5B: Habitat Loss – Impacts to Aquatic Habitat	None	63 springs and seeps impacted; 15 stock tanks impacted; and 0.8 acre of wetland impacted	63 springs and seeps impacted; 15 stock tanks impacted; and 0.8 acre of wetland impacted	63 springs and seeps impacted; 19 stock tanks impacted; and 0.8 acre of wetland impacted	63 springs and seeps impacted; 19 stock tanks impacted; and 0.8 acre of wetland impacted	67 springs and seeps impacted; 8 stock tanks impacted; and 0.8 acre of wetland impacted
5C: Nonnative Species – Acres of Disturbance†	None	6,380 to 6,461 acres disturbed	6,278 to 6,359 acres disturbed	7,014 to 7,095 acres disturbed	7,014 to 7,095 acres disturbed	7,363 to 7,444 acres disturbed
5D: Wildlife Movement – Change in Movement Corridors and Connectivity	None	Increased fragmentation and reduced connectivity	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
5D: Wildlife Movement – Traffic Related Mortality	No Change	Animal roadkills on State Route 83 will approximately double by year 20 of mine operations‡	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
5E: Species of Concern – Habitat Lost or Converted†	None	6,380 to 6,461 acres lost or converted	6,278 to 6,359 acres lost or converted	7,014 to 7,095 acres lost or converted	7,014 to 7,095 acres lost or converted	7,363 to 7,444 acres lost or converted
5E: Species of Concern – Effects on Population Viability	No Change	Could be reduced for at least 3 sensitive species	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
5F: Animal Behavior – Acres of Habitat Impacted	None	Up to 145,190 acres§ impacted	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action

Note: The acreages listed in this table are the acreages within the perimeter fence for each action alternative.

* Riparian area disturbance refers to acreage potentially affected indirectly by groundwater drawdown or reduction in surface flows. Direct impacts from surface disturbance are analyzed in the "Surface Water Quality" section.

† See table 101 for breakdown of impacts to vegetation type by landownership.

‡ See the "Transportation/Access" section.

§ See table 99 for acreages of vegetation community by landownership within the analysis area.

Affected Environment

Relevant Laws, Regulations, Policies, and Plans

Numerous environmental laws, regulations, policies, and one plan influence the analysis, as outlined below.

Federal

Endangered Species Act

The Endangered Species Act of 1973, as amended, requires Federal agencies to use their authority to conserve endangered and threatened species. Section 7(a)(2) of the act requires Federal agencies to consult with the U.S. Fish and Wildlife Service and/or the U.S. National Oceanic and Atmospheric Administration Fisheries Service to ensure that the actions they authorize, fund, or conduct are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (16 United States Code 703–711) provides Federal protection to all migratory birds, including nests and eggs. Under this act, it is unlawful to take, kill, or possess migratory birds. The Southwestern Regional Office of the Forest Service recommends analyzing the impacts as follows: (1) on Species of Concern listed by National Partners in Flight; (2) on important bird areas; and (3) on important overwintering areas, as discussed in a 2008 memorandum of understanding between the Forest Service and the U.S. Fish and Wildlife Service.

Executive Order 13186

Issued on January 11, 2001, this executive order states that a memorandum of understanding between the Forest Service and U.S. Fish and Wildlife Service was needed to establish conservation goals, mitigative measures, and accountability for ground-disturbing activities. The resulting memorandum of understanding states that the Forest Service shall "consider approaches, to the extent practicable, for identifying and minimizing take that is incidental to otherwise lawful activities . . . giving due consideration to key wintering areas, migration routes, and stopovers" (U.S. Forest Service 2008d). The Bureau of Land Management issued interim management guidance in 2008 to enhance coordination and communication toward meeting the agency's responsibilities under the Migratory Bird Treaty Act and the Executive Order 13186 (Bureau of Land Management 2007a). The interim management guidance establishes a consistent approach for addressing migratory bird populations and habitats when making project level implementation decisions.

Executive Order 13186 requires Federal agencies (Section 3(9)) to "identify where unintentional take reasonably attributable to agency actions is having, or is likely to have, a measurable negative effect of migratory bird populations, focusing first on species of concern, priority habitats, and key risk factors." "Unintentional take" is defined (Section 2(c)) as "take that results from, but is not the purpose of, the activity in question." "Take" is defined (50 Code of Federal Regulations 10.12) as to "pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect." Note that this law refers only to take, not habitat loss or conversion.

The Bald and Golden Eagle Protection Act

This law (16 United States Code 668–668c) was enacted in 1940 and amended several times. The U.S. Fish and Wildlife Service recently (September 11, 2009) announced a final rule on two new permit regulations that would allow for the nonpurposeful "take" of eagles and eagle nests under this act (50 Code of Federal Regulations 13 and 22). Take is defined as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." Disturb is defined as "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

National Forest Management Act

Under this 1976 act, the Secretary of Agriculture "provides for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives." The role of management indicator species in national forest planning is described in the 1982 implementing regulations for the National Forest Management Act.

Forest Service Sensitive Species

As described in Forest Service Manual 2670.12 (U.S. Forest Service 2005a), the Forest Service will do the following: (1) manage "habitats for all existing native and desired nonnative plants, fish, and wildlife species in order to maintain at least viable populations of such species;" and (2) avoid actions that "may cause a species to become threatened or endangered."

Bureau of Land Management Sensitive Species

Bureau of Land Management Manual 6840 (Bureau of Land Management 2008a) defines Bureau of Land Management sensitive species as those that "normally occur on Bureau of Land Management administered lands for which Bureau of Land Management has the capability to significantly affect

the conservation status of the species through management." In Arizona, Bureau of Land Management sensitive species are defined as "collectively, federally listed or proposed and Bureau sensitive species, which include both Federal candidate species and delisted species within 5 years of delisting."

Executive Order 13112

On February 3, 1999, the President signed Executive Order 13112, which directed Federal agencies to prevent introduction of invasive species, control populations, monitor populations, and provide for restoration of native species, among other requirements.

State

Arizona Native Plant Law

This law applies to all lands within the State of Arizona. State-protected native plants cannot be legally possessed, taken, or transported from any lands without a permit from the Arizona Department of Agriculture; permission of the landowner is also required. Landowners have the right to destroy or remove plants growing on their land, but they are required to notify the Arizona Department of Agriculture 20 to 60 days prior to the destruction of any protected native plants. The law includes two exemptions: (1) clearing of native plants that occur in the normal, ongoing practices of mining, farming, and livestock-raising operations, and (2) clearing of native plants on individually owned residential property of 10 acres or less, where initial construction has occurred. A list of protected plants is provided on the Arizona Department of Agriculture Web site (Arizona Department of Agriculture 2005).

Invasive Plant Species

The State of Arizona has laws addressing the control and eradication of noxious and invasive weeds and identifying specific species that fall under noxious weed definitions (Arizona Administrative Code R3-4-244 and 245). The Arizona Department of Agriculture is responsible for implementing state laws pertaining to noxious and invasive weeds.

County

Sonoran Desert Conservation Plan

Pima County has drafted the Sonoran Desert Conservation Plan, which includes priority vulnerable species. Some priority vulnerable species are not currently listed under the Endangered Species Act but are being considered and analyzed as potentially covered species under the Endangered Species Act.

Existing Conditions

This section discusses the existing biological resources in the analysis area. The section first gives biophysical and biological information that is important in understanding habitats in the analysis area and then discusses the plant and animal species that may occur in the analysis area.

Biophysical Features

The analysis area ranges in elevation from approximately 2,740 to 6,610 feet above mean sea level. The topography is dominated by rolling to steep hills, drainages, and canyons. The Santa Rita Mountain range includes numerous drainages that contain riparian habitat, but few are perennial

(National Audubon Society 2010). This is evident in the analysis area, as there are no perennial drainages present. Barrel Canyon is the principal drainage system within the analysis area (see figure 1). Wasp, McCleary, and Scholefield Canyons discharge to Barrel Canyon, which discharges to Davidson Canyon and then to Cienega Creek in the northeastern portion of the analysis area. Empire Gulch and Gardner Canyon discharge into upper Cienega Creek in the southeast portion of the analysis area. The northwest side of the analysis area is drained by a series of unnamed headwater tributaries of Sycamore Canyon. Box Canyon is the major drainage system within the southwest portion of the analysis area, west of the main ridgeline. There are 101 springs and seeps and 148 stock tanks in the analysis area (figure 52). Two springs in the analysis area were identified as being associated with wetlands: Scholefield Spring, located on a tributary to Scholefield Canyon; and Fig Tree Spring, which is a developed spring near the head of a minor unnamed tributary to Sycamore Canyon (2010d). These water sources provide habitat for aquatic plant and animal species within the analysis area. A comprehensive list of springs identified in the area is provided in table 50 in the "Groundwater Quantity" section, and a list of stock tanks in the area is given in table 78 in the "Surface Water Quantity" section. Refer to the "Groundwater Quantity," "Groundwater Quality," "Surface Water Quantity," and "Surface Water Quality" sections for discussion of the affected environment and water resources.

Previous mining activity has resulted in a number of mine adits and shafts within and adjacent to the analysis area (figure 53); mine adits and shafts provide roosting habitat for bats. For a more detailed evaluation of these features, see WestLand Resources Inc. (2009c; 2009d). There are numerous talus slopes and rock outcrops present on the steeper portions of the analysis area (figure 54); talus slopes and rock outcrops provide habitat for talussnails and other special status species. For a more detailed evaluation of these features, see WestLand Resources Inc. (2009g).

Vegetation Communities

Uplands

The proposed project is located in three upland vegetation communities: semidesert grassland, Madrean evergreen woodland, and Chihuahuan desertscrub (Brown 1994), shown in figure 55. Semidesert grassland, characterized by open grasslands with widely scattered shrubs and cacti, generally covers the lower elevations of the analysis area. Madrean evergreen woodland mostly covers the higher elevations of the analysis area, generally in the western and southern areas, and is characterized by open woodlands or savanna, consisting of trees interspersed with grasses and forbs. Chihuahuan desertscrub is dominated by creosotebush (*Larrea tridentata*) on plains, low hills, and valleys on the uplands surrounding middle Cienega Creek.

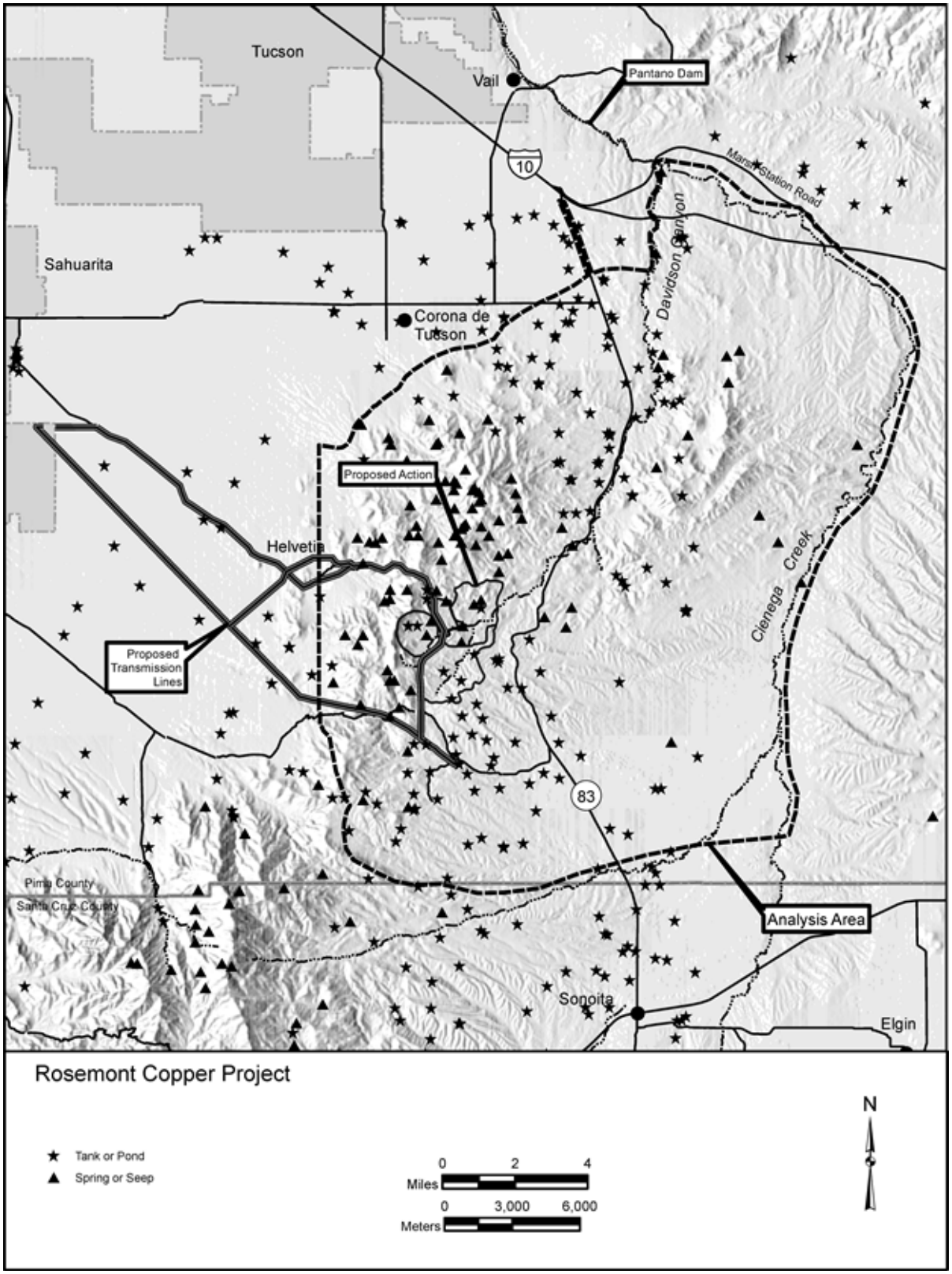


Figure 52. Springs, seeps, and stock tanks within the analysis area

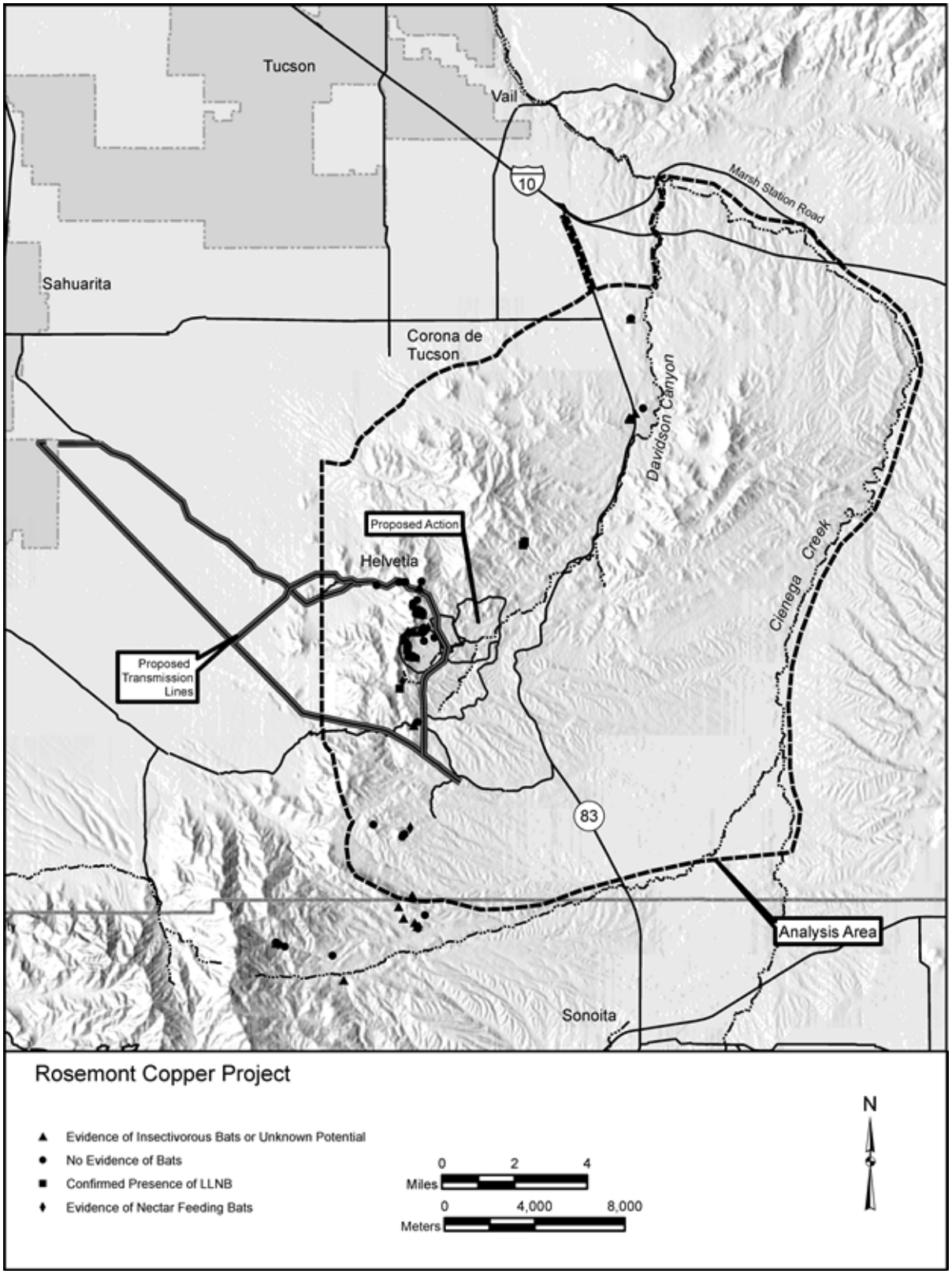


Figure 53. Mine adits and shafts within the analysis area (WestLand Resources Inc. 2009d)

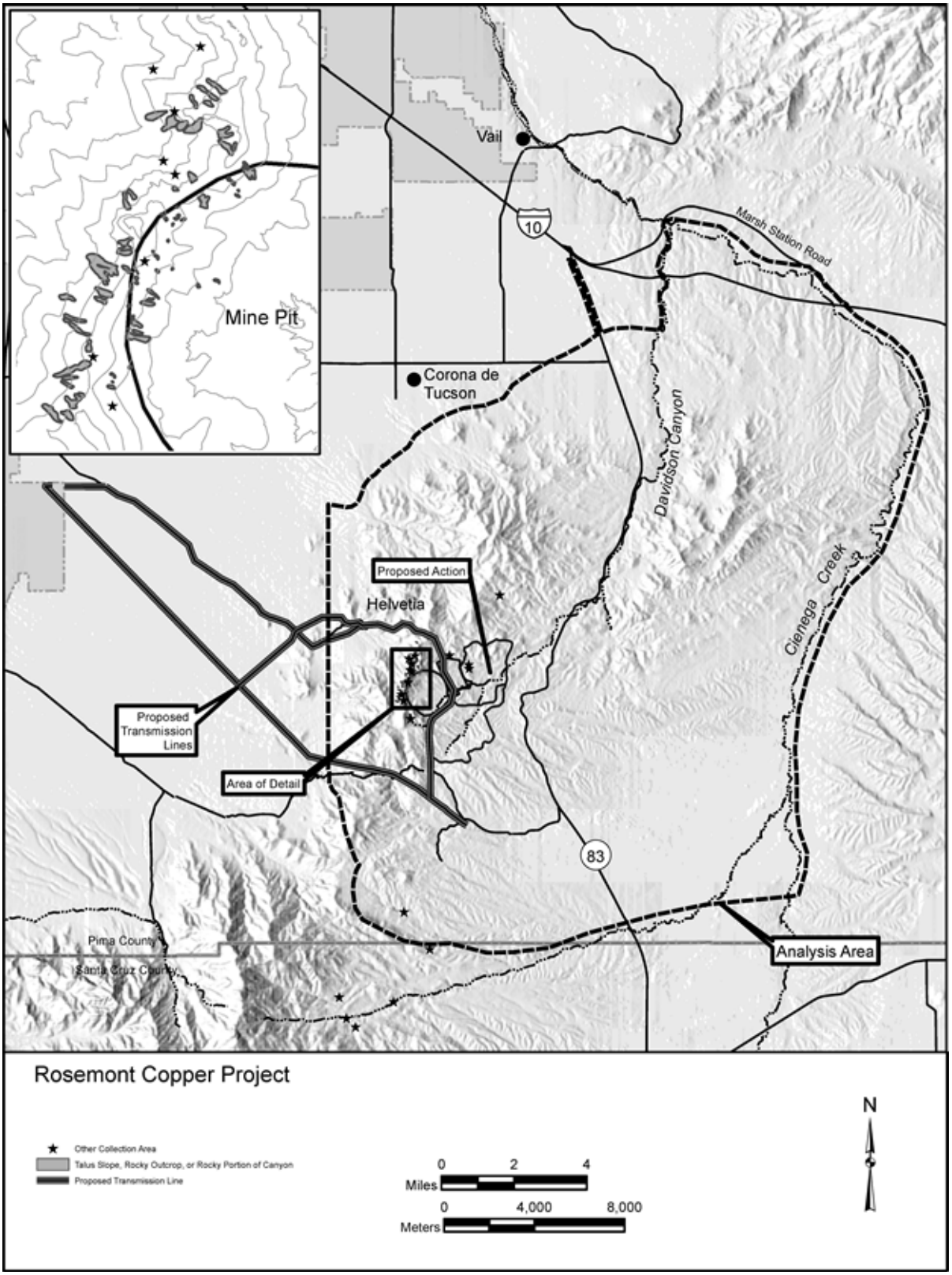


Figure 54. Talus slopes, rocky outcrops, and rocky canyon bottoms within the analysis area (WestLand Resources Inc. 2009g)

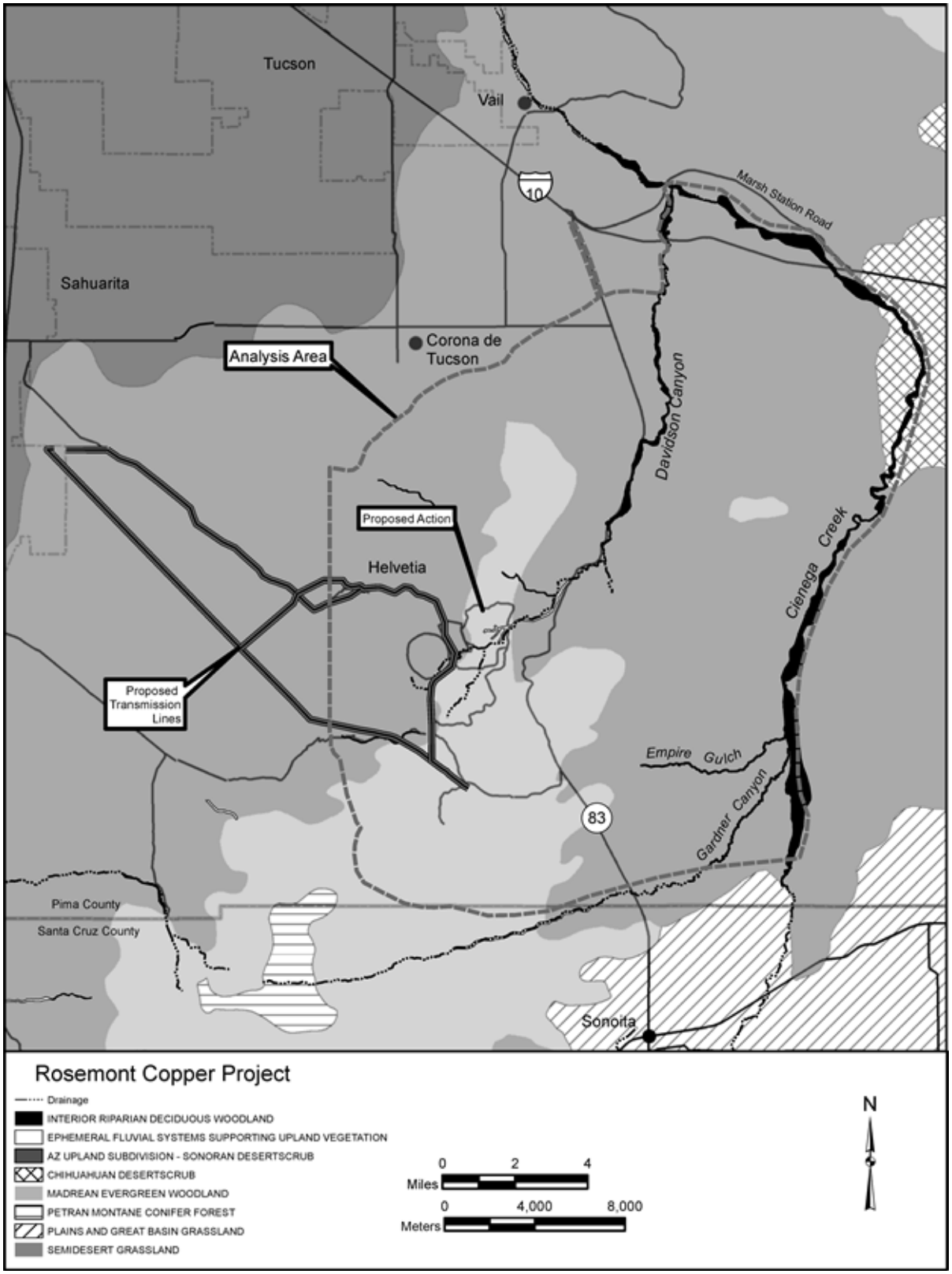


Figure 55. Vegetation types within the analysis area (Brown 1994)

Semidesert Grassland

There is a total of approximately 107,396 acres of the semidesert grassland vegetation community in the analysis area (table 99). In the semidesert grassland vegetation type, composition and density vary with geographic location, precipitation, and topography. Some areas within this vegetation community are nearly barren, with an abundance of sand, rock, gravel, scree, or talus, while other areas have sparse to dense vegetation cover that includes succulent species, grasses, shrubs, scattered trees, and some herbaceous cover (Brown 1994). Within the analysis area, semidesert grassland is characterized by grasses interspersed with a variety of low-growing trees, shrubs, and cacti, including whitethorn acacia (*Acacia constricta*), catlaw acacia (*A. greggii*), prickly-pear cactus (*Opuntia* spp.), cholla (*Cylindropuntia* spp.), soaptree yucca (*Yucca elata*), beargrass (*Nolina microcarpa*), desert spoon (*Dasylirion wheeleri*), and agave (principally *Agave schottii* and *Agave palmeri*). Native grass species include black grama (*Bouteloua eriopoda*), blue grama (*B. gracilis*), sideoats grama (*B. curtipendula*), hairy grama (*B. hirsuta*), buffalo grass (*B. dactyloides*), plains lovegrass (*Eragrostis intermedia*), little bluestem (*Schizachyrium cirratum*), plains bristlegrass (*Setaria machrostachya*), fluffgrass (*Dasyochloa pulchella*), burrograss (*Scleropogon brevifolius*), and slim tridens (*Tridens muticus*). The nonnative Lehmann lovegrass (*E. lehmanniana*) is one of the more abundant nonnative grass species in the analysis area.

Madrean Evergreen Woodland

There is a total of approximately 30,417 acres of the Madrean evergreen woodland vegetation community in the analysis area (see table 99). The Madrean evergreen woodland vegetation community occurs on foothills, canyons, bajadas, and plateaus between the semidesert grasslands and pine forests (Brown 1994). This community is dominated by evergreen oaks. In the analysis area, common oak species include Emory oak (*Quercus emoryi*), Mexican blue oak (*Q. oblongifolia*), Arizona white oak (*Q. arizonica*), and silverleaf oak (*Q. hypoleucoides*). Also present are alligator bark juniper (*Juniperus deppeana*), one-seed juniper (*J. monosperma*), velvet mesquite (*Prosopis velutina*), and Mexican pinyon (*Pinus cembroides*). All of the shrub and warm-season grass species and other ground cover listed in the semidesert grassland section can also be found in areas dominated by the Madrean evergreen woodland vegetation community.

Table 99. Vegetation type by landowner (acres) within analysis area

Vegetation Type	Forest Service	Bureau of Land Management	Arizona State Land Department State Trust Lands	Private	Total
Semidesert grassland	17,195	20,000	50,655	19,545	**107,396**
Madrean evergreen woodland	24,631	1,014	2,251	2,521	**30,417**
Chihuahuan desertscrub	0	97	2,295	230	**2,622**
Riparian*	318	2,006	926	1,506	**4,756**
Total	**42,144**	**23,117**	**56,127**	**23,802**	**145,190**

*These acreages are a combination of those mapped for interior riparian deciduous woodland and ephemeral fluvial systems supporting upland vegetation.

Chihuahuan Desertscrub

There is a total of approximately 2,622 acres of the Chihuahuan desertscrub vegetation community in the analysis area (see table 99) (Brown 1994). Chihuahuan desertscrub is limited to uplands in the vicinity of Cienega Creek within the analysis area (Brown 1994). The analysis area is within the Mexican Highlands Ecoregion, the Chihuahuan Desert influences this ecoregion, and McLaughlin

and Van Asdall (1977) noted that Chihuahuan desertscrub vegetation components are present in the mine site area.

Sonoran Desertscrub

Sonoran desertscrub is located outside the analysis area (Brown 1994). However, the analysis area falls within the Mexican Highlands Ecoregion, and the Sonoran Desert influences this ecoregion. One portion of the analysis area that contains elements of the Sonoran desertscrub biotic community is downstream, near the point where Davidson Canyon merges with Cienega Creek. The other portion of the analysis area that exhibits characteristics of the Sonoran desertscrub biotic community are the areas proposed for utility lines and access roads connecting the mine operations to the town of Sahuarita. The conspicuous vegetation of the Arizona Upland subdivision of the Sonoran Desert includes saguaro (*Carnegiea gigantea*), palo verde (*Parkinsonia* spp.), creosotebush, and numerous species of cacti, such as chain fruit cholla (*Opuntia fulgida*) and Engelmann prickly pear (*O. phaeocantha* var. *phaeocantha*).

Riparian

The word “riparian” is used to describe plant communities associated with natural washes, rivers, ponds, and springs. Riparian plant associations occur along a continuum of available soil moisture, and regulatory agencies and researchers have consequently developed numerous and varied definitions of riparian (WestLand Resources Inc. 2010d). Some definitions relate directly to the nature of the water supply (e.g., perennial streams only), others relate to the condition and nature of the habitats associated with the watercourse (e.g., vegetation location, density, and composition), and still others use definitions that incorporate varied combinations of these factors (WestLand Resources Inc. 2010d). Riparian areas in the analysis area have been mapped by three different entities: Pima County, the Forest Service, and WestLand Resources Inc. Each entity used different definitions and mapped different geographic areas. Mapping conducted by the Forest Service has been used as the primary source of data for analysis of biological resources; however, mapping from both Pima County and WestLand Resources has also been used for analysis of potential impacts to riparian resources along Davidson Canyon, Cienega Creek, Empire Gulch, and Gardner Canyon.

The Forest Service recognizes two riparian vegetation communities within the analysis area: interior riparian deciduous woodland and ephemeral fluvial systems, which support upland vegetation (Robbie 2009). There is a total of approximately 4,756 acres of riparian vegetation in the analysis area (see table 99). These vegetation communities are present in drainages within the analysis area and along downstream portions of Box, McCleary, Sycamore, Scholefield, Wasp, Barrel, Davidson, and Gardner Canyons; Empire Gulch; and Cienega Creek. While some limited riparian vegetation exists at other springs, only these two springs had large mappable areas of riparian vegetation: Scholefield No. 1 spring supports about 0.3 acre of wetland, and Fig Tree spring supports about 0.5 acre of riparian habitat, with a very limited wetland area. These water sources provide habitat for aquatic species within the analysis area.

Interior Riparian Deciduous Woodland

The vegetation in this type is a mix of riparian woodlands and shrublands, with a variety of vegetation associations. The dominant vegetation varies, depending on a suite of site-specific characteristics, including elevation, substrate, stream gradient, and depth to groundwater. In the analysis area, interior riparian deciduous woodland vegetation is mapped in portions of Scholefield, Davidson, and Gardner Canyons; Empire Gulch; and Cienega Creek. Vegetation includes a variety of trees and shrubs, including Arizona black walnut (*Juglans major*), Goodding’s willow (*Salix*

gooddingii), netleaf hackberry (*Celtis reticulata*), desert willow (*Chilopsis linearis*), desert broom (*Baccharis sarothroides*), and seep willow (*B. glutinosa*) (WestLand Resources Inc. 2010d). Also present are desert false indigo (*Amorpha fruticosa*), canyon grape (*Vitis arizonica*), American brooklime (*Veronica americana*), and southern cattail (*Typha domingensis*).

Ephemeral Fluvial Systems Supporting Upland Vegetation

These systems are found along major and minor ephemeral washes that do not contain a perennial flow of water. This vegetation type typically contains plant species also found in neighboring uplands, although riparian plants are typically larger and often occur at higher densities than those in uplands. In the analysis area, this vegetation community is mapped in portions of Box, McCleary, Sycamore, Scholefield, Wasp, Barrel, Davidson, and Gardner Canyons; Empire Gulch; and Cienega Creek (and numerous smaller named and unnamed unmapped washes within the analysis area), where the dominant plant species include Emory oak, Mexican blue oak, Arizona white oak, oneseed juniper, whitethorn acacia, catclaw acacia, and velvet mesquite.

Future Forest Service Riparian Mapping. It should be noted that the Southwestern Region of the Forest Service is currently conducting updated mapping of all riparian areas. This regional riparian mapping project will include updated mapping for the Coronado; this mapping may be completed and incorporated into this analysis prior to publication of the FEIS.

Pima County Riparian Mapping. Pima County ordinances regulate important riparian areas selected for their hydrologic, geomorphic, and biological values. Pima County's mapping of these important riparian areas is generally more expansive than either the Forest Service's or WestLand Resources Inc.'s mapping. Pima County uses three categories to define important riparian areas: hydroriparian, mesoriparian, and xeroriparian. Hydroriparian areas are wetlands characterized by soils that are never dry or are dry for only a short period of time and are typically associated with perennial or intermittent water. Mesoriparian areas have soils that are dry seasonally and are typically associated with intermittent waters or high-elevation ephemeral wetlands. Xeroriparian areas are typically ephemeral washes that receive more moisture than upland areas but do not have permanent or seasonal water; Pima County further defines four classes of xeroriparian areas based on vegetation volume.

WestLand Resources Inc. has noted that the widths of riparian habitat adopted by Pima County tend to be overestimated, compared with measurement of actual riparian habitat in the field, with the field-measured widths of riparian habitat averaging only 37 percent of that regulated by Pima County (WestLand Resources Inc. 2010d).

One benefit to the mapping conducted by Pima County is that it provides consistent coverage throughout the analysis area, including areas along Cienega Creek and Empire Gulch that are beyond Forest Service boundaries and the immediate mine site area mapped by WestLand Resources Inc.

WestLand Resources Riparian Mapping. WestLand Resources Inc. also conducted riparian mapping for the immediate mine site and Davidson Canyon (WestLand Resources Inc., 2011a). Supplemented by field measurements, WestLand Resources relied on analysis of satellite imagery to identify five different classes of riparian vegetation based on multi-spectral image analysis. Class V has the highest amount of vegetation, while Class I has the least amount of vegetation. This approach does not identify specific types of vegetation, nor does this classification lend itself to direct comparison with the definitions used by Pima County (hydroriparian, mesoriparian, xeroriparian).

Based on qualitative comparison of the two data sets, however, Class V is likely the only class that would encompass hydroriparian or mesoriparian riparian habitat.

Nonnative Plant Species

Surveys for nonnative plant species have not been conducted within the analysis area for the purposes of this project. Lehmann lovegrass, however, has been noted on Forest Service lands in the analysis area (McLaughlin and Van Asdall 1977).

Animal Movement Corridors

Cooperating agencies (Arizona Game and Fish Department, Bureau of Land Management, and Pima County) have identified the analysis area as being part of a critical wildlife movement corridor. All of the canyons and riparian areas within the analysis area may provide significant movement corridors for large and medium-sized species (e.g., black bear, mountain lions, bobcats (*Lynx rufus*), coyotes, mule deer, white-tailed deer, and collared peccary), and numerous small species. These species may either travel large distances between the surrounding areas and mountain ranges or may simply travel shorter distances within the Santa Rita Mountains as part of their daily movement patterns. Small species use smaller-scale movement corridors within the analysis area.

The analysis area falls within or adjacent to three different wildlife linkages (Arizona Wildlife Linkages Workgroup 2006): (1) Linkage 92: San Xavier-Sierrita-Santa Rita; (2) Linkage 94: Rincon-Whetstone-Santa Rita; and (3) Linkage 95: Santa Rita-Empire Complex (figure 56). Linkage 92 did not undergo the same level of detailed analysis as Linkages 94 and 95, and the shapefiles are not available for Linkage 92 at this time; therefore, Linkage 92 is not mapped in figure 56.

Target species associated with Linkage 92 include the following: black bear (*Ursus americanus*), cave myotis (*Myotis velifer*), giant spotted whiptail (*Aspidoscelis burti stictogrammus*), Gila topminnow (*Poeciliopsis occidentalis occidentalis*), jaguar (*Panthera onca*), mountain lion (*Puma concolor*), lesser long-nosed bat (*Leptonycteris yerbabuenae*), lowland leopard frog (*Lithobates yavapaiensis*), yellow-nosed cotton rat (*Sigmodon ochrognathus*), and western yellow-billed cuckoo (*Coccyzus americanus occidentalis*). Threats to this linkage include border security, the Central Arizona Project, Interstate 19, the railroad, and urbanization (including roads and utility corridors associated with mining).

A total of approximately 31,093 acres of Linkage 94 occurs within the analysis area. Target species associated with Linkage 94 include the following: Chiricahua leopard frog (*Lithobates chiricahuensis*), giant spotted whiptail, Gila chub (*Gila intermedia*), Gila topminnow, collared peccary (*Pecari tajacu*), mountain lion, lesser long-nosed bat, Mexican long-tongued bat (*Choeronycteris mexicana*), Mexican spotted owl (*Strix occidentalis lucida*), northern gray hawk (*Buteo nitida maximus*), Sonoran desert tortoise (*Gopherus agassizii* (Sonoran population)), white-tailed deer (*Odocoileus virginianus couesi*), and western red bat (*Lasiurus blossevillii*). Threats to this linkage include border security, Interstate 10 and State Route 83, the railroad, and urbanization (including roads and other impacts associated with mining).

A total of approximately 7,965 acres of Linkage 95 occurs within the analysis area. Target species associated with this Linkage 95 include most of the same species associated with Linkages 92 and 94, along with pronghorn (*Antilocapra americana*) and western black kingsnake (*Lampropeltis getula nigrita*). Threats to this linkage include border security, State Route 83, urbanization, and mining.

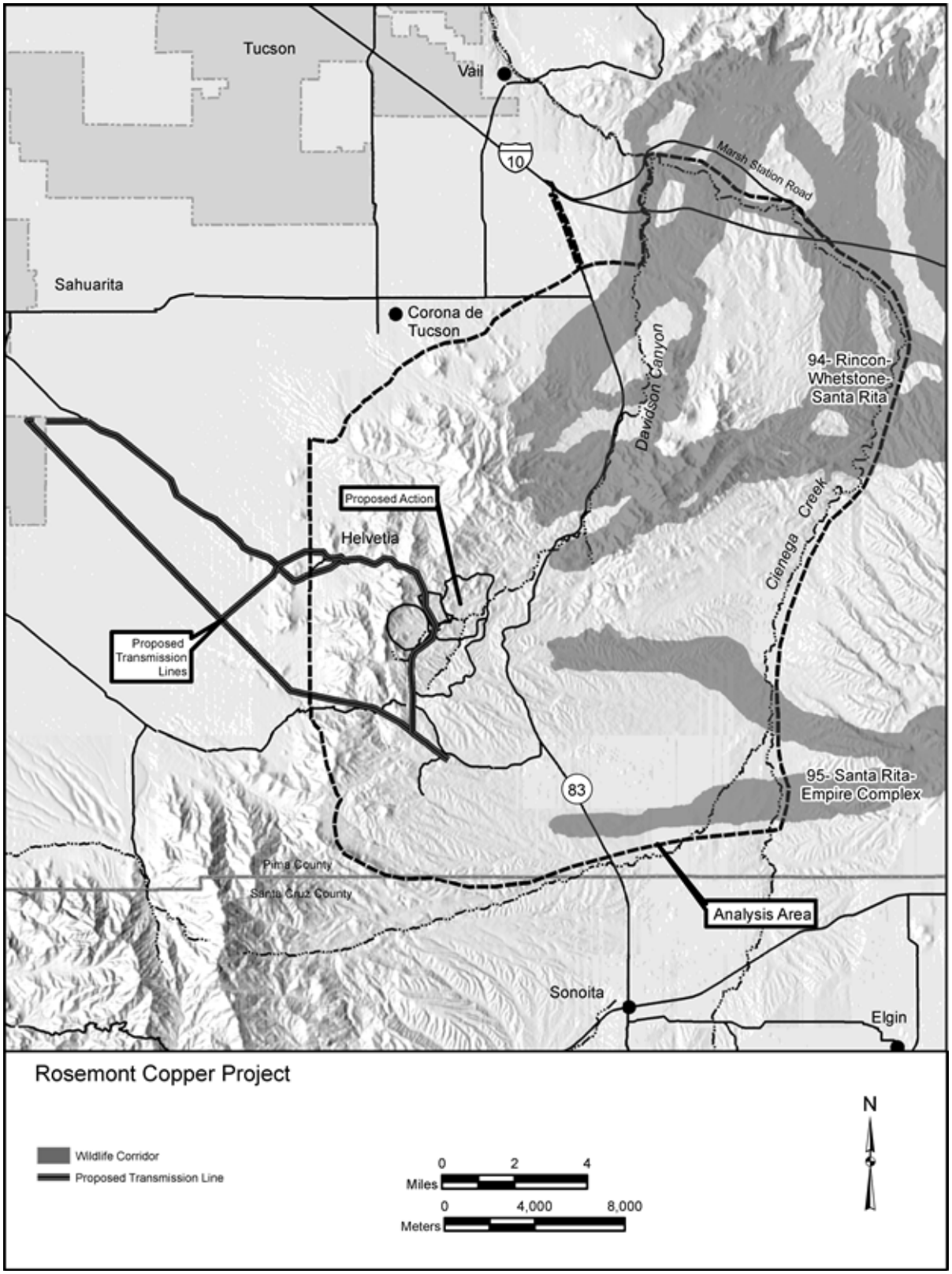


Figure 56. Wildlife linkages relative to the analysis area (Arizona Wildlife Linkages Workgroup 2006)

Special Status Species

Plants

This section identifies the one federally listed and nine other special status plant species in table 97 (1) that have been recently documented as occurring within the project footprint or the analysis area and (2) for which impacts are reasonably foreseeable.

Arid throne fleabane (*Erigeron arisolius*). In southeastern Arizona, this species has been observed in Pima, Cochise, and Santa Cruz Counties and typically occurs on moist, rocky soils in grassy openings or roadsides within semidesert grasslands and Madrean evergreen (oak, encinal) woodlands at elevations ranging from 4,265 to 5,650 feet above mean sea level (Arizona Game and Fish Department 2001c). It is listed as sensitive by the Southwestern Region of the Forest Service (see table 97) because of its infrequent occurrence; it is found at scattered localities in extreme southeastern Arizona and is susceptible to loss through grazing since it typically occurs in grassy areas, which are favorite feeding sites for livestock (Arizona Game and Fish Department 2001c; U.S. Forest Service 2007c). Arid throne fleabane was not documented as part of the flora of the Rosemont area during the ANAMAX surveys (McLaughlin and Van Asdall 1977). There have been seven collections of this species taken in the Santa Rita Mountains, all outside the footprint of the proposed mine (Southwest Environmental Information Network 2011a): three records near Empire Gulch and one record along State Route 83 that are all apparently within the analysis area, one record along Box Canyon Road (approximately 0.25 mile west of the analysis area), one record in Gardner Canyon (approximately 0.5 mile south of the analysis area), and one near Smith Canyon (approximately 1.5 miles south of the analysis area). Although the range of the species is within the analysis area and there are specimen records within the analysis area, arid throne fleabane was not observed during various surveys of the analysis area by WestLand Resources Inc.; however, a species-specific survey targeting arid throne fleabane was not conducted.

Arizona giant sedge (*Carex ultra*). Arizona giant sedge is an herbaceous perennial that occurs on moist soil near perennially wet springs and streams in riparian woodland or oak-pinyon woodland in southeastern Arizona at elevations ranging from 2,040 to 6,000 feet in Pima, Cochise, Pinal, Graham, Santa Cruz, and Yavapai Counties in Arizona (Arizona Game and Fish Department 2000a). This plant is listed as sensitive by the Forest Service because it grows in saturated soil near perennial seeps, streams, and springs, areas that could be heavily impacted by grazing if not properly managed (U.S. Forest Service 2007c), and the small populations of this plant that are typically observed are vulnerable to local disturbance of aquatic habitat (Arizona Game and Fish Department 2000a). This plant species was not observed within an approximately 25-square-mile area referred to as the Rosemont area during mid-1970s vegetation surveys by the University of Arizona (McLaughlin and Van Asdall 1977). Surveys for this species have not been conducted outside the proposed footprint of the mine within the analysis area for the purposes of this project; however, it was observed in the project footprint at Scholefield Spring during wetland delineations conducted by WestLand Resources Inc. (2010c) and has been documented along lower Cienega Creek within the analysis area (Arizona Game and Fish Department 2011d).

Arizona manihot (*Manihot davisiae*). In Arizona, this extremely rare perennial herb typically occurs on limestone slopes at elevations ranging from 3,500 to 4,000 feet above mean sea level in the Baboquivari, Santa Catalina, and Santa Rita Mountains (Arizona Rare Plant Committee n.d. (2000)). Only 11 specimens of Arizona manihot have been collected in the United States, and the main threat to the species is grazing (U.S. Forest Service 2007c). Arizona manihot was not observed within an approximately 25-square-mile area referred to as the Rosemont area during mid-1970s vegetation

surveys by the University of Arizona (McLaughlin and Van Asdall 1977). There have been two collections of this species taken in the Santa Rita Mountains outside the analysis area (Southwest Environmental Information Network 2011b): one south of Agua Caliente Canyon (approximately 10 miles southwest of the analysis area), and one in Florida Canyon (approximately 3.5 miles west of the analysis area). A survey was recently conducted and a small population of this species was found in lower McCleary Canyon within the footprint of the proposed mine, and several small populations were found at other locations in the Santa Rita Mountains outside the analysis area (WestLand Resources Inc. 2011b).

Bartram stonecrop (*Graptopetalum bartramii*). This species is only known from 12 small, widely scattered populations in Cochise, Pima, and Santa Cruz Counties within the Baboquivari, Dragoon, Chiricahua, Mule, Patagonia, Rincon, Santa Rita, and Tumacacori Mountains (Arizona Game and Fish Department 2001d). Bartram stonecrop occurs in the Madrean evergreen woodland on ledges or slopes of steep-walled canyons at elevations ranging from 3,650 to 6,700 feet above mean sea level. It typically occurs in cracks within rocky outcrops in shrub live oak/grassland communities alongside spikemoss, liverworts, lichens, and ferns on the sides of rugged canyons along arroyos, and where there is usually heavy litter cover and shade where moisture drips from rocks. Bartram stonecrop was not observed in the Rosemont area during vegetation surveys conducted in the mid-1970s by the University of Arizona (McLaughlin and Van Asdall 1977). This species was not observed during a 2010 survey for this species within and immediately surrounding the footprint of the proposed mine (WestLand Resources Inc. 2010c). This species was documented as occurring in the Empire Mountains near the Old Sonoita Highway junction with State Route 83 and in lower Gardner Canyon, within the analysis area but outside the proposed footprint of the mine (Southwest Environmental Information Network 2011c). There have been two additional collections of this species taken in the Santa Rita Mountains (Southwest Environmental Information Network 2011c): one record at Sweetwater Spring (approximately 2 miles southwest of the analysis area) and one record at Madera Canyon (approximately 5.5 miles west-southwest of the analysis area).

Beardless chinchweed (*Pectis imberbis*). This plant species is only currently known from 13 small, scattered populations in Cochise, Pima, and Santa Cruz Counties within the Atascosa, Huachuca, Patagonia, and Santa Rita Mountains and Canelo Hills (Arizona Game and Fish Department 2003d). Beardless chinchweed occurs on south-facing slopes of eroded granite along road cuts (slopes may be 95 to 100 percent) in open grassland and oak-grassland habitat in southern Arizona at elevations typically ranging from 3,600 to 6,475 feet above mean sea level in Arizona. The main known threats to this species are grazing and road maintenance. This species was not observed in the Rosemont area during vegetation surveys conducted in the mid-1970s by the University of Arizona (McLaughlin and Van Asdall 1977). At this time, it is unclear where in the Santa Rita Mountains this species has been collected. Five to seven individuals of this species were observed during a 2010 survey within the proposed fenceline of the proposed mine and adjacent to the proposed west access road over Lopez Pass (WestLand Resources Inc. 2010c). The actual number of plants present is not known because this species produces ramets from underground rhizomes.

Coleman's coral-root (*Hexalectris colemanii*). Coleman's coralroot is a xeroriparian obligate that grows along the slopes of intermittent drainages where large oaks (*Quercus* spp.) and other tree species provide shade or dappled sunlight and leaf litter between 4,500 and 5,200 feet above mean sea level (Baker 2003; Catling 2004; Coleman 2002:98–101). The known distribution of Coleman's coral-root is limited to McCleary Canyon and some small tributaries: a tributary of Wasp Canyon, Pima County; Sawmill Canyon (this area is variously referred to as Sawmill, Cave Creek, and Gardner Canyon because of its proximity to all of these drainages), Santa Cruz County; and the west

side of Cochise Stronghold in the Dragoon Mountains, Cochise County (Baker 2003; Catling 2004; WestLand Resources Inc. 2010c). It has also been reported from the Baboquivari Mountains, Pima County (Arizona Game and Fish Department 2004a; Catling 2004), but the current status of this population is unknown.

This orchid has been collected in the past along McCleary Canyon within the footprint of the proposed action and the Phased Tailings Alternative under dense leaf litter below an Emory oak. WestLand Resources Inc. (2010c) conducted a survey for this species in 2010 to determine whether the species also occurred in other drainages such as Barrel, Scholefield, and Sycamore canyons. The species was observed in Wasp Canyon (a cluster of four) within the footprint of all action alternatives and in other previously undocumented locations in McCleary Canyon within the project footprint, in addition to the previously known locations in McCleary Canyon (115 individuals in all within McCleary Canyon). Numerous other canyons in the Santa Rita Mountains and across southeastern Arizona were surveyed for this species (WestLand Resources Inc. 2010c). Approximately 25 individuals were observed in Sawmill Canyon in the Santa Rita Mountains, and approximately 140 were observed in West Stronghold Canyon in the Big Dragoon Mountains.

Huachuca water umbel (*Lilaeopsis schaffneriana* var. *recurva*). In Arizona, Huachuca water umbel has been documented at disjunct locations in Santa Cruz, Cochise, and Pima Counties (Arizona Game and Fish Department 2003c). In Santa Cruz County, it is known from Canelo Hills/Turkey Creek, Sonoita Creek, and the San Rafael Valley. Populations in Cochise County include the Huachuca Mountains, San Pedro River, and San Bernardino Valley. The majority of plants in Arizona are found along the San Pedro River. Before 2001, the only known extant site in Pima County was at Empire Gulch in the Las Cienegas National Conservation Area, which is within the analysis area (Pima County 2001). In the Las Cienegas National Conservation Area, Huachuca water umbel is found from the confluence of Gardner Canyon north to the northern boundary of the national conservation area and within Cienega Creek during past survey efforts. Surveys for this species have not been conducted within the analysis area for the purposes of this project.

Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*). This species is found in vegetation communities characterized as either Sonoran desertscrub (Arizona Upland subdivision) or semidesert grassland, or a combination of the two, and it is often associated with the following shrub species: desert zinnia (*Zinnia* sp.), snakeweed (*Gutierrezia sarothrae*), burroweed (*Isocoma tenuisecta*), and buckwheat (*Eriogonum* spp.) (U.S. Fish and Wildlife Service 2007). Pima pineapple cactus generally grows on slopes less than 10 percent and along the tops (upland areas) of alluvial bajadas within a range of soil types and depths at elevations between 2,360 and 4,000 feet above mean sea level (U.S. Fish and Wildlife Service 2007, 2008a). In Arizona, this cactus is found in a range that extends from the Arizona/Mexico border as far north as southern Tucson, bounded to the east by the Santa Rita Mountains and to the west by the Baboquivari Mountains (Arizona Game and Fish Department 2001b). This species is not known or expected to occur within the mine footprint but is found at lower elevations west of the mine site, where utility corridors are proposed. In all, 84 living and 4 dead Pima pineapple cacti have been found within the five alternative alignments for the proposed utility corridor (WestLand Resources Inc. 2009e, 2009f, 2010e).

Santa Rita yellowshow (*Amoreuxia gonzalezii*). Santa Rita yellowshow is known only from northern Mexico and extending north into southern Arizona. This species is only known from four populations in northern Mexico (NatureServe 2011a), three sites within the Santa Rita Mountains, and two sites in the Rincon Mountains in Arizona (Arizona Game and Fish Department 2003a; Southwest Environmental Information Network 2011e). All five sites in southern Arizona are located

on the Coronado National Forest (U.S. Forest Service 2007c). Threats to this species include development, grazing, mining, habitat degradation, rarity, and competition with introduced exotic grasses (e.g., buffelgrass, Lehmann's lovegrass) (Arizona Game and Fish Department 2003a). The three locations in the Santa Rita Mountains in Santa Cruz County are more than 10 miles southwest of the analysis area (Southwest Environmental Information Network 2011e). This species was observed in the project footprint during mid-1970s vegetation surveys by the University of Arizona (McLaughlin and Van Asdall 1977), and it has been observed in the past near Rosemont junction (Jenkins 2010). A survey was recently conducted, and this species was not found within the footprint of the proposed mine. However, a congener, *Amoreuxia palmatifida*, was observed during these surveys (WestLand Resources Inc. 2011b).

Sonoran noseburn (*Tragia laciniata*). This plant typically occurs on rocky, granitic soils in open woodlands along streams and canyon bottoms and on shaded hillsides in oak and mixed-conifer woodland at elevations ranging from 3,500 to 5,680 feet; it may also grow on limestone soils and coarse sand (Arizona Game and Fish Department 2004b; U.S. Forest Service 2007c). Sonoran noseburn has limited occurrence and grows at scattered locations that are subject to numerous activities, including grazing, mining, road building, and recreation (U.S. Forest Service 2007c). This species is known from the Huachuca Mountains in Cochise County; the Santa Rita Mountains in Pima County; and the Canelo Hills (O'Donnell Canyon) and Atascosa (Sycamore Canyon), Pajarito, Patagonia, and Santa Rita Mountains in Santa Cruz County (Arizona Game and Fish Department 2004b). This species was not observed in the project footprint during vegetation surveys conducted in the mid-1970s by the University of Arizona (McLaughlin and Van Asdall 1977). There has been one collection of this species in dense oak woodland from within the footprint of the mine and one from Gardner Canyon within the analysis area (Southwest Environmental Information Network 2011f). There have been two additional collections of this species in the Santa Rita Mountains outside the analysis area within Big Casa Blanca Canyon (approximately 10 miles south of the analysis area) (Southwest Environmental Information Network 2011f).

Southwestern (Box Canyon) muhly (*Muhlenbergia palmeri [=dubioides]*). This plant species is rare, having been collected at only seven different localities in Arizona, and it is palatable to ungulates (U.S. Forest Service 2007c). Habitat matching this description is present within the analysis area; therefore, it is possible that this species occurs within the analysis area. Box Canyon muhly is known only from southeastern Arizona and Sonora, Mexico. In Arizona, this species is known from the Huachuca Mountains and Canelo Hills in Cochise County; the Santa Rita, Santa Catalina, and Baboquivari Mountains in Pima County; and Sycamore Canyon of the Pajarito Mountains in Santa Cruz County (Arizona Game and Fish Department 2000b). Known threats to this species are grazing and associated erosion and scouring (Arizona Game and Fish Department 2000b).This species was not observed in the project footprint during mid-1970s vegetation surveys by the University of Arizona (McLaughlin and Van Asdall 1977). This species was not observed during a 2010 survey of the project footprint by WestLand Resources Inc. (2010c). This species has been collected numerous times from areas within and adjacent to the analysis area (Southwest Environmental Information Network 2011d) seven records near Box Canyon Road within the analysis area but outside the footprint of the proposed mine, and one record along Box Canyon Road (approximately 0.25 mile west of the analysis area).

Sycamore Canyon (or Weeping) muhly (*Muhlenbergia elongata [=xerophila]*). Weeping (or Sycamore Canyon) muhly is a perennial herbaceous grass that typically occurs in pockets of soil in crevices of cliffs, rocks, and bedrock in seeps and in wet soil adjacent to bedrock streambeds within riparian communities of Madrean evergreen woodland and the transition zone between the

Arizona Upland subdivision of Sonoran desertscrub and semidesert grassland at elevations ranging between 3,250 and 6,000 feet (Arizona Game and Fish Department 2000b; U.S. Forest Service 2007c). In Arizona, this species is known from the Santa Rita, Santa Catalina, Rincon, Tumacacori, and Baboquivari mountains in Pima County; and Sycamore Canyon of the Pajarito Mountains in Santa Cruz County (Arizona Game and Fish Department 2000b). This plant is listed as sensitive by the Forest Service because it is rare, having been collected at only 10 different localities in Arizona, and it is palatable to ungulates that graze in canyon bottoms (Arizona Game and Fish Department 2000b; U.S. Forest Service 2007c). This species was not observed in the Rosemont area during vegetation surveys conducted in the mid-1970s by the University of Arizona (McLaughlin and Van Asdall 1977). This species has been collected in two locations within the analysis area: one historic record west of the footprint of the proposed mine, and one record on the west side of the Empire Mountains (Southwest Environmental Information Network 2011g).

Animals

This section identifies the seven federally listed, four candidate, and four other special status animal species in table 97 (1) that are known to occur within or adjacent to the analysis area; (2) for which habitat exists within the analysis area; (3) for which the analysis area occurs within the known range of the species; and (4) for which impacts are reasonably foreseeable.

Chiricahua leopard frog (*Lithobates chiricahuensis*). Populations in central and east-central Arizona are disjunct from those in southeastern Arizona and may be distinct species. In southeastern Arizona, Chiricahua leopard frog occurs in a wide variety of human-made and natural permanent and semipermanent aquatic systems (typically springs, livestock tanks, and streams in the upper portions of watersheds) in oak and mixed oak-pine woodlands, chaparral, grassland, and desert habitats (Arizona Game and Fish Department 2006b; Stebbins 2003). Chiricahua leopard frog surveys of the Rosemont area and vicinity were conducted by WestLand Resources Inc. in 2006, 2008 (WestLand Resources Inc. 2009a), and 2009 (WestLand Resources Inc. 2009b). Several frogs were observed within the analysis area during these surveys, and this species has also been reported to occur in other locations in the Louisiana Gulch, Cienega Creek, and Empire Gulch basins within the analysis area (Arizona Game and Fish Department 2011d; WestLand Resources Inc. 2009a, 2009b). Suitable habitat could include any stock pond in the analysis area.

On March 15, 2011, the U.S. Fish and Wildlife Service proposed to designate critical habitat for the Chiricahua leopard frog (50 Code of Federal Regulations 17). The proposed designated critical habitat totals approximately 11,136 acres in Apache, Cochise, Gila, Graham, Greenlee, Pima, Santa Cruz, and Yavapai Counties, Arizona; and Catron, Hidalgo, Grant, Sierra, and Socorro Counties, New Mexico. One proposed critical habitat map unit (unit 8) occurs entirely within the analysis area; it consists of five tanks and approximately 5.22 drainage miles and 1,311 feet overland. Another proposed critical habitat map unit (unit 9) occurs partially within the analysis area; it consists of approximately 1.35 drainage miles.

Desert tortoise, Sonoran population (*Gopherus agassizii*). Tortoises are found in the Arizona Upland and Lower Colorado River subdivisions of the Sonoran Desert, desert grassland, and ecotonal areas that consist of Sonoran desertscrub with elements of Mojave desertscrub and juniper woodland, interior chaparral, and desert grassland (Averill-Murray and Klug 2000). The Sonoran population of the desert tortoise is known only from southeastern Arizona and Mexico (NatureServe 2011c), and is currently known to occupy Cochise, Gila, Pima, Santa Cruz, Pinal, Graham, La Paz, Mohave, Maricopa, Yuma, and Yavapai Counties within Arizona (NatureServe 2011c). Desert tortoises were not observed in the project footprint during surveys conducted by (Lowe and Johnson n.d. (1977)).

Surveys have not been conducted for desert tortoise within the analysis area for the purposes of this project; however, it is expected that they may occur in portions of the analysis area, such as within area proposed for utility corridors and in lower Davidson Canyon and Cienega Creek.

Giant spotted whiptail (*Aspidoscelis burti stictogrammus [=Aspidoscelis stictogrammus]*). The giant spotted whiptail is only known from Cochise, Pima, Graham, Pinal, and Santa Cruz Counties in Arizona, extreme southwestern New Mexico, and Sonora, Mexico (NatureServe 2011b); it is ranked by NatureServe as G4 to T4 (Globally Apparently Secure), N3 (Nationally Vulnerable), and S2 (Imperiled) in the State of Arizona. This lizard is known to occupy the Santa Rita, Santa Catalina, Baboquivari, and Pajarito Mountains (Arizona Game and Fish Department 2001a). This species inhabits dense shrubby vegetation and open areas of bunch grass among rocks near permanent and intermittent streams in mountain canyons, arroyos, and mesas in arid and semiarid regions, entering lowland desert along stream courses, in riparian habitat at elevations ranging from near sea level to 4,500 feet (Arizona Game and Fish Department 2001a; Stebbins 2003). The greatest threat to this lizard is its limited distribution (Arizona Game and Fish Department 2001a) and presumably anything that threatens riparian habitat.

The giant spotted whiptail was observed in the Rosemont area during surveys conducted by Lowe and Johnson (n.d. (1977)) and was referred to as follows: “Common. Occurs throughout the Rosemont area. Tends to be a riparian species at lower elevations in the desert grassland, as well as more abundant in rocky canyons throughout the site.” There is anecdotal information that this lizard currently inhabits the footprint of the proposed mine and areas within Davison Canyon, Empire Gulch, and Cienega Creek, but the lack of focused surveys conducted recently for this lizard in the analysis area prevents identification of the drainages in which this species occurs.

Gila chub (*Gila intermedia*). Currently, Gila chub is found in Yavapai, Pima County, Santa Cruz, Graham, Cochise, Gila, and Greenlee Counties. Gila chub is listed as endangered with critical habitat (2005 Final Rule, Federal Register 70(211):66664–66721). In Arizona, the Gila chub is normally found at elevations ranging between 2,720 and 5,420 feet above mean sea level in the smaller headwater streams, cienegas, and springs or marshes of the Gila River basin. It commonly inhabits pools, but it can also use a diversity of habitats, including small artificial impoundments such as human-made ponds. Critical habitat for Gila chub includes seven river units encompassing approximately 160 miles in Grant County, New Mexico, and Yavapai, Gila, Greenlee, Graham, Cochise, Pima, Santa Cruz, and Pinal Counties in Arizona (2005 Final Rule, Federal Register 70(211):66664–66721). Critical habitat for this species occurs along Cienega Creek from the confluence with Mescal Arroyo to Pantano Dam. Approximately 6 miles (474.9 acres) of this area of critical habitat occurs within the analysis area in lower Cienega Creek between Interstate 10 and the confluence with Davidson Canyon. Another 11.6 miles (843.6 acres) of critical habitat occurs within the analysis area in upper Cienega Creek and Empire Gulch on Bureau of Land Management lands within the Las Cienegas National Conservation Area.

Gila chub has been reported (Simms 2002; U.S. Fish and Wildlife Service 2005b) from the Las Cienegas National Conservation Area, approximately 12 miles upstream of the confluence of Davidson Canyon, and from the Cienega Creek Natural Preserve (owned and managed by Pima County) within the analysis area (2005 Final Rule, Federal Register 70(211):66664–66721). As part of an ongoing program established by the Bureau of Reclamation, Cienega Creek was one location in the Gila River basin where fish monitoring was conducted from 2007 through 2010 (Kesner and Marsh 2010; Marsh and Kesner 2011). Sampling was conducted at two locations in Cienega Creek: Station 1 (upstream of the confluence of Davidson Canyon) and Station 2 (downstream of the

confluence with Davidson Canyon). No Gila chub were taken at either station in 2007 and 2008; one Gila chub was collected at Station 1 in 2009; and five Gila chub were collected at Station 1 in 2010. Additionally, Gila chub have been documented in Empire Gulch in 1995 and in 2001 (2005 Final Rule, Federal Register 70(211):66664–66721).

Gila topminnow (*Poeciliopsis occidentalis occidentalis*). In Arizona, Gila topminnow historically was found in most perennial springs, streams, and vegetated margins of rivers in the Gila River drainage in Yavapai, Gila, Pinal, Maricopa, Graham, Greenlee, Cochise, Pima, Santa Cruz, and Yuma Counties (Arizona Game and Fish Department 2001e). Currently, disjunct populations are present in 9 to 11 natural locations, 22 to 24 reintroduced locations within the Gila River drainage, and one location in the Bill Williams River drainage (Yerba Mansa). Of these locations, 15 are springs, and the rest are creeks and washes. Critical habitat has not been designated for this species.

Gila topminnow has been reported from the Las Cienegas National Conservation Area and from the Cienega Creek Natural Preserve within the analysis area (Simms 2002; U.S. Fish and Wildlife Service 2005b). Gila topminnow were considered “numerous” in Stream Reaches 2 and 3 in 2005 (U.S. Fish and Wildlife Service 2005b), and in 2006, approximately 100 were collected immediately upstream of Stream Reach 2 (U.S. Fish and Wildlife Service 2005a). As part of an ongoing program established by the Bureau of Reclamation, Cienega Creek was one location in the Gila River basin where fish monitoring was conducted from 2007 through 2010 (Kesner and Marsh 2010; Marsh and Kesner 2011). Sampling was conducted at two locations in Cienega Creek (Station 1 and Station 2 as described above for the Gila chub); and 26 Gila topminnows were taken in 2007, 96 in 2008, 61 in 2009, and 255 in 2010.

Green ratsnake (*Senticolis triaspis*). The green ratsnake is primarily an inhabitant of Madrean evergreen woodland and the upper reaches of adjoining semidesert grassland communities in the Baboquivari, Pajarito, Atascosa, Santa Rita, Empire, Patagonia, Chiricahua, Swisshelm, Pedregosa, and Peloncillo Mountains of southeastern Arizona and southwestern New Mexico at elevations ranging from about 3,600 to 8,000 feet (Brennan and Holycross 2009). There are no major threats known for this species (NatureServe 2011d). This species was not observed in the Rosemont area during surveys conducted by Lowe and Johnson (n.d. (1977)); however, habitat matching this description is present within the analysis area and the proposed mine footprint, so it is possible that this species occurs within the footprint of the proposed mine. This snake currently inhabits a portion of the analysis area (Arizona Game and Fish Department 2011d), but the lack of focused surveys conducted recently for this snake in the analysis area prevents identification of the drainages in which this species occurs.

Jaguar (*Panthera onca*). Jaguars are known from a variety of vegetation communities in North and South America and in southern Sonora, Sinaloa, Nayarit, and Jalisco, Mexico. Jaguars appear to prefer a warm, tropical climate, including lowland wet communities, swampy savannas, and tropical rain forests (U.S. Fish and Wildlife Service 2008b), but they are also known to occur in arid areas, including thornscrub, desertscrub, lowland desert, mesquite grassland, Madrean oak woodland, and pine-oak woodland communities of northwestern Mexico and southwestern United States (Boydston and López-González 2005; McCain and Childs 2008). Some of these vegetation types are present within the analysis area, so it is possible that this species could occur within the analysis area. Studies indicate that jaguars selectively use areas away from certain forms of human influence (U.S. Fish and Wildlife Service 2008b). The U.S. Fish and Wildlife Service is in the process of developing a recovery outline for jaguars in the northern portion of their range, which will be considered in the preparation of a critical habitat proposal for the species (2010 Determination that Designation of

Critical Habitat Is Prudent for the Jaguar, Federal Register 75(8)). In an effort to identify opportunities for jaguar habitat management, habitat suitability criteria for the jaguar were developed, and a map was produced delineating potential jaguar habitat (approximately 6.5 million acres) in Arizona and New Mexico (Hatten et al. 2003).

Historically, jaguars have been reported in numerous locations in Arizona, as far north as the Grand Canyon. All Arizona records since 1965 have been in the southern portion of the state: one record near the Santa Cruz River, the other records in the Peloncillo, Baboquivari, Dos Cabezas, and Patagonia Mountain ranges within Cochise, Pima, and Santa Cruz Counties (Brown and C. López González 2001; U.S. Fish and Wildlife Service 2008b). Female jaguars with young have not been observed in the United States in nearly 50 years, and jaguars in the United States are thought to be part of a population originating (and breeding) in Mexico. Two male jaguars were repeatedly photographed in southeastern Arizona. One of these was the same individual that was observed in the Baboquivari Mountains in 1996, and this same male was captured, collared, and released in February 2009 (Arizona Game and Fish Department 2009; U.S. Fish and Wildlife Service 2008b). There are historical records of jaguars from southern Arizona: three from the Santa Rita Mountains (Helvetia in 1917, base of Mount Baldy in 1918, and Greaterville in 1919), and one from the Empire Mountains (1961) within the analysis area. Surveys for this species have not been conducted within the action area for the purposes of this project.

Lesser long-nosed bat (*Leptonycteris yerbabuenae*). In Arizona, the lesser long-nosed bat is found from the Picacho Mountains to the Agua Dulce Mountains in the southwest and the Galiuro and Chiricahua Mountains in the southeast. Habitat associations of the lesser long-nosed bat vary seasonally in Arizona. From April to July, the lesser long-nosed bat is known to occupy semidesert grasslands and Sonoran desertscrub at elevations below 3,500 feet (Arizona Game and Fish Department 2003b). From July to late September/early October, bats migrate to Madrean evergreen woodland habitats (oak transition regions) at elevations up to 5,500 feet. Within these plant communities, lesser long-nosed bats require two critical resources of which the distribution of these resources determines where these bats specifically occur: suitable day roosts and sufficient concentrations of food plants. The availability of roost sites is likely the most critical consideration; however, the suitability of a site and its ability to support bat populations over the long term depend on the availability and persistence of sufficient foraging habitat nearby (U.S. Fish and Wildlife Service 1997). In Arizona, lesser long-nosed bats feed primarily on flowers and the fruits of saguaro and organ pipe cactus (*Stenocereus thurberi*) in early summer and agave flowers later in the summer and early autumn. Night roosts can be the same roosts used during the day, or bats may use other caves or mines, or even rock crevices, trees and shrubs, and occasionally abandoned buildings. Critical habitat has not been designated for this species.

Surveys of the analysis area were conducted by WestLand Resources Inc. in 2008 and 2009 (Buecher et al. 2010; WestLand Resources Inc. 2009d). WestLand Resources Inc. (2009d) reported that both roosting and foraging individuals of lesser long-nosed bats are known to inhabit the area and that a large roost site within the analysis area was occupied by this species in 2009. Additionally, the Bureau of Land Management conducted surveys on their lands near Helvetia late in 2010, and lesser long-nosed bat individuals were observed roosting on abandoned mine land features (Hughes 2011).

Longfin Dace *(Agosia chrysogaster)*. The longfin dace can range from intermittent, hot, low-desert streams (desert scrub) to clear, cool brooks at higher elevations (up to the lower end of conifer woodlands), generally below 4,900 feet, but they have been recorded up to 6,700 feet (Arizona Game and Fish Department 2006a). This fish tends to occupy relatively small or medium-sized streams with

sandy or gravelly bottoms and eddies or pools near overhanging banks or other cover. The Longfin Dace occurs in aquatic habitats within Arizona, New Mexico, Utah, Nevada, and Mexico and occurs in nearly every county within Arizona (NatureServe 2010). The greatest threats to this fish are any activities that alter the flow or quality of water, and the presence of invasive species (Arizona Game and Fish Department 2006a).

This species was not observed in the Rosemont area during surveys conducted by (Lowe and Johnson n.d. (1977)). As part of an ongoing program established by the U.S. Bureau of Reclamation, Cienega Creek was one location in the Gila River Basin where fish monitoring was conducted from 2007 through 2010 (Kesner and Marsh 2010; Marsh and Kesner 2011). Sampling was conducted at two locations in Cienega Creek (Station 1 and Station 2 as described above for the Gila chub), and 501 longfin dace were taken in 2007, 591 in 2008, 882 in 2009, and 635 in 2010.

Mexican spotted owl (*Strix occidentalis lucida*). Mexican spotted owls are widely but patchily distributed in Arizona, being found in all but the arid southwestern portion of the state; known from the Colorado Plateau in northern Arizona, the Basin and Range Mountains of the southeastern part of the state, and the transition zone between these provinces in central and east-central Arizona (1993 final rule to list the Mexican spotted owl as threatened (Federal Register 58(49):14248–14271 and Ganey (1989)). The largest concentration of Mexican spotted owls in Arizona occurs in the central and east-central forests along the Mogollon Rim, in the White Mountains, and on the volcanic peaks near Flagstaff. In southern Arizona, Mexican spotted owls have been found in the Atascosa (Pajarito), Santa Rita, Santa Catalina, Patagonia, Whetstone, Galiuro, Huachuca, Chiricahua, Pinaleño, Superstition, Sierra Ancha, Mazatzal, and Bradshaw Mountains. Owls are located at scattered sites on the Kaibab Plateau and the Navajo Reservation, and there are also historic records from the Hualapai Mountains in northwestern Arizona.

The Mexican spotted owl occurs in disjunct localities on isolated mountain systems and canyons within mature mixed-conifer, pine-oak, and riparian forests (2004 Final Designation of Critical Habitat for the Mexican Spotted Owl, Final Rule, Federal Register 69(168):53182–53298, and U.S. Fish and Wildlife Service (1995b)). Owls are also found in canyon habitat dominated by vertical-walled rocky cliffs (including caves, ledges, and other areas that provide protected nest and roost sites) within complex watersheds such as tributary side canyons. Canyon habitats occupied by Mexican spotted owls may include small, isolated patches or stringers of forested vegetation in which owls regularly roost and forage. Owls are usually found in areas with some type of water source (i.e., perennial streams, creeks, springs, ephemeral water, small pools from runoff, reservoir emissions, etc.).

Approximately 8.6 million acres of critical habitat for Mexican spotted owl was designated in Arizona, Colorado, New Mexico, and Utah, mostly on Federal lands (2004 Final Designation of Critical Habitat for the Mexican Spotted Owl, Final Rule, Federal Register 69(168):53182–53298). Within this area, critical habitat is limited to areas that meet the definition of protected and restricted habitat, as described in the recovery plan. Protected habitat includes all known owl sites and all areas within mixed conifer or pine-oak habitat with slopes greater than 40 percent where timber harvest has not occurred in the past 20 years. Restricted habitat includes mixed-conifer forest, pine-oak forest, and riparian areas outside protected habitat. The analysis area overlaps approximately 430 acres of the far northeastern corner of unit BR-W-12 in Santa Cruz and Pima Counties. It is centered on the Santa Rita Mountains and contains much of the owl habitat within that mountain range. It is primarily on the Nogales Ranger District of the Coronado National Forest. There are no documented Mexican spotted owl records or protected activity centers within the analysis area. All known nearby protected

activity centers are located outside the analysis area, the closest being the Ramanote Canyon Protected Activity Center, approximately 0.7 mile to the west-southwest.

Northern Mexican gartersnake (*Thamnophis eques megalops*). The northern Mexican gartersnake is restricted to riparian areas, except when dispersing, and occurs at elevations ranging from 130 to 8,497 feet (U.S. Fish and Wildlife Service 2008c). An important component of suitable northern Mexican gartersnake habitat is a stable supply of native prey, and general habitat types include the following: (1) source-area wetlands; (2) large-river riparian woodlands and forests; and (3) streamside gallery forests. The northern Mexican gartersnake historically occurred in every county in Arizona. There are only eight perennial or intermittent stream reaches and wetlands in Arizona where northern Mexican gartersnakes apparently remain.

A significant survey effort for northern Mexican gartersnakes was conducted at the Las Cienegas National Conservation Area (Cienega Creek and Empire Cienega) from 2002 to 2008 (2008 12-month finding on a petition to list the northern Mexican gartersnake (*Thamnophis eques megalops*) as threatened or endangered with critical habitat (Federal Register 73:71788–71826). During the 2002 and 2003 field seasons, 29 northern Mexican gartersnakes were observed along upper Cienega Creek. (Rosen and Caldwell 2004: 21) considered the species to be ‘‘widely distributed, though perhaps reduced in abundance’’ in this area. In 2007, survey efforts were concentrated along approximately 2 miles of upper Cienega Creek, and only one juvenile northern Mexican gartersnake was observed (Servoss et al. 2007). Fish surveys also were conducted at Las Cienegas National Conservation Area in 2008, and no northern Mexican gartersnakes were caught or observed (2008 12-month Finding on a Petition to List the Northern Mexican Gartersnake (*Thamnophis eques megalops*) as Threatened or Endangered with Critical Habitat, Federal Register 73:71788–71826). The results from 2007 and 2008 indicate that the formerly stable northern Mexican gartersnake population at the Las Cienegas National Conservation Area has declined significantly and may no longer be viable.

Ocelot (*Leopardus pardalis*). Ocelots occur primarily within subtropical thorn forest, thornscrub, and dense, brushy thickets at elevations below 8,000 feet amsl or in other dense vegetation (>75 percent canopy cover) with suitable amounts of prey in tropical rainforest, pine forest, gallery forest, riparian forest, semideciduous forest, and dry tropical forest, to savanna, shrublands, and marshlands (U.S. Fish and Wildlife Service 1990). Historically, ocelots were believed to have ranged over much of Texas, southeastern Arizona, the west and east coasts of Mexico, and Central and South America, with individuals found as far south as northern Argentina (U.S. Fish and Wildlife Service 2002). Critical habitat has not been designated for this species, and an updated draft recovery plan has been released recently (U.S. Fish and Wildlife Service 1990).

Several unconfirmed sightings of ocelots have been made in Arizona in recent years, but until recently, the last confirmed account was of an ocelot that was shot on Pat Scott Peak in the Huachuca Mountains in 1964 (López González et al. 2003), more than 30 miles southeast location of the proposed mine. An ocelot was photographed by a remote camera in Cochise County in November 2009 (Arizona Game and Fish Department 2010). In April 2010, an ocelot was found dead along State Route 60 between Superior and Globe. In 2011, the Arizona Game and Fish Department confirmed the presence of an ocelot on private property in the Huachuca Mountains (Arizona Game and Fish Department 2011c) in February, and in May a trail camera in the Huachuca Mountains snapped another photo of an ocelot (Arizona Game and Fish Department 2011b). There are no confirmed recent sightings of ocelots in the Santa Rita Mountains, and there are no recent or historic

records of ocelots from within the analysis area (Arizona Game and Fish Department 2011d). Surveys for this species have not been conducted within the analysis area for the purposes of this project.

Rosemont talussnail (*Sonorella rosemontensis*). This talussnail occurs on rock slides and talus slopes solely on the Santa Rita Mountains in Arizona (Arizona Game and Fish Department 2008b). The Rosemont talussnail is threatened by anything that destroys or disturbs talus slopes. In the mid-1970s, University of Arizona biologists documented the status of federally listed Forest Service sensitive, rare, and poorly known species in the vicinity of the Rosemont Deposit. As part of this environmental survey of the area, Miller (n.d. (1977)) carried out field surveys for land snails in the general area of the Rosemont deposit. A major part of his survey consisted of a search for specimens of *Sonorella rosemontensis* in order to better document its occurrence in the general area. Field surveys, a literature review, and analysis regarding talussnails in the vicinity of the project footprint were conducted (WestLand Resources Inc. 2009g). Studies of talussnails in the vicinity of the proposed mine site revealed at least two species, presumably *S. rosemontensis* and *S. magdalenensis* (WestLand Resources Inc. 2009g). Both types were found, often together, on both sides of the ridgeline in rock slides and on talus slopes within the footprint of the proposed mine.

Sonoran talussnail (*Sonorella magdalenensis*). This talussnail occurs on rock slides and talus slopes in Pima and Santa Cruz Counties within Arizona and south into Mexico (Arizona Game and Fish Department 2008a). The Sonoran talussnail is threatened by anything that destroys or disturbs talus slopes. During the mid-1970s ANAMAX studies, Miller (n.d. (1977)) carried out field surveys for land snails in the general area of the Rosemont deposit, and only six species of mollusks were found in the project area, including *S. magdalenensis*. Miller noted that *S. magdalenensis* has a relatively limited range, namely along both sides of the Santa Cruz Valley from Tumamoc Hill in the north to the vicinity of Nogales in the south and on into Sonora as far as the vicinity of Ures, but this species is relatively common in its range. WestLand Resources Inc. (2009g) analyzed the talussnail specimens they collected in 2008 and 2009 in the vicinity of the proposed mine site in order to determine which taxon (taxa) is present. They concluded that they likely had collected specimens of both *S. rosemontensis* and *S. magdalenensis*. As mentioned above, both types were found, often together, on both sides of the ridgeline in rock slides and on talus slopes within the footprint of the proposed mine.

Southwestern willow flycatcher (*Empidonax traillii extimus*). The southwestern willow flycatcher breeds in dense riparian habitats where surface water is present or soil moisture is high enough to maintain the appropriate vegetation characteristics (Sogge et al. 2010). These habitats primarily contain willow species (*Salix* spp.), including coyote willow (*S. exigua*) and Goodding willow, but typically also contain boxelder (*Acer negundo*), saltcedar, Russian olive (*Elaeagnus angustifolia*), live oak (*Quercus agrifolia*), buttonbush (*Cephalanthus* sp.), cottonwood (*Populus* spp.), alder (*Alnus* spp.), blackberry (*Rubus ursinus*), and stinging nettle (*Urtica* spp.). Flycatcher territories and nests are typically in the vicinity of open water, cienegas, marshy seeps, or saturated soil, sometimes even in areas where nesting substrates are in standing water.

Although southwestern willow flycatchers have been documented in Cienega Creek, there are no records of this species breeding within 20 miles of the analysis area. From 1996 to 2007, the Arizona Game and Fish Department conducted flycatcher distribution and abundance surveys along five reaches of Cienega Creek, and Empire/Cienega/Cienega Creek were surveyed only once (Ellis et al. 2008). The only reach of Cienega Creek in which resident willow flycatchers have been documented was the uppermost reach, where a pair and nest were found in 2001. Willow flycatchers have not been found along this reach before or since. There is no designated critical habitat for this species within

the analysis area. Surveys for this species have not been conducted within the analysis area for the purposes of this project. There are no known occurrences of this species within the analysis area; however, habitat matching this description is present within the analysis area in Davidson Canyon at the confluence with Cienega Creek, in Empire Gulch, and along Cienega Creek, so it is possible that this species occurs within the analysis area.

On October 19, 2005, the U.S. Fish and Wildlife Service designated critical habitat for the southwestern willow flycatcher (2005 Designation of Critical Habitat for the Southwestern Willow Flycatcher (*Empidonax traillii extimus*), Final Rule, Federal Register 70(201):60886–61009). The proposed designated critical habitat totals approximately 120,824 acres in various counties within Arizona, California, Nevada, New Mexico, and Utah. There is no designated critical habitat for this species within the analysis area; however, on August 15, 2011, the U.S. Fish and Wildlife Service proposed to revise designated critical habitat for the southwestern willow flycatcher to add an additional 2,090 stream miles. One area proposed for critical habitat occurs within the analysis area along Cienega Creek from its confluence with Empire Gulch to its confluence with Stevenson Canyon (4.4 stream miles).

Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*). Western yellow-billed cuckoo has been found in mature Sonoran riparian deciduous forest, cottonwood-willow series, and Sonoran riparian scrub within well-developed mesquite bosques or areas of gallery forest found along the flood plains of stream and riverbanks in the southwestern United States (Corman and Wise-Gervais 2005). Potentially suitable migration habitat includes areas of Sonoran riparian deciduous forest, cottonwood-willow series, and Sonoran riparian scrub that are less well developed than breeding habitat. In southeastern Arizona, western yellow-billed cuckoo typically prefers streamside cottonwood, willow groves, and larger mesquite bosques (Arizona Game and Fish Department 2002; Corman and Wise-Gervais 2005). This species was observed within Barrel Canyon in the Rosemont area during surveys conducted by (Davis and Callahan n.d. (1977):167–194). In 1999, a minimum of three yellow-billed cuckoos were detected calling along lower Cienega Creek at the “Davidson Canyon confluence”(Corman 2009); it is unclear whether these detections were from the area immediately upstream or downstream of the Davidson Canyon confluence or both. This species is also known to occur in Empire Gulch, a cottonwood-willow riparian area (Institute for Bird Populations 2006). It is also known to occur throughout upper Cienega Creek (Arizona Game and Fish Department 2011d). Surveys for this species have not been conducted within the analysis area for the purposes of this project.

Other special status animal species. The analysis area also provides suitable habitat for numerous bats, rodents, and other special status species (i.e., cave myotis, fringed myotis, fulvous harvest mouse, Gila monster, Mexican long-tongued bat, northern pygmy mouse, pale Townsend’s big-eared bat, plains harvest mouse, and yellow-nosed cotton rat) that may occur there, but it is unclear whether these species would actually be impacted by the proposed project. These species have been observed within the analysis area in the past (Arizona Game and Fish Department 2011d), and suitable habitat exists in the analysis area within the known range of the species. However, depending on where these species occur within the analysis area, they may not be impacted from project activities in the same manner as riparian-dependent or other species. It is unclear at this time whether smaller species occurring in uplands areas within the outlying portions of the analysis area may be impacted at all by the impacts of noise, light, and dust. Additionally, depending on where the bats forage in the analysis area, they may also not be impacted by project activities; however, it is expected that any bats roosting near the project footprint would likely abandon those roost sites after project inception.

Migratory Birds

Migratory bird species considered for this project were selected from the latest version of the online "Migratory Nongame Birds of Management Concern in the United States" (U.S. Fish and Wildlife Service 1995a) and the national Partners in Flight list of priority bird species for Mexican Highlands Ecoregion (Partners in Flight 2006), accessed online on July 7, 2010 (see tables 3 and 4 of the draft "Migratory Bird Analysis" (SWCA Environmental Consultants 2011d).

Bald and Golden Eagles

There is no evidence that bald eagles occur in the analysis area, and there are no significant bodies of water that would sustain a nesting pair or provide foraging habitat. There are several documented records of golden eagles occurring in the area, and there is foraging habitat present. It is possible that golden eagles could be nesting nearby, particularly in the rocky ridge area, on trees (e.g., large oaks or junipers) or on power line poles.

Santa Rita Mountains Important Bird Area

Important bird areas are sites that provide essential habitat for one or more species of bird (National Audubon Society 2010). Important bird areas include sites for breeding, wintering, and/or migrating birds; they are usually discrete sites that stand out from the surrounding landscape and may include public and/or private lands. The Santa Rita Mountains Important Bird Area, encompassing 127,556 acres, contains a number of species of conservation status in the Sierra Madre bird community, which extends far south into central Mexico. The analysis area encompasses approximately 42,144 acres of Forest Service lands within the Santa Rita Mountains Important Bird Area (this important bird area is defined as including all Forest Service lands on the Santa Rita Mountains).

This important bird area contains numerous species of concern recognized by the Forest Service (Federal threatened or endangered, State of Arizona wildlife of special concern, Forest Service sensitive, etc.). These species include some of those noted in tables 3 and 4 of the "Migratory Bird Analysis" (SWCA Environmental Consultants 2011d): northern goshawk, northern gray hawk, Mexican spotted owl, whiskered screech-owl, Montezuma quail (*Cyrtonyx montezumae*), elegant trogon, Arizona woodpecker, violet-crowned hummingbird, Lucifer hummingbird, Costa's hummingbird, buff-breasted flycatcher, varied bunting, golden eagle, American peregrine falcon (*Falco peregrinus anatum*), elf owl, northern beardless-tyrannulet (*Camptostoma imberbe*), greater pewee, gray flycatcher, Bell's vireo (*Vireo bellii*), bridled titmouse, Virginia's warbler, MacGillivray's warbler, Lucy's warbler, black-throated gray warbler, Grace's warbler, red-faced warbler, Cassin's sparrow, Botteri's sparrow, and buff-collared nightjar. Some of these species are known to occur in the analysis area, or the analysis area contains suitable habitat for these species; thus, these species are subsequently evaluated in greater detail within either the "Biologists' Report" or "Migratory Bird Analysis" (SWCA Environmental Consultants 2011b, 2011d).

Important Overwintering Areas

The analysis area, including Las Cienegas National Conservation Area provides important overwintering habitat for a variety of bird species, as does nearly all of southeastern Arizona. The analysis area has not been officially designated as an important overwintering area for birds (National Audubon Society (2010).

Coronado National Forest Management Indicator Species

Thirty-three management indicator species in 8 indicator groups were identified in appendix G of the Coronado forest plan (U.S. Forest Service 1986). The EIS for the plan explains why these 33 species

were chosen as management indicator species. Drawing on the plan (U.S. Forest Service 1986), all 33 management indicator species identified for the Coronado National Forest were initially considered for project analysis. Following are the nine management indicator species and one management indicator species group (primary and secondary cavity nesters) found in Madrean evergreen woodland and semidesert grassland vegetation types or riparian vegetation types that are known to occur, or that may occur, in the project footprint on Forest Service lands (see table 99): American peregrine falcon, Arizona ridge-nosed rattlesnake (*Crotalus willardi willardi*), Bell's vireo, black bear, Gould's turkey (*Meleagris gallopavo mexicana*), Montezuma quail, northern beardless-tyrannulet, primary and secondary cavity nesters, western barking frog (*Craugastor augusti cactorum*), and white-tailed deer. A more detailed analysis of these species is provided in the supporting "Management Indicator Species Report" (SWCA Environmental Consultants 2011c) for this project.

Pima County Priority Vulnerable Species

Pima County priority vulnerable species are species that are being considered and analyzed as potentially covered species under Pima County's Sonoran Desert Conservation Plan. These species were chosen through a process of scientific review of more than 100 species that are already federally listed as threatened or endangered or recognized by the Federal government as imperiled, extirpated species, and a much larger number of species that are in decline and potentially on the way toward listing under the Endangered Species Act (Pima County 2006b). The Conservation Land System within the Sonoran Desert Conservation Plan categorizes and identifies locations of priority biological resources within Pima County and provides policy guidelines for the conservation of these resources.

Twenty-two priority vulnerable species were analyzed that are known to occur, or that may occur, in the analysis area. The following six priority vulnerable species were not addressed in detail in the biological evaluation but are discussed in the "Biologists' Report" (SWCA Environmental Consultants 2011b): desert box turtle (*Terrapene ornata luteola*), needle-spined pineapple cactus (*Echinomastus erectocentrus* var. *erectocentrus*), Rosemont talussnail, rufous-winged sparrow (*Aimophila carpalis*), Sonoran talussnail, and Swainson's hawk (*Buteo swainsoni*).

Other Plants and Animals

There are other plants and animals that occur, or have suitable habitat, in the analysis area but that are not designated as special status species covered by environmental laws, regulations, policies, or plans.

Environmental Consequences

Direct and Indirect Effects of Each Alternative[7]

No Action Alternative

The no action alternative would not change the Forest Service's responsibility to preserve biological resources and would result in no impacts to any special status species or other biological resources. If the no action alternative were selected, the Coronado would continue to manage the lands in the current manner.

[7] Effects determinations are only included for Forest Service and Bureau of Land Management sensitive species. Effects determinations for threatened or endangered plant or animal species are not included because Section 7 Formal Consultation with the U.S. Fish and Wildlife Service has not been completed.

Impacts Common to All Action Alternatives

This part of the section discusses common impacts related to the five action alternatives (proposed action, Phased Tailings, Barrel, Barrel Trail, and Scholefield-McCleary) on all evaluated biological resources (see figures in chapter 2 for details of each action alternative). Some action alternatives may result in additional impacts and are discussed separately within each action alternative's section.

Impacts to the aquifer from mine activities are expected to take many years, even centuries, to be fully realized. For this reason, the groundwater flow models were run and analyzed up to 1,000 years after mine closure. While the models have been found to be calibrated and adequate for estimating impacts, no model, however good, can realistically be expected to model events 1,000 years in the future with any certainty. The certainty of impacts using the groundwater flow models decreases with time. Impacts during the mine life would be expected to be reasonably accurate; however, impacts 1,000 years in the future are educated guesses, at best. Additionally, the actual impacts of groundwater drawdown, combined with the impacts of global climate change over time within the analysis area, are uncertain.

Impacts to sensitive riparian resources and stream flow in Cienega Creek and Empire Gulch have been modeled, and the first sign of impacts would not occur until approximately 50 years after mine closure; however, these impacts are expected to be negligible and immeasurable in the field in Empire Gulch until 150 years after mine closure and in Cienega Creek until 1,000 years after mine closure. Impacts may occur sooner or later, but reasonably could be expected to take several decades after mine closure to occur. Impacts can then reasonably be expected to continue to expand until the aquifer reaches equilibrium; as modeled, the water level drawdown eventually will expand to impact both Cienega Creek and Empire Gulch. Thus, the exact amount of impact to biological resources over time (e.g., 1,000 years after mine closure) carries a high level of uncertainty.

Biophysical Features

All five action alternatives will impact topography within the footprint of the mine. The greatest impacts to topography would be caused by the tailings, waste rock, and heap leach piles, which require blading and filling of numerous canyon bottoms and changing landforms from natural undulating topography to monolithic, relatively flat-topped, benched or terraced industrial shapes, and the open pit. The modified topography would contrast with the existing landscape in the short and long term because landforms would not blend into the natural landscape. Direct impacts to riparian areas by each alternative are described in the "Surface Water Quality" section, as these areas are defined by permitting under Section 404 of the Clean Water Act. Impacts range from 83 to 220 acres of direct impact to riparian vegetation.

However, riparian vegetation also has the potential to be impacted indirectly by changes in surface water and groundwater availability.

The "Groundwater Quantity," "Groundwater Quality," "Surface Water Quantity," and "Surface Water Quality" sections discuss the environmental consequences of the proposed action and alternatives on water resources. The following is a summary of impacts to key water resource characteristics:

- At the mine site, dewatering during active mine life would cause water losses from the regional aquifer, composed of both fractured rock near the mine site and basin fill in the Cienega Creek basin. These water losses would be perpetuated after closure of the mine because of evaporation from a pit lake that would form. It would take hundreds of years for the aquifer to equilibrate to these changes.

- Groundwater drawdown greater than 100 feet is expected to occur in the immediate vicinity of the site. Less drawdown would occur to the north along Davidson Canyon, to the east toward Cienega Creek, and to the south toward Empire Gulch. Drawdown estimates vary between models.
- There are two springs (Reach 2 and Escondido Springs) that support surface flow in Davidson Canyon. These springs most likely are not connected to the regional aquifer, although this is not known with certainty. Davidson Canyon is expected to experience a 10 percent reduction in surface flow in this reach, which could impact these springs. The regional aquifer is modeled to experience drawdown at Reach 2 Spring (less than 5 feet), which could also reduce flow if the spring is connected to the regional aquifer. Groundwater drawdown and reduction of ephemeral storm flow would likely impact riparian vegetation.
- Hydroriparian and mesoriparian habitat is considered the most likely to be impacted by potential changes in groundwater level. Based on Pima County mapping, the amount of hydroriparian and mesoriparian habitat along Davidson Canyon is approximately 17.2 acres. WestLand Resources Inc. estimates the amount of Class V habitat along Davidson Canyon as 204.7 acres, along approximately 4.4 linear miles. Based on field investigations, WestLand Resources Inc. indicates that these areas reflect mesoriparian habitat (2011d). Aside from these mesoriparian areas, WestLand Resources Inc. identified an additional 471.2 acres of xeroriparian areas (identified as Classes II through IV) in Davidson Canyon. These areas could be impacted by reductions in surface water flow. WestLand Resources Inc. (2011d) conducted an analysis specific to the likely effects of the mine on riparian habitat along Davidson Canyon. They concluded,

    > While xeroriparian vegetation in upper Davidson and lower Barrel will be affected and could experience sub-lethal effects that include canopy dieback, the upland-associated species that characterize these habitats are better able to withstand fluctuations in water availability. The isolated pockets of mesic vegetation in upper Davidson Canyon, however, are expected to experience greater sub lethal effects and could experience mortality. As a consequence, species composition of these areas could change and habitats identified . . . as either transitional between xeroriparian and mesoriparian or mesoriparian in character could become decidedly xeroriparian in nature. (WestLand Resources Inc.(2011d)

- Cienega Creek is expected to experience drawdown, potentially starting about 50 years after closure of the mine; however, this drawdown is expected to be negligible at this point in time (less than 0.01 cubic feet per second). Drawdown could reduce surface flow by up to 0.04 cubic feet per second after 150 years and could reduce surface flow by up to 0.09 cubic feet per second after 1,000 years after mine closure. On average, this represents only 1 to 3 percent of annual flow after 1,000 years; however, impacts could be much greater during critical periods of low flow. During critical times of year (May and June), even small flow reductions could cause some portions of Cienega Creek to stop flowing. Overall, the modeled decreases in groundwater (less than 1 foot) would occur over a long period of time and are unlikely to cause large changes in riparian vegetation extent or health; however, the reduction in stream flow could impact aquatic species needing standing or flowing water.
- Based on Pima County mapping, the amount of hydroriparian and mesoriparian habitat along Cienega Creek between the confluence with Gardner Canyon and the confluence with Davidson Canyon is approximately 490.9 acres. Hydroriparian and mesoriparian habitat is considered the most likely to be impacted by potential changes in groundwater level.

- The Upper Empire Gulch Springs are expected to experience groundwater drawdown up to 1 foot approximately 50 years after mine closure and up to 10 feet approximately 150 years after closure of the mine. Groundwater drawdown of this magnitude would likely cause die-back in some riparian vegetation and would reduce spring or surface flow. Based on Pima County mapping the amount of hydroriparian and mesoriparian habitat in Empire Gulch is approximately 58.3 acres.
- Lower Gardner Canyon is expected to experience groundwater drawdown up to 10 feet approximately 150 years after closure of the mine. Groundwater drawdown of this magnitude would likely cause die-back in some riparian vegetation and would likely reduce spring or surface flow. Based on Pima County mapping the amount of hydroriparian and mesoriparian habitat in Lower Gardner Canyon is approximately 139.6 acres.
- Springs would be impacted by surface disturbance and by drawdown in the regional aquifer. Specifically, impacts to Scholefield No. 1 and Fig Tree springs are likely to occur within the active life of the mine as a result of drawdown in the regional aquifer. Riparian vegetation associated with these springs likely would be lost completely; WestLand Resources estimates approximately 0.8 acre of riparian habitat are associated with these springs (WestLand Resources Inc. 2010d).
- Stock tanks would be impacted by surface disturbance, but reductions in surface water flow are not expected to affect the use of stock tanks nor any vegetation adjacent to stock tanks.

All five action alternatives would have the same direct impacts on upper Wasp Canyon because of the placement of the mine pit and the same direct impacts on Davidson Canyon because of the onsite diversion and impoundment of surface water at the mine site. All five action alternatives would have the same indirect impacts on springs and riparian areas within Lower Barrel Canyon, Empire Gulch, Gardner Canyon, and Cienega Creek because of the downgradient impacts on the surface water and groundwater. The riparian acreage potentially affected is summarized in Table 100.

Table 100. Riparian acreage potentially affected

Drainage	Type of Impact	Type of Habitat	Acreage Based on Pima County Mapping	Acreage Based on WestLand Resources Inc. Mapping
Davidson Canyon	Direct surface disturbance	Xeroriparian	–	83 to 220 (varies by alternative)
Davidson Canyon	Indirect from groundwater drawdown	Hydroriparian or mesoriparian	17.2	204.7
Davidson Canyon	Indirect from reduction of surface flows	Xeroriparian	–	471.2
Davidson Canyon	Indirect from impacts to Fig Tree and Scholefield Springs	Hydroriparian or mesoriparian	–	0.8
Cienega Creek	Indirect from groundwater drawdown	Hydroriparian or mesoriparian	490.9	–
Empire Gulch	Indirect from groundwater drawdown	Hydroriparian or mesoriparian	58.3	–
Gardner Canyon	Indirect from groundwater drawdown	Hydroriparian or mesoriparian	139.6	–

Springs, stock tanks, and seeps provide habitat for aquatic plant and animal species within the analysis area. All action alternatives would directly impact at least 12 springs and seeps because they

occur within the proposed footprint of the mine and would indirectly impact 51 springs and seeps in the analysis area owing to groundwater drawdown associated with the mine pit. The areas to be potentially impacted by this project include downstream impacts to springs and drainages receiving surface water discharge from the mine site, including Davidson Canyon wash to the confluence with lower Cienega Creek, and springs and seeps within the area of projected groundwater drawdown associated with the mine pit. Springs and seeps are affected not only by groundwater level changes, but also by the footprint of the various alternatives as well. These impacts are assessed by individual alternative. All action alternatives would directly impact at least eight stock tanks because they occur within the footprint of the proposed mine.

The results of geochemical modeling for the mine pit lake and studies of the expected water quality from heap leach seepage indicate that various contaminant levels that would result from these mining processes may exceed aquifer or surface water quality standards for wildlife. The mine pit lake water quality could exceed standards for silver, cadmium, lead, copper, mercury, selenium, and zinc. Silver is known to be a bactericide and is toxic to aquatic species. Cadmium is highly toxic to wildlife, is carcinogenic and teratogenic, and can have sublethal and lethal effects at low environmental concentrations. It affects respiratory functions, enzyme levels, muscle contractions, growth reduction, and reproduction. Cadmium is known to bioaccumulate in the food chain. Lead is carcinogenic and adversely affects reproduction, liver and thyroid function, and disease resistance. The main potential ecological impacts result from direct exposure of algae, invertebrates, and freshwater fish and amphibians. It can be bioconcentrated from water but does not bioaccumulate. Copper is highly toxic in aquatic environments and affects fish, invertebrates, and amphibians. A portion of mercury released into the environment is transformed by abiotic and biotic chemical reactions to organic derivatives, such as methylmercury, which bioaccumulates in individual organisms, biomagnifies in aquatic food chains, and is the most toxic form of mercury to which wildlife are exposed. Risks from selenium are primarily associated with aquatic species. Selenium is a bioaccumulative pollutant, and aquatic life is exposed to selenium primarily through diet. Risks stem from aquatic life eating food that is contaminated with selenium, rather than from direct exposure to selenium in the water. Zinc can adversely affect growth, survival, and reproduction in aquatic species. The “Groundwater Quality,” “Surface Water Quality,” and “Hazardous Materials” sections discuss other expected reasonable increases in contaminants that may occur as a result of the project.

Mine adits and shafts provide roosting habitat for bats. All action alternatives would directly impact at least 11 mine adits and shafts in the analysis area because they occur within the footprint of the proposed mine. Construction and operation of the mine pit, tailings, waste rock, and leach facilities may result in the loss of mine adits and shafts. Talus slopes and rock outcrops provide habitat for talussnails and other special status species. All action alternatives would directly or indirectly impact at least 29 acres of talus slopes and rock outcrops in the analysis area because they occur within the footprint of the proposed mine. Construction and operation of the mine pit, tailings, waste rock, and leach facilities may result in the loss of talus slopes and rock outcrops.

Ability to meet legal and regulatory requirements for riparian areas

Regulation of riparian areas occurs through Pima County ordinances regulating important riparian areas as well as Section 404 of the Clean Water Act regulating dredging and filling within waters of the United States. Regulation of riparian areas is based in general on the hydrologic, geomorphic, and biological value of those areas. Surface disturbance of xeroriparian areas within the project footprint would directly alter these characteristics.

Davidson Canyon could see potential impacts to both xeroriparian and mesoriparian areas from groundwater drawdown and surface water flow reductions. Both of these impacts could result in reduced spring flow in Reach 2 and Escondido Springs and alter the quality and extent of both xeroriparian and mesoriparian habitat. This could impact the hydrologic, geomorphic, and biological value of this habitat.

Cienega Creek, Empire Gulch, and Gardner Canyon could see potential impacts to mesoriparian and hydroriparian areas from groundwater drawdown. Empire Gulch and Gardner Canyon are modeled to experience levels of groundwater drawdown that could cause die-back of riparian vegetation and reduce spring or surface flow; these impacts would alter the hydrologic and biological value of the habitat in these areas. Cienega Creek is modeled to experience less drawdown over a much longer period of time. Riparian vegetation could potentially experience less impact, although the potential exists for reduction of surface flows during critical times of the year. This could impact the hydrologic and biological value of this habitat.

Vegetation Communities

All of the action alternatives would result in long-term, permanent impacts to at least approximately 6,278 acres of vegetation communities (table 101) within the analysis area (including the clearing of thousands of acres of these vegetation communities, burying other portions under waste rock or tailings, downstream impacts, etc.) as a result of the construction and placement of the pit, facilities and structures, tailings and waste piles, road and utility corridors, and other facilities. Detailed acreages of upland vegetation communities (i.e., semidesert grassland, Madrean evergreen woodland, and Chihuahuan desertscrub) and riparian vegetation communities (i.e., interior riparian deciduous woodland and ephemeral fluvial systems supporting upland vegetation) are outlined in the discussion of each action alternative. Groundwater drawdown would be expected to cause reduction in the health and extent of riparian vegetation. Additionally, all of the action alternatives may create conditions conducive to the introduction, establishment, and/or spread of nonnative species, which may out-compete native vegetation and degrade plant communities within the entire analysis area.

Table 101. Direct impacts to vegetation type by land ownership (acres) from the proposed Rosemont Copper Mine, access roads, and transmission and water lines*

Vegetation Type	Forest Service	Bureau of Land Management	Arizona State Land Department State Trust Lands	Private	Total
Semidesert Grassland	2,025 to 2,650	3 to 14	32 to 132	995 to 1,272	**3,055 to 4,068**
Madrean Evergreen Woodland	2,841 to 3,238	0	0	209 to 236	**3,050 to 3,474**
Chihuahuan Desertscrub	0	0	0	0	**0**
Riparian†	71 to 119	0	0	1 to 19	**72 to 138**
Total	**4,937 to 6,007**	**3 to 14**	**32 to 132**	**1,205 to 1,527**	**6,177 to 7,680**

* Acreage varies by action and TEP utility alignment alternatives selected.

†These acreages are a combination of those mapped for interior riparian deciduous woodland and ephemeral fluvial systems supporting upland vegetation.

Animal Movement Corridors

As a result of the construction of all mine related infrastructure (i.e., facilities, pit, utility lines, access roads, etc.), and all mining activities (e.g., clearing and crushing by construction equipment and

vehicles) and associated increases in noise, vibrations, light and dust, all action alternatives have the potential to do the following: (1) modify, disrupt, fragment, or even discourage movement through corridors for numerous species between the Santa Rita and Rincon, Whetstone, and Empire Mountains; (2) reduce connectivity between habitats; (3) increase animal roadkills from the transportation system and increased traffic; and (4) result in a loss of genetic flow. It is expected that in some portions of the analysis area, certain species will not use current movement corridors as a result of these impacts, whereas other species' movement may not change. Additionally, in other portions of the analysis area, it is expected that these impacts may be permanent for some species, but temporary for others. It is also thought that these impacts would be greater closer to the mine than in surrounding areas on the outside edges of the analysis area.

The proposed action and other action alternatives may result in a permanent loss, disturbance, or fragmentation of at least approximately 6,278 acres of upland and riparian vegetation communities from the pit, tailings and waste piles, and associated infrastructure, leading to a loss of movement corridors and gene flow—thus, eventually, the overall biological diversity of the area—for numerous species. Reclamation, if successful, would result in portions of the disturbed areas returning to functionality as wildlife movement corridors for some species after the project is completed. All action alternatives would have the same impact on upper Wasp Canyon because of the placement of the mine pit. This portion of Wasp Canyon (and possibly portions of Barrel Canyon) would be permanently lost as providing habitat for animal movement.

A temporary (i.e., 20-year) impact on, or fragmentation of, an unknown number of acres of upland and riparian habitats could lead to a loss of local movement corridors and gene flow for numerous species. These impacts would result from: construction and placement of the utility corridors; increased traffic in the area; altered surface water flow; and the impacts of light pollution, noise pollution, and increased dust. Animal movement and connectivity within Cienega Creek, Empire Gulch, and Davidson Canyon may be impacted as a result of the indirect downgradient impacts on the surface water and groundwater, and these canyons are likely currently used as movement corridors for numerous species. Impacts to all other canyons in the analysis area are assessed by individual alternative.

Special Status Species

All action alternatives would result in direct, permanent loss of at least approximately 6,278 acres of habitat and the indirect, temporary loss of, and disturbance to, up to approximately 138,912 acres of habitat, which may result in the loss of individuals and suitable habitat for some special status species (both plants and animals) analyzed in this document. Direct impacts to vegetation would occur as a result of the construction of all mine related infrastructure (i.e., facilities, pit, utility lines, access roads, etc.) and all mining activities (e.g., clearing and crushing by construction equipment and vehicles). An increase in vehicle and construction equipment traffic into and within the analysis area would occur during project construction, and increased travel associated with day-to-day operations and maintenance activities would occur for the life of the project.

There would also be indirect impacts on these special status species from dust, noise, and light resulting from mine construction and operation, transportation, etc., within the analysis area. Windborne fugitive dust negatively impacts nearby vegetation by coating leaves and reducing photosynthetic activity. Physical impacts of dust on plants may include blockage and damage to stomata, shading, abrasion of leaf surface or cuticle, and cumulative impacts (e.g., drought stress on already stressed species) (Goodquarry 2011). Chemical impacts of dust, either directly on the plant surface or on the soil, may be more important than any physical impacts because dust deposited on

the ground may produce changes in soil chemistry, which may result in the long-term changes in plant chemistry, species competition, and community structure. Applicant-committed dust-suppression treatment of dirt roadways in and around the mine would mitigate or minimize impacts to vegetation from fugitive dust resulting from grading, development, and travel on dirt and paved roads.

The extent and degree of these impacts would depend on local climatic conditions and other factors that are difficult to quantify. Mining operations, including drilling and blasting, would result in noise and vibrations that would impact animal behavior. Additionally, nocturnal animals (e.g., bats and predatory cats) and others may be adversely affected by the brighter night skies produced by the mine.[8] The project also may impact special status species as a result of the introduction, establishment, and/or spread of nonnative species, which may out-compete special status species for resources, including out-competing native plant species within suitable habitat.

Plants

This section evaluates impacts to special status plant species discussed in the "Affected Environment" part of this section (1) that have been recently documented as occurring within the project footprint or the analysis area and (2) for which impacts are reasonably foreseeable. The following special status plant species will be directly and/or indirectly impacted, regardless of which action alternative is chosen. Impacts may be temporary, permanent, direct, and/or indirect, depending on the action alternative selected. Any special status plant individuals growing in the footprint of the mine infrastructure (including the pit, buildings, roads, tailings or waste piles, etc.) or in the path of either the water or transmission lines would be expected to be lost (i.e., crushed, cleared, trampled, etc.) owing to project activities.

Arid throne fleabane — Several documented occurrence records for this species are within the analysis area but are outside the footprint of the mine; therefore, no individuals are expected to be directly impacted (i.e., crushed, cleared, trampled, etc.) by project activities. Any individuals growing in the analysis area outside the mine footprint may experience indirect impacts, such as fugitive dust and increased potential for competition from nonnative plant species, etc. Although uncommon, the species is found in several mountain ranges in southern Arizona. Impacts would be localized to the Rosemont vicinity and would not affect other populations across the forest. Based on this, the biological evaluation for this project determined that, for all action alternatives, the project may impact individuals but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Arizona manihot — There has been one collection of this species from within the fenceline of the proposed mine. This species may be directly impacted (i.e., crushed, cleared, trampled, etc.) by project activities. Any individuals growing in the analysis area outside the mine footprint may experience indirect impacts, such as fugitive dust and increased potential for competition from nonnative plant species, etc. Although uncommon, the species is found in other mountain ranges in southern Arizona. Impacts would be localized to the Rosemont vicinity and would not affect other populations across the forest. Based on this, the biological evaluation for this project determined that, for all action alternatives, the proposed project may impact individuals but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

[8] See the "Dark Skies" section.

Bartram stonecrop — Two documented occurrence records for this species are within the analysis area but are outside the footprint of the mine; therefore, no individuals are expected to be directly impacted (i.e., crushed, cleared, trampled, etc.) by project activities. Any individuals growing in the analysis area outside the mine footprint may experience indirect impacts, such as fugitive dust and increased potential for competition from nonnative plant species, etc. Although uncommon, the species is found in other mountain ranges in southern Arizona. Impacts would be localized to the Rosemont vicinity and would not affect other populations across the forest. Based on this, the biological evaluation for this project determined that, for all action alternatives, the proposed project may impact individuals but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Beardless chinch weed — A small population of this species was documented within the proposed fenceline of the proposed mine and adjacent to the proposed west access road. This species may be directly impacted (i.e., crushed, cleared, trampled, etc.) by project activities. Any individuals growing in the analysis area outside the mine footprint may experience indirect impacts, such as fugitive dust and increased potential for competition from nonnative plant species, etc. Although uncommon, the species is found in other mountain ranges in southern Arizona. Impacts would be localized to the Rosemont vicinity and would not affect other populations across the forest. Based on this, the biological evaluation for this project determined that, for all action alternatives, the proposed project may result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Coleman's coral-root — All action alternatives would directly impact this species owing to construction of the mine pit in the location of a known population of Coleman's coral-root in Wasp Canyon. This population would be eliminated, regardless of which action alternative was selected. Because this uncommon species has a limited distribution restricted to a small area in southern Arizona, the biological evaluation for this project determined that, for all action alternatives, the proposed project may result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Huachuca water umbel — Huachuca water umbel was found historically in Empire Gulch and is known to currently occur in Cienega Creek in the Las Cienegas National Conservation Area, both of which are within the analysis area. Direct impacts to Huachuca water umbel are not anticipated as a result of this project because this species is not known to occur within the footprint of the proposed mine. Impacts to water quality and/or disruption of surface water flow resulting from the capture of runoff in the pit are only expected to occur along the Barrel Canyon drainage through Davidson Canyon to its confluence with Cienega Creek; however, the Huachuca water umbel is not known to currently occur in any of these reaches. The Huachuca water umbel is known to occur within the analysis area in Empire Gulch and Cienega Creek and may be affected by groundwater drawdown and decreased stream, seep, and spring flows within the analysis area; however, these indirect impacts are not anticipated to begin until 50 years after project closure.

Pima pineapple cactus — All action alternatives would result in direct impacts to Pima pineapple cactus and Pima pineapple cactus habitat owing to the placement of electrical and water transmission lines and associated access roads. At least 33 Pima pineapple cacti and at least 88 acres of Pima pineapple cactus habitat would be impacted, depending on which utility alignment is chosen. Areas of permanent disturbance would remove portions of the seed bank, and areas of temporary disturbance could alter the seed bank. Disturbance of soils would change water infiltration, compact soil, and change local site conditions. Recently disturbed areas have an increased potential to be invaded by

noxious weeds (e.g., Lehmann lovegrass), which can negatively affect Pima pineapple cactus. Although some areas of temporary disturbance may recover, it may take many years before full recovery is achieved. Any individuals growing in the analysis area outside the mine footprint may experience indirect impacts, such as fugitive dust.

Sonoran noseburn — There has been one collection of this species from within the footprint of the mine and another from Gardner Canyon within the analysis area. This species may be directly impacted (i.e., crushed, cleared, trampled, etc.) by project activities. Any individuals growing in the analysis area outside the mine footprint may experience indirect impacts, such as fugitive dust and increased potential for competition from nonnative plant species, etc. Although uncommon, the species is found in other mountain ranges in southern Arizona. Impacts would be localized to the Rosemont vicinity and would not affect other populations across the forest. Based on this, the biological evaluation for this project determined that, for all action alternatives, the proposed project may impact individuals but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Southwestern (Box Canyon) muhly — Numerous documented occurrence records for this species are within the analysis area but are outside the footprint of the mine; therefore, no individuals are expected to be directly impacted (i.e., crushed, cleared, trampled, etc.) by project activities. Any individuals growing in the analysis area outside the mine footprint may experience indirect impacts, such as fugitive dust and increased potential for competition from nonnative plant species, etc. Although uncommon, the species is found in other mountain ranges in southern Arizona. Impacts would be localized to the Rosemont vicinity and would not affect other populations across the forest. Based on this, the biological evaluation for this project determined that, for all action alternatives, the proposed project may impact individuals but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Sycamore Canyon (weeping) muhly — One recent and one historic documented occurrence record for this species are within the analysis area but are outside the footprint of the mine; therefore, no individuals are expected to be directly impacted (i.e., crushed, cleared, trampled, etc.) by project activities. Any individuals growing in the analysis area outside the mine footprint may experience indirect impacts, such as fugitive dust and increased potential for competition from nonnative plant species, etc. Although uncommon, the species is found in other mountain ranges in southern Arizona. Impacts would be localized to the Rosemont vicinity and would not affect other populations across the forest. Based on this, the biological evaluation for this project determined that, for all action alternatives, the proposed project may impact individuals but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Other special status plant species — Additionally, there are other plant species for which either suitable habitat exists within the analysis area and/or the analysis area occurs within the known range of the species (see table 97 for remaining plant species not addressed above); however, no surveys were conducted for these species and occurrence records have not been submitted for these species within the analysis area. Therefore, it is unknown whether they may occur within the analysis area. Thus, the impacts analysis below addresses potential impacts to these remaining Forest Service and Bureau of Land Management special status plant species.

Impacts may potentially occur to any individuals of these species growing in the analysis area. Any individuals growing in the footprint of the mine infrastructure (including the pit, buildings, roads, tailings or waste piles, etc.) or in the path of either the water or transmission lines would be

expected to be lost (i.e., crushed, cleared, trampled, etc.) owing to project activities. Any individuals growing in the analysis area outside the mine footprint may experience indirect impacts, such as fugitive dust and increased potential for competition from nonnative plant species, etc. Based on this, the biological evaluation for this project determined that, for all action alternatives, the proposed project may impact individuals but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Animals

This section evaluates impacts to special status animal species in table 97 (1) that are known to occur within or adjacent to the analysis area; (2) for which habitat exists within the analysis area; (3) for which the analysis area occurs within the known range of the species; and (4) for which impacts are reasonably foreseeable. All action alternatives would impact special status animal species evaluated in the analysis area, and potential habitat, as described above. Impacts may be temporary, permanent, direct, or indirect, depending on the action alternative selected. Impacts may potentially occur to any individuals of this species present in the analysis area. Any individuals present in the footprint of the mine infrastructure (including the pit, buildings, roads, tailings or waste piles, etc.) or in the path of either the water or transmission lines could be lost (i.e., crushed, trampled, etc.) or otherwise harmed (forced to relocate, cut off from other individuals causing a lack of genetic transfer or reproduction, foraging or fecundity success decreased, etc.) owing to project activities. Within and adjacent to the footprint of the proposed mine, light from artificial illumination at night would create a “perpetual full moon” situation, which could disrupt animals, resulting in changes in dispersal, reproductive behavior, communication patterns, and decreased foraging success (Longcore and Rich 2004). Similarly, within and adjacent to the footprint of the mine, noise from construction of the mine or blasting could cause changes in dispersal, reproductive behavior, communication patterns, decreased foraging success, and increased predation for numerous species (NoiseQuest 2011). Impacts of noise and light are expected to decrease as the distance from the mine increases. The following special status animal species would be directly and/or indirectly impacted, regardless of which action alternative is chosen.

Chiricahua leopard frog —All action alternatives could result in direct impacts to Chiricahua leopard frogs because this species was observed in a stock tank within the footprint of the proposed mine pit in 2008, which apparently serves as a nonbreeding dispersal site (WestLand Resources Inc. 2009b). Additionally, numerous Chiricahua leopard frogs have been observed within the analysis area; therefore, direct impacts could occur during wet years, when individual frogs could disperse from breeding sites within other portions of the analysis area into the proposed mine footprint and could be crushed or trampled. Any individuals present within or adjacent to the mine footprint would experience direct impacts from noise, vibrations, and light.

The project would result in indirect impacts to Chiricahua leopard frogs through long-term habitat alteration. There is evidence to suggest that the project may also indirectly impact Chiricahua leopard frog breeding sites. Groundwater flow models were designed to simulate conditions prior to pit development, during pit dewatering, and for a 1,000-year postclosure period of groundwater level recovery and potential pit lake development (Montgomery and Associates Inc. 2010; Tetra Tech 2010g), and it was determined that groundwater level drawdown could result in the dewatering of key breeding sites and other springs supporting, or that may support, breeding frogs in the Empire Gulch basin within the analysis area. Impacts to water quality and/or disruption of surface water flow resulting from the capture of runoff in the pit are only expected to occur along the Barrel Canyon drainage through Davidson Canyon to its confluence with Cienega Creek. The Chiricahua leopard

frog is not known to currently occur in any of these reaches; however, lower Davidson Canyon Creek may provide suitable habitat for this species during high-water events, when Chiricahua leopard frogs are able to move upstream to temporary pools downstream of the head cut barrier to movement.

The Chiricahua leopard frog is known to occur within the analysis area in Empire Gulch and Cienega Creek and may be affected by groundwater drawdown and decreased stream, seep, and spring flows within the analysis area; however, these indirect impacts are not anticipated to begin until 50 years after project closure. Prey species of the Chiricahua leopard frog are likely to experience the same direct impacts as the frog, hence altering their predator-prey relationships. Additionally, because the mine pit lake water quality could exceed wildlife standards for three contaminants that are known to bioaccumulate (i.e., cadmium, mercury, and selenium), indirect impacts to this species could occur from eating aquatic invertebrates originating from the mine pit lake (see "Biophysical Features" within the "Environmental Consequences" part of this section above for details on impacts of these toxins on aquatic species (i.e., aquatic insects are potential food sources for this species)).

The project could directly or indirectly impact some of the primary constituent elements of proposed critical habitat for this species, including suitable dispersal habitat proposed for critical habitat (i.e., the 6.57 miles of ephemeral and intermittent drainages and 1,311 feet of associated uplands within the analysis area). Project activities would create a barrier for individual Chiricahua leopard frogs moving overland to disperse to and from proposed critical habitat.

Desert tortoise, Sonoran population — It is possible that this species could experience a direct loss of suitable habitat as a result of the construction and placement of the mine infrastructure (including the pit, buildings, roads, tailings or waste piles, etc.) or the water or transmission lines. Additionally, any individuals present within the footprint could be crushed, removed, etc., owing to construction activities. It is unclear at this point whether the impacts of noise, vibrations, etc., may indirectly impact individuals occupying other portions of the analysis area or impact this species' ability to forage and use these areas. Because of groundwater drawdown, changes in water quality, and decreased stream, seep, and spring flows, suitable habitat for this species, including food sources, within Davidson Canyon or other downstream waterways may be indirectly impacted by this project. Based on this, the biological evaluation for this project determined that, for all action alternatives, the proposed project may impact individuals but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Giant spotted whiptail — Any individuals present within the footprint of the mine infrastructure (including the pit, buildings, roads, tailings or waste piles, etc.) or in the path of either the water or transmission lines would be expected to be crushed or trampled owing to project activities.
Any individuals present adjacent to the mine footprint would experience direct impacts from noise, vibrations, and light. Because of groundwater drawdown, changes in water quality, and decreased stream, seep, and spring flows, suitable habitat for this species, including food sources, adjacent to stock tanks and permanent/or intermittent pools or within downstream waterways may be indirectly impacted by this project. Increased pollutant loading of stormwater runoff could result in water quality deterioration that would potentially impact giant spotted whiptails or giant spotted whiptail habitat. Indirect impacts on giant spotted whiptails could also result from potential downstream impacts to water quality of surface water flow. Increased pollutant loading of stormwater runoff within the footprint of the project could result in water quality deterioration that would potentially impact giant spotted whiptails or giant spotted whiptail habitat. Prey species of the giant spotted whiptails are likely to experience the same direct impacts as this lizard, hence altering their predator-prey relationships. Additionally, because the mine pit lake water quality could exceed wildlife

standards for three contaminants that are known to bioaccumulate (i.e., cadmium, mercury, and selenium), indirect impacts to this species could occur from eating aquatic invertebrates originating from the mine pit lake (see "Biophysical Features" within the "Environmental Consequences" part of this section above for details on impacts of these toxins on aquatic species (i.e., aquatic insects are potential food sources for this species)). Based on this, the biological evaluation for this project determined that, for all action alternatives, the proposed project may impact individuals but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Gila chub — Direct impacts to Gila chub are not anticipated as a result of this project because there is no habitat and no known occurrences of this species within the footprint of the proposed mine or near the confluence of Davidson Canyon and Cienega Creek. Furthermore, impacts to water quality and/or disruption of surface water flow resulting from the capture of runoff in the pit are only expected to occur along the Barrel Canyon drainage through Davidson Canyon to its confluence with Cienega Creek, and the Gila chub is not known to occur in any of these reaches, nor are any of these reaches expected to provide suitable habitat for this species. Indirect impacts to the Gila chub are also not anticipated as a result of this project. A population of Gila chub has been reported from within the analysis area in lower Cienega Creek (approximately 1 mile above the confluence of Davidson Canyon with Cienega Creek), and this population may be affected by groundwater drawdown and decreased stream, seep, and spring flows within the analysis area; however, these indirect impacts are not anticipated to begin until 50 years after project closure.

The project could impact water quality, one of the primary constituent elements of Gila chub designated critical habitat, at the confluence of Cienega Creek and Davidson Canyon; however, this reach is dry for most of the year, no Gila chub were recorded during fish surveys just downstream in Cienega Creek from 2002 through 2010, and the impacts to water quality and turbidity from the project that far downstream are expected to be insignificant or negligible. Impacts to designated critical habitat within upper Cienega Creek are not reasonably foreseeable because groundwater drawdown is not anticipated to occur in this portion of Cienegas Creek until approximately 50 years after mine closure.

Gila topminnow — Direct impacts to this species could occur at the confluence of Davidson Canyon and Cienega Creek. Impacts to water quality and/or disruption of surface water flow resulting from the capture of runoff in the pit are only expected to occur along the Barrel Canyon drainage through Davidson Canyon until its confluence with Cienega Creek. The Gila topminnow is not known to currently occur in any of these reaches; however, lower Davidson Canyon Creek may provide suitable habitat for this species during high-water events, when Gila topminnows are able to move upstream to temporary pools downstream of the head cut barrier to movement. The Gila topminnow is known to occur within the analysis area in Cienega Creek and may be affected by groundwater drawdown and decreased stream, seep, and spring flows within the analysis area; however, these indirect impacts are not anticipated to begin until 50 years after project closure.

Green ratsnake — Any individuals present within the footprint of the mine infrastructure (including the pit, buildings, roads, tailings or waste piles, etc.) or in the path of either the water or transmission lines would be expected to be crushed or trampled owing to project activities. Any individuals present adjacent to the mine footprint would experience direct impacts from noise, vibrations, and light. Prey species of the green ratsnake are likely to experience the same direct impacts as this lizard, hence altering their predator-prey relationships. Because of groundwater drawdown, changes in water quality, and decreased stream, seep, and spring flows, suitable habitat for this species, including food

sources, may be indirectly impacted by this project. Based on this, the biological evaluation for this project determined that, for all action alternatives, the proposed project may impact individuals but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Jaguar — Direct impacts to jaguars are not anticipated as a result of this project: the species' occurrence in Arizona is considered rare, this species has not been observed within 20 miles of the analysis area since 1961, and it is expected that the action area does not contain suitable breeding habitat for this species. The loss of jaguar habitat resulting from the proposed mine and the size of the analysis area for this project are both relatively small, compared with the amount of suitable jaguar habitat in southeastern Arizona (approximately 0.1 and 2.2 percent, respectively).

Indirect impacts could potentially occur to jaguars: it is possible that individuals could travel across, or adjacent to, the analysis area while moving between other suitable habitats; therefore, project activities (i.e., noise, vibrations, light) could cause jaguars in the analysis area, if present, to shift travel routes. Hence, the construction and operation of the mine could disrupt the local and regional movement corridors for this species. Any individuals moving through the analysis area could experience indirect impacts from groundwater drawdown, noise, vibrations, and light to suitable habitat, including a change in prey base availability and habitat conversion.

Lesser long-nosed bat — All action alternatives would directly impact at least one known lesser long-nosed bat postmaternity roost site within the footprint of the proposed mine. Any individuals present within the footprint of the mine infrastructure (including the pit, buildings, roads, tailings or waste piles, etc.) would either be crushed or forced to relocate. Given the anticipated levels of project related activity and associated disturbance from noise, vibrations, and light, there exists the potential for direct impacts to two additional lesser long-nosed bat postmaternity roosts adjacent to the proposed mine footprint; more than 5,100 lesser long-nosed bats were counted at one of these sites in 2009.

All action alternatives would result in indirect impacts to potential lesser long-nosed bat forage plants (i.e., paniculate agaves) in the late summer range of the species. Based on surveys, it was estimated that between 196,268 and 306,209 Palmer agave rosettes would be impacted as a result of the proposed project (WestLand Resources Inc. 2009c). Indirect impacts to lesser long-nosed bat forage plants may result from an increase in dust levels adjacent to access roads and mining areas. Known lesser long-nosed bat maternity roosts are all more than 75 miles from the project area; therefore, no indirect impacts to lesser long-nosed bat maternity roosts are anticipated.

Longfin dace — Direct impacts to this species could occur at the confluence of Davidson Canyon and Cienega Creek. Impacts to water quality and/or disruption of surface water flow resulting from the capture of runoff in the pit are only expected to occur along the Barrel Canyon drainage through Davidson Canyon to its confluence with Cienega Creek. The longfin dace is not known to currently occur in any of these reaches; however, lower Davidson Canyon Creek may provide suitable habitat for this species during high-water events, when longfin dace are able to move upstream to temporary pools downstream of the head cut barrier to movement. The longfin dace is known to occur within the analysis area in Cienega Creek and may be affected by groundwater drawdown and decreased stream, seep, and spring flows within the analysis area; however, these indirect impacts are not anticipated to begin until 50 years after project closure. Based on this, the biological evaluation for this project determined that, for all action alternatives, the proposed project may impact individuals but is not

likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Mexican spotted owl — Direct impacts to Mexican spotted owls are not anticipated as a result of this project because all construction activities and discernible impacts from noise, light, and vibration would occur outside the nearest known Mexican spotted owl protected activity centers, which are all outside the analysis area. There also will be no increase in vehicular traffic and associated noise (no new access roads) within 4.5 miles of the nearest protected activity center. Impacts to Mexican spotted owl designated critical habitat are also not anticipated as a result of this project because the impacts of noise, light, and vibration within this area of critical habitat will be minor over the life of the mine (approximately 20 years), and these minor impacts will not alter any primary constituent elements.

Northern Mexican gartersnake — All action alternatives could result in direct impacts to northern Mexican gartersnakes, if present, within the footprint of the mine and downstream in Barrel and Davidson Canyons to the confluence of Cienega Creek because of potential impacts to water quality and/or disruption of surface water flow. Direct impacts to individuals of this species within the proposed mine footprint could include being crushed, trampled, or forced to relocate, and those individuals within or adjacent to the mine footprint could experience impacts from noise, vibrations, and light.

The northern Mexican gartersnake is known to occur within the analysis area in Cienega Creek and may be indirectly impacted by groundwater drawdown and decreased stream, seep, and spring flows within the analysis area; however, these indirect impacts are not anticipated to begin until 50 years after project closure. Prey species of the northern Mexican gartersnake are likely to experience the same direct impacts as the snake, hence altering their predator-prey relationships. Additionally, because the mine pit lake water quality could exceed wildlife standards for three contaminants that are known to bioaccumulate (i.e., cadmium, mercury, and selenium), indirect impacts to this species could occur from eating vertebrates that eat aquatic invertebrates originating from the mine pit lake (see “Biophysical Features” within the “Environmental Consequences” part of this section above for details on impacts of these toxins on aquatic species).

Ocelot — Direct impacts to ocelots are not anticipated as a result of this project: the species’ occurrence in Arizona is considered rare, this species has never been documented as occurring within the analysis area, and it is expected that the action area does not contain suitable breeding habitat for this species. Furthermore, it is expected that the possibility of ocelots passing through the analysis area is extremely unlikely because this species has a propensity to use areas with dense vegetation cover in tropical rainforest, pine forest, gallery forest, riparian forest, semideciduous forest, and dry tropical forest, to savanna, shrublands, and marshlands habitats, which are not available within the analysis area. The loss of ocelot habitat resulting from the proposed mine and the size of the analysis area for this project are both relatively small, compared with the amount of suitable ocelot habitat in Arizona, New Mexico, and Mexico.

Indirect impacts could potentially occur to ocelots: it is possible that individuals could travel across, or adjacent to, the analysis area while moving between other suitable habitats; therefore, project activities (i.e., noise, vibrations, light) could cause ocelots in the analysis area, if present, to shift travel routes. Hence, the construction and operation of the mine could disrupt the local and regional movement corridors for this species. Any individuals moving through the analysis area could

experience indirect impacts from groundwater drawdown, noise, vibrations, and light to suitable habitat, including a change in prey base availability and habitat conversion.

Rosemont talussnail — All action alternatives could result in potential direct and indirect impacts to the Rosemont talussnail as a result of destruction or alteration of up to 29 acres of talus slopes, rocky outcrops, or rocky canyon bottoms. Individual Rosemont talussnails crushed during mine construction and operations, especially in the area proposed for the open pit, would be directly impacted. Indirect impacts may potentially occur to any individuals of this species present in the analysis area owing to impacts from groundwater drawdown and vibrations. Blasting may cause talus slopes to shift possibly impacting microhabitat features for this species (i.e., pockets within the talus slopes).

Sonoran talussnail — All action alternatives could result in potential direct and indirect impacts to the Sonoran talussnail as a result of destruction or alteration of up to 29 acres of talus slopes, rocky outcrops, or rocky canyon bottoms. Individual Sonoran talussnails crushed during mine construction and operations, especially in the area proposed for the open pit, would be directly impacted. Indirect impacts may potentially occur to any individuals of this species present in the analysis area owing to impacts from groundwater drawdown and vibrations. Blasting may cause talus slopes to shift possibly impacting microhabitat features for this species (i.e., pockets within the talus slopes).

Southwestern willow flycatcher — None of the action alternatives are expected to result in direct impacts to southwestern willow flycatcher because there are no known occurrences of, or suitable habitat for, this species within the footprint of the proposed mine or within Barrel or Davidson canyons. There is one documented occurrence (in 2001) of the southwestern willow flycatcher within the analysis area in Cienega Creek, and suitable habitat for this species is also present in Empire Gulch. If present, this species and its habitat may be indirectly impacted by groundwater drawdown and decreased stream, seep, and spring flows within the analysis area; however, these indirect impacts are not anticipated to begin until 50 years after project closure. Prey species of the southwestern willow flycatcher are likely to experience the same direct impacts as the bird, hence altering their predator-prey relationships. The project could indirectly impact some of the primary constituent elements of proposed critical habitat for this species, including a general impact on riparian vegetation and the presence of surface water.

Western yellow-billed cuckoo — There are documented occurrences of the western yellow-billed cuckoos within the analysis area in Barrel Canyon, Davidson Canyon, Empire Gulch, and Cienega Creek. All action alternatives could result in direct impacts to individuals of this species if present within or adjacent to the proposed mine footprint from noise, vibrations, and light, and they could be forced to relocate. Direct impacts on western yellow-billed cuckoos could also result from potential downstream impacts to water quality of surface water flow in Barrel and Davidson Canyons. Increased pollutant loading of stormwater runoff within the footprint of the project could result in water quality deterioration that would potentially impact western yellow-billed cuckoos or western yellow-billed cuckoo habitat in these canyons.

This species and its habitat may be indirectly impacted by groundwater drawdown and decreased stream, seep, and spring flows within the analysis area; however, these indirect impacts are not anticipated to begin until 50 years after project closure. Prey species of the western yellow-billed cuckoo are likely to experience the same direct impacts as the bird, hence altering their predator-prey relationships. Additionally, because the mine pit lake water quality could exceed wildlife standards for three contaminants that are known to bioaccumulate (i.e., cadmium, mercury, and selenium),

indirect impacts to this species could occur from eating aquatic invertebrates originating from the mine pit lake (see “Biophysical Features” within the “Environmental Consequences” part of this section above for details on impacts of these toxins on aquatic species (i.e., aquatic insects are primary food sources for this species)). Based on this, the biological evaluation for this project determined that, for all action alternatives, the proposed project may impact individuals but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Other special status animal species. There are other animal species for which suitable habitat exists within the analysis area and/or the analysis area occurs within the known range of the species; however, no surveys were conducted for these species and it is unknown whether they may occur within the analysis area. Also, as mentioned in the Affected Environment” part of this section, it is unclear whether many of these species would be impacted by the project even if they do occur within portions of the analysis area. Thus, the impacts analysis below addresses potential impacts to the remaining Forest Service and Bureau of Land Management special status plant species presented in table 97.

Impacts may potentially occur to individuals of most of these species that are present in the analysis area. Any individuals present within the footprint of the mine infrastructure (including the pit, buildings, roads, tailings or waste piles, etc.), or in the path of either the water or transmission lines could be crushed, trampled, or forced to relocate owing to project activities. The construction and operation of the mine could both directly and indirectly disrupt the local movement corridors for some species. Any individuals present in the analysis area outside the mine footprint could experience direct impacts from noise, vibrations, and light and indirect impacts from noise, vibrations, light, and groundwater drawdown to suitable habitat, including changes in food source and habitat conversion. However, it is unclear how these impacts will affect some species, such as the fulvous harvest mouse, Gila monster, northern pygmy mouse, plains harvest mouse, and yellow-nosed cotton rat. Depending on where these species occur within the analysis area, their daily movement and foraging patterns may or may not be altered by the impacts of noise, dust, light, etc. resulting from proposed project activities.

For the four special status bat species, in addition to lesser long-nosed bat (see impacts discussion above), that are known to occur in the analysis area (Mexican long-tongued bat, pale Townsend’s big-eared bat, cave myotis, and fringed myotis), additional impacts are expected beyond those listed for other special status animal species. Blasting associated with the mine may result in direct or indirect impacts on roost sites. Because three of these bat species (pale Townsend’s big-eared bat, cave myotis, and fringed myotis) feed on insects, it is important to note that the mine pit lake water quality could exceed standards for silver, cadmium, lead, copper, mercury, selenium, and zinc (see “Biophysical Features” within the “Environmental Consequences” part of this section above for details on impacts of these toxins on aquatic species (i.e., aquatic insects are potential food sources for these species)). Based on this, the biological evaluation for this project determined that, for all action alternatives, the proposed project may impact individuals of these species but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability of these species.

Migratory Birds

All action alternatives would result in direct, permanent impacts to at least approximately 4,937 acres of grassland, woodland, desertscrub, and riparian vegetation on Forest Service lands, potentially resulting in nest destruction for some species of migratory and resident birds. For all action

alternatives, take (manifested as wound or kill, especially for eggs and nestlings) is expected to occur but would be unintentional, as the purpose of the action is extraction of minerals, rather than taking of birds. Migratory birds are different from most other animals because they are highly mobile, and populations are (not without exception) fairly contiguous, with occurrences that are subject to shift, if needed. Because of this, migratory birds occupying the northern Santa Rita Mountains could fly off and become established elsewhere. Thus, populations are generally considered contiguous, occupying the full extent of the species' range, unless there are well established distributional gaps.

Activities resulting from all of the action alternatives that would be expected to result in unintentional take include the following:

- removal of trees,
- clearing surface lands,
- waste rock and tailings deposition,
- road building and maintenance, and
- facilities construction.

There should be little to no unintentional take of the less-common transient or fringe-habitat species. This includes species such as cactus ferruginous pygmy-owl, northern beardless tyrannulet, and five-striped sparrow. It also includes species that do not nest in the project area but may forage there, such as golden eagle and American peregrine falcon. Some common species that are widespread in the project area and nest in situations that would be directly impacted by mining or land-clearing activities may include Gambel's quail, ash-throated flycatcher, and Bewick's wren. Of the relatively uncommon migratory bird species that are thought to use the area, most are found at higher elevations or near perennial streams (e.g., all of the rare hummingbirds, buff-breasted flycatcher, northern beardless tyrannulet, etc.) and, thus, are not expected to be directly impacted by the action alternatives. The analysis area only contains suitable breeding habitat for three migratory bird species that have small breeding ranges within the United States: Botteri's sparrow, rufous-winged sparrow, and varied bunting. These three species have been documented in the proposed project area, but all are listed as rare to uncommon (Davis and Callahan n.d. (1977)).

Bald and golden eagles — All action alternatives are expected to alter or remove foraging habitat for golden eagles. Because it is not believed that golden eagles currently nest in the immediate area, it is not expected that there would be a loss of the breeding population. Foraging eagles would probably just shift their foraging activity to other nearby areas. Although there would be noise and vibrations resulting from implementation of the action alternatives, eagles would probably just avoid the activity area, thus not resulting in "take."

Power lines are a potential source of electrocution for raptors, including golden eagles, which would constitute a violation of the Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act (Lehman 2001). This would qualify as "take" and would result in a net loss of the breeding population.

Santa Rita Mountains Important Bird Area — All action alternatives would result in direct, permanent impacts to at least approximately 4,937 acres of grassland, woodland, desertscrub, and riparian vegetation, potentially resulting in nest destruction for some species of migratory and resident birds within the Santa Rita Mountains Important Bird Area (approximately 3.9 percent of the important bird area). Up to approximately 42,144 acres of nesting, overwintering, foraging, and

roosting habitat for migratory and resident birds within this important bird area may be indirectly impacted by any of the action alternatives (approximately 33 percent of the important bird area). Habitat within portions of the important bird area to be directly impacted by construction or operating activities (including the pit, buildings, roads, tailings or waste piles, etc.) or in the path of either the water or transmission lines would be modified, altered, or lost to certain species of migratory birds. Habitat within the important bird area outside the mine footprint may be indirectly impacted by noise, vibrations, groundwater drawdown, and light, causing a decrease in food availability for some migratory bird species and resulting in a loss of nest sites and cover.

Important Overwintering Areas — Up to approximately 138,912 acres of overwintering habitat for migratory birds within the analysis area may be indirectly impacted by any of the action alternatives. Overwintering habitat within the footprint of the mining activities would be directly impacted by construction or operating activities (including the pit, buildings, roads, tailings or waste piles, etc.) or construction and placement of the water or transmission lines. Overwintering habitat within the analysis area outside the mine footprint may be indirectly impacted by noise, vibrations, groundwater drawdown, and light, causing a decrease in food availability and cover for some migratory bird species.

Coronado National Forest Management Indicator Species

The action alternatives are not expected to result in forest-level impacts to any management indicator species for Coronado National Forest. A detailed explanation of the potential impacts to management indicator species is provided in the draft “Management Indicator Species Report” (SWCA Environmental Consultants 2011c).

Pima County Priority Vulnerable Species

Each of the action alternatives would result in direct, permanent impacts to approximately 6,278 acres of habitat for Pima County priority vulnerable species. In addition, up to approximately 138,912 acres of habitat for Pima County priority vulnerable species within the analysis area may be indirectly impacted by any of the action alternatives. Pima County priority vulnerable species with the potential to occur within the analysis area were evaluated in the draft “Biologists’ Report” (SWCA Environmental Consultants 2011b).

Other Plants and Animals

Impacts to other plants that occur, or have suitable habitat, in the analysis area that are not designated as special status species may be temporary, permanent, direct, and/or indirect, depending on the action alternative selected. Any plants growing in the footprint of the mine infrastructure (including the pit, buildings, roads, tailings or waste piles, etc.) or in the path of either the water or transmission lines would be expected to be lost (i.e., crushed, cleared, trampled, etc.) owing to project activities. Any individuals growing in the analysis area outside the mine footprint may experience indirect impacts, such as fugitive dust and increased potential for competition from nonnative plant species, etc.

Impacts to other plants that occur, or have suitable habitat, in the analysis area that are not designated as special status species may be temporary, permanent, direct, and/or indirect, depending on the action alternative selected. Any individuals present within the footprint of the mine infrastructure (including the pit, buildings, roads, tailings or waste piles, etc.) or in the path of either the water or transmission lines could be crushed, trampled, or forced to relocate owing to project activities. The construction and operation of the mine could both directly and indirectly disrupt the local

movement corridors for some species. Any individuals present in the analysis area outside the mine footprint could experience direct impacts from noise, vibrations, and light and indirect impacts from noise, vibrations, light, and groundwater drawdown to suitable habitat, including changes in food source and habitat conversion.

Impacts Specific to the Proposed Action

The primary difference between the proposed action and the other action alternatives, with the exception of the Phased Tailings Alternative, is that the proposed action would place the dry-stack tailings within McCleary Canyon (see figure 9). Impacts specific to the proposed action, other than those discussed in the "Impacts Common to All Action Alternatives" part of this section, are detailed below.

Biophysical Features

The proposed action would directly impact upper and lower Barrel and McCleary Canyons.
The proposed action would directly impact 12 springs and seeps because they occur within the footprint of the proposed mine. The proposed action could indirectly impact 51 springs and seeps in the analysis area as a result of groundwater drawdown. The construction and operation of the mine pit, tailings, waste rock, and leach facilities associated with the proposed action would directly impact 15 stock tanks and 17 mine adits and shafts and would indirectly impact up to 22 mine adits and shafts in the analysis area.

Vegetation Communities

Vegetation communities would be disturbed by construction, operation, and maintenance activities that remove existing vegetation. Permanent, direct impacts to vegetation communities from the proposed action would result from the removal of approximately 6,380 to 6,461 acres[9] of vegetation: 3,128 to 3,161 acres of semidesert grassland, 3,180 to 3,228 acres of Madrean evergreen woodland, 0 (no) acres of Chihuahuan desertscrub, and 72 acres of riparian vegetation. Although the Sonoran desertscrub biotic community is located outside the analysis area, there are portions of the analysis area that exhibit characteristics of Sonoran desertscrub that may be directly or indirectly impacted by the proposed project.

Animal Movement Corridors

The proposed action may result in a permanent loss or fragmentation of approximately 6,380 to 6,461 acres of upland and riparian vegetation communities from the pit, tailings and waste piles, and associated infrastructure, leading to a loss of movement corridors and gene flow—thus, eventually, the overall biological diversity of the area—for numerous species. The proposed action would directly impact both McCleary and Barrel Canyons; thus, implementation of this alternative is expected to fragment, or even eliminate, these two canyons as potential movement corridors for animals using these areas to move between the Santa Rita Mountains and nearby Empire, Rincon, and Whetstone Mountains.

Special Status Species

Plants

Arizona giant sedge — The proposed action would place the primary access road through Scholefield Spring, which would result in direct impacts to a population of Arizona giant sedge, the

[9] Depending on which transmission line alternative is selected.

only known population of this species in the footprint of the proposed mine. Individuals growing in Scholefield Canyon in the proposed footprint of the primary access road would be either partially or completely lost (i.e., crushed, cleared, trampled, etc.). Although uncommon, the species is found in other mountain ranges in southern Arizona. Impacts would be localized to the Rosemont vicinity and would not affect other populations across the forest. Based on this, the biological evaluation for this project determined that the proposed action will directly impact the population of this species in Scholefield Canyon but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Coleman's coral-root — The proposed action would directly impact this species owing to the placement of dry-stack tailings over a known population of Coleman's coral-root in McCleary Canyon. This population would be eliminated with the selection of the proposed action.

Other special status plant species — See the "Impacts Common to All Action Alternatives" part of this section.

Animals

The proposed action would impact suitable habitat for special status animal species, including the following: direct impacts to approximately 6,380 to 6,461 acres of vegetation; direct impacts to 12 and indirect impacts to 51 springs and seeps; direct impacts to 15 stock tanks; and direct impacts to 17 and indirect impacts to up to 22 mine adits and shafts in the analysis area.

Other special status animal species — See the "Impacts Common to All Action Alternatives" part of this section.

Migratory Birds

See the "Impacts Common to All Action Alternatives" part of this section.

Coronado National Forest Management Indicator Species

See the "Impacts Common to All Action Alternatives" part of this section.

Pima County Priority Vulnerable Species

See the "Impacts Common to All Action Alternatives" part of this section.

Other Plants and Animals

See the "Impacts Common to All Action Alternatives" part of this section.

Impacts Specific to the Phased Tailings Alternative

Like the proposed action, the Phased Tailings Alternative would place the dry-stack tailings within McCleary Canyon (see figure 12). The primary differences between the proposed action and the Phased Tailings Alternative include the following: portions of the dry-stack tailings areas would be reclaimed in phases and earlier than under the proposed action, and the location of the primary access road would be south of, and outside, Scholefield Canyon for the Phased Tailings Alternative. Impacts specific to the Phased Tailings Alternative, other than those discussed in the "Impacts Common to All Action Alternatives" part of this section, are detailed below.

Biophysical Features

See "Biophysical Features" in the "Impacts Specific to the Proposed Action" part of this section.

Vegetation Communities

Vegetation communities would be disturbed by construction, operation, and maintenance activities that remove existing vegetation. Permanent, direct impacts to vegetation communities from the Phased Tailings Alternative would result from the removal of approximately 6,278 to 6,359 acres[10] of vegetation: 3,130 to 3,163 acres of semidesert grassland, 3,077 to 3,125 acres of Madrean evergreen woodland, 0 (no) acres of Chihuahuan desertscrub, and 71 acres of riparian vegetation. Although the Sonoran desertscrub biotic community is located outside the analysis area, there are portions of the analysis area that exhibit characteristics of Sonoran desertscrub that may be directly or indirectly impacted by the proposed project.

Animal Movement Corridors

The Phased Tailings Alternative may result in a permanent loss or fragmentation of approximately 6,278 to 6,359 acres of upland and riparian vegetation communities from the pit, tailings and waste piles, and associated infrastructure, leading to a loss of movement corridors and gene flow—thus, eventually, the overall biological diversity of the area—for numerous species. See "Animal Movement Corridors" in the "Impacts Specific to the Proposed Action" part of this section for a more complete description of impacts.

Special Status Species

Plants

Arizona giant sedge — The Phased Tailings Alternative would place the primary access road south of, and outside, Scholefield Spring, which would avoid directly impacting that population of Arizona giant sedge. Any individuals growing in the analysis area outside the mine footprint may experience indirect impacts, such as the effects of fugitive dust, groundwater drawdown, and increased potential for collecting or trampling or competition from nonnative plant species, etc. Although uncommon, the species is found in other mountain ranges in southern Arizona. Impacts would be localized to the Rosemont vicinity and would not affect other populations across the forest. Based on this, the biological evaluation for this project determined that the Phased Tailings Alternative may indirectly impact individuals but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Coleman's coral-root — The Phased Tailings Alternative would directly impact this species owing to the placement of dry-stack tailings over a known population of Coleman's coral-root in McCleary Canyon. This population would be eliminated with the selection of the Phased Tailings Alternative.

Other special status plant species — See the "Impacts Common to All Action Alternatives" part of this section.

Animals

The Phased Tailings Alternative would impact suitable habitat for special status animal species, including the following: direct impacts to approximately 6,278 to 6,359 acres of vegetation; direct impacts to 12 and indirect impacts to 51 springs and seeps; direct impacts to 15 stock tanks; and direct impacts to 17 and indirect impacts to up to 22 mine adits and shafts in the analysis area.

Other special status animal species — See the "Impacts Common to All Action Alternatives" part of this section.

[10] Depending on which transmission line alternative is selected.

Migratory Birds

See the "Impacts Common to All Action Alternatives" part of this section.

Coronado National Forest Management Indicator Species

See the "Impacts Common to All Action Alternatives" part of this section.

Pima County Priority Vulnerable Species

See the "Impacts Common to All Action Alternatives" part of this section.

Other Plants and Animals

See the "Impacts Common to All Action Alternatives" part of this section.

Impacts Specific to the Barrel Alternative

Unlike the proposed action and Phased Tailings Alternative, the Barrel Alternative would place all dry-stack tailings and waste rock within Barrel Canyon, keeping direct impacts out of McCleary Canyon (see figure 14). Impacts specific to the Barrel Alternative, other than those discussed in the "Impacts Common to All Action Alternatives" part of this section, are detailed below.

Biophysical Features

The Barrel Alternative would directly impact upper and lower Barrel Canyon and would indirectly impact McCleary Canyon. The Barrel Alternative would directly impact 12 springs and seeps because they occur within the footprint of the proposed mine. The Barrel Alternative could indirectly impact 51 springs and seeps in the analysis area as a result of groundwater drawdown and potential spills or other accidental releases. The construction and operation of the mine pit, tailings, waste rock, and leach facilities associated with the Barrel Alternative would directly impact 19 stock tanks and 17 mine adits and shafts, and would indirectly impact up to 22 mine adits and shafts in the analysis area.

Vegetation Communities

Vegetation communities would be disturbed by construction, operation, and maintenance activities that remove existing vegetation. Permanent, direct impacts to vegetation communities from the Barrel Alternative would result from the removal of approximately 7,014 to 7,095 acres[11] of vegetation: 3,465 to 3,498 acres of semidesert grassland, 3,472 to 3,520 acres of Madrean evergreen woodland, 0 (no) acres of Chihuahuan desertscrub, and 77 acres of riparian vegetation. Although the Sonoran desertscrub biotic community is located outside the analysis area, there are portions of the analysis area that exhibit characteristics of Sonoran desertscrub that may be directly or indirectly impacted by the proposed project.

Animal Movement Corridors

The Barrel Alternative may result in a permanent loss or fragmentation of approximately 7,014 to 7,095 acres of upland and riparian vegetation communities from the pit, tailings and waste piles, and associated infrastructure, leading to a loss of movement corridors and gene flow—thus, eventually, the overall biological diversity of the area—for numerous species. The Barrel Alternative would directly impact Barrel Canyon; thus, implementation of this alternative is expected to fragment, or even eliminate, this canyon as a potential movement corridor for animals using this area to move

[11] Depending on which transmission line alternative is selected.

between the Santa Rita Mountains and nearby Empire, Rincon, and Whetstone Mountains. At this point in the project analysis, it is unclear how indirect impacts related to this alternative would impact McCleary Canyon as a movement corridor for local fauna.

Special Status Species

Plants

Arizona giant sedge — The Barrel Alternative would place the primary access road south of, and outside, Scholefield Spring, which would avoid directly impacting that population of Arizona giant sedge. Any individuals growing in the analysis area outside the mine footprint may experience indirect impacts, such as the effects of fugitive dust, groundwater drawdown, and increased potential for collecting or trampling or competition from nonnative plant species, etc. Although uncommon, the species is found in other mountain ranges in southern Arizona. Impacts would be localized to the Rosemont vicinity and would not affect other populations across the forest. Based on this, the biological evaluation for this project determined that the Barrel Alternative may indirectly impact individuals but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Coleman's coral-root — The Barrel Alternative would not place dry-stack tailings in McCleary Canyon and, therefore, would not directly impact the population of Coleman's coral-root within McCleary Canyon. Dry-stack tailings are proposed upslope of the known McCleary Canyon population of Coleman's coral-root for the Barrel Alternative; therefore, this population may be indirectly impacted by the dry-stack tailings. At this point in the project analysis, it is unclear how indirect impacts related to this alternative would impact the McCleary Canyon population, but it is expected that indirect impacts would occur as a result of groundwater drawdown, the runoff of chemicals into McCleary Canyon, the impacts of dust on individual plants, and/or any potential impacts on host oak trees within McCleary Canyon.

Other special status plant species — See the "Impacts Common to All Action Alternatives" part of this section.

Animals

The Barrel Alternative would impact suitable habitat for special status animal species, including the following: direct impacts to approximately 7,014 to 7,095 acres of vegetation; direct impacts to 12 and indirect impacts to 51 springs and seeps; direct impacts to 19 stock tanks; and direct impacts to 17 and indirect impacts to up to 22 mine adits and shafts in the analysis area.

Chiricahua leopard frog — The Barrel Alternative would result in direct impacts to an additional nonbreeding dispersal site for this species because in 2008 one Chiricahua leopard frog was observed at this site, which occurs within the footprint of the proposed mine (WestLand Resources Inc. 2009b).

Other special status animal species — See the "Impacts Common to All Action Alternatives" part of this section.

Migratory Birds

See the "Impacts Common to All Action Alternatives" part of this section.

Coronado National Forest Management Indicator Species

See the "Impacts Common to All Action Alternatives" part of this section.

Pima County Priority Vulnerable Species

See the "Impacts Common to All Action Alternatives" part of this section.

Other Plants and Animals

See the "Impacts Common to All Action Alternatives" part of this section.

Impacts Specific to the Barrel Trail Alternative

Like the Barrel Alternative, the Barrel Trail Alternative would place all dry-stack tailings within Barrel Canyon, keeping direct impacts out of McCleary Canyon (see figure 15). Unlike the Barrel Alternative, waste rock would also be placed over nearly the entire Trail Canyon drainage, which is adjacent to Barrel Canyon, and the overall waste rock storage would cover a larger area than all other action alternatives. Impacts specific to the Barrel Trail Alternative, other than those discussed in the "Impacts Common to All Action Alternatives" part of this section, are detailed below.

Biophysical Features

The Barrel Trail Alternative would directly impact upper and lower Barrel Canyon and Trail Canyon and would indirectly impact McCleary Canyon. The Barrel Trail Alternative would directly impact 12 springs and seeps because they occur within the footprint of the proposed mine. The Barrel Trail Alternative could indirectly impact 51 springs and seeps in the analysis area as a result of groundwater drawdown. The construction and operation of the mine pit, tailings, waste rock, and leach facilities associated with the Barrel Trail Alternative would directly impact 19 stock tanks and 17 mine adits and shafts and would indirectly impact up to 22 mine adits and shafts in the analysis area.

Vegetation Communities

Vegetation communities would be disturbed by construction, operation, and maintenance activities that remove existing vegetation. Permanent, direct impacts to vegetation communities from the Barrel Trail Alternative would result from the removal of approximately 7,014 to 7,095 acres[12] of vegetation: 3,465 to 3,498 acres of semidesert grassland, 3,472 to 3,520 acres of Madrean evergreen woodland,
0 (no) acres of Chihuahuan desertscrub, and 77 acres of riparian vegetation. Although the Sonoran desertscrub biotic community is located outside the analysis area, there are portions of the analysis area that exhibit characteristics of Sonoran desertscrub that may be directly or indirectly impacted by the proposed project.

Animal Movement Corridors

The Barrel Trail Alternative may result in a permanent loss or fragmentation of approximately 7,014 to 7,095 acres of upland and riparian vegetation communities from the pit, tailings and waste piles, and associated infrastructure, leading to a loss of movement corridors and gene flow—thus, eventually, the overall biological diversity of the area—for numerous species. The Barrel Trail Alternative would directly impact Barrel and Trail Canyons; thus, implementation of this alternative is expected to fragment, or even eliminate, these canyons as potential movement corridors for animals using these areas to move between the Santa Rita Mountains and nearby Empire, Rincon, and Whetstone Mountains. At this point in the project analysis, it is unclear how indirect impacts related to this alternative would impact McCleary Canyon as a movement corridor for local fauna.

[12] Depending on which transmission line alternative is selected.

Special Status Species

Plants

Arizona giant sedge — The Barrel Trail Alternative would place the primary access road south of, and outside, Scholefield Spring, which would avoid directly impacting that population of Arizona giant sedge. Any individuals growing in the analysis area outside the mine footprint may experience indirect impacts, such as the effects of fugitive dust, groundwater drawdown, and increased potential for collecting or trampling or competition from nonnative plant species, etc. Although uncommon, the species is found in other mountain ranges in southern Arizona. Impacts would be localized to the Rosemont vicinity and would not affect other populations across the forest. Based on this, the biological evaluation for this project determined that the Barrel Trail Alternative may indirectly impact individuals but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Coleman's coral-root — The Barrel Trail Alternative would not place dry-stack tailings in McCleary Canyon and, therefore, would not directly impact the population of Coleman's coral-root within McCleary Canyon. Dry-stack tailings are proposed upslope of the known McCleary Canyon population of Coleman's coral-root for the Barrel Trail Alternative; therefore, this population may be indirectly impacted by the dry-stack tailings. At this point in the project analysis, it is unclear how indirect impacts related to this alternative would impact the McCleary Canyon population, but it is expected that indirect impacts would occur as a result of groundwater drawdown, the runoff of chemicals into McCleary Canyon, the effects of dust on individual plants, and/or any potential impacts on host oak trees within McCleary Canyon.

Other special status plant species — See the "Impacts Common to All Action Alternatives" part of this section.

Animals

The Barrel Trail Alternative would impact suitable habitat for special status animal species, including the following: direct impacts to approximately 7,014 to 7,095 acres of vegetation; direct impacts to 12 and indirect impacts to 51 springs and seeps; direct impacts to 19 stock tanks; and direct impacts to 17 and indirect impacts to up to 22 mine adits and shafts in the analysis area.

Chiricahua leopard frog — The Barrel Alternative would result in direct impacts to an additional nonbreeding dispersal site for this species because in 2008 one Chiricahua leopard frog was observed at this site, which occurs within the footprint of the proposed mine (WestLand Resources Inc. 2009b).

Other special status animal species — See the "Impacts Common to All Action Alternatives" part of this section.

Migratory Birds

See the "Impacts Common to All Action Alternatives" part of this section.

Coronado National Forest Management Indicator Species

See the "Impacts Common to All Action Alternatives" part of this section.

Pima County Priority Vulnerable Species

See the "Impacts Common to All Action Alternatives" part of this section.

Other Plants and Animals

See the "Impacts Common to All Action Alternatives" part of this section.

Impacts Specific to the Scholefield-McCleary Alternative

The Scholefield-McCleary Alternative is different from all the other action alternatives because dry-stack tailings and waste rock would not be placed in upper or lower Barrel Canyon; rather, dry-stack tailings and waste rock would be placed entirely within Scholefield Canyon and upper McCleary Canyon (see figure 17). Impacts specific to the Scholefield-McCleary Alternative, other than those discussed in the "Impacts Common to All Action Alternatives" part of this section, are detailed below. While most of the footprint for this alternative is largely outside McCleary Canyon, the waste rock pile is anticipated to be adjacent to the edge of the drainage. There may be a greater impact to the canyon's flora and fauna than from the Barrel or Barrel Trail Alternatives, as it is difficult to predict the precise impacts this waste rock pile may have on resources in the immediate vicinity of the channel in McCleary Canyon.

Biophysical Features

The Scholefield-McCleary Alternative would directly impact upper McCleary Canyon and Scholefield Canyon and would indirectly impact all of McCleary Canyon. The Scholefield-McCleary Alternative would directly impact 19 springs and seeps because they occur within the footprint of the proposed mine. The Scholefield-McCleary Alternative could indirectly impact 48 springs and seeps in the analysis area as a result of groundwater drawdown. The construction and operation of the mine pit, tailings, waste rock, and leach facilities associated with the Scholefield-McCleary Alternative would directly impact 8 stock tanks and 17 mine adits and shafts, and would indirectly impact up to 22 mine adits and shafts in the analysis area.

Vegetation Communities

Vegetation communities would be disturbed by construction, operation, and maintenance activities that remove existing vegetation. Permanent, direct impacts to vegetation communities from the Scholefield-McCleary Alternative would result from the removal of approximately 7,363 to 7,444 acres[13] of vegetation: 3,942 to 3,975 acres of semidesert grassland, 3,283 to 3,331 acres of Madrean evergreen woodland, 0 (no) acres of Chihuahuan desertscrub, 138 acres of riparian vegetation. Although the Sonoran desertscrub biotic community is located outside the analysis area, there are portions of the analysis area that exhibit characteristics of Sonoran desertscrub and may be directly or indirectly impacted by the proposed project.

Animal Movement Corridors

The Scholefield-McCleary Alternative may result in a permanent loss or fragmentation of approximately 7,363 to 7,444 acres of upland and riparian vegetation communities from the pit, tailings and waste piles, and associated infrastructure, leading to a loss of movement corridors and gene flow—thus, eventually, the overall biological diversity of the area—for numerous species. The Scholefield-McCleary Alternative would directly impact upper McCleary Canyon and most of Scholefield Canyon; thus, implementation of this alternative is expected to fragment, or even eliminate, these canyons as potential movement corridors for animals using these areas to move between the Santa Rita Mountains and nearby Empire, Rincon, and Whetstone Mountains. At this

[13] Depending on which transmission line alternative is selected.

point in the project analysis, it is unclear how indirect impacts related to this alternative would impact McCleary Canyon as a movement corridor for local fauna.

Special Status Species

Plants

Arizona giant sedge — The Scholefield-McCleary Alternative would place dry-stack tailings and/or waste rock within Scholefield Canyon, which would result in direct impacts to a population of Arizona giant sedge, the only known population within the footprint of the proposed mine. Individuals growing in Scholefield Canyon in the proposed footprint of the dry-stack tailings and/or waste rock would be completely lost (i.e., covered). Although uncommon, the species is found in other mountain ranges in southern Arizona. Impacts would be localized to the Rosemont vicinity and would not affect other populations across the forest. Based on this, the biological evaluation for this project determined that the Scholefield-McCleary Alternative will directly impact the population of this species in Scholefield Canyon but is not likely to result in a downward trend toward Federal listing as threatened or endangered or in a loss of population viability.

Coleman's coral-root — The Scholefield-McCleary Alternative would place waste rock in upper McCleary Canyon upstream of the known McCleary Canyon population of Coleman's coral-root and, therefore, would not directly impact the population of Coleman's coral-root within McCleary Canyon. At this point in the project analysis, it is unclear how indirect impacts related to this alternative would impact the McCleary Canyon population, but it is expected that indirect impacts would occur as a result of the groundwater drawdown, runoff of chemicals into McCleary Canyon, the effects of dust on individual plants, and/or any potential impacts on host oak trees within McCleary Canyon.

Other special status plant species — See the "Impacts Common to All Action Alternatives" part of this section.

Animals

The proposed action would impact suitable habitat for special status animal species, including the following: direct impacts to approximately 7,363 to 7,444 acres of vegetation; direct impacts to 19 and indirect impacts to 48 springs and seeps; direct impacts to 8 stock tanks; and direct impacts to 17 and indirect impacts to up to 22 mine adits and shafts in the analysis area.

Chiricahua leopard frog — The Barrel Alternative would result in direct impacts to an additional nonbreeding dispersal site for this species because in 2008 one Chiricahua leopard frog was observed at this site, which occurs within the footprint of the proposed mine (WestLand Resources Inc. 2009b).

Other special status animal species — See the "Impacts Common to All Action Alternatives" part of this section.

Migratory Birds

See the "Impacts Common to All Action Alternatives" part of this section.

Coronado National Forest Management Indicator Species

See the "Impacts Common to All Action Alternatives" part of this section.

Pima County Priority Vulnerable Species

See the "Impacts Common to All Action Alternatives" part of this section.

Other Plants and Animals

See the "Impacts Common to All Action Alternatives" part of this section.

Cumulative Effects

The Council on Environmental Quality defines a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 Code of Federal Regulations 1508.7). As outlined in the chapter 3 introduction, cumulative impacts of past and present actions are identified and analyzed in the "Affected Environment" part of each resource section, including for "Biological Resources." This cumulative effects discussion addresses the cumulative impacts of the action alternatives and any applicable reasonably foreseeable actions as identified on the Coronado ID team's list of reasonably foreseeable future actions, provided in the chapter 3 introduction. The following reasonably foreseeable actions from that list were determined to contribute to a cumulative impact to biological resources:

- Beaver reintroductions at Cienega Creek by the Arizona Game and Fish Department and the Bureau of Land Management
- Closure of approximately 35 abandoned mines in the Santa Rita Mountains
- Continued maintenance of Forest Service and private roads in support of permitted Rosemont grazing operations
- Pavement preservation activities on State Route 83 between Sonoita and milepost 43 by the Arizona Department of Transportation

The planned beaver reintroductions in Cienega Creek would occur within the analysis area and would change the hydrology of the creek. Reestablishing beavers into Cienega Creek would benefit the riparian area by decreasing bank erosion and downcutting of the stream channel and producing more stable stream flows beneficial to invertebrates, fish, and other wildlife. Groundwater drawdown from the mine is expected to be negligible until at least 150 years after mine closure; however, the presence of beavers in the creek was not included in the model. The planned closure of approximately 35 small and abandoned mines in the Santa Rita Mountains, when combined with the expected effects from the action alternatives, would likely further contribute to the possibility that currently occupied bat roost sites in the analysis area may become abandoned or reduced in number and distribution. The exact disposition of the bats using these abandoned mines is difficult to predict, especially without knowledge of the methods of closure. Continued road maintenance, grazing activities, and recreation in the analysis area, current and future development, other nearby mining projects, and other various activities in the surrounding area, combined with the expected effects from the proposed project (no matter which action alternative is selected), would cumulatively contribute to impacts such as loss or fragmentation of habitat (including riparian) and noise, air, and light pollution.

Mitigation Effectiveness

The following elements were designed to avoid or reduce impacts on native biological plant communities, wildlife habitat, and wildlife species from the mine and related actions:

- Rosemont Copper will revegetate disturbed areas with native vegetation, excluding the pit area. This includes linear features such as utilities and pipe lines, which will be reclaimed to avoid fragmentation of native biological communities. Specifications will be included in the Rosemont Reclamation Plan.
- Process water ponds, such as raffinate ponds, pregnant leach solution collection ponds, or chemical or fuel storage areas, will be enclosed, covered, or otherwise managed to protect wildlife, livestock, and public safety. Location and construction criteria for project facilities will prevent deleterious exposure of livestock, wildlife, or birds to toxic chemicals or hazardous conditions created by, used in, or resulting from processing operations. Further details are contained in the preliminary MPO.
- In order to protect wildlife breeding habitat, Rosemont Copper will fence selected exclusion areas of the highest-value riparian habitat to restrict livestock access from critical breeding areas for sensitive wildlife species within the Rosemont Ranch land system. The Rosemont, Thurber, DeBaud, and Greaterville grazing allotment permits will be modified to reflect fence locations and livestock exclusion periods.
- Rosemont Copper will monitor disturbed and revegetated areas associated with mine activities for noxious and invasive weeds and will take action to prevent, eliminate, or control weeds should they occur. Methods of control may include removal by hand, spray, mechanical, or other approved methods. An invasive species control plan will be developed that will contain specific measures to prevent, control, and reduce noxious weed introduction and control weeds throughout the project area and that will acknowledge that noxious and invasive weed prevention is preferable to remedial action.
- Upon indication or discovery of a cave, sinkhole, underground drainage into a solution cavern, or similar karst features, Rosemont Copper will suspend work at that site and contact the designated Forest Service contact to investigate the discovery before work is reinitiated. The designated Forest Service contact will promptly coordinate the investigation with the appropriate agency resource specialists. Any natural void in rock that is large enough for a human to enter constitutes a cave. Any collapse feature in or over carbonate rock constitutes a sinkhole.
- In order to reduce or avoid impacts to habitats specific to rocky slopes on the east side of the Santa Rita Mountains, including talus slopes, the west side pit operations power loop will be located within the disturbance perimeter of the ultimate pit.

While the revegetation of native species and control of noxious weeds as proposed will mitigate some of the adverse effects expected to occur as a result of this project, it is not expected to mitigate these impacts completely. Some noxious weeds are still expected to infest the site, as typically occurs with revegetation and reclamation projects, and revegetation is not expected to completely replicate nature's efforts.

The protection of wildlife from the use of potentially deadly toxic ponds and solutions is expected to decrease the overall mortality of individual animals, especially birds and bats. The protection of prime riparian habitat from livestock use is expected to decrease the further degradation of onsite riparian areas.

Keeping the west side pit operations power loop within the perimeter of the pit should mitigate potential impacts to the Rosemont and Sonoran talussnails. The no action alternative will not impact any special status species analyzed for this project. For almost every special status species, with the

exception of only a few (e.g., Coleman's coral-root), the impacts are expected to be the same, no matter which alternative is selected.

Irretrievable and Irreversible Commitment of Biological Resources

This part of the section describes the irreversible and irretrievable commitments of biological resources associated with implementation of the proposed action or any of the other action alternatives. The direct loss of productivity of thousands of acres of Madrean evergreen woodland, semidesert grassland, and riparian vegetation would result in both irreversible and irretrievable commitments of the resources that these areas provide for wildlife (i.e., wildlife breeding, foraging, wintering, and roosting habitat; animal movement corridors; etc.) and the vegetation communities themselves. The mine pit would be considered an irreversible commitment of vegetation and topographic resources, as the pit would remain in perpetuity after the project is complete. Thus, 955 acres is considered lost to future use by wildlife, and this would also represent 955 acres of lost Madrean evergreen woodland.

Proper implementation of the reclamation plan and mitigation recommendations would ensure that most of the rest of the analysis area would be considered an irretrievable commitment of vegetation and topographic resources, as these areas would be replanted, rehabilitated, etc., anywhere from immediately after to 20 or more years after project inception. However, it is possible that some of these areas will include an irreversible commitment of an unknown number of acres of native vegetation communities. For example, some of these areas may be converted from their current native vegetation state (Madrean evergreen woodland, semidesert grassland, etc.) and may not be expected to return to the previous condition during the temporal bounds of analysis, thus being lost for this period for certain plant and animal species.

Additionally, there would be an overall reduced presence of wildlife in the project area as a result of lost habitat as described above and the effects of noise, light (particularly nighttime lighting), and other human activity during the life of the project. Most of this would be considered an irretrievable commitment of resources, as it is expected that many species will use the area again after the project is completed and activity has ceased. However, it is certainly possible that some species may never return to the area for a variety of reasons (change in topography resulting from waste rock piles, tailings piles, and the pit; groundwater drawdown of springs, seeps, or tanks; introduction of nonnative vegetation; etc.), and this would then constitute an irreversible commitment of resources for wildlife.

The impacts to riparian areas, springs, and seeps from groundwater drawdown and surface diversion would likely result in an irreversible commitment of resources. These springs, seeps, and riparian areas would continue to be impacted long after the project is completed and, thus, would not provide the same support to biological resources that they currently do.

Landownership and Boundary Management

Introduction

Landownership within the analysis area consists of private lands owned by Rosemont Copper and other private landowners, State lands managed by the Arizona State Land Department and the University of Arizona, and lands managed by the Forest Service and the Bureau of Land Management. The temporal bounds of analysis for landownership includes all four phases of the proposed action: construction, operation, closure, and postclosure.

Figures 57 through 61 show the analysis areas for the five action alternatives: the proposed action (see figure 57), Phased Tailings (see figure 58), Barrel (see figure 59), Barrel Trail (see figure 60), and Scholefield-McCleary (see figure 61). The analysis areas consist of the perimeter fences, primary and secondary access road corridors, and the utility corridor alternatives within which surface-disturbing activities could damage, destroy, or obliterate corner monuments or landownership boundaries.

Issues, Cause and Effect Relationships of Concern

During the scoping period, no public comments or significant issues concerning landownership or boundary management were identified. However, the protection of survey monuments and landownership boundaries is an important concern for the Forest Service, and all action alternatives would damage, destroy, or obliterate corner monuments and landownership boundaries. Even though impacts to landownership and boundary management were not identified as significant issues during the public scoping process, the following section addresses the alternatives' impacts to these resources in order to provide a full impact analysis as well as to provide background information that is used in the analysis of impacts to other resources. The issues that are analyzed in this section include the following:

- Acreage of private, National Forest System, Bureau of Land Management, and Arizona State Land Department State Trust land impacted
- Effects on mineral survey fractions
- Effects on boundary management

Analysis Methodology, Assumptions, Uncertain and Unknown Information

The analysis methodology for determining the impacts to corner monuments and landownership boundaries involves comparing the footprint of the action alternatives to the existing ownership boundaries, rectangular network (sections, townships, and range lines), and patented mining claim lines. It is assumed that corner monuments and landownership boundary lines within the overall mining operation and facilities footprint will be obliterated; however, mitigation under all action alternatives includes a complete resurvey and control network. Table 102 summarizes the impact of the mining alternatives on landownership within the analysis area. Table 103 summarizes the impact of the utility corridor alternatives on landownership within the analysis area.

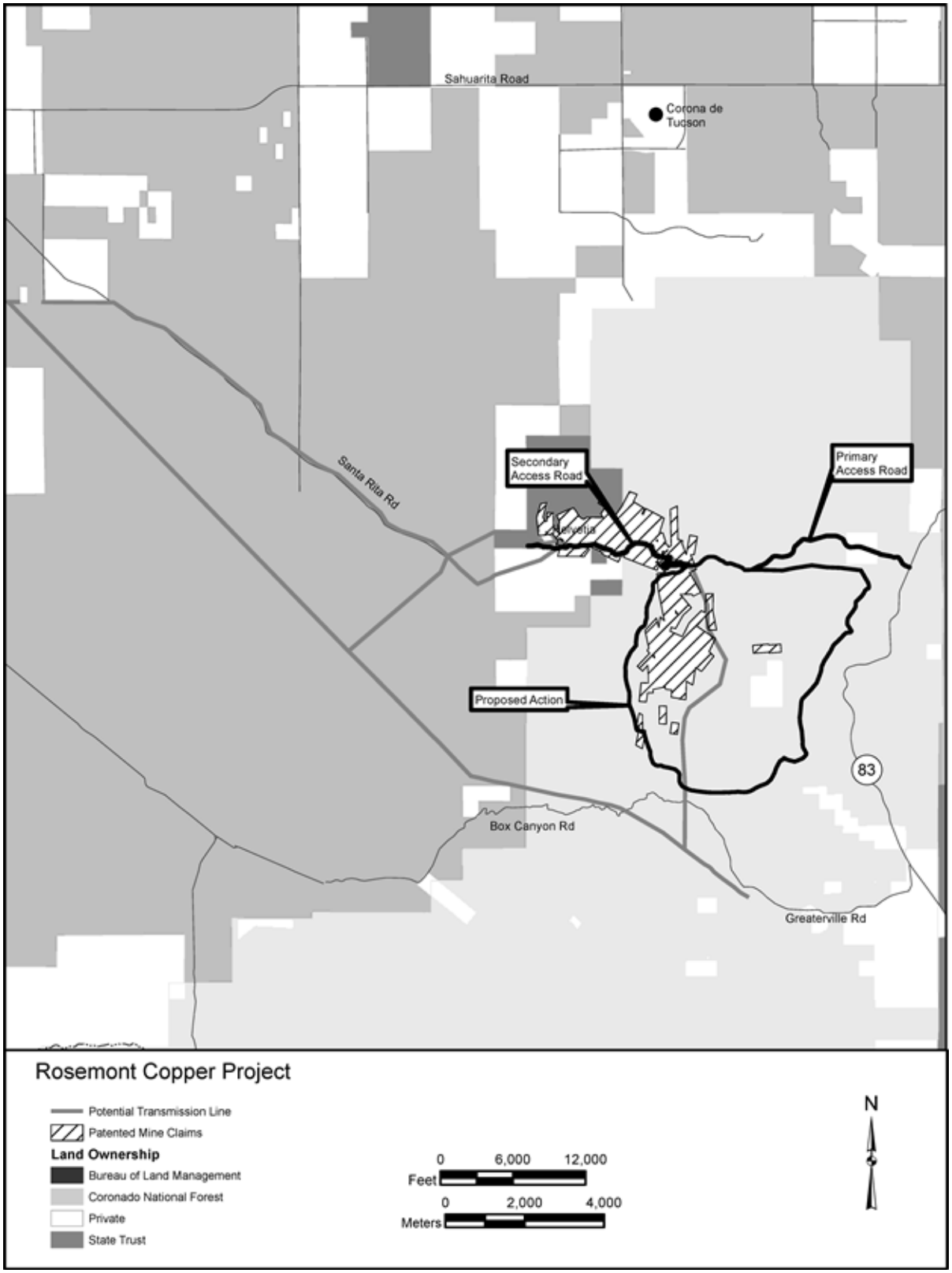


Figure 57. Analysis area for proposed action

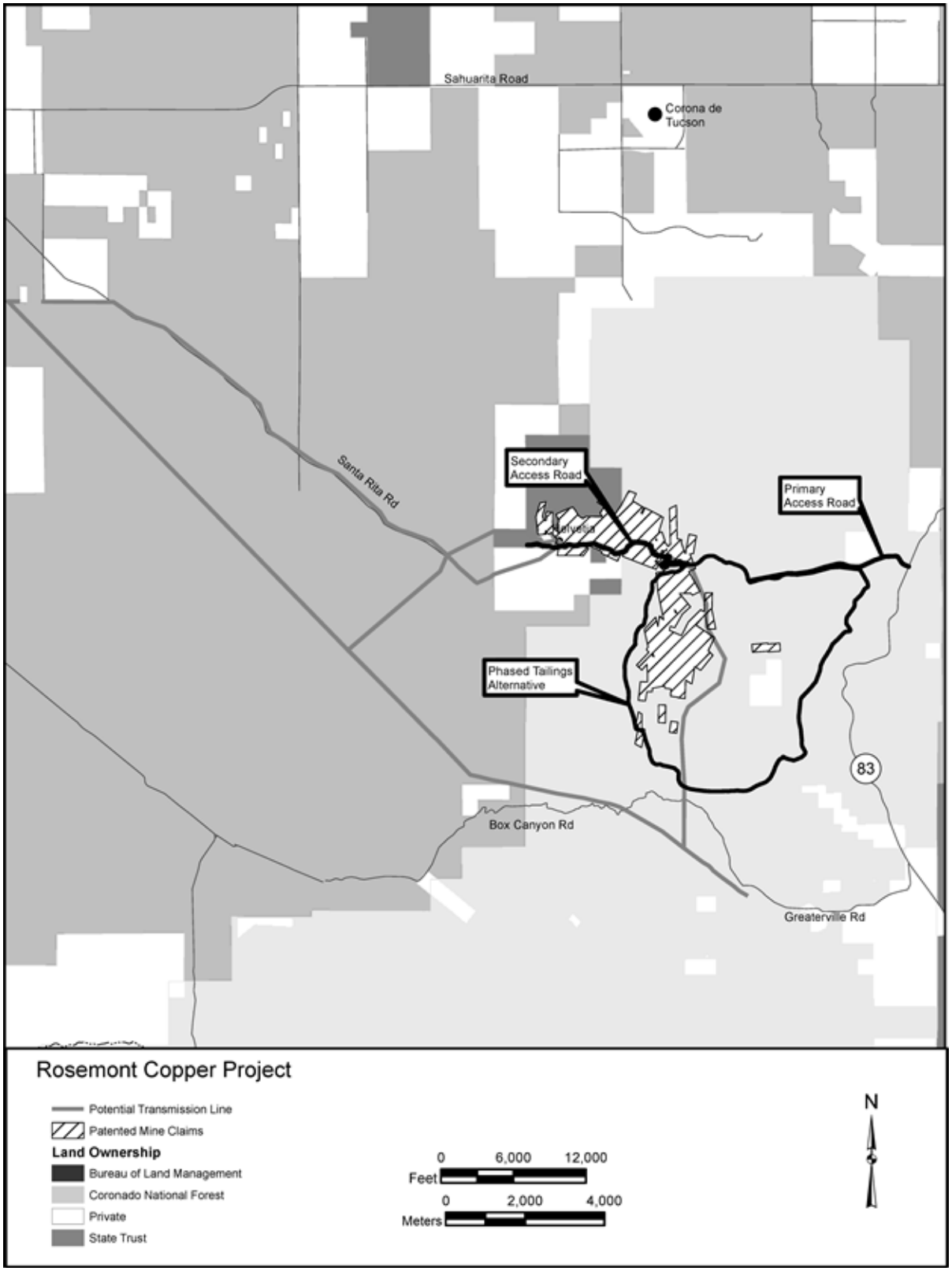


Figure 58. Analysis area for Phased Tailings Alternative

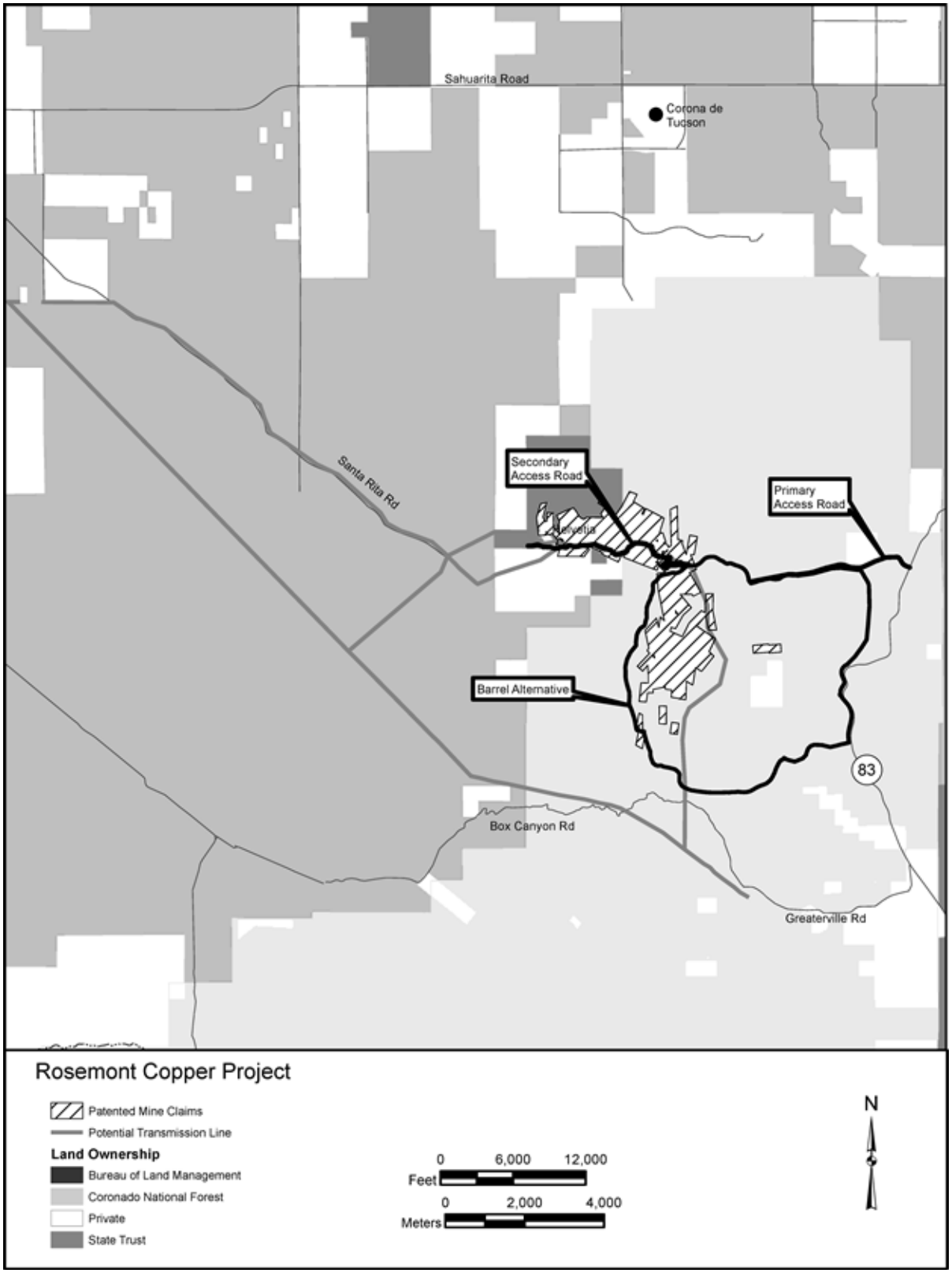


Figure 59. Analysis area for Barrel Alternative

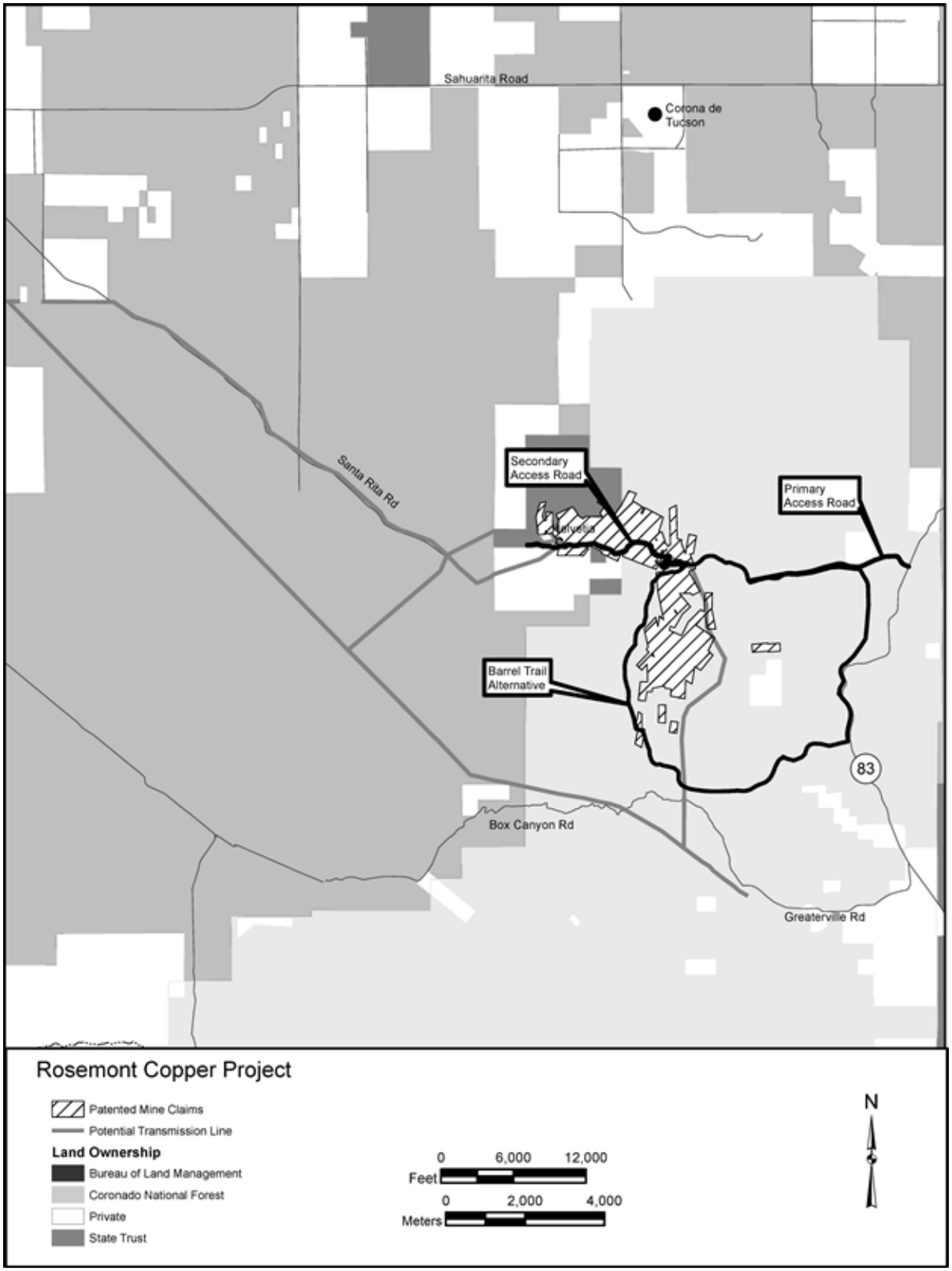


Figure 60. Analysis area for Barrel Trail Alternative

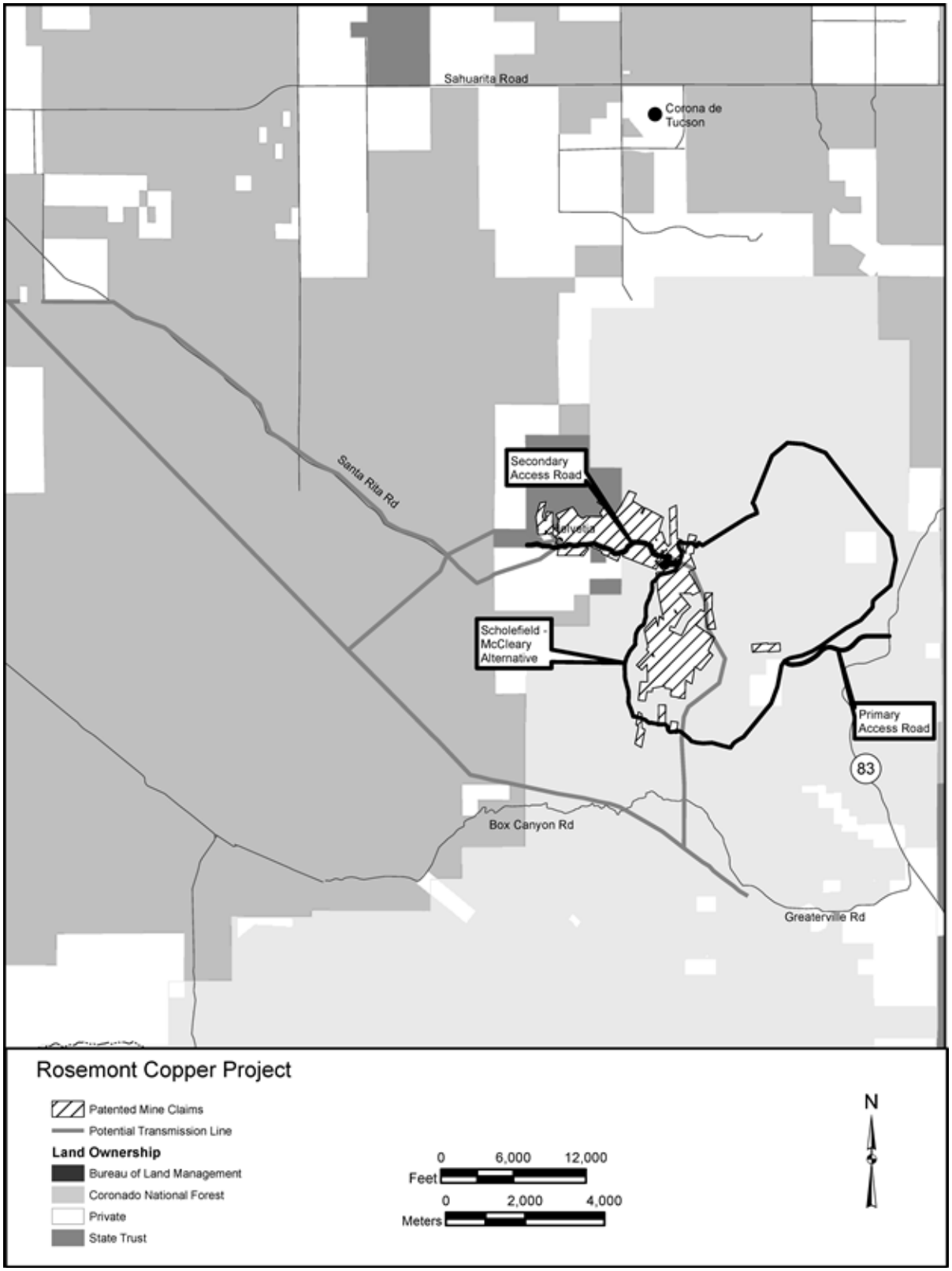


Figure 61. Analysis area for Scholefield-McCleary Alternative

Summary of Effects by Issue Measures by Alternative

Table 102. Summary of effects (mining alternatives)

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
Other Effects Considered						
Total acres	0	6,226	6,122	6,859	6,859	7,208
Private land (acres)	0	1,215	1,212	1,212	1,212	1,369
National Forest System land (acres)	0	5,008	4,906	5,644	5,644	5,837
Bureau of Land Management land (acres)	0	3	3	3	3	3
Arizona State Land Department land (acres)	0	0	0	0	0	0
Effect on mineral survey fractions	None	Sale of currently Federally owned mineral survey fractions to Rosemont Copper as permitted by the Small Tracts Act negates need for future management	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
Effect on boundary management	None	Proposed activities include Bureau of Land Management administered resurvey and control network, resulting in no impacts to boundary management	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action

Table 103. Summary of effects (utility corridor alternatives)

Issue Measure	No Action	TEP Preferred Alternative	TEP Alternative 1	TEP Alternative 2	TEP Alternative 3	TEP Alternative 4
Other Effects Considered						
Total acres	0	157	155	183	181	236
Private land (acres)	0	55	44	44	32	3
National Forest System land (acres)	0	7	7	7	7	95
Bureau of Land Management land (acres)	0	0	11	0	11	0
Arizona State Land Department land (acres)	0	95	93	132	131	138
Effect on boundary management	None	Proposed activities include Bureau of Land Management administered resurvey and control network, resulting in no impacts to boundary management	Same as preferred TEP preferred alternative	Same as preferred TEP preferred alternative	Same as preferred TEP preferred alternative	Same as preferred TEP preferred alternative

Affected Environment

Relevant Laws, Regulations, Policies, and Plans

Major legislation, mandates, and guidance directing the administration of land use on public lands include the following:

- 1986 "Coronado National Forest Land and Resource Management Plan," as amended (U.S. Forest Service 1986)
- General Mining Law of 1872
- Title 18 United States Code 1858 (62 Statute 789)
- Forest Service Manual 5571 (U.S. Forest Service 2003b)
- Forest Service Manual 7152 (U.S. Forest Service 2000)
- Small Tracts Act of January 12, 1983 (Public Law 97-465)
- Bureau of Land Management Manual and Handbook 1790-1 and Departmental Guidance (516 DM 1-4) (Bureau of Land Management 2008b, 2009)
- Arizona Revised Statutes 33-103(d) and (e)

Existing Conditions

Landownership

Private Lands

Private land in the vicinity of these analysis areas include private property, fee lands, and patented mine claims. Rosemont Copper owns 132 patented lode mining and mill site claims totaling approximately 1,969 acres. Rosemont Copper also owns approximately 742 acres in fee lands (e.g., Rosemont Ranch) in the vicinity of the 132 patented claims within the Rosemont and Helvetia mining districts.

National Forest System, Public, and State Trust Lands

National Forest System Lands

The analysis areas include National Forest System land in the Nogales Ranger District's Santa Rita Ecosystem Management Area.

Public Land

The analysis areas include public land managed by the Bureau of Land Management Tucson Field Office.

Arizona State Trust Land

State land managed by the Arizona State Land Department and the University of Arizona are located within the analysis areas.

Mineral Survey Fractions

Mineral survey fractions are small parcels of National Forest System lands interspersed within or adjacent to lands transferred out of Federal ownership under the mining laws (36 Code of Federal Regulations 254.31, "Definitions"). Mineral survey fractions are difficult to efficiently manage because of their size and location. The Coronado's specialist report titled "Rosemont Mine Boundary Management Mitigation" (McKay 2010) states, "The current fragmented and irregularly-shaped

landownership configuration in the proposed Rosemont Copper project area is based on numerous patented lode mining and mill-site claims as well as lands patented under the Homestead Act of 1862 (rectangular system).” Seven known mineral survey fractions with a total of approximately 5.5 acres are completely surrounded by the patented mining claims owned by Rosemont Copper. Additional mineral survey fractions may be identified as a part of a Bureau of Land Management dependent resurvey. Figure 62 shows the location of the seven mineral survey fractions known to exist within the patented mining claims.

Boundary Management

Approximately 202 mineral survey corner monuments (150 wood posts, 13 stones, and 33 iron pipes) control approximately 19.5 miles of property boundary between National Forest System lands and private land owned by Rosemont Copper within or very near the footprint of the proposed action (pit, roads, plant site, truck shop, waste rock pile, dry-stack tailings**,** pollution management area, and security fencing) on the Coronado National Forest. The mineral survey corner monuments were originally set between 1881 and 1978.

In addition, there are approximately 81 section and quarter-section corner monuments (Rectangular System of Surveys) within or very near the footprint of the proposed action that either control approximately 7.5 miles of property boundaries between National Forest System and private land patented under the Homestead Act or that may be needed for future administrative or management purposes. The section and quarter-section corner monuments were originally set between 1874 and 1926. There are also 29 intersection points where patented mineral surveys overlap areas controlled by mineral survey corner monuments and nine intermediate corner monuments controlled by section and quarter-section corner monuments. These will need to be located and corner monuments set to identify the property boundary between National Forest System lands and the private land. Many of these corners are currently in some stage of deterioration or are completely lost and difficult to identify and recover (especially wood post and stone monuments).

Preservation of these corner monuments in their original location is important for both the protection of private property rights and the sound management of the National Forest System lands (now and in the future) in the area. In addition, it is a Federal penalty for the unauthorized alteration or removal of any government survey monument or marked tree (18 United States Code 1858 (62 Statute 789)).

Environmental Consequences

Direct and Indirect Effects of Each Alternative

No Action Alternative

Landownership and boundary management would not incur direct or indirect effects under the no action alternative. Private land in the form of patented mining claims and fee lands would remain, and management responsibilities of the Coronado, Bureau of Land Management, and Arizona State Land Department would continue for National Forest System lands, public lands, and state lands, respectively. The Bureau of Land Management dependent resurvey would not be conducted, and mineral survey fractions would continue to exist between the patented mining claims.

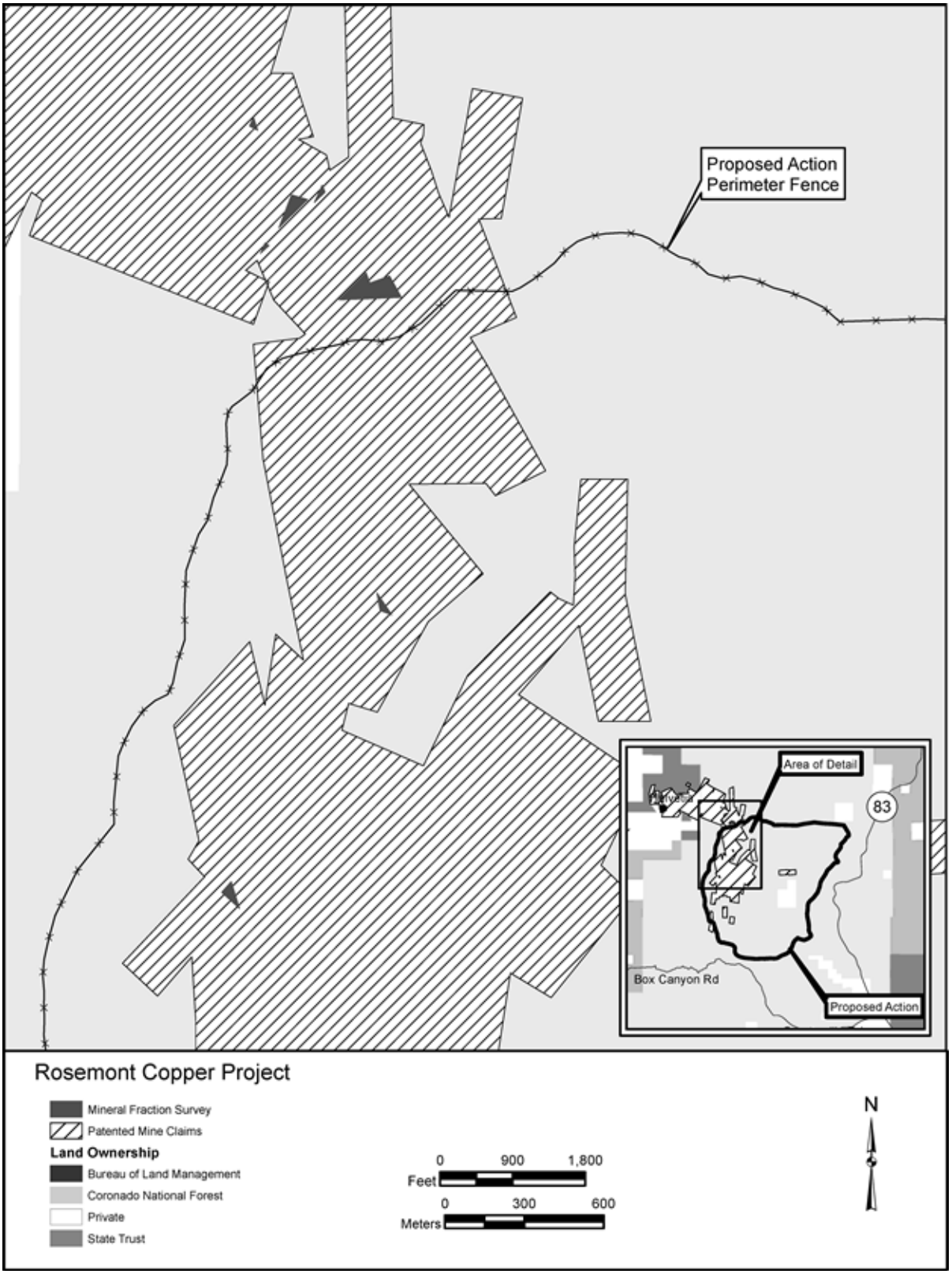


Figure 62. Mineral survey fractions

Impacts Common to All Action Alternatives

Although the acreages of impacted lands vary according to the footprint of each action alternative and the transmission line alternatives, the differences in impacted acres and obliterated corner and survey monuments are not enough to warrant separate landownership and boundary management impact analysis for each alternative. Therefore, impacts to landownership and boundary management are assessed as impacts common to all action alternatives.

The direct effects of the action alternatives to landownership and boundary management are the destruction of the corner monuments that are used to delineate property boundaries. The action alternatives would also incorporate the mineral survey fractions into the operations facilities and render the Coronado's postclosure management responsibilities of these parcels difficult, if not impossible.

Because the spatial disposition of corner monuments is such that they are referentially dependent on one another, the loss of even a single monument affects the positions of other corner monuments and the boundary management system as a whole. Therefore, the indirect effect of the action alternatives would be the loss of ability to effectively determine boundaries between public and private lands. In turn, protection of private property rights and the sound management of National Forest System lands would be compromised.

All action alternatives include the design element of a Bureau of Land Management dependent resurvey and control network in order to preserve the landownership boundaries. Furthermore, each action alternative would include the sale of mineral survey fractions by the Coronado to Rosemont Copper through the Small Tracts Act. The transfer of ownership of the mineral survey fractions to Rosemont Copper would relieve the Coronado of the agency's management responsibilities for the parcels after they become incorporated into the mining facilities.

Land Ownership

Private Lands

Between 1,212 and 1,369 acres of private land within the analysis area would be directly impacted by the proposed action and all action alternatives. These private lands consist of Rosemont Copper owned patented mining claims and fee lands.

Utility corridor alternatives would directly impact between 3 and 55 acres of private land.

National Forest Service Lands

The proposed action and all action alternatives would directly impact between 4,906 and 5,837 acres of National Forest System lands managed by the Coronado. Impacts to these acres would consist of portions of the mining pit, construction of waste rock and tailings piles, heap leach facility, operations facilities, and access and facilities roads. Utility corridor alternatives would directly impact between 7 and 95 acres of National Forest System lands.

Public Lands

All action alternatives would impact approximately 3 acres of public lands managed by the Bureau of Land Management on the west side of the Santa Rita Mountains. Impacts to these 3 acres would consist of the construction of the secondary access road over the Santa Rita Mountains.

TEP Alternative 1 and TEP Alternative 3 would directly impact approximately 11 acres. Impacts to these acres would consist of the construction of the electrical transmission line; water pipeline, including a booster pump station; and an access road, all of which would serve the mine.

State Trust Lands

Between 93 and 138 acres of State Trust lands managed by the Arizona State Land Department would be directly impacted by the utility corridor alternatives. Impacts to these acres would consist of the construction of the electrical transmission line; water pipeline, including booster pump stations; and an access road, all of which would serve the mine.

Mineral Survey Fractions

Seven known mineral survey fractions of approximately 5.5 acres of Coronado National Forest lands would be impacted by the action alternatives. These mineral survey fractions would be incorporated into the operations facilities, such as the tailings and waste rock piles and the pit, during the construction and operation phases. Unless the Coronado uses the Small Tracts Act of 1983 to transfer these parcels out of Federal ownership to private land owned by Rosemont Copper, the Coronado would resume management responsibilities for these parcels during the postclosure phase. Because these parcels would be covered by tailings and waste rock or located within the pit, the Coronado's ability to effectively manage these parcels would be negatively impacted.

The Small Tracts Act sets forth procedures to mitigate future management problems associated with irregularly shaped mineral survey fractions that will more or less become an integral part of the adjoining private land. The Forest Service has the discretionary authority under the Small Tracts Act to dispose of Forest Service lands to resolve management problems associated with mineral survey fractions through sale, exchange, or interchange to the adjoining private landowner. Conveyance of the Forest Service mineral survey fractions via the Small Tracts Act would improve future management efficiency and reduce management costs by eliminating the need to maintain, establish, or reestablish 32 corner monuments and approximately 0.85 mile of property boundary between Forest Service and private lands (McKay 2010).

Boundary Management

Because the spatial disposition of corner monuments is such that they are referentially dependent on one another, the loss of even a single monument affects the positions of other corner monuments and the boundary management system as a whole. Therefore, the indirect effect of the action alternatives would be the loss of the ability to effectively determine boundaries between public and private lands. In turn, protection of private property rights and the sound management of National Forest System lands would be compromised.

Approximately 202 mineral survey corner monuments that control approximately 19.5 miles of property boundary between National Forest System lands and private land owned by Rosemont Copper are within or very near the footprints of the action alternatives.

Approximately 81 section and quarter-section corner monuments are within or very near the footprint of the action alternatives. These corner monuments control approximately 7.5 miles of property boundaries between National Forest System lands and private land patented under the Homestead Act of 1862 and are needed for future administrative or management purposes.

Bureau of Land Management Administered Dependent Resurvey and Control Network.

A Bureau of Land Management administered dependent resurvey that extends beyond the project area of the chosen alternative would be required prior to any ground-disturbing activities. According to the Bureau of Land Management's glossary of surveying and mapping terms,

> The Bureau of Land Management dependent resurvey is a retracement and reestablishment of the lines of the original survey in their true original positions according to the best available evidence of the positions of the original corners. The dependent resurvey includes the restoration of lost corners in accordance with procedures described in the Manual of Surveying Instructions.

The intent of the Bureau of Land Management administered dependent resurvey would be to inventory all corner monuments, including lost corner monuments, that would be impacted by the chosen alternative.

A control network of monuments referenced to the property corner monuments would be set outside the disturbance area during the Bureau of Land Management administered dependent resurvey. The purpose of the control network would be to perpetuate the corner monuments and property lines that would be impacted by the chosen alternative by providing position data for locating the destroyed corner monuments in the reclamation phase. By setting the control network outside the disturbance area prior to ground-disturbing activities, the "control network will ensure the easy recovery of any corner position or property line of the dependent resurvey at any time in the future ant mitigate the difficulty and future expense to reestablish lost corner positions and property lines during reclamation" (McKay 2010).

Cumulative Effects

The Council on Environmental Quality defines a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 Code of Federal Regulations 1508.7). As outlined in the chapter 3 introduction, cumulative impacts of past and present actions are identified and analyzed in the "Affected Environment" part of each resource section, including for "Landownership and Boundary Management." This cumulative effects discussion addresses the cumulative impacts of the action alternatives and any applicable reasonably foreseeable actions as identified on the Coronado ID team's list of reasonably foreseeable future actions, provided in the chapter 3 introduction. The list was reviewed, and no reasonably foreseeable future actions are expected to have a cumulative effect on landownership and boundary management.

Mitigation Effectiveness and Remaining Effects

Landownership

The sale of the seven currently known mineral survey fractions (approximately 5.5 acres total), plus any additional survey fractions identified by a dependent resurvey, by the Coronado to Rosemont Copper would mitigate the impacts to landownership and meet National Environmental Policy Act requirements for the sale of said fractions. By selling the currently Federally owned mineral survey fractions to Rosemont Copper as permitted by the Small Tracts Act, the Coronado would avoid the impact of increased difficulty in managing these parcels after they become integrated in the mining facilities. No remaining effects on landownership would be anticipated under the action alternatives.

Boundary Management

No mitigation measures are proposed to avoid or reduce impacts to boundary management because all action alternatives include a Bureau of Land Management administered dependent resurvey and control network to avoid impacting boundary management. No remaining effects on boundary management would be anticipated from the action alternatives.

Irretrievable and Irreversible Commitment of Resources

The action alternatives' impacts to landownership and boundary management would not constitute an irretrievable and irreversible commitment of resources.

Livestock Grazing

Introduction

A large portion of the project area is classified by the Forest Service as being capable of supporting livestock grazing, and the majority of the land is currently under grazing permits held by Rosemont Copper. The project area is located within portions of the Rosemont, DeBaud, Thurber, Greaterville, Helvetia, and Stone Springs grazing allotments on the Nogales Ranger District (figure 63).

Issues, Cause and Effect Relationships of Concern

Although effects on livestock grazing were not identified as a significant issue through the scoping process, all action alternatives will cause impacts to the grazing allotments within the project area by removing lands suitable for livestock grazing, impacting water sources, and altering grazing patterns. The following section addresses the alternatives' impacts to livestock grazing in order to provide a full impact analysis as well as to provide the background information that is used in the analysis of impacts to other resources. Other issues not identified during public and agency scoping that are analyzed in this section include the following:

- Change in classification of capability of each grazing allotment from fully capable to potentially capable or not capable (acres)
- Potential stock tanks lost
- Potential seeps and springs lost
- Reduction in animal unit months

Analysis Methodology, Assumptions, Uncertain and Unknown Information

The temporal bounds of analysis includes construction, operation, closure, and postclosure. Grazing will still take place where not in conflict with mine activities during all of these phases, but it will be reduced. Postclosure, grazing will continue to be limited to allow reclamation to proceed. The analysis area for livestock grazing represents the total fenced areas of the various alternatives, as shown in figure 63, which are the areas for which grazing will be restricted. Utility corridors were not included in the analysis area. Utilities on public land do not preclude the use of lands for livestock grazing and would not result in any change in grazing management; therefore, impacts on livestock grazing from utility corridors were considered negligible.

Grazing will continue on all allotments during all mine phases, although some grazing allotments will be reduced in capacity. The analysis methodology for determining the existing conditions of grazing

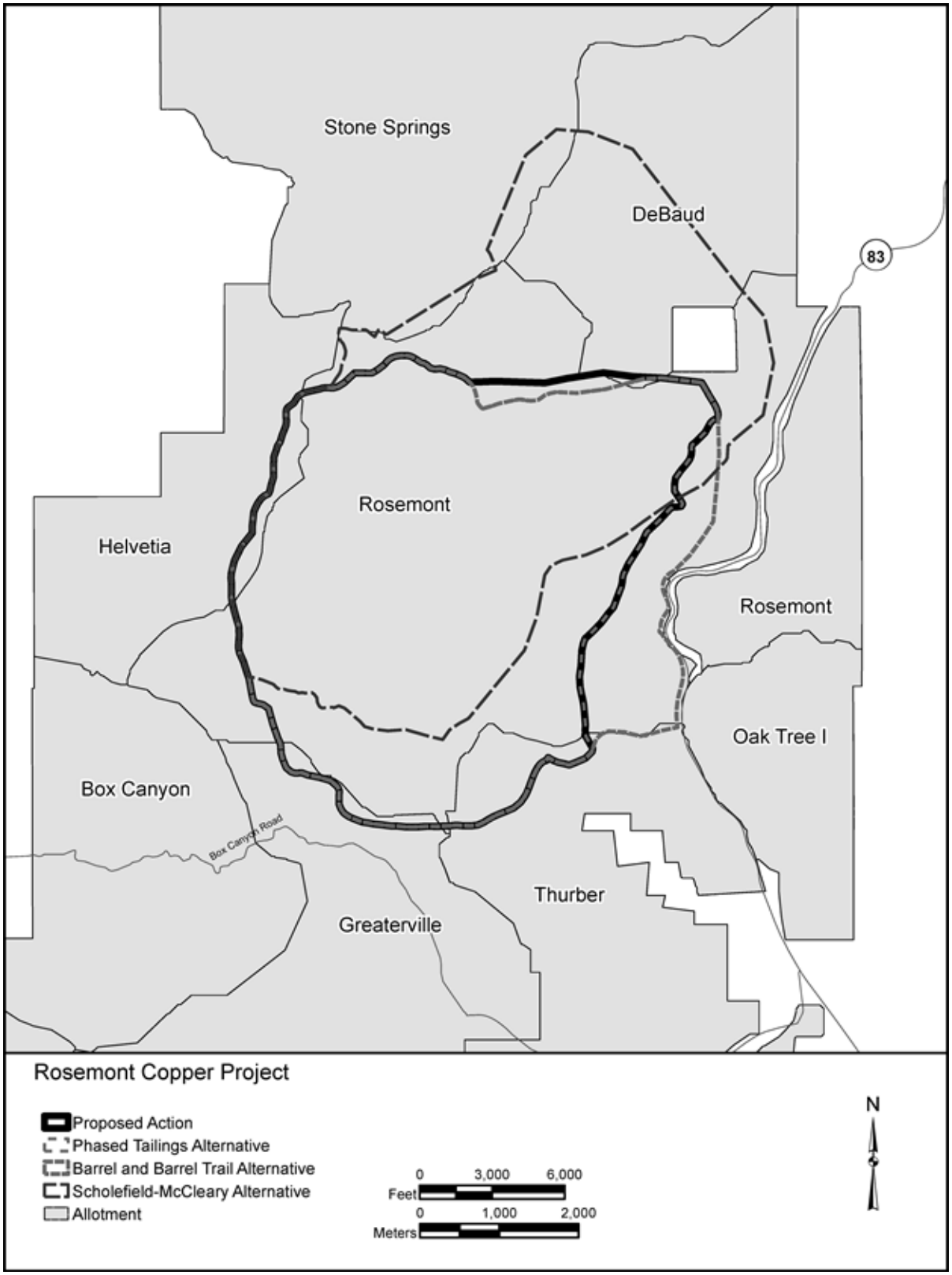


Figure 63. Grazing allotments impacted by action alternatives

allotments and impacts to grazing allotments includes obtaining geospatial data for the existing allotments from the Forest Service and overlaying the data with the total fenced areas of the action alternatives. Acreages of impacted grazing allotments are calculated where the total fenced areas overlap the locations of the grazing allotments. It is assumed that grazing would be reintroduced in the postclosure phase to areas suitable for grazing. It is not known when revegetation will be established enough to reinstate grazing, but assessment of the acreage of suitable grazing habitat returned to productivity during reclamation is estimated based on ongoing research conducted by the University of Arizona and funded by Rosemont Copper.

Forest lands are classified for relative capability of supporting grazing activities and are classified as either being fully capable, potentially capable, or not capable. Areas disturbed from existing conditions temporarily but eventually returned to grazing are considered potentially capable. Areas permanently removed from grazing are considered not capable.

Adequate information was found to analyze livestock grazing impacts. No uncertain or unknown information was identified.

Summary of Effects by Issue Measures by Alternative

Table 104 presents the summary comparison of impacts from each alternative.

Table 104. Approximate acres of impact, potential reduction in animal unit months, and springs directly and indirectly lost for each alternative

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
Other Effects Considered						
Issues Analyzed: Impact to Allotments						
Change from Fully to Partially Capable within Rosemont Allotment (acres)	0	4,684	4,590	5,316	5,316	4,445
Change from Fully to Partially Capable within Thurber Allotment (acres)	0	280	280	290	290	0
Change from Fully to Partially Capable within Greaterville Allotment (acres)	0	88	88	88	88	0
Change from Fully to Partially Capable within DeBaud Allotment (acres)	0	18	8	8	8	1,235
Change from Fully to Partially Capable within to Helvetia Allotment (acres)	0	155	155	155	155	155
Change from Fully to Partially Capable within Stone Springs Allotment (acres)	0	0	0	0	0	219
Change from Fully to Not Capable within Rosemont Allotment (acres)	0	950	950	950	950	950
Stock Ponds Lost	0	15	15	19	19	8
Springs Lost	0	63	63	63	63	67
Potential Reduction in Animal Unit Months Each Year over 25-Year Mine Life	0	1,146	1,129	1,075	1,075	1,409

Affected Environment

Relevant Laws, Regulations, Policies, and Plans

Major legislation, guidance, and mandates directing the administration of livestock grazing on public lands are as follows (from Forest Service Manual 2200, "Range Management"):

- Organic Administration Act of June 4, 1897 (Chapter 2, 30 Statute 34, as amended; 16 United States Code 551)
- Bankhead-Jones Farm Tenant Act, Title III, of July 22, 1937, Sections 31–33 (Chapter 517, 50 Statute 525, as amended; 7 United States Code 1010–1012)
- Granger-Thye Act of April 24, 1950, Sections 1, 5, 7, 11, 12, 18, 19 (Chapter 97, 64 Statute 82; 16 United States Code 571c, 572, 580d, 580g, 580h, 580k, 580)
- Multiple-Use Sustained-Yield Act of June 12, 1960 (Public Law 86-517, 74 Statute 215; 16 United States Code 528–531)
- National Environmental Policy Act of January 1, 1970 (Public Law 91-190, 83 Statute 852; 42 United States Code 4321 (note), 4321, 4331–4335, 4341–4347)
- Forest and Rangeland Renewable Resources Planning Act of August 17, 1974 (Public Law 93-378, 88 Statute 476, as amended; 16 United States Code 1601 (note), 1600–1614)
- National Forest Management Act of October 22, 1976 (Public Law 94-588, 90 Statute 2949, as amended; 16 United States Code 472a, 476, 500, 513–516, 518, 521b, 528 (note), 576b, 594-2 (note), 1600 (note), 1601 (note), 1600–1602, 1604, 1606, 1608–1614)
- Federal Land Policy and Management Act of October 21, 1976, Sections 206, 310, 401–404 (Public Law 94-579, 90 Statute 2743, as amended; 43 United States Code 1716, 1740, 1751–1753)
- Public Rangelands Improvement Act of October 25, 1978 (92 Statute 1803; 43 United States Code 1752–1753, 1901–1908)

General Management Direction for Grazing on the Coronado National forest

Objectives of the Range Management Program for the national forests and national grasslands are as follows (from Forest Service Manual 2200, "Range Management" (U.S. Forest Service 2005b:4)):

- To manage range vegetation in order to protect basic soil and water resources, provide for ecological diversity, improve or maintain environmental quality, and meet public needs for interrelated resource uses
- To integrate management of range vegetation with other resource programs to achieve multiple-use objectives contained in forest land and resource management plans
- To provide for livestock forage, wildlife food and habitat, outdoor recreation, and other resource values dependent on range vegetation
- To contribute to the economic and social well-being of people by providing opportunities for economic diversity and by promoting stability for communities that depend on range resources for their livelihood
- To provide expertise on range ecology, botany, and management of grazing animals.

In general, the goal of the Coronado for every allotment is to manage livestock in a manner that allows for the attainment of sustainable multiple-use resource objectives that are compatible with the standards and guidelines in the forest plan and the principles of ecosystem management. In doing so, the Coronado ensures the following: (1) the proper use of water resources; (2) compliance with the

Endangered Species Act; (3) compliance with the National Historic Preservation Act; (4) compliance with the forest plan (U.S. Forest Service 1986); (5) overall satisfactory watershed condition; and (6) sustainable vegetation (or range) conditions.

To accomplish the above objectives, the Coronado will do the following: (1) establish maximum utilization levels annually for each pasture (within each allotment or management unit) based on current management objectives and depending on the season of use; (2) adjust livestock movement patterns based on water and forage availability, typically through the use of salt blocks (placed away from water areas) to help control movement; (3) make necessary range improvements, such as repairing fencing and routine maintenance of existing improvements; and (4) implement a monitoring system. This monitoring system includes the establishment of key areas, monitoring of utilization levels, and inspections to ensure that desired management goals and objectives are met.

Existing Rangeland Management and Conditions

Rosemont Copper holds the grazing permits for the allotments within the proposed project area. Rosemont Copper plans to continue all current grazing activities (table 105) as permitted throughout the course of the project. Currently, Rosemont Copper holds term grazing permits on four allotments: Rosemont, Thurber, Greaterville, and DeBaud. Each year, 325 head of cattle are permitted to graze the Rosemont allotment between March 1 and 31, 325 head between September 1 and October 31, and 150 head between November 1 and February 28 (U.S. Forest Service 2002). For the Greaterville allotment, 325 head of cattle are permitted to graze between April 1 and August 31 each year (U.S. Forest Service 2002); 150 head are permitted to graze the DeBaud allotment between November 1 and February 28 each year (U.S. Forest Service 2002); and 221 head of cattle are permitted to graze the Thurber allotment each year (U.S. Forest Service 2008f). The Helvetia and Stone Springs allotments are impacted only slightly by proposed mine activities; these term grazing permits are held by other parties.

Table 105. Summary of current grazing activities within project area

Season	Permitted Head of Cattle Rosemont Allotment*	Permitted Head of Cattle Thurber Allotment*	Permitted Head of Cattle Greaterville Allotment*	Permitted Head of Cattle DeBaud Allotment*	Permitted Head of Cattle Helvetia Allotment†	Permitted Head of Cattle Stone Springs Allotment‡
January	150	221		150	60	245
February	150	221		150	60	245
March	325	221			60	245
April		221	325		60	
May		221	325		60	
June		221	325		60	
July		221	325		60	
August		221	325		60	
September	325	221			60	
October	325	221			60	245
November	150	221		150	60	245
December	150	221		150	60	245

* Rosemont, Thurber, Greaterville, and DeBaud grazing permits held by Rosemont Copper.
† Helvetia grazing permit held by Santa Rita Ranch.
‡ Stone Springs grazing permit held by ANAM, Inc.

The four allotments permitted to Rosemont Copper contain a mixture of Federal, State, and private lands totaling approximately 22,190 acres, with 19,370 acres of land suitable for livestock grazing. The Rosemont, DeBaud, and Greaterville allotments are permitted for a rotation of use and rest; the Thurber allotment can be used year-round. Rosemont Copper (or parent company) is permitted to graze cattle on all four allotments, and approximately 6,454 animal unit months of grazing are currently authorized each year. An animal unit month refers to the amount of forage necessary to feed 1 animal unit for a period of 1 month. An animal unit is defined as 1 mature cow of approximately 1,000 pounds and a calf up to weaning age, usually 6 months, or their equivalent of other animals.

Rangeland within the project area encompasses two major vegetation types: semidesert grassland and Madrean evergreen woodland (Brown 1994). There are also a few areas that contain riparian woodland vegetation and xeroriparian vegetation. Madrean evergreen woodland covers the higher elevations of the project area, generally in the western and southern areas. This community is characterized by open woodlands or savanna composed of trees interspersed with grasses and forbs. Semidesert grassland, characterized by open grasslands with widely scattered shrubs and cacti, covers the lower elevations of the project area. Vegetation types are described more fully in the “Biological Resources” section.

Current rangeland conditions on the district are partially hampered as a result of recent drought conditions; the conditions also reflect a history of intense grazing pressure that resulted in erosion. The Coronado currently employs a rotational grazing system on all of its allotments in order to allow the development of an adaptive management strategy intended to rest pastures when necessary. A combination of rest and use, or even complete deferral for at least one full growing season, is commonly and regularly employed across the Coronado National Forest on all allotments when necessary to ensure that range conditions do not deteriorate (Brown 2009).

The majority of the capable rangeland in the project area appears to be in satisfactory condition (a Forest Service measure of the health of the vegetation and soil relative to their combined potential to produce a sound and stable biotic community) based on range vegetation transect studies conducted on the Rosemont, Greaterville, and DeBaud allotments in fall 2009 (Biedenbender 2010a, 2010b; Lockwood 2010) and as evidenced by pace, cluster, and line vegetation transects conducted in a variety of locations on the Thurber allotment in November 2006 (U.S. Forest Service 2008f).

Vegetation and soil conditions on the Greaterville, Rosemont, and DeBaud allotments are stable or have improved since monitoring transects were initially established in the 1960s (Biedenbender 2010a, 2010b; Lockwood 2010). In spite of the more than 10-year drought, vegetation on the Greaterville, Rosemont, and DeBaud allotments is currently in fair to excellent condition, and soil condition on all the monitoring sites is satisfactory, the highest category in the Natural Resources Conservation Service Soil Condition Rating Guide (Biedenbender 2010a, 2010b; Lockwood 2010). This indicates that hydrologic function, soil and site stability, and nutrient cycling are intact on these sites (Biedenbender 2010a, 2010b; Lockwood 2010). Rangeland monitoring analysis results are shown in table 106 for the Rosemont, Greaterville, and DeBaud allotments.

The purpose of any monitoring program is to be able to determine whether management actions are being properly implemented and are effective at achieving the desired conditions (U.S. Forest Service 2005b). The Coronado employs a combination of effectiveness and implementation monitoring in an attempt to achieve a successful monitoring program. Effectiveness monitoring is used to track conditions and trends in upland and riparian vegetation, soils, and watersheds and follows the procedures outlined in Cooperative Extension Service (1999) and Forest Service (1996).

Effectiveness monitoring occurs at least once over the 10-year term of the grazing permit, or more frequently if necessary (U.S. Forest Service 2008f). Implementation monitoring includes inspection reports, forage utilization measurements, livestock counts, and facilities inspections (U.S. Forest Service 2008f). Utilization measurements are conducted in accordance with the principles and procedures outlined in Cooperative Extension Service (1999) and Smith et al. (2007). Utilization is monitored for key forage species, i.e., native perennial grasses palatable to livestock. As livestock use patterns change, new key areas may be established and existing key areas may be modified or discontinued.

Table 106. Rangeland conditions from 1965 to 2009

Allotment	1967 to 1969 Vegetation	1967 to 1969 Soils	1995 Vegetation	1995 Soils	2009 Vegetation	2009 Soils
Rosemont	Fair to Good	High Fair to Excellent	Fair to Excellent	–	Good to Excellent	Satisfactory
Greaterville	Good	High Fair to Excellent	Fair to Excellent	–	Fair to Excellent	Satisfactory
DeBaud	Fair to High Fair	Fair to Good	Fair to Good	–	High Fair to Good	Satisfactory

Sources: Biedenbender (2010a; 2010b); Lockwood (2010).

Environmental Consequences

Direct and Indirect Effects of Each Alternative

No Action Alternative

Under the no action alternative, there would be no loss of grazing access from any of the allotments and no loss of seeps, springs, or stock tanks. Site conditions would remain satisfactory.

Impacts Common to All Action Alternatives

Impacts to livestock grazing during construction and operation of the mine vary by alternative and are described more fully below.

Proposed Action

As a result of the proposed action, there would be a change from fully capable to potentially capable for approximately 4,684 acres of suitable rangeland habitat on the Rosemont allotment, 18 acres on the DeBaud allotment, 280 acres on the Thurber allotment, 88 acres on the Greaterville allotment, and 155 acres on the Helvetia allotment. Approximately 950 acres of the Rosemont allotment would change from fully capable to not capable (i.e., the area of the mine pit). The remaining disturbance would be temporary, as it is expected that the areas used for waste rock and tailings and building facilities (e.g., solvent extraction and electrowinning, heap leach facilities, etc.) would revert to suitable grazing habitat once revegetation has been implemented and reclamation criteria have been met in those areas.

During construction and operation, some limitation of grazing would occur, as summarized in table 107. A perimeter fence will exclude all grazing within the mine site itself during these times; fencing outside the perimeter will not be impacted. Reductions in the suitable acreage for the Thurber, DeBaud, and Greaterville allotments are minor enough that no reductions in animal unit months are necessary. However, a reduction of 1,146 animal unit months could occur under the proposed action

from the Rosemont and Helvetia allotments. Overall, there would be no impact to the ability of the Forest Service to manage grazing allotments (i.e., rest and rotation).

In addition, 15 stock ponds and 63 springs are expected to be lost to direct disturbance or to potential lowering of the groundwater table during construction and operation (table 108). Note that most of these springs are located based solely on literature review or topographic maps and may not provide water for livestock; see the "Groundwater Quantity" section for more detail.

Table 107. Potential loss of grazing during construction and operation under proposed action

Allotment	Suitable Acres	Disturbed Acres	Percentage of Allotment Impacted	Current Animal Unit Months	Reduction in Animal Unit Months
Thurber	4,480	280	6	2,652	0
Rosemont	8,410	5,634	67	1,575	1,055
DeBaud	2,360	18	0.8	592	0
Greaterville	4,120	88	2	1,635	0
Helvetia	1,231	155	13	720	91

Table 108. Stock ponds and springs lost under proposed action

Name of Water Source	Cadastral Location	Allotment
Springs		
California Mine Spring	D-17-17 19db	Bureau of Land Management (BLM)
Cow Spring	D-17-16 19dca	BLM
Hilton Spring	D-17-17 32caa	BLM
Unnamed Spring No.12	D-18-17 6ac	BLM
Upper Empire Gulch Spring	D-19-17 18AAD	BLM
Proctor Spring	D-19-15 3acc	Box Canyon
Papago Spring (No. 2)	D-18-16 16bba	DeBaud
Scholefield No. 3	D-18-16 17caa	DeBaud
Water Develop Spring	D-18-16 17ab	DeBaud
Bowman Spring	D-19-15 13ac	Greaterville
Chavez Spring	D-18-15 14dbb	Helvetia
Diesler Spring	D-18-15 24cc	Helvetia
Feliz Spring	D-18-15 35ba	Helvetia
Helvetia Spring	D-18-15 14DBA	Helvetia
Peligro Adit	D-18-15 24dcc	Helvetia
Ruelas Spring Number Two and Three	D-18-15 26aa	Helvetia
Shamrod Spring	D-18-15 14BCD	Helvetia
Soldier Spring	D-18-15 25bb	Helvetia
Sycamore Spring	D-18-15 12dba	Helvetia
Unnamed Spring No. 1	D-18-15 23ba	Helvetia
Unnamed Spring No. 13	D-18-15 34aa	Helvetia
Zackendorf Spring	D-18-15 14ADA	Helvetia
Bee Spring	D-18-16 31bb	Rosemont
Deering Spring	D-19-15 1dbd	Rosemont
Hole Seep Spring	D-19-15 1bc	Rosemont
Locust Spring	D-19-15 1bdb	Rosemont
McCleary Dam	D-18-16 29bda	Rosemont

Name of Water Source	Cadastral Location	Allotment
McCleary No. 1	D-18-16 30abc	Rosemont
McCleary No. 2	D-18-16 19cdd	Rosemont
Mueller Spring	D-18-16 29cc	Rosemont
Questa Spring	D-18-16 27ddd	Rosemont
Rosemont Spring	D-18-16 32bbc	Rosemont
Ruelas Spring	D-18-15 35bdc	Rosemont
SW	D-19-15 1bbb	Rosemont
Unnamed Spring No. 2	D-18-16 30cd	Rosemont
Unnamed Spring No. 3	D-18-16 30cd	Rosemont
Unnamed Spring No. 5	D-18-16 29ab	Rosemont
Unnamed Spring No. 6 (Possibly same as McCleary No. 2)	D-18-16 19cd	Rosemont
Unnamed Spring No. 14	D-18-16 21bc	Rosemont
Dam Spring	D-17-16 32aac	Stone Springs
Fence Spring	D-17-15 35bdb	Stone Springs
Fig Tree Spring	D-18-16 19abb	Stone Springs
Indian Spring	D-17-15 36cbc	Stone Springs
La Cholla Spring	D-18-16 5cba	Stone Springs
Little Indian Spring	D-17-15 36cbc	Stone Springs
Mesquite Flat Spring	D-18-16 7aaa	Stone Springs
Mudhole Spring	D-18-16 17bb	Stone Springs
Oak Spring	D-18-16 17bbc	Stone Springs
Ojo Blanco Spring	D-18-16 4cd	Stone Springs
Rock Spring	D-18-16 6ddd	Stone Springs
Rust Spring	D-18-15 1acb	Stone Springs
Siphon Spring	D-17-16 31cda	Stone Springs
SS-2	D-18-15 13aab	Stone Springs
Tree Spring	D-18-16 8acc	Stone Springs
Tub Spring	D-1816 6dd	Stone Springs
Tunnel Spring	D-17-16 32cb	Stone Springs
Tunnel Spring #2	D-17-16 31bbd	Stone Springs
Unnamed Spring No. 17	D-18-16 8ac	Stone Springs
Unnamed Spring No. 18	D-18-15 13ac	Stone Springs
Unnamed Spring No. 19	D-18-15 13ad	Stone Springs
Unnamed Spring No. 20	D-17-16 31cd	Stone Springs
Unnamed Spring No. 21	D-18-16 6dc	Stone Springs
Unnamed Spring No. 23	D-18-16 8ba	Stone Springs
Stock Tanks		
Stock Tank	D-19-16 06ab	Greaterville
Upper Barrel Tank	D-18-15 25dc	Rosemont
Unnamed Stock Tank	D-19-16 05bc	Thurber
Barrel Tank	D-19-16 06dd	Thurber
North Basin Tank 2	D-19-16 05bc	Thurber
McCleary Tank	D-18-16 30bb	Rosemont
South Basin 4 Tank	D-19-16 06dd	Thurber
East Dam Header Tank	D-18-16 29ac	Rosemont
North Basin Tank	D-19-16 05bc	Thurber
North Dam Header Tank	D-18-16 29ac	Rosemont
Section 25	D-18-15 25dd	Rosemont

Name of Water Source	Cadastral Location	Allotment
Unnamed Stock Tank	D-18-16 32c	Rosemont
Unnamed Stock Tank	D-18-16 19cc	Rosemont
Unnamed Stock Tank	D-19-15 01da	Rosemont
Unnamed Stock Tank	D-19-15 01da	Rosemont

Phased Tailings Alternative

Under the Phased Tailings Alternative, there would be a change from fully capable to potentially capable for approximately 4,590 acres of suitable rangeland habitat on the Rosemont allotment, 8 acres on the DeBaud allotment, 280 acres on the Thurber allotment, 88 acres on the Greaterville allotment, and 155 acres on the Helvetia allotment. Approximately 950 acres of the Rosemont allotment would change from fully capable to not capable (i.e., the area of the mine pit). The remaining disturbance would be converted to suitable grazing habitat once vegetation reclamation has been implemented in those areas.

During construction and operation, some limitation of grazing would occur, as summarized in table 109. A perimeter fence will exclude all grazing within the mine site itself during these times; fencing outside the perimeter will not be impacted. Reductions in the suitable acreage for the Thurber, DeBaud, and Greaterville allotments are minor enough that no reductions in animal unit months are necessary. However, a reduction of 1,129 animal unit months could occur under the Phased Tailings Alternative from the Rosemont and Helvetia allotments. Overall, there would be no impact to the ability of the Forest Service to manage grazing allotments (i.e., rest and rotation).

Impacts to stock ponds and springs are expected to be the same as for the proposed action.

Table 109. Potential loss of grazing during construction/operation under Phased Tailings Alternative

Allotment	Suitable Acres	Disturbed Acres	Percentage of Allotment Impacted	Current Animal Unit Months	Reduction in Animal Unit Months
Thurber	4,480	280	6	2,652	0
Rosemont	8,410	5,540	66	1,575	1,038
DeBaud	2,360	8	0.3	592	0
Greaterville	4,120	88	2	1,635	0
Helvetia	1,231	155	13	720	91

Barrel Alternative

Under the Barrel Alternative, there would be a change from fully capable to potentially capable for approximately 5,316 acres of suitable rangeland habitat on the Rosemont allotment, 290 acres on the Thurber allotment, 8 acres on the DeBaud allotment, 88 acres on the Greaterville allotment, and 155 acres on the Helvetia allotment (table 110). Approximately 950 acres of the Rosemont allotment would change from fully capable to not capable (i.e., the area of the mine pit). The remaining disturbance would be converted to suitable grazing habitat once vegetation reclamation has been implemented in those areas.

Table 110. Potential loss of grazing during construction and operation under Barrel Alternative

Allotment	Suitable Acres	Disturbed Acres	Percentage of Allotment Impacted	Current Animal Unit Months	Reduction in Animal Unit Months
Thurber	4,480	290	6	2,652	0
Rosemont	8,410	6,266	62	1,575	984
DeBaud	2,360	8	0.3	592	0
Greaterville	4,120	88	2	1,635	0
Helvetia	1,231	155	13	720	91

During construction and operation, some limitation of grazing would occur, as summarized in table 110. A perimeter fence will exclude all grazing within the mine site itself during these times; fencing outside the perimeter will not be impacted. Reductions in the suitable acreage for the Thurber, Greaterville, and Helvetia allotments are minor enough that no reductions in animal unit months are necessary. However, a reduction of 1,075 animal unit months could occur under the Barrel Alternative from the Rosemont allotment. Overall, there would be no impact to the ability of the Forest Service to manage grazing allotments (i.e., rest and rotation).

Impacts to springs are expected to be the same as under the proposed action. The Barrel Alternative will impact four additional stock tanks, compared with the proposed action, as shown in table 111.

Table 111. Additional stock ponds lost under Barrel Alternative

Name of Water Source	Cadastral Location	Allotment
Stock Tanks		
Section 33 Tank	D-18-16-33cc	Rosemont
Section 33 Tank	D-18-16-33cc	Rosemont
Dirt Tank	D-18-16 33cc	Rosemont
East Dam Tank	D-18-16 28ac	Rosemont

Barrel Trail Alternative

Under the Barrel Trail Alternative, there would be a change from fully capable to potentially capable for approximately 5,316 acres of suitable rangeland habitat on the Rosemont allotment, 290 acres on the Thurber allotment, 88 acres on the Greaterville allotment, 8 acres on the DeBaud allotment, and 155 acres on the Helvetia allotment. Approximately 950 acres of the Rosemont allotment would change from fully capable to not capable (i.e., the area of the mine pit). The remaining disturbance would be converted to suitable grazing habitat once vegetation reclamation has been implemented in those areas.

During construction and operation, some limitation of grazing would occur, as summarized in table 112. A perimeter fence will exclude all grazing within the mine site itself during these times; fencing outside the perimeter will not be impacted. Reductions in the suitable acreage for the Thurber, Greaterville, and DeBaud allotments are minor enough that no reductions in animal unit months are necessary. However, a reduction of 1,075 animal unit months could occur under the Barrel Trail Alternative from the Rosemont and Helvetia allotments. Overall, there would be no impact to the ability of the Forest Service to manage grazing allotments (i.e., rest and rotation).

Impacts to stock tanks and springs are expected to be the same as under the Barrel Alternative.

Table 112. Potential loss of grazing during construction and operation under Barrel Trail Alternative

Allotment	Suitable Acres	Disturbed Acres	Percentage of Allotment Impacted	Current Animal Unit Months	Reduction in Animal Unit Months
Thurber	4,480	290	6	2,652	0
Rosemont	8,410	6,266	62	1,575	984
DeBaud	2,360	8	0.3	592	0
Greaterville	4,120	88	2	1,635	0
Helvetia	1,231	155	13	720	91

Scholefield-McCleary Alternative

Under the Scholefield-McCleary Alternative, there would be a change from fully capable to potentially capable for approximately 4,445 acres of suitable rangeland habitat on the Rosemont allotment, 1,235 acres on the DeBaud allotment, 155 acres on the Helvetia allotment, and 219 acres on the Stone Springs allotment. Approximately 950 acres of the Rosemont allotment would change from fully capable to not capable (i.e., the area of the mine pit). The remaining disturbance would be converted to suitable grazing habitat once vegetation reclamation has been implemented in those areas.

During construction and operation, some limitation of grazing would occur, as summarized in table 113. A perimeter fence will exclude all grazing within the mine site itself during these times; fencing outside the perimeter will not be impacted. Reductions in the suitable acreage for the Stone Springs allotment are minor enough that no reductions in animal unit months are necessary. However, a reduction of 1,409 animal unit months could occur under the Scholefield-McCleary Alternative from the Rosemont, Helvetia, and DeBaud allotments. Overall, there would be no impact to the ability of the Forest Service to manage grazing allotments (i.e., rest and rotation).

Table 113. Potential loss of grazing during construction and operation under Scholefield-McCleary Alternative

Allotment	Suitable Acres	Disturbed Acres	Percentage of Allotment Impacted	Current Animal Unit Months	Reduction in Animal Unit Months
Rosemont	8,410	5,395	64	1,575	1,008
DeBaud	2,360	1,235	52	592	310
Helvetia	1,231	155	13	720	91
Stone Springs	3,013	219	7	1,466	0

Impacts to stock tanks are expected to be the same as under the proposed action, with the exception that seven stock tanks will not be impacted under the Scholefield-McCleary Alternative: South Basin 4 Tank, North Basin Tank, North Basin Tank 2, Barrel Tank, and four unnamed tanks. In addition, the East Dam Tank in the Rosemont allotment will be impacted under the Scholefield-McCleary Alternative. The Scholefield-McCleary Alternative will impact four additional springs, compared with the Proposed Action Alternative, as shown in table 114.

Table 114. Additional springs lost under Scholefield-McCleary Alternative

Name of Water Source	Cadastral Location	Allotment
Springs		
Unnamed No. 14	D-18-16 21bc	DeBaud
Water Develop Spring	D-18-16 17ab	DeBaud
Scholefield No. 2	D-18-16 17caa	DeBaud
Papago Spring No. 2	D-18-16 16bba	DeBaud

Cumulative Effects

The Council on Environmental Quality defines a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 Code of Federal Regulations 1508.7). As outlined in the chapter 3 introduction, cumulative impacts of past and present actions are identified and analyzed in the "Affected Environment" part of each resource section, including for "Livestock Grazing." This cumulative effects discussion addresses the cumulative impacts of the action alternatives and any applicable reasonably foreseeable actions as identified on the Coronado ID team's list of reasonably foreseeable future actions, provided in the chapter 3 introduction. The list was reviewed, and no reasonably foreseeable future actions are expected to have a cumulative effect on livestock grazing.

Mitigation Effectiveness

Mitigation related to reclamation is pertinent to the ability to return grazing allotments to full use in the long term. Three mitigation measures will help return grazing allotments to full use: implementation of a mine reclamation plan, revegetation activities, and implementation of a voluntary water source enhancement and mitigation plan.

Revegetation activities are detailed in chapter 2, and the revegetation potential is fully analyzed in the "Soils" section. With respect to grazing, the most pertinent measure of revegetation potential is the expected productive capacity of the reclaimed areas, also discussed in the "Soils" section. Soil productivity for the project area ranges from roughly 450 to 2,400 pounds per acre (Fehmi et al. 2008; Natural Resources Conservation Service 2010a). The University of Arizona has conducted greenhouse studies using three material types from the project area that represent the substrates provided by waste rock and tailings. Two of the three materials tested in the greenhouse with the recommended seed mixture resulted in soil productivity ranging from 1,010 to 1,080 pounds per acre, well within the natural range for the site. The third material tested showed limited productivity (290 pounds per acre) and may have limited revegetation potential.

Rosemont Copper will also implement a voluntary water source enhancement and mitigation plan. For each individual manmade source of seasonal or permanent surface water lost to wildlife or grazing use, whether through direct or indirect project related impacts, new water sources will be created to provide a replacement water source in the area impacted. The result will be no net loss in the current preproject number of manmade water sources for livestock and wildlife. The water source enhancement and mitigation plan will apply to private and public lands contained within Rosemont Copper's Forest Service grazing permits.

Irretrievable and Irreversible Commitment of Resources

With respect to livestock grazing, irreversible changes to resources are not expected. Vegetation on the site will be constantly changing as reclamation procedures are implemented. Eventually, reclamation is expected to return the site to conditions equivalent to those currently experienced on the grazing allotments. Irretrievable commitment of grazing resources will occur until reclamation has returned the site to conditions acceptable for grazing.

However, the approximately 950-acre open pit does represent an irretrievable and irreversible loss of grazing allotment on National Forest System land that will not be reclaimed.

Dark Skies

Introduction

The Coronado National Forest, with its topographic and biological diversity and unique “sky islands” ecosystems, provides many opportunities for recreation. The major recreational activities include developed and backcountry camping, hiking, sightseeing, biking, and scenic driving; the “Recreation and Wilderness” section provides detailed information on these activities on the Coronado National Forest. An important component of the recreational experience is night sky viewing. The cloudless night skies, minimal atmospheric pollution, and low humidity of the southwestern United States provide ideal conditions for this activity, besides maintaining the natural light conditions and fluctuations that are important to native plants and animals. Night sky viewing is an important aspect of southwestern tourism (Cinzano 2000). The area within and adjacent to the Santa Rita Mountains in Pima County is particularly well suited for night sky viewing, and these excellent viewing conditions have been recognized and exploited by astronomers for many years. The Kitt Peak National Observatory and the Smithsonian Institution’s Fred Lawrence Whipple Observatory are world-class astronomy research facilities located on the Coronado National Forest that rely on the area’s naturally dark, unpolluted night skies for optical and infrared astronomy research.

Issues, Cause and Effect Relationships of Concern

Issue 8: Impact on Dark Skies and Astronomy

This issue relates to the potential for the mine operation and facilities to reduce night sky visibility. Increased light and air particulates from mine related facilities, equipment, vehicles, and processes may diminish dark skies. Airborne sulfur or sulfur compounds are known to damage the aluminum coatings on telescope optics. The increased sky glow would reduce the visibility of all celestial objects, particularly the faint ones, which are often the subject of scientific study. Area residents, recreationists, research and amateur astronomers, and stargazers value the current dark skies in the area. Key observation points and the Smithsonian Institution’s Fred Lawrence Whipple Observatory may be adversely affected. This issue also relates to the impact of particulate emissions and vibration from blasting and drilling on sensitive astronomy equipment.

Pima County has enacted the Pima County Outdoor Lighting Code. Mine operations are exempt from this code, and some aspects of the operation may not be able to conform to the code because of worker safety concerns.

Issue 8 Factor for Alternative Comparison

- Distribution of fractional increase in sky brightness from mine facility and vehicle lighting

Analysis Methodology, Assumptions, Uncertain and Unknown Information

Analysis Area

The analysis area for analyzing potential impacts to dark skies and astronomy resulting from the action alternatives consists of all areas in which night sky viewing would potentially be affected by the proposed project. This includes the Santa Rita Ecosystem Management Area, where native plants, animals, and visitors would likely be affected, and surrounding areas in the region, where the project night lighting would be visible and could have potential impacts. These areas include eastern Pima County, Santa Cruz County, and western Cochise County. Six observation points between 1 and 15 miles from the proposed mine site, including two observatories, were chosen for modeling the potential impacts within the analysis area (figure 64). The temporal bounds of analysis is the construction and operational lifetime of the project from the time that mine lighting is installed until mine closure, when it is removed.

The effects of project area night lighting with other past, present (ongoing), and reasonably foreseeable activities within the region constitute the cumulative impacts. There are potential impacts to dark skies for Coronado National Forest plants and animals, visitors, and residents in the lands adjacent to and/or surrounding the project area; in addition, astronomy research observatories that are located in the analysis area could be impacted. Note that for cumulative effects, past and present actions are described and considered in the “Affected Environment” part of this section; reasonably foreseeable future actions that could cumulatively contribute to dark skies impacts are described and considered in the “Cumulative Effects” part of this section.

Methodology

Lighting related impacts to existing night sky conditions can be created by the upward spill of light from an unshielded light source. Dust, water vapor, and other particles suspended in the atmosphere will scatter and reflect light that is emitted into the atmosphere, creating a phenomenon called light pollution or “sky glow.” Light that escapes directly upward into the night sky is a major contributor to the loss of the dark night sky. Thus, unshielded or improperly controlled outdoor lighting can impede the view and adversely affect the view of a natural, dark, night sky (National Park Service 2007).

The method used to quantify the potential impacts of project area lighting on the region’s existing dark sky conditions is based on a computer model that calculates sky glow or sky brightness caused by artificial outdoor lighting. The model accounts for the effects of light dispersion or reflection caused by grounded objects such as buildings, terrain, and vegetation; the model also accounts for light emitted by nearby cities and towns, housing developments, industrial areas, and shopping centers, with the capability of accounting for spatial distribution, shielding, and intensities of light sources (Dark Sky Partners LLC 2011).

The model’s calculation of lighting impacts was based on the initial Rosemont Lighting Plan (M3 Engineering and Technology Corporation 2009). However, a revised lighting plan (M3 Engineering and Technology Corporation 2011) was submitted that calls for a total of 21,815,355 lumens for the project; this is 4.4 times the lighting used in the Dark Sky Partners 2011 report, which was based on the 2009 Rosemont Lighting Plan (M3 Engineering and Technology Corporation 2009). Time constraints prevented a full reanalysis based on model calculations, so the results presented below were based on an assumption of linearity, namely that sky glow changes in direct proportion to the lumen changes. A full analysis will be produced at a later date.

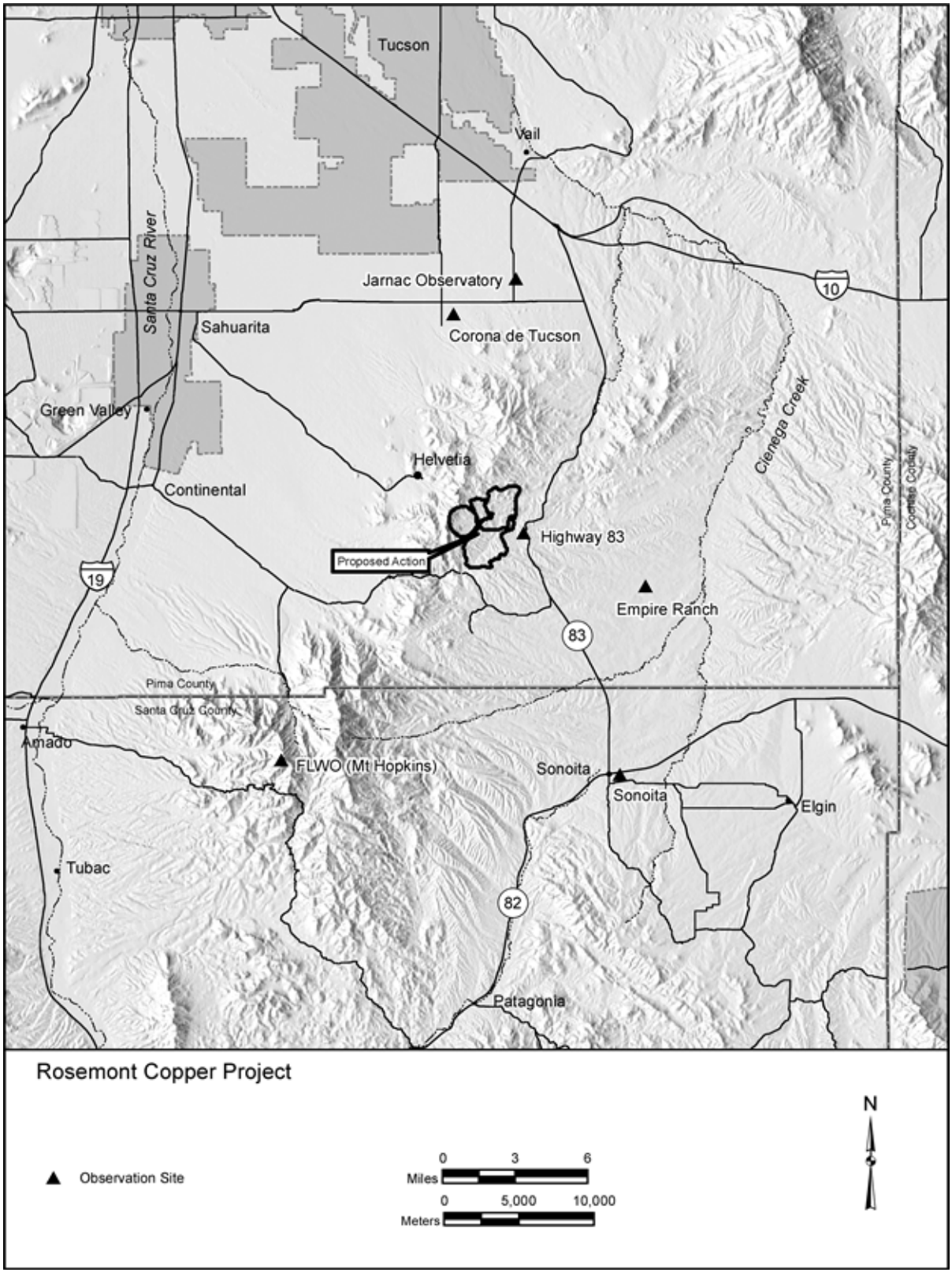


Figure 64. Analysis area for dark skies

The revised lighting plan (M3 Engineering and Technology Corporation 2011) specifies that nighttime lighting would consist of six lighting uses: (1) fixed lights at the mine headquarters and ore processing area for parking and walkway illumination and security; (2) mobile lighting of mine pit shovels and ore loaders, along with portable light towers at the active mine site; (3) adjustable lighting for the heap leach pad; (4) fixed roadway lighting along the primary access road (from State Route 83 to the mine site) and along in-mine roadways; (5) fixed lighting at the dry-stack conveyor; and (6) mine vehicle lighting (i.e., headlights). It was assumed that alignments of portable lighting fixtures within the open pit and on the leach pad would direct approximately 30 percent of the light flux upward. Mine vehicular lighting was calculated under the assumption that a fraction (11 percent) of headlight light would be projected upward and that all vehicular lighting would be produced onsite (not on public roadways). The total intensity of light produced at all of these mine locations was calculated for all of the mine site light sources.

The model assumed that the largest source of nighttime lighting from cities and towns and remote residences relevant to the project area would be in eastern Pima County. Year 2010 U.S. Census data were used to calculate the approximate amount of light produced per capita, as well as the amount of outdoor light for communities without any outdoor lighting controls(Dark Sky Partners LLC 2011). For the project area, the total light intensity in areas around the mine site (in eastern Pima County) was calculated using the per capita light use of the populations of Tucson, Nogales, Benson, Sonoita, Tubac, and Sierra Vista.

Once lighting data had been collected for the proposed mine site and surrounding municipal light sources, site-specific analysis points were selected. The sites were chosen to represent the impacts to nearby astronomy observatories, to towns near the proposed mine, and to motorists traveling along State Route 83 (where the maximum night lighting visual impact would most likely be because of proximity to the mine site). The night sky analysis points are as follows:

- Mount Hopkins (Whipple Observatory)
- Jarnac Observatory
- The town of Sonoita
- The town of Corona de Tucson
- State Route 83, at a point close to the mine
- Empire Ranch

Using the above six observations points to assess the amount of sky glow or sky brightness that would be observed within the region, the computer model was run to predict the fractional increase in sky brightness beyond current conditions that would be produced by the project's night lighting. Sky brightness was calculated from the sky zenith (directly overhead, at 0 degrees) to the horizon (90 degrees), with results showing the potential fractional increase in night sky brightness caused by the Rosemont Copper Mine.

Summary of Effects by Issue Measures by Alternative

Table 115 presents the summary comparison of impacts from each alternative.

Table 115. Summary of impacts to dark sky visibility, by issue measures

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
8: Fractional increase in sky brightness from mine facility and vehicle lighting at Whipple Observatory	No impact, but subject to regional trends and conditions; night sky lighting intensity meets regional Outdoor Lighting Code	2,300% increase at horizon. Increase would be perceptible up to 50 degrees from horizon. Long-term, adverse impacts to astronomy research.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
8: Fractional increase in sky brightness from mine facility and vehicle lighting at Jarnac Observatory	Same as Whipple	540% increase at 5 degrees above the horizon. Increase would be perceptible throughout the sky. Long-term, adverse impacts to astronomy research.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
8: Fractional increase in sky brightness from mine facility and vehicle lighting at Sonoita	Same as Whipple	1,600% increase at horizon. Increase would be perceptible up to 50 degrees above horizon.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
8: Fractional increase in sky brightness from mine facility and vehicle lighting at Corona de Tucson	Same as Whipple	1,900% increase at 5 degrees above the horizon. Increase would be perceptible everywhere in the sky.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
8: Fractional increase in sky brightness from mine facility and vehicle lighting at State Route 83	Same as Whipple	4,000% increase at 5 degrees above the horizon. Increase would be dramatic up to the zenith (directly overhead).	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
8: Fractional increase in sky brightness from mine facility and vehicle lighting at Empire Ranch	Same as Whipple	11,000% increase at horizon. Increase would be perceptible up to the zenith.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action

Affected Environment

Relevant Laws, Regulations, Policies, and Plans

Federal

Forest Service Manual 2300, “Recreation, Wilderness and Related Resource Management,” chapter 2380, “Landscape Management,” states that mining operations are subject to the rules of 36 Code of Federal Regulations 228 Subpart A, “Locatable Minerals,” which include requirements for harmonizing mineral operations with scenic values (Part 228.8) and protecting scenic values when approving access to those operations (Part 228.12).

Pima County

Pima County, along with the Town of Marana and the City of Tucson, adopted Final Ordinance No. 2001-138, "The Outdoor Lighting Code." The purpose and intent of the Outdoor Lighting Code is to preserve the unique desert environment and night sky by controlling the obtrusive aspects of excessive and careless outdoor lighting usage. All outdoor lighting and associated illuminating devices must be specified and installed in conformance with the provisions of the Outdoor Lighting Code under the appropriate permit and inspection. Intended outcomes of the Outdoor Lighting Code include continuing support of astronomy activity and minimizing wasted energy while not compromising the safety, security, and well-being of persons engaged in outdoor nighttime activities (Pima County 2006a).

The Outdoor Lighting Code defines Lighting Area E1a as "special areas around astronomical observatories and includes all areas within 15 miles of the summit of Kitt Peak and 12.5 miles of the summit of Mount Hopkins, and those areas within any national park, monument, or forest boundary. In these areas, the preservation of a naturally-dark environment, both in the sky and in the visible landscape, is considered of paramount concern" (Pima County 2006a).

However, under Arizona Revised Statutes 11-830, mining is exempt from county planning and zoning codes, including the Outdoor Lighting Code.

Existing Conditions

Night Sky Conditions

At present, night sky conditions in the Santa Rita Mountains near the project area are minimally affected by artificial light sources. The area in and adjacent to the project area is dark at night, as there are few artificial light sources and no developed areas to affect night sky views or the natural light conditions and cycles that are important to native plants and animals. Background sources of lighting include headlights from vehicles traveling at night along State Route 83 and along forest roads. There are no pole-mounted fixtures along those roadways, nor is there lighting in visitor use areas to illuminate their roads, signs, access paths and trails, or parking areas. Sky glow is visible, caused primarily by lighting in the Tucson metropolitan area to the north, with distant sky glow caused by lighting in Nogales and Sierra Vista to the south.

Regionally, there are numerous active hardrock mines throughout the analysis area (e.g., the Mission Complex, Sierrita, Morenci, and Safford mines) and rock quarrying on the Coronado National Forest in the Dragoon Mountains, which potentially contribute to degraded night sky conditions from facility lighting and fugitive dust production. Another ongoing activity that potentially affects night sky conditions is the Stakaer Parsons concrete plant, which produces fugitive dust.

Trends

Regionally, the population of southeastern Arizona continues to increase, and the growth of urban areas contributes to degradation of night sky conditions. However, a recent study at Kitt Peak Observatory shows that there has been no increase in sky brightness over the past 10 years from regional population growth; this steady-state level is attributed to rigorous enforcement of light shielding ordinances (see the Pima County ordinance above) to prevent or minimize undirected urban light (Dark Sky Partners LLC 2011). Other regional trends that could affect night sky conditions would be regional population growth, which requires lighted residences and infrastructure, such as residential and commercial access roads, power lines, and telecommunication towers and lines.

Environmental Consequences

Direct and Indirect Effects of Each Alternative

The final Rosemont Lighting Plan would be applicable to all action alternatives. The lighting of the major mine features (the mine pit, processing facility, heap leach pad, and primary access road) would not change because of mine safety needs, nor could these mine features be constructed in a substantially different (and more advantageous) location to reduce sky glow impacts. Thus, the night lighting impacts would be the same for all action alternatives.

Brightness impacts on night skies for the viewpoints are described by identifying how an observer at a viewpoint would or would not be able perceive the increase of brightness when looking toward the horizon in line with the project area. Brightness from the project area diminishes as the observer increases the angle above the horizon until viewing the zenith (directly overhead). The angle above the horizon at which the observer would cease to notice an increase in brightness from the project area is identified for each viewpoint.

No Action Alternative

Under the no action alternative, the Rosemont Copper Mine would not be constructed or operated in the Santa Rita Ecosystem Management Area and would not produce sky glow or night light pollution within the region or on the Coronado National Forest. Night sky conditions would continue to be affected by the existing conditions and trends discussed above.

Impacts Common to All Action Alternatives

The results of the night sky computer modeling of current conditions, with the addition of Rosemont Copper Mine lighting, show that sky glow would increase at all of the analysis viewpoints, although to varying degrees (Dark Sky Partners LLC 2011). Since the preliminary Rosemont Lighting Plan (M3 Engineering and Technology Corporation 2009) would be applicable to all action alternatives, the impacts would be the same for all actions. For all actions, the impacts of Rosemont night lighting as seen from the analysis viewpoints would be as discussed below. Note that sky brightness would vary, depending on the angle of view above the Rosemont mine site: the higher the angle of view, the lower the intensity of sky brightness or sky glow from light dispersion and dissipation. Table 116 provides a comparative analysis of the lumens and uplight fraction that would be produced at night by the proposed action, compared with the lumens and uplight fraction produced at night by towns and cities in southern Arizona and Sonora, Mexico.

Table 116. Comparison of light source locations and outputs

Location	Population	Lumens	Uplight Fraction
Rosemont Mine Site			
Ore Processing Area		4,911,990	0.000
Mine Pit		3,660,690	0.300
Entry Road and in Plant Roads		3,374,135	0.000
Leach Field		5,964,300	0.300
Dry-Stack Conveyor		3,744,240	0.000
Vehicles		160,000	0.110
Total		**21,815,355**	

Location	Population	Lumens	Uplight Fraction
Other Communities			
Tucson/Eastern Pima County	1,050,000	1,795,500,000	0.082
Nogales, Sonora, Mexico	160,000	273,600,000	0.100
Nogales, Arizona	19,573	33,469,830	0.100
Benson	4,833	8,264,430	0.100
Sonoita	910	1,556,100	0.100
Tubac	2,000	3,420,000	0.100
Sierra Vista	43,320	74,077,200	0.100

Sources: (M3 Engineering and Technology Corporation 2011); (Dark Sky Partners LLC 2011).

Direct, Indirect, and Cumulative Effects

As mentioned above, the computer model was used to calculate the increase in sky brightness as a percentage of existing night sky conditions. In this model, a 10 percent increase in brightness is just barely perceptible to most viewers; a brightness increase of 50 percent would be perceptible to most viewers (Dark Sky Partners LLC 2011).

Proposed Action Alternative

Whipple Observatory Viewpoint

Sky brightness intensity would vary, depending on the angle above the Rosemont mine site. At 30 degrees above the horizon (60 degrees from zenith), sky glow would increase by 23 percent because of mine lighting. At 20 degrees above the horizon (70 degrees from zenith), existing sky glow would increase by 42 percent and become clearly perceptible to the average naked-eye viewer. At the horizon (89 degrees from zenith), sky glow would increase by 2,300 percent and would be clearly visible. The potential impacts to night sky observation and astronomy research would be adverse in the long term (during mine operations) in the vicinity of the project area because light pollution and sky glow would be significant (i.e., greater than 10 percent).

Jarnac Observatory Viewpoint

Sky brightness above the Jarnac Observatory would increase by 9 percent at the zenith and become clearly perceptible by naked-eye viewers at 30 degrees from the horizon (60 degrees from zenith). At 20 degrees above the horizon (70 degrees from zenith), brightness would increase by nearly 100 percent. At the horizon (in this instance, 85 degrees because of topography), lighting would increase by more than 500 percent. The impacts to night sky observation and astronomy research would be similar to those at Whipple Observatory for the same reasons.

Sonoita Viewpoint

Sky brightness would become perceptible at 20 degrees above the horizon (70 degrees from zenith), increasing by 53 percent over existing conditions at this angle. At the horizon, sky brightness would increase by about 1,600 percent.

Corona de Tucson Viewpoint

From this viewpoint, sky brightness created by the Rosemont mine site would become perceptible at about 50 degrees from the zenith. At 20 degrees above the horizon, sky brightness would increase by more than 130 percent over current conditions. At the horizon (85 degrees for this viewpoint), sky brightness would increase by almost 1,900 percent over current conditions.

State Route 83 Viewpoint

Sky brightness, as viewed from the highway (at 4.5 miles from the mine site), would be obviously visible at sky zenith, with an increase in brightness of 110 percent over existing conditions. At 20 degrees above the horizon (70 degrees from zenith), sky brightness would increase by 620 percent. Sky brightness directly visible over the mine site (85 degrees from zenith) would increase by more than 4,100 percent over existing conditions.

Empire Ranch Viewpoint

From Empire Ranch, sky brightness would be perceptible at about 45 degrees from the zenith. At 20 degrees above the horizon (70 degrees from zenith), sky brightness would increase by 140 percent over existing conditions. At the horizon, sky brightness would increase by 11,000 percent.

Any substantial increase in sky glow or sky brightness (i.e., a more than approximately 10 percent increase over existing levels) would have direct, adverse impacts on dark skies because natural light conditions and cycles required for plant and animal species would be altered and because night sky viewing would be impaired for naked-eye viewers. Therefore, all action alternatives would have direct, adverse, long-term impacts to night sky viewing until mine closure.

The region's astronomy observatories would be affected by sky brightening to a substantial, adverse degree in the long term until mine closure because the "useful" regions of the sky for astronomy extend from the zenith to 20 degrees from the horizon (70 degrees from zenith). Rosemont Copper Mine lighting would increase sky brightening at 20 degrees from the horizon by 42 percent for the Whipple Observatory, by 97 percent for the Jarnac Observatory, and by 140 percent for the Empire Ranch viewpoint in the direction of mine operations.

Phased Tailings Alternative

The impacts would be the same as discussed under the proposed action because the same project lighting plan would be followed.

Barrel Alternative

The impacts would be the same as discussed under the proposed action because the same project lighting plan would be followed.

Barrel Trail Alternative

The impacts would be the same as discussed under the proposed action because the same project lighting plan would be followed.

Scholefield-McCleary Alternative

The impacts would be the same as discussed under the proposed action because the same project lighting plan would be followed.

Cumulative Effects

The Council on Environmental Quality defines a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or

person undertakes such other actions" (40 Code of Federal Regulations 1508.7). As outlined in the chapter 3 introduction, cumulative impacts of past and present actions are identified and analyzed in the "Affected Environment" part of each resource section, including for "Dark Skies." This cumulative effects discussion addresses the cumulative impacts of the action alternatives and any applicable reasonably foreseeable actions as identified on the Coronado ID team's list of reasonably foreseeable future actions, provided in the chapter 3 introduction. The following reasonably foreseeable actions from that list were determined to contribute to a cumulative impact to dark skies:

- Sahuarita Road Phase II
- Stakaer Parsons concrete plant
- Ongoing mineral exploration

Reasonably foreseeable future actions that could cumulatively affect night lighting would be a continuation of construction of Sahuarita Road, which would produce localized fugitive dust, and the Stakaer Parsons concrete plant, which would produce night lighting and fugitive dust. Proposed mining actions include mineral exploration within three mineral potential areas adjacent to the Coronado National Forest: Peach-Elgin, Broad Tom, and Copper World. Cumulatively, mine exploration (and potential mineral development) near the Coronado National Forest, along with the construction of the Rosemont Copper Project, would have long-term, adverse impacts on regional night sky viewing and on astronomy research.

All of these actions, including those ongoing activities and trends described under the "Affected Environment" part of this section, would have potentially adverse impacts on night lighting and dark skies and on astronomy research because they would potentially contribute to sky glow and light pollution. While the Pima County Outdoor Lighting Code currently keeps light pollution at levels that do not adversely affect astronomy research, the trend toward increasing urban and industrial development and mineral resource exploration, development, and extraction would adversely impinge on the nighttime light levels required for astronomy research.

Mitigation Effectiveness and Remaining Effects

Lighting mitigation measures would be applied under air quality and climate change and under visual resources, in accordance with the preliminary Rosemont Lighting Plan (M3 Engineering and Technology Corporation 2009). Mine related buildings would be painted or stained to produce flat-toned, nonreflective surfaces, which would have minor, beneficial impacts on dark skies by reducing the potential for building related reflected night lighting. Physical or chemical dust control agents, organic or inorganic binders, and/or stabilizing polymers would be used to prevent chemical releases into the atmosphere. Roads, material transfer points, and processing areas would be treated with dust control agents, water sprays, physical covers, and wind barriers. Acid leaching on the heap leach pile would use drip emitters to prevent or minimize aerosol production and losses to wind. All of these mitigation measures would have minor, long-term, beneficial impacts on dark skies by reducing potential light dispersion by atmospheric particles and aerosols during the lifetime of the proposed project.

Under the preliminary Rosemont Lighting Plan (M3 Engineering and Technology Corporation 2009), all exterior and access route lighting would be designed and operated with the intent to reduce light pollution and meet the City of Tucson and Pima County Outdoor Lighting Code. Outdoor lighting design would incorporate light shields, dimmers, cutoff lighting fixtures, timers, motion sensors, directional lighting, and the production of the minimum light intensities practicable. All of these

measures would have minor, long-term, beneficial impacts on dark skies by reducing sky glow and light pollution at the mine site by containing light within the mine site. However, the degree to which these mitigation measures would reduce sky glow and regional light pollution cannot be determined because these measures would be subject to Mine Safety and Health Administration requirements and nighttime mine operational needs.

Irreversible and Irretrievable Commitment of Resources

There would be an irretrievable, regional, long-term loss of night sky viewing during Rosemont Copper Mine construction and operation because night sky brightening, light pollution, and sky glow caused by mine lighting would diminish nighttime viewing conditions in the direction of the mine. There would be no irreversible loss of the resource because once the mine completes operations and is closed (including removal of mine lighting), night sky visibility would return to conditions similar to those prior to mine construction and operation.

Visual Resources

Introduction

Encompassing more than 1.7 million acres in southeastern Arizona and a small portion of New Mexico, landscapes on the Coronado National Forest range from deserts to alpine meadows and snow-covered mountain peaks. The Coronado National Forest's scattered mountain ranges, or "sky islands," reach elevations of more than 10,000 feet and offer high quality scenery and a diverse range of settings. Coronado National Forest visitors have opportunities to hike, mountain climb, mountain bike, sightsee along scenic roads and forest roads, camp in developed and back-country camping areas, and generally enjoy extraordinarily high scenic quality in predominantly undeveloped landscapes far from densely populated urban areas (U.S. Forest Service 2010c). The results of a recent Forest Service survey show that more than 68 percent of visitors to the Coronado National Forest participate in viewing nature features (scenery), that this activity was the second most popular primary activity after hiking and walking, and that more than 25 percent of Coronado National Forest visitors travel on a forest scenic byway (U.S. Forest Service 2008e).

Issues, Cause and Effect Relationships of Concern

Issue 7: Impact on Visual Resources

This issue focuses on the visual impacts that would result from the mine pit, placement of tailings and waste rock piles, and development and use of other facilities. The proposed mine tailings and waste rock piles would create significant changes to the landscape within the mine footprint. The piles may block valued mountain views. The processing plant and transportation and utility corridors may also affect visual resources in the area. The character of the State Route 83 designated scenic corridor and the views from it may change. The ability for the area to meet assigned scenic integrity objectives in the forest plan may be reduced. Regardless of mitigation measures or reclamation required, the scenic quality of the landscape may be permanently degraded.

Issue 7 Factors for Alternative Comparison

- Area that would no longer meet current forest plan scenic integrity objectives designations (acres)
- Qualitative assessment/degree of change in landscape character from analysis viewpoints over time

- Miles of State Route 83 with direct line-of sight views of the project area
- Miles of project area visibility along concern level 1 and 2 roads and trails

Other Effects Considered

While not raised as a major concern during scoping, the following issue has also been analyzed in order to provide a complete analysis of visual resource impacts:

- Project area regional visibility (acres)

Analysis Methodology, Assumptions, Uncertain and Unknown Information

Temporal Bounds of Analysis and Spatial Analysis Area

Analysis of visual resources potentially affected by the proposed project includes both spatial and temporal dimensions. The temporal bounds of analysis for visual resources is defined by the proposed phases of project construction, operation, and deconstruction, which are projected to occur over 25 years. The postclosure phase would be very long term or permanent: reclamation vegetation would approach maturity in 50 to 100 years, and the stormwater drainage system would need to be monitored and maintained indefinitely.

The spatial analysis area is defined as all areas in which visual resources would potentially be affected by the proposed project and would be potentially visible to the public. This includes the following: (1) the immediate project site, (2) the Santa Rita Ecosystem Management Area of the Coronado National Forest, and (3) areas from which the project would be visible (including eastern Pima County, Santa Cruz County, and western Cochise County). Figure 65 depicts the analysis area for assessing potential impacts to visual resources and scenic quality.

Cumulative effects will also consider the entire Coronado National Forest and southeastern Arizona. Potential impacts to visual resources for viewers, residents, and visitors in the lands adjacent to and/or surrounding the project area are in Santa Cruz County, eastern Pima County, and western Cochise County. Note that for cumulative effects, past and present (ongoing) actions are described and considered in the “Affected Environment” part of this section; reasonably foreseeable future actions that could cumulatively contribute to scenic quality impacts are described and considered in the “Cumulative Effects” part of this section.

Coronado Scenic Resource Management

The purpose of forest visual resource management is to maintain and protect the visual integrity of the forest landscapes as viewed and experienced by forest visitors. Its purpose is also to provide guidelines and planning directions for rehabilitating or enhancing existing visual quality in support of other resource management practices within the forest (U.S. Forest Service 2006). To meet these management goals, the Forest Service applies a systematic and consistently applied method to analyze impacts to forest scenic quality. The analysis methodology applied to visual resources for the Rosemont Copper Project DEIS follows the Forest Service Scenery Management System, which the Forest Service has been directed to use since 1995.

In 2001, the Coronado completed its Scenery Management System based visual inventory. The scope of the Scenery Management System permits a thorough analysis of impacts by providing standards

Figure 65. Analysis area for visual resources

and guidelines for scenery management and consistent techniques for assessing resource impacts and monitoring impacts, which range from broad-scale land planning to site-specific projects.

Prior to 1995, the Forest Service Visual Management System was used to inventory and analyze impacts to forest visual resources. Under this system, land and resource management plans, including the forest plan (U.S. Forest Service 1986), were directed to establish visual quality objectives; the Visual Management System goals, resource objectives, and standards were used to manage visual resources on the Coronado until the newer visual system came into use. The Visual Management System method used visual quality objectives comparable to the management objectives in the Scenery Management System (table 117).

Table 117. Comparison of Scenery Management System and Visual Management System objectives

Scenery Management System Scenic Integrity Objectives	Visual Management System Visual Quality Objectives
Very High – Unaltered, intact, natural-appearing landscape. The existing landscape character and sense of place is expressed at the highest possible level.	***Preservation –*** Allows for ecological changes only, management activities, except for very low visual impact recreation facilities, are prohibited.
High – Landscape character appears unaltered and intact. Deviations may be present, but must repeat the line, form, color, and textures so completely that they are not evident.	***Retention –*** Provides for management activities that are not visually evident. Activities may only repeat the form, line, color, and texture frequently found in the existing landscape.
Moderate – Slightly altered, with visually subordinate landscape changes. Noticeable changes must remain visibly subordinate to the landscape character being viewed.	***Partial Retention –*** Permits management activities that are visually evident. Activities in this classification may repeat form, line, color, texture, size, and intensity of the characteristic landscape but must remain subordinate to the existing landscape.
Low – Appears moderately altered; landscape changes begin to dominate. Deviations begin to dominate the valued landscape, but they borrow valued attributes from the surrounding landscape.	***Modification –*** Enables management activities that are visually dominant. Activities that alter vegetation and landforms must borrow from naturally established form, line, color, and texture of the natural characteristics of the existing landscape.
Very Low – Appears heavily altered, landscape changes predominate. Deviations may strongly dominate the valued landscape character. However, deviations must be shaped and blended with the natural terrain (landforms) so that elements such as unnatural edges, roads, landings, and structures do not dominate the composition.	***Maximum Modification –*** Also allows visually dominant management activities. When viewed as background, visual characteristics must be those of natural occurrences. As viewed in the foreground or middle ground, visual characteristics may not appear to completely borrow the naturally established form, line, color, and texture of the existing landscape.
Unacceptably Low*– Appears extremely altered. Deviations are extremely dominant and borrow little or no line, form, color, texture, or scale elements from the characteristic landscape. Landscape at this level of integrity will require rehabilitation.	***Unacceptable Modification –*** A landscape condition in which all of the dominant landscape contrasts and elements caused by facilities or activities are visually unrelated to the characteristic landscape. This includes visual impacts that exceed 10 years' duration.

Source: Forest Service (1995).

* Under both the Scenery Management System and Visual Management System, the unacceptable landscape classification is not used to designate an area's management objectives but rather is used to rate landscapes for inventory purposes.

Although the forest plan uses the Visual Management System, the Scenery Management System is more applicable to the scope and complexity of the Rosemont Copper Project than the Visual Management System, and the Coronado has, therefore, been directed to use this newer system for analyzing visual resource impacts (Laford 2010).

A comparison of the Scenery Management System scenic objectives (the Scenic Integrity Objectives) and the Visual Management System management objectives are shown in table 117. The scenic integrity objectives for the Santa Rita Ecosystem Management Area are depicted in figure 66.

Methodology

The Scenery Management System, as described in the Forest Service's "Landscape Aesthetics Scenic Management Handbook" (U.S. Forest Service 1995), directs that the assessment of potential impacts to scenic resources be based on the public's concern for scenic quality or scenic values within a landscape and on potential project related changes to the existing landscape. Public concern is gauged using Forest Service concern levels, which are used to rank or measure the importance the public places on landscapes as seen from specific viewing locations.

The Scenery Management System applies three concern levels: concern level 1 (high), concern level 2 (moderate), and concern level 3 (low). Concern level 1 areas include major recreational use areas, high use travel ways such as interstates, highways, other major roadways, and high visitation use areas (such as designated scenic viewpoints), where the public would likely have a concern for scenic resources. Concern level 2 areas include "back-country" or secondary travel ways that receive limited to low levels of use and where the likely interest in scenic quality is moderate. Visitors in these areas generally have some concern for scenery. Concern level 3 areas are travel ways and public use areas that receive low to minimal use and are used by visitors with no concern for scenery or scenic quality.

The Forest Service's scenic management guidelines direct scenic analysis to be conducted from the perspective of public travel ways and public use areas both within and outside forest boundaries. Other Scenery Management System criteria included in assessing potential project visual impacts are landscape visibility to viewers, the capability of the landscape to absorb or accept human alterations without loss of existing character, project slope angles (assuming that the greater the slope, the greater the visibility), and project area vegetation cover (assuming that the greater the coverage, the greater the potential that impacts may be screened). The assessment incorporates the effects of viewing distance from the potential impact using distance zones: foreground is defined as a distance up to
0.5 mile from the potential impact; middle ground is 0.5 to 4 miles; and background is 4 miles to the horizon.

Based on the above criteria, eight representative visual analysis viewpoints were selected within visually sensitive areas surrounding the project area (figure 67). Figure 67 depicts the nine viewpoints initially considered for analysis; however, only eight were used to analyze visual impacts. These viewpoints provide representative views of the existing landscape and of potential visual impacts resulting from project development within the foreground, middle ground, and background viewing distances across a spectrum of ownership (e.g., Forest Service lands, Bureau of Land Management lands, and non-Federal lands).

The representative viewpoints were established in places and travel ways with high concern levels, including the State Route 83 Scenic Road, Arizona National Scenic Trail, Box Canyon Road, Bureau of Land Management Las Cienegas National Conservation Area, and rural residential access routes with views of the project area. Full descriptions of the analysis viewpoints are described below in the "Affected Environment" part of this section.

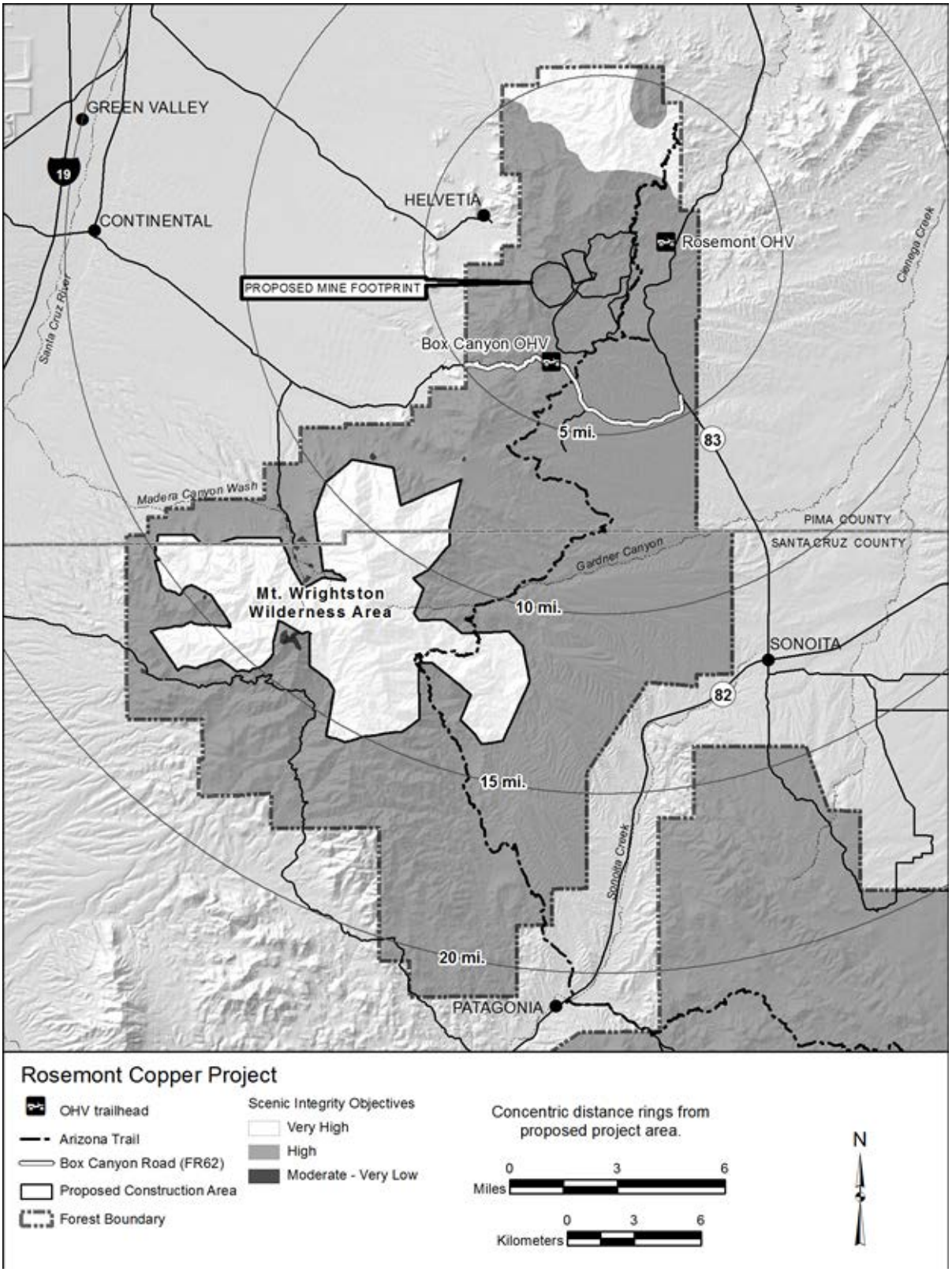


Figure 66. Coronado National Forest scenic integrity objectives

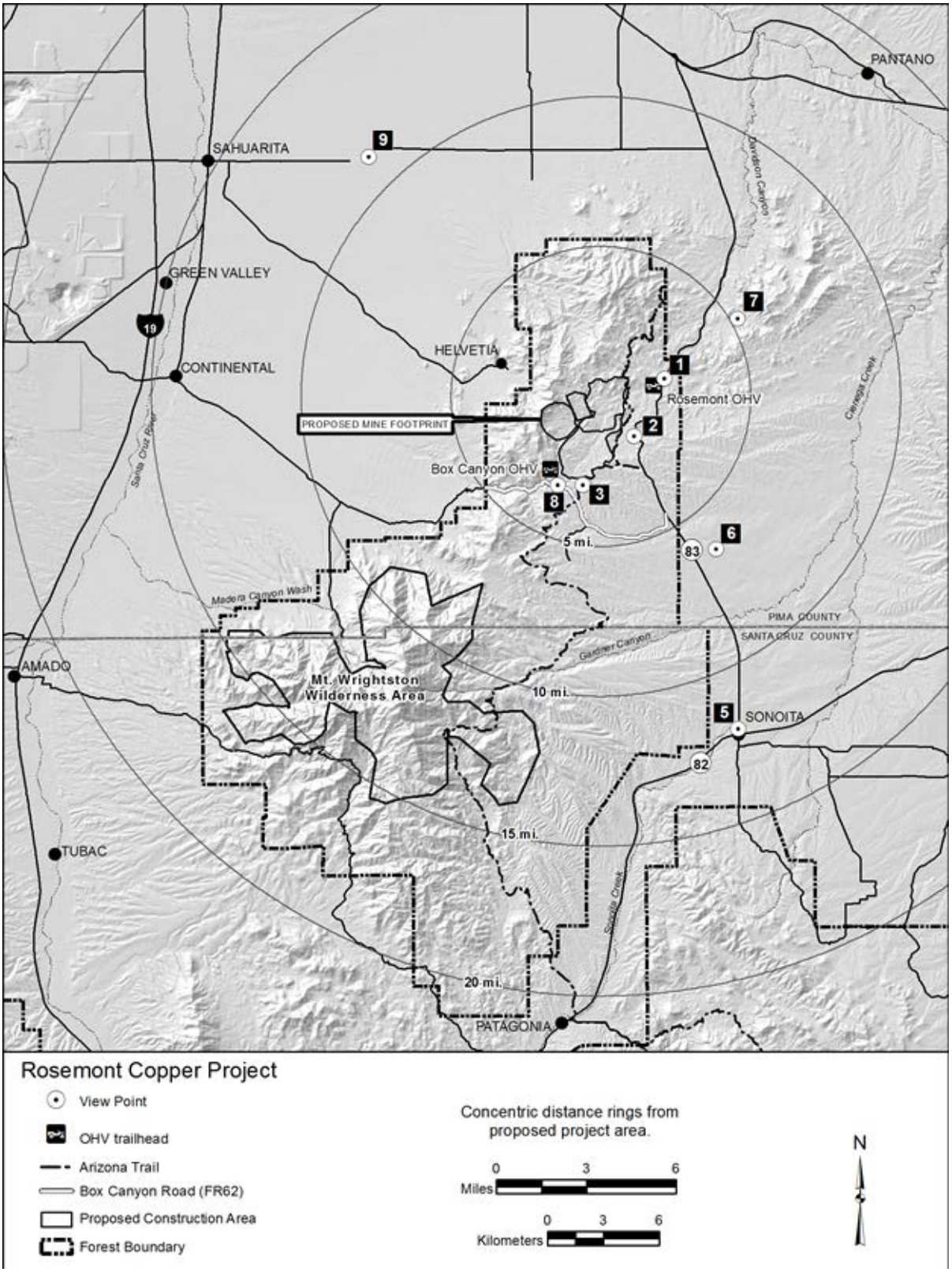


Figure 67. Analysis viewpoints

It should be noted that the methodology applied to analyzing impacts to forest visual resources is based on the changes in scenic quality as viewed by the public from areas within and outside the forest boundary. Thus, the emphasis in the analysis is on changes to the sensitive viewscapes on the Coronado National Forest and the visibility and degree of those changes to the viewing public when viewed from travel ways and use areas.

Contrast Analysis

Contrast analysis is a method by which potential project related changes to the landscape are assessed. The Forest Service and Bureau of Land Management use this type of analysis to describe landscapes and analyze the impacts to scenic quality, the goal being to apply a level of objectivity and consistency to the process and, thereby, reduce the subjectivity associated with assessing landscape character and scenic quality impacts.

Contrast analysis can be summarized as follows: the degree to which a project or activity affects scenic quality depends on the visual contrasts created or imposed by a project on the existing valued landscape. These imposed contrasts can be measured by comparing the project's features with the major features in the existing landscape (Bureau of Land Management 1986).

The Forest Service and Bureau of Land Management apply the concept slightly differently (e.g., different terminology, different ranges for assessing impacts); however, the essential contrast analysis process described below is common to both agencies. Contrast analysis was used to characterize scenic quality within the analysis area and, in combination with other Forest Service analysis criteria, was used to assess potential scenic quality impacts.

The landscape features used to compare the existing landscape with the potentially modified landscape are landscape forms, colors, textures, and lines. Landscape form refers to the unified masses or shapes of the landscape being analyzed, such as existing structures, topography, and natural objects (e.g., conical peaks, rolling grassland, flat river valleys). Landscape color refers to the colors of vegetation, soils, water, rock, sky, and cultural elements. Landscape textures are the variations, patterns, density, and graininess of the landscape surface (e.g., uneven, sparse, and randomly spaced shrubs in an arid landscape; dense, tightly packed trees in an old growth forest) and the dimensions of those surface variations (e.g., tall conifers, low shrubs, short grasses). Linear landscape features are the real or imagined paths that the eye follows when perceiving abrupt changes in form, color, or texture. These are often noticeable as the edge effect created at the boundary of two contrasting areas (e.g., a line of trees along a rocky slope or ledge, the abrupt boundary between forest and grassland, a dark ridgeline silhouetted against a bright sky). It should be noted that all of these observable landscape features (line, form, color, and texture) can be affected by environmental factors that include the viewing distance, the angle of view, atmospheric effects (e.g., haze, fog, dust, smoke), lighting conditions, and time of day.

In general, the project related landscape changes that repeat the natural features of the landscape or changes that are well integrated with existing landscape features are considered to be in harmony with their surroundings. These changes produce low levels of contrast and are considered to have a low impact on existing scenic quality or on the existing scenic values of the landscape. Landscape modifications that do not harmonize with the surrounding landscape are considered to be in contrast with that landscape; that is, the contrasts appear obvious, stand out, and can be aesthetically displeasing to viewers because they are not well integrated with the existing natural landscape.

For the Rosemont Copper Project, the degree of change to the landscape was determined for areas with high scenic attractiveness (distinctive and typical) and high scenic value (i.e., very high and high scenic integrity). Areas with high visual sensitivity were also considered (i.e., landscapes that are most interesting and appealing to the public and whose changed scenic values would be of concern to the public). On the Coronado National Forest, roads and trails with high sensitivity have been designated as concern levels 1 and 2 (figure 68). These travel ways tend to lie within undeveloped, natural landscapes and include nearly all of the Coronado National Forest landscape within and surrounding the project area (see figures 66 (scenic integrity) and 68 (concern levels)).

The process of analysis is as follows: an evaluator obtains a detailed description of the proposed project to ascertain the types of activities proposed, identifies the designated scenic or visual management objectives within the project area, and selects representative viewpoints from which the project area's landscapes are described and the project related impacts on scenic quality are determined. Forest Service and Bureau of Land Management analysis viewpoint selection criteria are similar: viewpoints used for analysis are selected along well used roadways and trails and near communities, as these are areas from which the greatest number of people would see the project impacts for the greatest length of time.

Once the representative viewpoints have been selected, the project area's existing landscape character is described from the viewpoints using the landscape elements or features of form, line, color, and texture as discussed above. The purpose of characterizing or describing the landscape is to establish a qualitative baseline of existing scenic values and scenic quality. Typically, the landscape is digitally photo documented from the viewpoints, the precise location of the viewpoint is recorded using the global positioning system, and any relevant field notes are recorded. The digital photographs are then used to prepare the landscape description and prepare visual simulations of the proposed project.

After reviewing the project description, determining the types and intensities of proposed development, describing the project area landscape, and noting the visual management objectives for the area, landscape contrast analysis is conducted to determine the potential impacts to the baseline scenic values. The degree of landscape contrasts potentially created by a project are then compared with the existing landscape character and with the scenic management objectives for that area to determine whether the potentially imposed project related landscape contrasts are consistent with designated scenic management objectives. For the Forest Service, these would be the designated scenic integrity objectives; for the Bureau of Land Management, these would be the Visual Resource Management System class objectives.

Projects that create landscape contrast with the existing lines, forms, colors, textures, or scale of the valued landscape character would have adverse impacts; projects that are in harmony with the existing landscape's line, form, colors, textures, and scale would not have adverse impacts. Computer based visual simulations of the proposed project development and visual contrasts are produced prior to analysis and are used as an aid in visualizing the degree of change that would be imposed on the existing landscape. The impacts to visual resources are considered important, substantial, or significant (in the context of the National Environmental Policy Act) if the effects of the proposed action or the action alternatives would exceed scenic management objectives.

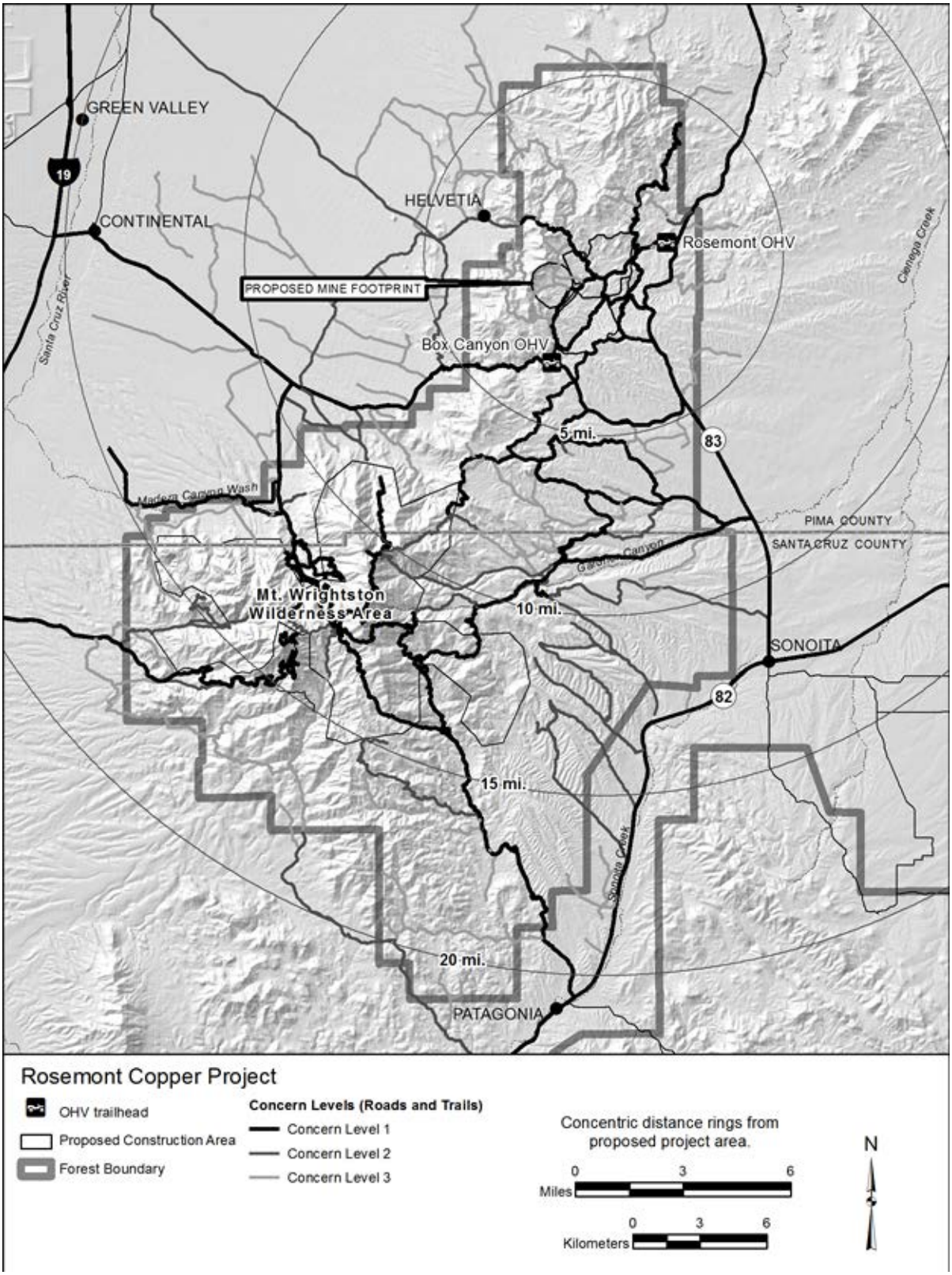


Figure 68. Coronado National Forest road and trail concern levels

Assumptions and Unknowns

For this analysis, the project area is defined as the area within the Rosemont project perimeter fenceline of the action alternatives. While the chapter 2 descriptions of the alternatives conceptually depict the mine tailings and waste footprints, roadways, and structures, it is assumed that surface disturbances could be anywhere within the perimeter fenceline.

As discussed in detail below, the project would include reclamation and revegetation efforts to partially mitigate the impacts of the project on the landscape. It is assumed that revegetation of the disturbed landscapes both during mine operations and after mine closure would be successful to the degree anticipated, based on Forest Service field experience with project reclamation within the region (Lefevre 2010) (see "Soils" section for estimated vegetation success and coverage). Specifically, waste rock and tailings piles slope recontouring and terracing, combined with a seed mix adapted to the local environment, would create conditions for the establishment and spread of grasses, forbs, shrubs and a limited amount of trees.

It is assumed that these vegetation types would eventually become established at a density to provide sufficient coverage to reduce the color, texture, and line contrasts created by the project. It is presently unknown how long it would take after reseeding to achieve the degree of plant density and coverage needed to mitigate the highly visible slope contrasts, as seen from nearby travel ways and use areas. Moreover, as noted in the "Air Quality and Climate Change" section of this DEIS, climate change research indicates that temperatures in the Southwest will rise and precipitation will decrease over the next 100 years, which would reduce the success rate of revegetation efforts. Additionally, it is assumed that erosion and slope failures would be minimal and that larger slope failures would be repaired and revegetated quickly.

Postmine treatments along the pit edge to protect public safety are unknown. A barbed wire fence would be constructed to prevent any approach to the pit edge, but additional safety measures may be required, such as berms, boulders, additional fences, or a combination of these. The impacts to scenic quality from these structures are unknown.

It is unknown how visible the top of the tailings piles would be during the early years of Rosemont Copper Mine development for each alternative, as the annual projected heights of the tailings, heap leach pads, and waste rock piles are currently unknown. The Hilton Ranch area to the east of the project area is a locale where this could be an issue.

As mentioned in chapter 2, sections of the Arizona National Scenic Trail would need to be rerouted or relocated under all of the action alternatives because the trail would lie within the project area boundary and waste rock and tailings piles would cover segments of the existing trail. At the time of DEIS publication, the exact routes of the proposed trail realignments are unknown. The realignments shown are conceptual routes, with no on-the-ground trail feasibility determination and no verification that the realignments would meet Forest Service trail standards (U.S. Forest Service 2008c). The current conceptual alignments for the Barrel Alternative and the Scholefield-McCleary Alternative lie within narrow strips of land between the project area perimeter fence and the State Route 83 right-of-way, on steep topography with few opportunities to re-route the trail.

As discussed in more detail below (see the "Impacts Common to All Action Alternatives" part of this section), a general qualitative analysis of impacts to Arizona National Scenic Trail scenic quality is possible. However, the lack of data on the precise trail realignment prevents the quantitative calculation of miles of direct line-of-sight views of the project area from the trail and prevents a

quantitative analysis of acres of impacts to the foreground, middle ground, and background views from the trail.

Magnitude and Duration of Impacts

To assess the impacts of each alternative, the National Environmental Policy Act requires that potential impacts be considered in terms of their context and intensity. The context for impacts to scenic quality is the analysis area depicted in figure 65. The intensity of impacts refers to the magnitude or severity of the impact and its duration (U.S. Forest Service 2008c). Table 118 shows the level of impacts (and their definitions) used to assess the magnitude and severity of impacts to scenic resources within the analysis area. The ranges of magnitude and duration shown were derived from Forest Service and Bureau of Land Management visual management systems and are a combination of elements from both systems.

Table 118. Magnitude and degrees of effects

Attribute of Effect	Description Relative to Visual Resources
Impact Magnitude	
No Impact	Would not produce obvious changes in landscape contrasts.
Minor	Project related impacts to scenic quality that would retain the existing character of the landscape, would create a low level of change, and, while seen, would not attract the attention of the casual viewer.
Moderate	Impacts to scenic quality that would partially retain the existing character of the landscape and, while attracting the attention of the casual viewer, would not dominate the view.
Major	Project related impacts that would create a high degree of change within the existing landscape, would dominate the view, and would be a focus of viewer attention.
Impact Duration	
Short Term	Less than 5 years (including the period of project construction).
Long Term	More than 5 years through the end of the project (including project closure).
Permanent	Beyond project closure. Permanent impacts would range from project closure to approximately 100 years for partial revegetation, and to geological time periods for rock weathering.

Significance Criteria

Forest Service policy pertaining to the National Environmental Policy Act stipulates that assessing the impacts of each alternative also includes consideration of the significance of project related changes to the environment (U.S. Forest Service 2010c). In the context of impacts to scenic quality, the National Environmental Policy Act threshold for significance would be a Federal agency determination about whether the magnitude of project related visual contrasts meet or exceed Forest Service and/or Bureau of Land Management visual resource management objectives. Specifically, the significance threshold indictors for impacts to visual resources within the project area would be as follows:

- Consistency with and conformity to Forest Service scenic integrity objectives; and
- Consistency with and conformity to designated Bureau of Land Management Visual Resource Management System class objectives.

Data Sources

The following data sources were referenced when conducting the field survey, visual resource characterization, and subsequent analyses:

- Geographic information system data – Field maps, including geographic information system coverage of visual management on the Coronado National Forest, were prepared and reviewed for use in field surveys and impacts analysis. A geographic information system based viewshed analysis was conducted to determine the extent of visibility of the project as seen from sensitive viewing areas. Other geographic information system based analyses were conducted to determine where forest concern levels, scenic integrity objectives, and scenic attractiveness coverage intersected with project visibility. A quantitative determination of the number of miles of the project area that would be visible from State Route 83 (the Patagonia-Sonoita Scenic Road), the Arizona National Scenic Trail, and other major scenic travel ways was calculated using geographic information system software.
- Field surveys – Visual resources field surveys were conducted by SWCA Environmental Consultants in 2009 within the project area, outside the project area, and on the Coronado National Forest where project impacts could potentially be seen, and at potentially sensitive viewing areas and along travel ways within the region surrounding the Coronado National Forest. These include forest roads, Arizona state routes, and Pima County roads; recreational use areas and viewing areas; State Route 83 Scenic Road; local communities and urban areas; and rural residential areas. Analysis viewpoints were selected based on the results of the surveys.
- Forest plan, as amended – The forest plan (U.S. Forest Service 1986) was considered for its policy and management directions.
- Rosemont Copper Project documents – Project related data, proposed project alternatives, construction details, and proposed reclamation and revegetation alternatives were considered for their potential impacts on scenic quality.

Summary of Effects by Issue Measures by Alternative

Table 119 presents the summary comparison of impacts from each alternative.

Table 119. Summary of effects on visual resources by alternative

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
7: Coronado National Forest scenic integrity impacts (acres of project area visibility within very high and high scenic integrity objectives)	No impact.	13,742	13,427	14,773	21,170	21,904

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
7: Qualitative assessment/degree of change in landscape character from analysis viewpoints: Open pit impacts	No impact.	Strong contrasts and adverse impacts from highly visible pit face and diversion channel.	Similar to proposed action, but more visible in early years and slightly less visible permanently.	Pit face and diversion channel permanently visible.	Same as Barrel Alternative.	More adverse impacts than proposed action because of open views of pit face and diversion channel.
7: Qualitative assessment/degree of change in landscape character from analysis viewpoints: Waste rock and tailings impacts	No impact.	Permanent, major, adverse impacts from highly visible piles; irreversible loss of scenic views.	Permanent, major, adverse impacts from highly visible piles; irreversible loss of scenic views; scree slopes and increased pile visibility would increase adverse contrasts.	Same as proposed action.	Same as proposed action.	Same as proposed action, but also visible from west side of Santa Rita Mountains.
7: Qualitative assessment/degree of change in landscape character from analysis viewpoints: Processing facility impacts	No impact.	Facility exposed to view for up to 7 years, then screened by waste rock and tailings.	Facility exposed to view for 12 years, then screened by waste rock and tailings.	Facility visible for approximately 10 years, then partially screened by waste rock and tailings.	Same as Barrel Alternative.	Visible for entire mine lifetime.
7: Qualitative assessment/degree of change in landscape character from analysis viewpoints: Power line impacts	No impact.	Adversely visible in Box Canyon, along ridgeline, and at Lopez/Gunsight Pass for life of the project.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.
7: Miles of project area visibility along concern level 1 and 2 forest roads and trails within the Coronado National Forest (and outside the project area)	No impact.	40	40	42	59	52
7: Miles of State Route 83 with direct, line-of-sight views of the project area*	No impact.	3.4	3.5	3.9	4.9	3.5
Other Effects Considered						
Project area regional visibility (acres)	No impact.	187,893	245,038	264,795	260,589	763,295

* Miles of the realigned Arizona National Scenic Trail with direct line-of-sight views of the project area cannot be calculated until the Forest Service has reviewed and approved the final realignment routes.

Affected Environment

Relevant Laws, Regulations, Policies, and Plans

Mining projects on Federal lands are guided by Federal laws, regulations, and policies, with some State-specific directions. Therefore, Federal policy and regulations, and planning guidance stipulated within the forest plan serve as the basis for visual resource management for the project.

Federal laws require Federal land management agencies to consider scenery and aesthetic resources in resource planning, project design, implementation, and monitoring. Federal laws applicable to the Rosemont Copper Project include the Multiple-Use Sustained-Yield Act of 1960, National Trails System Act of 1968, National Environmental Policy Act of 1969, Environmental Quality Act of 1970, Forest and Rangeland Renewable Resources Planning Act of 1974, National Forest Management Act of 1976, Surface Mining Control and Reclamation Act of 1977, and Public Rangelands Improvement Act of 1978.

Forest Service Manual 2380, “Landscape Management,” provides direction for visual resources inventory, evaluation, management, and, when applicable, restoration of scenic quality as a fully integrated part of the ecosystems of national forest lands. Specifically, Forest Service Manual 2380.15 addresses minerals management by referencing 36 Code of Federal Regulations 228 and requires minerals operations to be harmonized with scenic values. A series of Forest Service handbooks provides technical guidance in managing landscape aesthetics and scenery.

Visual inventory and management guidelines under the Visual Management System are described in Forest Service Handbook 462, “National Forest Landscape Management, Vol. 2.” However, since the mid-1990s, national forests have been directed to use the improved Scenery Management System and scenic integrity objectives as defined within Forest Service Handbook 701, “Landscape Aesthetics: A Handbook for Scenery Management” (U.S. Forest Service 1995). The Scenery Management System handbook provides guidance for defining landscape units based on landscape character types, scenic integrity, and scenic attractiveness. These concepts are discussed in detail below. It also provides guidance for identifying sensitive views (views that are of concern to the public) and for mapping landscape visibility. In 2001, the Coronado Scenery Management System Inventory was completed, and Forest Service letter 2380 from the Coronado forest supervisor directed that the Scenery Management System inventory be used for project-level planning where activities have the potential to affect scenic resources (U.S. Forest Service 2003a).

Coronado Forest Plan

The amended Coronado forest plan defines five forestwide visual resource management standards and guidelines; three are applicable to the proposed project area (U.S. Forest Service 1986):

1. Continue to maintain and protect the visual integrity of the landscape by meeting or exceeding the established visual quality objectives.
2. Rehabilitate or enhance the existing visual quality in the process of accomplishing other management practices.
3. Viewshed corridors management plans will be prepared for management activities that fall within viewing areas of recreational roads and their associated recreation areas.

The forest plan provides direction for management areas 1, 4, and 7 and specifies that visual quality objectives will be met.

Other Scenery Management Plans and Guidance

Patagonia-Sonoita Scenic Road

The Patagonia-Sonoita Scenic Road was designated by the Arizona Department of Transportation in 1985 because of the variety of highly scenic views visible to motorists as the road passes along the southern Arizona desert floor, through rolling hills, and across mountain ranges (National Scenic Byways Program 2010). The scenic road designation includes portions of State Route 83 (from mileposts 58 to 33) and State Route 82 (from mileposts 32 to 4.5) in order to preserve the unique scenic and historic richness of the areas through which the scenic road passes. A section of the Patagonia-Sonoita Scenic Road lies within the northeast corner of the Coronado National Forest, and it also passes through the communities of Sonoita and Patagonia.

The "Patagonia-Sonoita Scenic Road Corridor Management Plan" was completed in 2003 to encourage collaborative community planning for the road and to provide strategies to preserve the visual and cultural-historic resources along the road (Wheat Scharf Associates 2003). The corridor management plan describes the existing conditions and opportunities for the road, defines the six intrinsic qualities as archaeological, cultural, historic, natural, recreational, and scenic resources, and lays out strategies to preserve and enhance the intrinsic qualities that draw residents and visitors to the corridor. It defines the measure of scenic quality as "how memorable, distinctive, uninterrupted, and unified" the view is perceived to be (Wheat Scharf Associates 2003).

Visual resources along State Route 83 include views while driving, scenic stops, and attractions. One scenic rest stop and one pulloff along the route are on the Coronado National Forest (mileposts 44 and 42, respectively). The corridor management plan states, "The first goal of the Patagonia-Sonoita Scenic Road is to conserve and enhance the natural and scenic resources that make this area such an important place to protect and a privilege to visit" (Wheat Scharf Associates 2003).
The corridor management plan proposed three objectives with specific strategies for the management of scenic and natural resources that focused on protecting the biotic communities, unique habitats, watersheds, and scenic vistas. Specific strategies for scenic resource protection included prioritizing land acquisition, developing design review boards, and developing land use zoning with overlay zones to protect scenic visits.

Bureau of Land Management

The proposed Rosemont Copper Project electric transmission line would cross portions of the Bureau of Land Management Tucson Field Office. Portions of the field office lie within sensitive viewscapes as seen from the selected visual analysis viewpoints (see below). Note that the Bureau of Land Management defines the "field office" as the entire area within its land management jurisdiction and not just the physical structure that contains the offices for agency personnel. The Bureau of Land Management is a land management agency similar to the Forest Service in that it also uses a systematic approach to managing and assessing impacts to visual resources within its jurisdiction.

The Bureau of Land Management uses a Visual Resource Management System and impacts assessment process that also employs contrast analysis, specific analysis viewpoints (referred to as key observation points) and analysis criteria (e.g., viewer sensitivity, slope, visibility, project size) to analyze potential project related impacts to landscapes. Under the Bureau of Land Management's Visual Resource Management System, visual resource management objectives are designated through the resource management plan process as visual resource management classes.

The primary objectives of the Visual Resource Management System are to maintain the existing visual quality of Bureau of Land Management administered public lands and to protect unique and fragile visual resources. The Visual Resource Management System uses four classes to describe the different degrees of project related impacts allowed to the basic elements of the existing landscape, as discussed above for the Forest Service Scenery Management System (i.e., line, form, color, and texture). The Visual Resource Management classes and objectives are as follows:

> **Class I.** The objective is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and should not attract attention.
>
> **Class II.** The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
>
> **Class III.** This class objective is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
>
> **Class IV.** The objective of class IV is to provide for management activities that require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repetition of the basic elements of the landscape. (Bureau of Land Management 1986)

Under the Bureau of Land Management current resource management plan, the Las Cienegas National Conservation Area is designated Visual Resource Management Class II (49,000 acres), and the Santa Rita parcels west of the project area are designated Visual Resource Management Class III (Bureau of Land Management 2003). Within the Las Cienegas National Conservation Area is the Empire Ranch Headquarters, which is listed in the National Register of Historic Places; management to preserve the historic integrity of the ranch includes consideration of the visual resources and landscape setting.

For the project, areas within Bureau of Land Management administered public lands that have been determined to have sensitive views and could potentially be impacted by project development are the landscapes surrounding the Las Cienegas National Conservation Area and the landscapes surrounding the Santa Rita Ecosystem Management Area. In addition to its regular planning and resource management processes, the Bureau of Land Management has participated in the Sonoita Valley Planning Partnership as a voluntary association of Federal, State, and local agencies, organizations, and private citizens.

The Sonoita Valley Planning Partnership was formed to collectively resolve local and national issues affecting public lands in the Sonoita Valley (Bureau of Land Management 2003). The Bureau of Land Management Las Cienegas Resource Management Plan adopted, through incorporation, many of the

recommendations resulting from the Sonoita Valley Planning Partnership process, including the vision, goals, and resource objectives. The Sonoita Valley Planning Partnership goals for the planning area include the following:

> [Goal] 7. Maintain the region's scenic beauty and open spaces.
>
> 1. Protect the Empire-Cienega Planning Area and the integrity of public lands in the Sonoita Valley.
> 2. Maintain the character of the Empire-Cienega Planning Area by limiting building of any new roads or structures; maintaining the existing road system in its primitive character and condition; using existing road conditions to help control speed while providing sufficient recreational opportunities.
> 3. Alter or upgrade existing roads where needed to protect natural resources on public lands in the Sonoita Valley.
> 4. Encourage interaction and cooperation with other agencies and landowners, including acquiring land to protect and enhance the region's scenic beauty. (Bureau of Land Management 2003)

Arizona National Scenic Trail

Designed as an 807-mile-long nonmotorized trail that extends from the U.S.-Mexico border to the border of Arizona and Utah, the Arizona National Scenic Trail provides opportunities for mountain bikers, equestrians, cross-country skiers, and hikers to experience Arizona's topographic, biological, cultural, and historical diversity. The trail was designated a national scenic trail by Congress under the Omnibus Public Land Management Act of 2009. National scenic trails were designated under the act to protect areas of particular natural and beauty and scenic quality.

Portions of the trail lie within public lands administered by the Forest Service, Bureau of Land Management, and National Park Service. Arizona State trail management partnerships include the Arizona Trail Association and Arizona State Parks (Bureau of Land Management 2011). Trail segments that lie within federally administered lands are managed according to the goals and resource objectives for that agency (e.g., the Coronado forest plan and Bureau of Land Management Field Office management plans). However, as a designated long-distance trail under the National Trails System (16 United States Code 1421), the lead Federal agency for managing the trail is the Forest Service (Arizona Trail Association n.d. (2011)).

The 1995 interagency plan for managing the trail states that the vision of the Arizona National Scenic Trail includes "providing opportunities to experience and reflect upon Arizona's diverse cultural and natural heritage along the trail corridor" (Arizona State Parks 1995). The plan also states that the trail corridor was "conceived in 1985 and has evolved to connect Arizona's public lands, mountain ranges, trail systems, communities, as well as, to traverse the great variety of natural settings present within the state" (Arizona State Parks 1995). The plan contains guidance for enhancing and maintaining the trail, such as the following:

- "Scenic sites or areas of natural beauty such as bluff lines, ridgetops, and other features not directly accessible by the Arizona trail, should be connected to the Arizona Trail by spur trails. These areas of high scenic quality provide additional destinations for trail users and enhance their experience" (Arizona State Parks 1995); and

- "To maintain a primitive experience for Arizona Trail users, a scenic and natural corridor is necessary to adequately buffer the Trail from incompatible activities on adjacent lands. Ideally, a 1,000-foot corridor width, such as used with the U.S. Forest Service's Visual Management System, is generally an adequate guideline. There will be instances where the corridor should be widened to provide additional protection, and other cases where it can be narrowed to accommodate adjoining land uses. Public land managing agencies should not only address long-term protection of the Trail alignment within their resource management or general plans, but also how the surrounding Trail corridor will be protected or managed" (Arizona State Parks 1995).

Activities and events along the trail that have and are presently affecting scenic quality include power transmission line and utility corridor construction and right-of-way clearing, prescribed burning within the forest to reduce wildland fire risks, naturally occurring fires, rock quarrying, and forest restoration projects. Specifically, the actions currently affecting the scenic quality of the trail are as follows:

- The Warm Fire – The 2006 Kaibab National Forest wildland fire burned more than 7 miles of the trail, with long-term losses of scenic value;
- The Willow Fire – Located in the Tonto National Forest, this 2004 wildland fire burned more than 60 miles of the trail, with long-term losses of scenic value;
- The Schultz Fire – This fire, on the Coconino National Forest, affected 5 miles of the trail. The trail was closed along this affected section and re-routed;
- The Monument Fire – Located on the Coronado National Forest, this 2011 wildfire burned 7.75 miles of the trail, with long-term losses of scenic value; and
- Numerous transmission line and utility corridors on Forest Service, Bureau of Land Management, and State Trust Lands along the trail.

Existing Conditions and Landscape Character

Landscape character consists of the geological, biological, and cultural attributes that give an area a "sense of place." These attributes include landforms, vegetation, water elements, and cultural or human-made features. Lands with the most natural variety and the most harmonious composition have the greatest scenic quality.

Southeastern Arizona (and the project area) lies at the junction of the Rocky Mountains, the north end of the Sierra Madre, and where the Chihuahua and Sonoran Deserts overlap. This juncture creates unique biological resources and unique landforms. The landforms are characterized as a series of mountain ranges separated by deserts that rise above the arid lands and are known as the "sky islands." This ecoregion ranges from southern Arizona and New Mexico to northern Mexico, with approximately 40 islands in the sky (Warshall 1995).

The topography of the sky island region includes defined ridges, rocky outcrops and canyons, rolling foothills, and wide valleys. The Santa Rita Mountains reach an elevation of 9,453 feet, and the project area is located on the northeast flank of the mountains at approximately 4,800 feet. The project area includes rolling hills near State Route 83, a series of canyons and incised arroyos, and rocky, sharply undulating ridgelines. Figure 69 shows a typical project area landscape view.

Figure 69. A project area landscape

In the lower elevations within and surrounding the project area, the landscape includes rolling hills, where lines from light-colored grasses of the savannas contrast with the vertical angles of the trees and shrubs within the woodlands and rocky outcrops along the ridge. Landform features include converging lines from gentle, undulating slopes and the jagged, sharp skyline of the Santa Rita Mountains. In the bottom of drainages, vegetation typically includes very large oak and walnut trees, and where water is more plentiful, riparian species such as cottonwoods. For more detailed information on vegetation, see the “Biological Resources” section.

Textures in the area vary from smooth, low-lying grasslands to patchy clumps of trees and shrubs. Striations of vegetation define northern slopes and arroyo bottoms. Rough, rocky canyons and ridges contrast with expanses of smooth, grassy slopes and patches of trees and shrubs. Isolated, dense stands of lush green vegetation cluster around the rural residential areas and ranches that surround the Coronado National Forest.

Landscape colors are greatly affected by season and by variations in lighting, sun angle, dust, air quality, and distance. Grasses and savannahs are typically bright green during summer and winter rainy seasons but tend to be golden yellow during the drier parts of the year. Dark green evergreen trees contrast with the grasses. Rock colors are generally weathered, light to dark in hue, broken, and mottled. Light-colored elements such as roads, talus fields, and disturbed soils tend to contrast sharply with other landscape colors.

Cultural elements are those human-altered attributes in a landscape that are valued because of historical or nostalgic connotations. Visual evidence of human activities includes working ranches,

old homesteads, and remnants of small mines. Evidence of Native American sites is less prominent. Old homesteads that were settled followed the Gadsden Purchase of 1853 still exist; remnants of gold, silver, and copper mine operations that continued into the 20th century are also visible on the landscape.

As mentioned above under the "Analysis Methodology" part of this section, eight analysis viewpoints were selected to assess the potential impacts of the project to scenic quality on the forest landscapes surrounding the project area. The viewpoints are described below. The locations of the analysis viewpoints are depicted in figure 67.

Viewpoint 1 – State Route 83, Scenic Rest Stop

The viewpoint is located at milepost 46 at a scenic view pulloff and picnic area rest stop along State Route 83, near open views to the Santa Rita Mountains as motorists travel south from Interstate 10. This viewpoint was selected because it provides unobstructed views within the Coronado National Forest of the Santa Rita Mountains slopes and ridgeline, along with wide, expansive views of the landscape. The viewscape is generally to the south and west and includes views of Mount Wrightson Wilderness. This viewpoint is described in the Patagonia-Sonoita Corridor Management Plan as a future point of interpretation for travelers.

Foreground views are of a relatively flat topography, with low ridges and hills in the far foreground. A strong line contrast is visible where the flat foreground converges with steep middle ground slopes. Foreground colors are dominated by buff and green vegetation composed of dense, evenly spaced grasses and shrubs. Middle ground views are dominated by a series of low ridges and slopes. An undulating ridgeline creates a silhouette effect with the background sky, and middle ground ridge slopes are sparsely vegetated with patchy and clumpy, low-growing vegetation. Middle ground colors are predominantly buff to tan soil and exposed rock. Background views are of the Santa Rita Mountains. The range is partly obscured by middle ground topography, but dark-colored vegetation and exposed rock outcrops are visible.

Viewpoint 2 – State Route 83, Scenic Pulloff

The scenic pulloff is located at milepost 44 and provides expansive views to the west and east of the route. This pulloff is often visited by tourists, recreationists, and photographers as they are driving through the Coronado National Forest. Forest roads used for dispersed recreation are accessed immediately to the south of this pulloff. This pulloff has been considered in the Patagonia-Sonoita Corridor Management Plan for future scenic tourism development.

From this perspective, the foreground view is foreshortened by rising topography. An undulating landscape with evenly spaced shrubs and dense grasses dominates the foreground view. Colors range from tan grasses and exposed rock and soil to light and dark green shrubs and small trees. Middle ground views are partially obscured by the rising topography in the foreground but are a continuation of the foreground view, with gentle, undulating slopes receding into the background. Background views are of the Santa Rita Mountains, where a strong linear contrast is created by the range's ridgeline with the background sky. Background topography is steep, complex, and rugged, with clear views of exposed gray rock. Patchy, dark green vegetation is visible on the middle to lower ridge slopes.

Viewpoint 3 – Arizona National Scenic Trail

This viewpoint is located north of Box Canyon Road and was selected as a typical view from the Arizona National Scenic Trail as experienced by hikers, bikers, and equestrians. As the trail traverses and climbs several rises and ravines, the views are unobstructed in all directions. Although this viewpoint is typical of many of the views along the trail, views from other parts of the trail will be similar to viewpoints 1 and 2.

The foreground views are dominated by rolling topography along the lower slopes of the Santa Rita Mountains. Densely growing, buff grasses interspersed with occasional shrubs and trees cover the landscape. Middle ground views are of the Santa Rita Mountains middle and upper slopes. Middle ground topography is rugged, rough, and irregular. Dark green and tan vegetation grows in dense patches and lines along the middle and upper slopes, and a strong line contrast is created between the sky and the range's irregular ridgeline. Background views are fully obscured by the proximity of the range.

Viewpoint 4 – Mount Wrightson Wilderness

This viewpoint was not used in the analysis because field conditions during photo documentation were poor. Smog and haze reduced visibility of the project area, as seen from the upper slopes of Mount Wrightson, to the degree that acceptable, representative long-distance views were unobtainable. Photographs taken from this location were unacceptable for use in analyzing impacts.

Viewpoint 5 – Rural Sonoita

This viewpoint is located approximately 0.25 mile north of Sonoita Junction and the intersection of State Routes 83 and 82. The existing conditions photograph was taken on the first rise when traveling north from Sonoita toward the Santa Rita Mountains and project area. The view is representative of several sensitive viewsheds—the views tourists and residents have as they are traveling north on State Route 83 and the views from rural residences that surround the Sonoita area. The views are generally panoramic, expansive, and rural in nature, bounded only by the various distant mountain ridges on either side of the valley floor.

Immediate foreground views are of State Route 83 receding into the distance, a relatively flat landscape covered with brown and tan grasses and occasional trees and shrubs. A higher density of trees is visible in the far foreground. The middle ground is a continuation of the foreground landscape, with a gentle topographic rise that partially blocks views to the north. The background view is defined by the middle and upper slopes of the Santa Rita Mountains. From this perspective, the landscape details are indistinct because of the viewing distance, but rocky outcrops, patchy vegetation on the upper slopes, and the ridgeline are visible.

Viewpoint 6 – Bureau of Land Management Las Cienegas National Conservation Area

The viewpoint is located along the entrance road between a Bureau of Land Management information kiosk and the entrance to historic Empire Ranch. The view is representative of visitors' views from the Las Cienegas National Conservation Area and Empire Ranch, along the primary access road into this popular destination for dispersed recreation and other activities associated with Las Cienegas Creek.

Views are highly dependent on the direction of travel: visitors entering the area would be focused on the prominent horizon of the Empire Mountains to the east, while visitors leaving the area would have views to the west of rolling hills, grasslands, and the higher points of the Santa Rita Mountains. From this point of view, and looking toward the project area, the foreground is composed of a series of long, low hills that block most of the middle ground from view. Dense grasses and a random scattering of dark green shrubs and low trees cover the foreground. A power transmission line recedes from the foreground into the middle ground. Visible middle ground views are a continuation of the foreground landscape features. Background views are composed of the middle to upper slopes of the Santa Rita Mountains. The landscape features are similar to those described above for viewpoint 5: an indistinct view of the range because of the long viewing distance but with the larger features such as rock outcrops, dense patchy vegetation, and the ridgeline distinctly visible.

Viewpoint 7 – Rural Residential Areas North of the Project Area

This viewpoint was selected to represent private, rural residential views in areas several miles north of the project area and east of the Santa Rita Mountains, as well as outside the Coronado National Forest boundary. Located near Hilton Ranch Road, the landscape is predominantly rural residential and mostly natural, with ranch buildings, houses, and supporting infrastructure spread throughout the area. Views are framed by steep topography to the west and focused on the Santa Rita Mountains to the south and west of the private properties.

In the foreground, the landscape topography consists of low hills and ridges. Scrubby trees and shrubs, grasses, and cacti cover much of the foreground landscape, with colors ranging from tan-buff grasses to dark green shrubs and trees. The middle ground is composed of a series of steep slopes rising toward the Santa Rita Mountains in the background. Vegetation covering the steep slopes is diverse and ranges from dense to diffuse and patchy. Gray rock outcrops are visible on the middle ground slopes and contribute to the gray-green vegetation and dark tan-brown exposed soil that is also visible from this perspective. Background views are of the Santa Rita Mountains, which are partially obscured by the high middle ground ridges. Strong line contrasts are created by the background ridgeline with the sky. Dark green vegetation is visible on the gray, rugged, steep, rocky mountain slopes. Rocky outcrops are visible among the dense patches and upper slope vegetation, and strong, complex color and form contrasts are created by the juxtaposition of rock and vegetation.

Viewpoint 8 – Box Canyon Road, Recreation Access, and Off-Highway Vehicle Staging Area

This viewpoint is along a popular east-west connector and travel route within the Coronado National Forest. Box Canyon Road offers a variety of scenic views for visitors who seek access to primitive roads, trails, camping sites, and other dispersed activities.

Views along the road are largely of the linear, riparian landscape and canyon walls that rise above the road; however, views to the north and south offer occasional opportunities to view Mount Wrightson and the Santa Rita Mountains through the vegetation. Many visitors to the Coronado National Forest use the resources at the Box Canyon off-highway vehicle staging area to prepare for their activities. The foreground view to the north of the road, toward the proposed mine site, is extremely limited at this viewpoint because roadside hillocks and raised areas obscure much of the view. Dense stands of trees and open grassy areas along the roadside also obscure the view. Landscape colors are predominantly dark green trees and shrubs and tan grasses and exposed soil. The middle ground and background views are obscured by intervening roadside topography.

Viewpoint 9 – Sahuarita Road

This viewpoint is along East Sahuarita Road, with the Santa Rita Mountains visible to motorists eastbound while traveling from Sahuarita and Interstate 19 toward Corona de Tucson and State Route 83 north of the Santa Rita Ecosystem Management Area boundary. It is a popular thoroughfare for rural residents who live near the forest boundary. It is also representative of the Tucson residential view of the Santa Rita Mountains. The outlying area of Tucson is approximately 8 miles to the north of the road, but views of the Santa Rita Mountains would be similar because the aspect would be comparable to Sahuarita Road views.

The foreground and middle ground views are similar from this perspective along the roadway: a topographically flat, unobstructed landscape with patches of exposed tan to buff soil covered with scrubby vegetation and low-lying trees and shrubs. Indistinct buildings and residences surrounded by trees are visible in the far foreground and middle ground. The foreground and middle ground landscape exhibits weak form, color, and line contrasts. The background is dominated by the rugged, visually complex, highly contrasting western slopes and ridges of the Santa Rita Mountains. A strong line contrast is created at the boundary of the flat topography in the far middle ground and the rapidly rising vertical mountain slopes. Background landscape colors are predominantly gray-brown exposed rock and patches of light green and dark green slope vegetation. Landscape textures are coarse. A strong linear contrast is created between the undulating ridgeline and background sky.

Sensitive Viewsheds

The analysis area has numerous sensitive scenic corridors that lie along travel ways and in public use areas (table 120). Travel ways include freeways, highways, roads, and trails where opportunities exist for scenic viewing. Public use areas include sites that receive concentrated public viewing use. Potential viewers of sensitive view corridors on travel ways include tourists and scenic recreational touring motorists, viewers traveling on local and commuting highways, and those using recreational trails. Public use area viewers include residents of the towns, communities, and rural areas that surround the project area, as well as viewers who use recreational sites surrounding the project area (e.g., local parks, trailheads, campgrounds, picnic grounds). This analysis uses concern level data obtained during the Scenery Management System inventory. Figure 68 shows public travel way concern levels.

Table 120. Sensitive viewsheds

Viewers	Distance from Project Area	Analysis Viewpoint*
Towns/Communities		
Tucson	Background	Viewpoint 9
Sonoita	Background	Viewpoint 5
Green Valley	Background	Viewpoint 9
Corona de Tucson	Middle ground	Viewpoint 9
San Xavier Mission	Background	Viewpoint 9
Sahuarita	Background	Viewpoint 9
Rural Residents		
Sonoita–rural	Background	Viewpoint 5
Hilton Ranch	Background	Viewpoint 7
Recreational Users		
Madera Canyon	Background	Unseen

Viewers	Distance from Project Area	Analysis Viewpoint*
Rosemont Off-Highway Vehicle Area	Foreground	
Roadside Table State Route 83	Foreground	Viewpoint 1
Box Canyon Road Forest Road 62	Foreground to Middle ground	Viewpoint 8
Arizona National Scenic Trail	Foreground	Viewpoint 3
Bureau of Land Management Empire Ranch	Middle ground	
Las Cienegas National Conservation Area	Middle ground	Viewpoint 6
Drivers–Tourists/Scenic		
Patagonia-Sonoita Scenic Road	Foreground to Middle ground	Viewpoints 1, 2, and 5
Box Canyon Road	Foreground to Middle ground	Viewpoint 8
Drivers–Residents/Commuters		
Interstate 19	Background	Viewpoint 9
East Sahuarita Road	Background	Viewpoint 9
State Route 83	Foreground to Middle ground	Viewpoints 1, 2, and 5
Wilderness Visitors		
Mount Wrightson Wilderness	Background	Viewpoint 4–No useful viewpoint photographic data obtained
Saguaro National Park (and Saguaro Wilderness)	Background	
Rincon Mountain Wilderness	Background	

* The communities, towns, recreation areas, and roads listed in the table are important areas of consideration within the analysis area. Note that the locations with analysis viewpoints are representative views for analyzing the potential impacts to the viewshed and to the viewers within that category. Describing the potential viewshed impacts of the proposed project from every major community, town, and recreation area listed in this table is beyond the scope of the analysis.

Cities, towns, and smaller communities with public concern about the project's visual impacts include Tucson, Green Valley, Sonoita, Sahuarita, Vail, and Corona de Tucson. There is also concern about sensitive views from rural residents adjacent to Coronado National Forest lands, including rural developments in Corona de Tucson, Sonoita, Fellows Ranch, Empire Ranch, Hilton Ranch, and Sycamore Estates.

Tourists, recreational motorists, and commuters use the major thoroughfares surrounding the project area: State Routes 82 and 83 (Patagonia-Sonoita Scenic Road) and Interstates 10 and 19. Other areas about which there are concerns about visual quality include roads used by local residents, commuters, and regional travelers, such as East Sahuarita Road and Box Canyon Road (Forest Road 62).

Local residents and visitors recreate in Madera and Box Canyons (where there is an off-highway vehicle staging area on Forest Road 231), along the Arizona National Scenic Trail, in Las Cienegas National Conservation Area, and in Saguaro National Park. Wilderness area visitors, such as those who visit Mount Wrightson Wilderness and Saguaro Wilderness in Saguaro National Park, also are concerned about high scenic quality views.

Existing Scenic Integrity

Existing scenic integrity is defined as the current state of the landscape, taking into consideration previous human alterations. It is the degree to which the landscape is considered "complete" or "intact." Very high scenic integrity landscapes are those that are unaltered by human activities.

High scenic integrity areas are those landscapes with little or no evidence of deviation or degradation from the desired landscape character and with no disharmonious landscape features. Deviations may be present but should repeat the line, form, color, and textures of the existing landscape character so completely, and at such a scale, that they are not evident (U.S. Forest Service 2003a). Moderate scenic integrity landscapes appear altered and noticeable, but deviations remain subordinate to the existing landscape form, line, color, and textures. Low scenic integrity are landscapes where the valued landscape character appears altered, and deviations from the valued landscape begin to dominate; however, those deviations borrow valued landscape features from the line, form, color, and textures beyond the area being viewed. Very low scenic integrity refers to landscapes that have been altered to a high degree. Landscape deviations strongly dominate the desired landscape character.

The scenic integrity of the project area and surrounding landscapes, as determined by the Coronado, is shown in figure 66. The Rosemont project area has high scenic integrity.

Coronado National Forest scenic integrity deviations are primarily caused by past and present mining. A quarry on the northwest side of the Dragoon Mountain ridgeline on the Coronado National Forest is visible from Tucson and Interstate 10; an active marble quarry lies on the northwestern slopes of the Santa Rita Mountains (visible from the Tucson Valley); and an electronic site at Melendez Pass on the Coronado National Forest is visible from surrounding areas. The Mount Hopkins Observatory, within the Coronado National Forest, is also regionally visible. More recent impacts are from Rosemont Copper's preconstruction activities on private land, including areas cleared as revegetation test plots.

Night Sky Conditions

At present, night sky conditions in the Santa Rita Mountains near the project area are minimally affected by artificial light sources. The area in and adjacent to the project area is dark at night, as there are few artificial light sources and no developed areas to affect night sky views. Background sources of lighting include headlights from vehicles traveling at night along State Route 83 and along forest roads, but there are no light poles along these roadways, nor are there lights in parking lots or visitor use areas to illuminate the roads, signs, access paths and trails, or parking areas. Sky glow is visible, caused primarily by lighting in the Tucson metropolitan area to the north; there is distant sky glow caused by lighting in Nogales and Sierra Vista to the south.

Regionally, the population of southeastern Arizona continues to grow, and the growth of urban areas contributes to degradation of night sky conditions. However, a recent study at Kitt Peak Observatory shows that there has been no increase in sky brightness over the past 10 years from regional population growth, which has been attributed to enforcement of metropolitan light shielding ordinances to prevent or minimize undirected light (Dark Sky Partners LLC 2011). See the "Dark Skies" section of this DEIS for an analysis of impacts to night sky viewing.

Regional Trends

Over the past century, landscapes and land uses in southeastern Arizona have changed dramatically. In 1902, when the Coronado National Forest was established, Tucson's population was less than 10,000, open space was abundant, and natural and cultural resources were minimally impacted by human use. Today, the population of metropolitan Tucson is more than 1 million, open space is increasingly scarce, and natural resources in the area are affected by urban sprawl, border impacts, and numerous human uses both off and on the Coronado National Forest. In addition, fire suppression

and long-term drought have resulted in widespread forest health problems and catastrophic wildfires. All of these affect scenic quality.

Arizona has the fastest rate of population growth in the United States, increasing from a statehood population in 1912 of approximately 200,000 to more than 6 million in 2005 (Arizona State Parks 2007). The population of metropolitan Tucson currently exceeds 1 million and also attracts seasonal migrations of “snowbird” Americans from northern states. The population of Arizona is expected to exceed 12 million by 2050 (Arizona State Parks 2007).

As population growth continues throughout the area, there is an associated trend toward increasing infrastructure development to support this population growth, including roads, housing, and commercial developments (sometimes adjacent to the Coronado National Forest boundary), along with utility lines and cell phone towers, which can further degrade scenic landscapes (Arizona National Forests Socioeconomic Assessment Team 2005).

Approximately 58 miles of the Coronado National Forest lies along the international border with Mexico. Every year since 1998, the Tucson sector of the U.S. Border Patrol has had the largest number of apprehensions of border crossers in the Southwest. In 2008, the Tucson sector accounted for 317,709, or 45 percent of all Southwest border apprehensions (U.S. Department of Homeland Security 2009). In recent years, a larger percentage of border crossers have been using the Coronado National Forest because of increased border security off forest. The increasing number of border crossers and drug smugglers traveling through the area means increased associated wildcat roads and trails, camps, and trash and debris piles, which affects forest scenery. Related to this activity is the increasing number of U.S. Border Patrol facilities (i.e., fences, roads, walls, and towers) necessary to control and apprehend border crossers, which contributes to scenic quality and scenic landscape degradation. The effects of these activities now extend many miles into the Coronado National Forest, not just along the international border.

Other activities exacerbating the trend toward loss of forest scenic landscapes include mining activities, construction of astrophysical facilities on mountaintops (including the Mount Hopkins complex in the Santa Rita Mountains, Mount Graham International Observatory in the Pinaleño Mountains, and Steward Observatory in the Santa Catalina Mountains), and the development of privately owned forest inholdings.

Closed and reclaimed copper mines and mine complexes are highly visible near the Coronado National Forest and continue to affect regional and forest scenic quality. The large Twin Buttes Copper Mine and waste complex near Green Valley is closed but is highly visible within the analysis area. Other past activities include limestone waste rock dumping near Sahuarita, as well as San Manuel Mine, which has been reclaimed but continues to affect visual quality.

Large mining activities that are presently ongoing within southeastern Arizona include the Mission Complex and Sierrita Mines near Green Valley. These are open-pit copper mines with surface disturbances and tailings and waste rock piles that are visible from Interstate 19 and nearby communities. Other mining activities include mines near Safford, Arizona, and the Silver Bell Mine near Marana, Arizona.

Although it has been closed since the 1960s, the new owners of the Twin Buttes Mine (Freeport McMoRan Copper and Gold, Inc.) are exploring opportunities to reopen the mine and have submitted an application to the State to purchase State land to construct a tailings dam for the currently active Sierrita Mine. Both of these would likely result in additional land disturbance and additional tailings

piles, some of which are expected to be high enough in elevation to be visible from surrounding areas.

The increasing demand for recreational opportunities on the Coronado National Forest is creating recreation area overuse, where recreation users are meeting and exceeding the carrying capacity of recreation areas and causing scenic resource damage. The increasing popularity of off-highway vehicle use on forest roads and trails, particularly in the Santa Rita Mountains and project area, is causing scenic resource degradation. Off-highway vehicles are four times as popular as they were a decade ago, and in the West, off-highway vehicle sales are double the national average and increased by 154 percent over a 5-year period between 2002 and 2007 (Arizona State Parks 2007). Both public and U.S. Border Patrol related use of these vehicles contribute to the creation of unofficial, unmanaged off-highway vehicle routes, which damages fragile desert vegetation and soils and affects scenic quality.

It should be noted also that weather related trends, including drought and climate change, also affect forest vegetation and scenic quality by contributing to large insect and disease outbreaks (and associated tree mortality) and catastrophic wildfires.

The Coronado National Forest sky islands are the largest natural landscapes in southeastern Arizona. The recreation trends discussed above highlight the growing importance of open space and scenic quality in this area and the need to protect these resources.

In southeastern Arizona, the supply of natural landscapes for outdoor recreation still exceeds demand in most places, but recreational use in some parts of the Coronado is already exceeding capacity, and regional trends threaten the sustainability of scenic quality. Public support and interest in natural resources (including scenery) continues to increase, as evidenced in recent years by scenic road and trail designations, increased public input on proposed projects, environmental group activity, planning efforts (such as corridor management plans for scenic highways, the Arizona National Scenic Trail, and the Sonoran Desert Conservation Plan), and Pima County open space bonds.

Environmental Consequences

Direct and Indirect Effects of Each Alternative

No Action Alternative

Under the no action alternative, the proposed Rosemont Copper Mine would not be constructed, nor would the pit, waste rock and tailings piles, processing facility, access roads, power transmission line, or other proposed infrastructure be built. Conditions within the project area and surrounding landscapes would remain as they presently exist, subject to existing trends and conditions as described above in the “Affected Environment” part of this section.

There would be no impacts to Coronado National Forest scenic quality from road, diversion channel, or pit face cut slopes. Traffic volume would not increase on State Route 83, nor would scenic quality be potentially degraded along this roadway from Rosemont Copper Mine activity. Scenic views along other roads and trails would not be adversely affected, and the Arizona National Scenic Trail would not need to be rerouted or relocated. There would be no fugitive dust related, long-distance viewing impacts to regional scenic quality. Under the no action alternative, regional scenic quality would be generally preserved within the northern portion of the Santa Rita Ecosystem Management Area.

Impacts Common to all Action Alternatives

Under the proposed action and action alternatives, the potential impacts to scenic quality would include a combination of short-term (less than 5 years), long-term (greater than 5 years), and permanent (beyond mine closure) impacts. Scenic quality impacts within the mine site would be visible from numerous roads, trails, and other locations, including State Route 83, the Arizona National Scenic Trail, many forest roadways, other public lands, and several communities.

The greatest impacts to visual quality would be caused by the tailings, waste rock, and heap leach piles, which require clearing and burying most of the native vegetation in the area (including mature trees along numerous canyon bottoms) and changing landforms from natural undulating topography to monolithic, relatively flat-topped, benched or terraced industrial shapes, along with the open pit high on a mountainside in a location that will make it regionally visible. These project elements would contrast sharply with the existing landscape in the short term, long term, and permanently because landforms, colors, and vegetation patterns and textures would not blend into the natural landscape. The processing facility (and associated facilities such as access roads and utilities) would create additional major impacts during the approximately 20 years of mine operation. The following provides an overview of these impacts.

Short-term impacts would be caused by activities related to mine construction and during the initial years of mining, including ground surface disturbances that would remove vegetation, remove or disturb topsoil, and expose rock and/or underlying soil. Additional construction phase impacts would include numerous mine buildings, access roads (including cuts and fills), transmission lines, and other infrastructure.

Throughout construction and early mining, further impacts would be caused by construction vehicles and heavy equipment moving along the major travel ways that access the project area, as well as traffic from construction crews, mine materials deliveries to the site, and transportation of mine products out of the site. During the first years of mining, digging of the pit on the upper slopes of the Santa Rita ridge would commence, which would expose light-colored, unweathered rock that would contrast sharply with the existing dark vegetation and existing darkly weathered, exposed rock and soil.

Early mining operations would cause visual impacts from the construction of buttresses, the heap leach pile, waste rock piles, and tailings piles, all of which would greatly alter the landscape topography. Diversion channels, sediment and attenuation ponds, and perimeter roads would also create visual impacts. The piles and buttresses would contrast sharply with the existing landscape because the landforms and lack of vegetation would not mimic the surrounding natural topography. Lesser impacts would be created by the perimeter fence and relocation or rerouting of the Arizona National Scenic Trail.

Fugitive dust production in construction areas caused by windblown exposed and disturbed soils and waste rock would affect long-distance scenic views during the construction phase and early mining. At night, lighting from the mine processing plant, pit, conveyors, haul trucks, and traffic and headlights on access roads would change the landscape character by increasing sky glow or light pollution.

Long-term potential impacts would be related to mine operations. The greatest impacts would result from the growing, rising, and laterally extending waste rock, tailings, and heap leach piles, along with the expanding, visible portions of the open pit and pit face. Other impacts would consist of a

continuation of effects from the processing plant, access roads, and transmission line towers and lines crossing the landscape, as well as from conveyors (and associated roads and power lines) and other mine elements.

Visible slope cuts and terraces used as ore hauling access roads along the upper pit face would remove vegetation and expose underlying, unweathered, often light-colored rock; in addition, linear benches or terraces in the pit would create unnatural horizontal lines in the landscape. Although revegetation on these slopes would slowly improve over many years (with estimates of 50 to 100 years for vegetation maturity) (Lefevre 2010), they would contrast with surrounding vegetation because there would be fewer trees on the new piles and because more vegetation would be likely to grow on the horizontal benches, resulting in unnatural looking lines of larger and darker vegetation.

Stormwater and erosion control features built into the waste rock and tailings slopes would change the existing landscape characteristics. Pit blasting and drilling and continuous waste rock and tailings dumping along the tops of the piles would increase fugitive dust in the long term and affect long-distance scenic viewing of the Santa Rita Mountains. Scenic quality viewing would be affected by mine related traffic (and potential traffic congestion) along State Route 83. Lighting from the mine processing plant, haul trucks, and traffic, along with headlights on access roads, would continue to impact the nighttime landscape character (see the “Dark Skies” section).

Permanent scenic quality impacts would be those that would exist indefinitely after postproduction mitigation, reclamation, and revegetation and would be visible to the public. Impacts to scenic quality from the processing facility, mine structures, and most internal haul roads would be reduced, as these facilities and roads would be removed and the areas reclaimed. Impacts from the pit would be caused by the light-colored exposed rock and horizontal benches visible along the upper pit faces, and impacts from the waste rock and tailings piles would include fewer vegetated areas (particularly along south-facing slopes) and unnatural landforms with uniform slopes, horizontal benches, and relatively flat tops.

Additionally, the waste rock and tailings piles would permanently obscure portions of foreground and middle ground views of the Santa Rita Mountains from State Route 83, the Arizona National Scenic Trail, and Box Canyon Road. Background views of the mountain range would be partially obscured from Hilton Ranch Road and State Route 83.

Indirect effects of mine construction, operation, and postclosure would be a reduction in forest visitors because of scenic quality degradation and loss. Displaced visitors would likely cause crowding in other areas, visitor conflicts, and increased resource damage. These effects are described in the “Recreation and Wilderness” section.

Arizona National Scenic Trail

The Arizona National Scenic Trail would be relocated or rerouted under all of the action alternatives. Three realignments have been proposed, and all of the realignments would lie between the project perimeter fence and the State Route 83 right-of-way boundary. A trail realignment for the proposed action (preliminary MPO) and Phased Tailings Alternative would parallel State Route 83, but at a distance (the realignment would lie approximately 0.25 mile from the highway at its closest point). The trail realignment for the Scholefield-McCleary Alternative would follow a route similar to the proposed action and Phased Tailings Alternative, except that it would closely parallel State Route 83 along its north end (from south of Helvetia Road to north of Hidden Springs Road). The realignment

for the Barrel and Barrel Trail Alternatives would closely parallel State Route 83 for approximately 1.75 miles (see the trail realignments on the figures for each alternative in chapter 2).

It should be noted that the realignments are conceptual and are not the only routes the Forest Service is willing to consider, or what it deems as feasible; other trail realignments would likely involve other Federal and State agency land management jurisdictions. Prior to designating a final trail reroute, the proposed routes will be further reviewed and refined to meet Forest Service recreational trail standards for trail steepness, trail width, trail surface, hiker/biker accessibility, and trail switchbacks (U.S. Forest Service 2008c). Areas along the realignments that exceed maximum allowable trail conditions would be addressed through site-specific trail siting and design.

Under all of the action alternatives, and from the perspective of the trail user, the proposed trail realignments would have long-term, permanent adverse impacts to scenic quality. All of the routes would closely parallel the project area perimeter fenceline, allowing foreground views and long viewing times of waste rock and tailings piles, slope terraces, the pit face, drainage features, access and perimeter roads, and ore processing infrastructure during the long-term construction and operation of the mine.

As described in detail in chapter 2 (and as shown in the simulations in appendix D on the CD), the tailings and waste rock stacks would permanently rise above the trail and would dominate the view. During mine construction and operation, mining vehicles and fugitive dust from vehicles and mining equipment would be visible in the long term during the day. Vehicle and equipment movement could be distracting and visually intrusive. Mine pit and processing facility lighting would be visible at night in the long term.

As mentioned above, rerouted trail segments for the Barrel, Barrel Trail, and Scholefield-McCleary Alternatives would closely parallel State Route 83. The trail reroute of the proposed action and Phased Tailings Alternative would lie farther away from the highway, but views of the highway would be within the foreground. The proximity of the trail routes to the highway would have permanent, adverse impacts to scenic quality.

Scenic views to the east for all of the proposed routes would include foreground views and extended viewing times of the highway and shoulder, automobile and truck traffic, and rest stops and highway travelers. In the long term, construction and operation of the mine and the additional mine-related truck and mining commuter traffic along the highway would heighten the adverse impacts to scenic quality for trail users.

It should also be noted that the reroutes for the Barrel, Barrel Trail, and Scholefield-McCleary Alternatives would lie between the project perimeter fence on one side and the highway right-of-way fence on the other side. These narrow trail widths would limit the possibilities for trail adjustment, and hilly topography along these very narrow trail segments would require extensive earthwork, slope recontouring, erosion control, and switchbacks to meet Forest Service trail standards. It may not be possible to construct the necessary switchbacks within the small widths between the highway fence and project area perimeter fence in some sections, and other structures would be needed to stabilize the trail on steep slopes. The impacts of the trail structures and construction would be permanently adverse until vegetation regrowth partially obscured the earthwork and trail construction disturbances.

Power Transmission Line

The power transmission line is a project element under the action alternatives that would visually extend beyond the project area for most of its length. Although much of the proposed primary power line is located off-forest, it would impact visual quality on the Coronado National Forest and could impact Bureau of Land Management administered public lands to the west of the Santa Rita Mountains (see the Bureau of Land Management impacts part of this section below).

Depending on the route chosen, the 138-kilovolt power transmission line would be constructed either (1) along a utility corridor, of which approximately 15 miles would lie within or close to landscapes designated Bureau of Land Management Visual Resource Management Class III, entering the mine site from the northwest, and/or (2) along a route that intersects Box Canyon Road and enters the site from the south (see "Viewpoint 8" under the "Impacts to Viewpoints" part of this section below). The power line for construction of the mine is expected to follow the southern route, but this route may remain in the long term to provide secondary backup power.

Under the preferred route and all TEP alternatives except TEP Alternative 4, the routes would follow an existing power line route alignment that parallels Santa Rita Road and then enters the project area from the northwest, terminating at the Rosemont substation. TEP Alternative 4 would follow an alignment that would cross Box Canyon Road and terminate at the existing substation near Box Canyon Road (the Greaterville Substation). TEP Alternative 4 would connect with the Rosemont Substation along a north-south route that would again intersect and cross Box Canyon Road (see chapter 2 for maps of the proposed routes).

For all alternatives, the power line northern terminus would be located at an existing substation east of the town of Sahuarita. It should be noted that the exact alignments of the primary and backup power lines have not yet been determined, but the analysis has been conducted under the assumption that the power line would be aligned along the center of the 1,000-foot-wide study corridor.

Under all of the alternatives, the single-circuit line would have direct, adverse, short-term construction related impacts on scenic quality from surface and vegetation disturbances along the utility right-of-way, installation of visually intrusive 90- to 100-foot-high power poles, and power line stringing vehicles and equipment. These vehicles and equipment would create moderate color and form contrasts with the existing landscape, especially for motorists traveling on the western slopes of the Santa Rita Mountains and along Box Canyon Road (a Coronado National Forest scenic sightseeing route), Santa Rita Road, and Helvetia Road. Short-term, adverse impacts to scenic quality would also be created by windblown fugitive dust from exposed, disturbed soil within the power line right-of-way, which would create localized haze and would likely diminish long-distance scenic viewing of the Santa Rita Range in the short term.

Mitigation to reduce the visual impacts of the power line would include the use of nonreflective wire and monopoles (rather than lattice structures). The monopoles would have a surface material that would weather to a flat, nonreflective dark brown color.

Based on the TEP simulations of the proposed transmission line (Swanson et al. 2010), long-term, moderately adverse impacts to scenic quality would be produced on the western lowlands and lower slopes of the Santa Rita Range (Swanson et al. 2010), when viewed from middle ground along Santa Rita Road within the Santa Rita Experimental Range and along Helvetia Road, southeast of Green Valley and Sahuarita.

Vertical form contrasts and color contrasts would be created by the tall, regularly spaced power poles on a landscape with low, sparse vegetation cover. However, as viewing distance increased to background distances, away from the above mentioned travel ways, the impacts to scenic quality would diminish to a minor degree because the power poles and lines would tend to blend in with the surrounding landscape or become hidden by vegetation and topography.

On Bureau of Land Management administered land, the long-term impacts from construction, operation, and maintenance of the lines would be adverse and long term until power line removal. However, Bureau of Land Management Visual Resource Management Class III visual objectives would likely be met because of the following: (1) the proposed line would follow an existing road shoulder and conform to existing surface disturbances, and (2) moderate to minor levels of landscape contrast created by the power line would not likely dominate the view, although these visual contrasts would likely attract casual viewer attention.

The impacts of the proposed power transmission line on the Coronado National Forest would be adverse and major to scenic quality in the long term, when viewed from forest roads and trails, because of the proximity of the line to hikers, motorists, and off-highway vehicle users at the Santa Rita Mountains ridge crest. At the mountain crest, the line would also be visible from both sides of the mountain range, with adverse form contrasts created by the silhouette of the line against the background sky.

The power lines would also be visible along the eastern slopes of the Santa Rita Mountains from State Route 83 and the Arizona National Scenic Trail. The line would create obvious power pole color, vertical form, and horizontal transmission line contrasts in the travel way foreground within a landscape that is classified as having distinctive scenic attractiveness and high scenic integrity. High scenic integrity objectives require that landscape deviations not be evident, and the visibility of the power poles and lines would be inconsistent with and likely not meet these objectives.

When viewed from the middle ground and background, the impacts would be moderately adverse in the long term because of the following: (1) transmission line contrasts would tend to blend in with the surrounding landscape as viewing distance increased; and (2) the line would be hidden or partially obscured by Santa Rita Mountains topography within the Coronado National Forest. As the project would not be consistent with scenic goals, objectives, and standards, a forest plan amendment would be necessary. See the “Forest Plan Consistency” section in chapter 2 for further detail.

Primary and Secondary Access Roads

Similar to the power transmission line, access roads are project elements under the proposed action and the action alternatives and would extend beyond the mine site for most of their length. Two roads are proposed for construction to improve access to the proposed mine. A 2-lane primary access road would be constructed from State Route 83 to the mine site. This road would be gravel-paved. A single-lane secondary access road would be constructed to connect the mine site to Santa Rita Road, on the western slope of Santa Rita range, via Lopez Pass.

Moderate short-term, adverse impacts during construction of the primary access road would be caused by vegetation clearing, linear disturbances, cuts/fills, drainage structures, and construction vehicles and road grading heavy equipment visible to motorists from State Route 83, the Arizona National Scenic Trail, and other forest roads. Localized fugitive dust production from vegetation clearing and road grading and contouring would diminish long-distance views in the short term.

The short-term impacts during construction of the secondary access road would be lower because this roadway would be considerably narrower and is on an existing road in most locations.

Construction on both roads would likely exceed scenic management objectives because both areas proposed for access road construction are classified as having distinctive scenic attractiveness, and both areas are in zones with high scenic integrity. Thus, the project would not comply with visual quality direction in the forest plan.

Long-term impacts to scenic quality would be adverse along both proposed routes because of linear disturbances that contrast with the existing landscape. Fugitive dust mitigation (e.g., gravel paving, road sealing) would reduce the potential for substantial dust production. Mine operation related vehicle traffic would be visible to motorists traveling along State Route 83. The long-term impacts to scenic quality from constructing the primary access road would be adverse: the estimated daily mine related large truck traffic on State Route 83 would be approximately 88 round trips per day, 7 days per week, to ship copper concentrate and resupply the mine with processing materials. In addition, mine related commuter traffic would also contribute to traffic use along this scenic roadway.

The potential impacts of road congestion would diminish or reduce the scenic motoring experience. The increase in traffic along State Route 83 could increase the amount of trash and debris along the roadway, further diminishing the scenic experience. Thus, there would be an irretrievable loss of scenic quality from increased access roads and commuter and truck traffic during the operating phase of the mine.

The permanent impacts of the mine's internal haul and access roads to scenic quality would be minor because of reclamation and low visibility from use areas and travel ways. During mine closure, the internal mining access roads would be closed and reclaimed, and traffic volume would likely return to a premining level of use. Postmine closure, the primary and secondary access roads would be opened to the public and would not be reclaimed. A single north-south through road across the reclaimed mine site would also be permanently maintained to allow public travel between the northern and southern portions of the Coronado National Forest. The impacts to scenic quality from these maintained roads would also be permanent and minor because of low visibility and an assumed low traffic volume.

Direct, Indirect, and Cumulative Effects on Viewsheds

Sensitive Travel Way and Use Area Contrast Analysis

The Forest Service has determined that existing public travel ways and designated use areas in and around the forest are appropriate locations to conduct visual analyses. Public travel ways represent linear concentrations of public viewing and include the highways, forest roads, and trails from which the project area would be visible. Use areas are locations that receive concentrated public viewing use and include trailheads and other recreation sites within the forest boundary. Use areas also include the urban and suburban areas, towns, subdivisions, and parks that surround forest lands and from which the project area would be seen.

For the project, contrast analysis was conducted from representative sensitive travel way and use area viewpoints within and surrounding the Coronado National Forest. The viewers receiving consideration from these viewpoints are tourists and motorists traveling along routes within and adjacent to the Coronado National Forest (represented by viewpoints 1, 2, 5, 8, and 9), those seeking recreational opportunities within and around the Coronado (viewpoints 1, 3, 6, and 8), those residing

in or visiting surrounding towns and communities (viewpoints 6 and 9), and rural residents (viewpoints 5 and 7). Figure 67 shows the locations of the analysis viewpoints.

It should be noted that the visual simulations used in the contrast analyses discussed below show impacts to the landscape at year 20 of Rosemont Copper Mine operations, prior to mine closure, with the processing facility intact. As described in the "Methodology" part of this section, visual simulations are computer generated images of how the project's features and landscape features would appear on the proposed mine site for each alternative. The simulated features were created from the description of the mine pit dimensions, proposed waste rock and tailings dimensions and locations, and proposed roads and processing facility locations for each alternative. These simulated mine features were then overlaid onto digital photographs that were recorded at the analysis viewpoints. It should be noted that the proposed mitigation measure to apply a weathering agent to exposed rock faces has not been applied to the simulations, resulting in a greater contrast of the pit wall to adjacent undisturbed surfaces. An example of the project simulations is shown below in figure 70. This is a cropped panoramic simulation of the Scholefield-McCleary Alternative as seen from viewpoint 2.

Figure 70. Visual simulation of the Scholefield-McCleary Alternative as seen from viewpoint 2. The fully displayed panoramic simulations for the proposed action and the action alternatives as seen from all of the analysis viewpoints are located in appendix D on a CD in the sleeve of the DEIS.

The fully displayed panoramic simulations for all of the action alternatives, as seen from all of the analysis viewpoints, are located on a compact disc (CD) in appendix D in the sleeve of the DEIS. Year 20 was chosen for simulating the proposed mine because this would show the final pit configuration, the final topographic impacts from waste rock, heap leach, and tailing piles, and the visibility of the processing facility.

These simulations do not show the impacts that would occur in the earlier years of the mine, such as visibility of the more open views of the pit and processing facility and the possibility that the top of the light-colored tailings may be visible until the tailings piles (or rock buttresses) grow high enough to block views into the tailings. It is assumed that vegetation would have been growing on the lower waste rock terraces and slopes for 20 years. Finally, it should be noted that numerous detailed features have not been depicted in the simulations because data were lacking to accurately describe them (e.g., the stormwater control structures, the density of vegetation growth on the terraces).

Impacts to Viewpoints

Viewpoint 1

This viewpoint is located along State Route 83 at milepost 46 at a roadside rest stop and picnic area.

Proposed Action Alternative — From this perspective, the tailings and waste rock piles to the southwest would be clearly visible to motorists and those at the rest stop in the foreground and middle ground. Motorists would have a brief view of these mine features, but rest stop visitors would have opportunities to study the Rosemont Copper Mine landscape. Form contrasts would be created by the continuous extension of the long, level, unbroken rock slope and buttresses behind existing undulating, discontinuous rock slopes and ridgelines. The artificially smooth, regular, continuous, unbroken waste rock pile ridgeline would create a strong linear contrast with the more complex, curving, irregular slope lines adjacent to the tailings and waste rock piles. Moderate line contrasts would also be created by the horizontal slope terraces and diagonal stormwater drainage channels. Color contrasts would be created by the discontinuity of existing rock and soil colors with waste rock buttress colors.

The impacts to scenic quality from construction of the central rock drainage system would be long term, adverse, and minor. The porous rock used for the drain would be similar to the surrounding waste rock, and as it was completed, the drain would be buried under waste rock. Prior to being buried, the drainage system would likely create minor color and texture contrasts with the surrounding waste rock because of differences in rock particle size; these differences in particle size would be visible to casual viewers but would not likely be a focus of attention because of the more obvious waste rock features (i.e., slope terraces, slope height, and size). Moderate, adverse line contrasts would be created along the edges of the drainage system because of the immediate changes in rock size. However, these contrasts would be a lower focus of attention when viewed in the context of the larger waste rock and tailings piles that surround it, and once buried under waste rock, they would no longer be visible.

Although not shown on the simulation, the mine processing facility would be visible for approximately 7 years from this perspective until a planned waste rock ridge was built to hide the facility from view. The facility's buildings would create bold, angular and rectangular form contrasts within an undulating, rough landscape; adverse color contrasts would be created by uniform facility building colors and clearings that would contrast with the surrounding color variability of the landscape; structural color mitigation would reduce this to a minor degree. The impacts of this mine feature, however, would have long-term, major, adverse impacts on scenic quality until hidden from view because of the strong form contrasts that the facilities would create with the surrounding landscape.

Over hundreds of years, the permanent color impacts of waste and tailings rock would gradually diminish to a minor, adverse level of impact because rock weathering and vegetation establishment on the waste rock slopes would gradually blend the slopes in with the surrounding landscape. Until sufficient revegetation, slope vegetation coverage, and rock weathering of slopes occurs, there would be an irretrievable loss of scenic quality.

In the long term, however, the fine, smooth, regular waste rock textures would contrast with the existing patchy landscape, with strong texture discontinuities with the existing landscapes in the foreground and the undisturbed landscapes to the north and south of the project area. Similar to the color contrasts, texture contrasts would also diminish to a minor, adverse degree permanently, as vegetation establishment and growth on the waste rock top and slopes would become similar to and

eventually blend in with the surrounding vegetation. Vegetation would not likely become established and reach maturity for 50 to 100 years (Lefevre 2010), and vegetation would likely grow heavier on horizontal benches, which would result in unnatural linear landscape patterns. Strong, permanent landscape contrasts would be created by the waste rock, with major adverse impacts to scenic quality, as the background views of the Santa Rita Mountains would be irreversibly lost behind the waste rock slopes.

Where visible from elevated locations that allow views into the interior of the mine site, the attenuation and sediment ponds would have permanent, major adverse impacts to scenic quality because the potential number and size of the ponds along the reclaimed waste rock terraces would create strong line and color contrasts with the landscape that would attract and be a focus of viewer attention. There would be permanent, indirect, beneficial impacts to scenic quality produced by the ponds; moist soil caused by pond water seepage would enhance the conditions for vegetation establishment and regrowth around the ponds, which would permanently create a diversity of vegetation and vegetation textures on the reclaimed site and contribute to slope revegetation. There would be permanent beneficial impacts to scenic quality because of the vegetation related mitigating effect on waste rock colors and textures, which would reduce waste rock contrasts with the surrounding landscape.

Phased Tailings Alternative — The Phased Tailings Alternative would have strong, permanent, major adverse direct and indirect impacts on scenic quality for the same reasons as described for the proposed action because the dimensions and features of the waste rock, tailings piles, and attenuation and sediment ponds would be similar. However, under this alternative, the waste rock and tailings piles would be reversed, compared with the proposed action, and would expose the processing facilities to view for a longer time. The processing facility would, thus, have greater long-term, adverse color and form impacts because the structures would be visible to viewers for at least 12 years before being hidden from view behind the waste rock and tailings piles. As discussed for the proposed action, linear contrasts would be created by vegetation growth along the horizontal terraces around the attenuation and sediment ponds that would visually amplify, permanently, the waste rock and tailings slope terracing, with moderate adverse impacts to scenic quality until vegetation matures.

In addition, this alternative would include the construction of a series of scree slopes on the waste rock pile (to improve habitat and slope stability) that would be visible from the State Route 83 viewpoint; this would create moderately strong color, line, and texture contrasts with the surrounding landscape, with permanent, direct, moderate, adverse impacts to scenic quality because the slopes would likely attract viewer attention from rest stop visitors. Scree color and texture contrasts would be produced by the differences in rock size on the waste rock slopes (slope rock would be fine grained, scree rock would be coarse grained and larger); moderately adverse line contrasts would be produced along the edges of the scree slopes from the distinct transition from fine to coarse rock.

Barrel Alternative — Under this alternative, waste rock and tailings would be placed entirely within Barrel Canyon, south of the mine pit. The Barrel Alternative, as seen from this viewpoint, would impose strong landscape contrasts and would have permanent, major adverse impacts on scenic quality for the same reasons that were described for the proposed action. The indirect, permanent, beneficial impacts of the attenuation and sediment ponds would be the same as discussed under the proposed action, for the same reasons.

There would be additional mine features visible from this viewpoint that would have major, adverse impacts to scenic quality to a greater degree than under the proposed action; this is because the mine

processing facility and related structures would be visible in the long term for a longer period of time, the mine pit and pit wall would be permanently visible, and the pit diversion channel running along the upper slopes of the pit would be permanently visible. The exposed, light colored, unvegetated, and unweathered rock on the pit face and along the cut slope above the diversion channel would create strong color and line contrasts with the surrounding mottled, vegetated, dark-colored rock.

The pit diversion channel cut slope would create strong line contrasts and would, along with the pit face, be a focus of viewer attention. The impacts of pit face and pit diversion channel contrasts would cause scenic quality along the upper Santa Rita range to be reduced and irretrievably lost until the exposed rock had weathered and revegetated to reduce color contrasts, and it would be irretrievably lost until the haul road terraces were removed to reduce color and line contrasts.

Under this alternative, a waste rock ridge would not be built to hide the processing facility buildings, which would likely be visible for approximately 10 years until the waste rock and tailings piles reached sufficient height to partially hide the facility (the waste and tailings rock would shield views of the facility from areas south of the project). Color mitigation would reduce the visibility of the structures to a minor degree for motorists traveling on State Route 83, but some structures would remain visible until mine closure, especially to rest stop visitors, who would have potentially long viewing times to study the landscape. The long-term impacts of facility visibility would be the same as discussed for the proposed action.

Barrel Trail Alternative — The Barrel Trail Alternative would be a variation of the Barrel Alternative, with a different alignment and configuration of the waste rock and tailings piles. The impacts to scenic quality would be the same as those described above under the Barrel Alternative, except that there would be an increase in the adverse, permanent impacts to the existing foreground landscape because under this alternative the tailings and waste rock would extend farther across the project area, and thus more foreground areas would be impacted.

Scholefield-McCleary Alternative — Under this alternative, waste rock and tailings would be placed within Scholefield Canyon, north of the mine pit, with a small heap leach pile and the remaining waste rock located south of the processing facility and mine pit. The adverse impacts to scenic quality would be greater than for the other action alternatives because the pit and processing facility would be fully visible for the approximately 25-year life of the project. The upper pit face and pit diversion channel would be highly visible and would create strong color and line contrasts.

The impacts to scenic quality would be major and adverse because the strong landscape contrasts of these mine features with the surrounding landscape would become a focus of viewer attention and would likely dominate the view. The impacts of pit face contrasts would cause scenic quality along the upper Santa Rita Range to be reduced and irretrievably lost until the exposed rock had weathered and revegetated to reduce color contrasts; the haul road terraces and cut slope along the pit face would create an irretrievable loss of scenic quality until roads were removed, rock had weathered, and slopes had revegetated to reduce color and line contrasts. Under this alternative, there would be an irreversible loss of scenic background views of the Santa Rita Mountains, caused by the height and lateral extent of the waste rock and tailings piles.

The heap leach pile to the south of the pit would create minor, adverse form and color impacts because slope terracing form contrasts and color contrasts with the surrounding landscape would be visible to State Route 83 viewers and rest stop visitors; however, because of topographic hiding, its relatively small size, and slope contouring, mitigation would reduce the pile’s visual impacts in the

long term so that, while visible to the casual viewer, the pile would not likely be a focus of attention. Slope revegetation and rock weathering would reduce the impacts of the heap leach pile to minor impacts permanently because this mine feature would eventually blend in with the surrounding landscape. Background views of the existing Santa Rita Mountains would be irreversibly blocked from view from this perspective by the leach pad, but this would have a minor, adverse impact on scenic quality because of the relatively small area that would be affected.

Impacts to the Scenic Road Experience — Contrast analysis from specific viewpoints along the scenic road is useful for assessing impacts to the landscape from the perspective of travelers at scenic overlooks or rest stops. However, stationary views represent only a portion of the traveling experience and the potential impacts to road scenic quality. Assessed as a linear sequence, in which the viewer perspective is continuously changing while traveling north or south (the typical experience for most motorists traveling this roadway), the impacts to scenic quality can be more completely described.

For all of the action alternatives, the view of the east side of the road from the proposed mine site would be of relatively undisturbed scenic landscapes, with scenic quality as described above under the “Existing Conditions” and “Landscape Character” part of this section. Traveling views of the mine features would be intermittent and unpredictable and would depend on roadside topography. Views of undisturbed landscape would very quickly change to views of the processing facility, waste rock and tailings piles, and the mine pit face (with impacts to scenic quality as described above for the action alternatives), and then back to undisturbed landscape. The impacts would be permanent and adverse to a major degree because the abrupt scenic quality changes caused by the mine features and the strong surface disturbance related line, form, color, and texture contrasts would attract viewer attention and would likely dominate the view while in view.

Viewpoint 2

This viewpoint is located along State Route 83 near milepost 44 where the scenic road makes its closest approach to the proposed mine site.

Proposed Action Alternative — From this perspective, the mine features would be highly visible to passing motorists driving north or south along the scenic road. The proposed mine would create strong contrasts with the surrounding landscape: the level, terraced, monolithic, and uniformly sloped waste rock and tailings piles would dominate the middle ground and background views, creating very strong form contrasts with the surrounding undulating, incised foreground and middle ground ridges and drainages.

Strong line contrasts would be created by the exposed pit face in the background, the horizontal pit diversion channel cut slope, and the long, unnaturally flat top of the waste rock and tailings piles with the background ridgelines and sky. Color contrasts would be very strong because of color differences between unweathered waste rock and the surrounding weathered rock and soil; however, the permanent color impacts would become less adverse as the rock weathered, vegetation became established, and vegetation coverage increased on the slopes. Until then, the impacts of pit face contrasts would cause scenic quality along the upper Santa Rita Range to be reduced and irretrievably lost until the exposed rock had weathered and revegetated to reduce color contrasts, and to be irretrievably lost until the haul road terraces were removed, rock had weathered, and slopes had revegetated to reduce color and line contrasts.

Texture contrasts would be produced by the differences between the uniformly smooth, fine waste rock slopes with the surrounding fine to medium-textured landscape of patchy grasses, shrubs, and small conifers. This contrast would also be reduced to a minor adverse impact under permanent conditions because established vegetation textures would eventually become similar to, and blend in with, the surrounding landscape. Slope vegetation maturity would likely take 50 to 100 years to achieve partial slope coverage, and vegetation would likely grow heavier on horizontal benches, which would result in unnatural landscape patterns.

This alternative would have permanent, adverse, major impacts on scenic quality because a substantial area of the existing middle ground and background landscape would be obscured and replaced by the tailings and waste rock piles. In the long term and permanent timescales, the background views of the Santa Rita Mountains would be irreversibly lost behind the waste rock and tailings piles because the height and horizontal extent of the rock would obscure all but the highest mountain ridges.

The impacts to scenic quality caused by processing facility contrasts would be the same as discussed above for "Viewpoint 1 – Proposed Action Alternative," for the same reasons.

Phased Tailings Alternative — The changes in scenic quality from this alternative would be similar to those discussed for the proposed action because the contrasts would be similar and the visible dimensions of the tailings and waste rock piles would be similar. This alternative would have permanent, adverse, major impacts to the scenic landscape, but with reductions in contrasts from rock weathering and slope revegetation and vegetation coverage on a permanent timescale.

Under this alternative, the exposed rock on the visible portion of the mine pit face and along the pit diversion channel would not be visible from this perspective because the waste rock piles would be stacked higher than under the proposed action and would, thus, hide these features from view. However, the background views of the Santa Rita Mountains as seen from this portion of the scenic road would be irreversibly hidden behind the waste rock piles. As discussed for the proposed action above, foreground and middle ground views of the slope terraces and permanent vegetation growth along the terraces would create strong, adverse, major linear contrasts until sparse vegetation maturity is reached in an estimated 50 to 100 years.

The impacts to scenic quality caused by processing facility form and color contrasts would be the same as discussed above for "Viewpoint 1 – Phased Tailings Alternative," for the same reasons.

Barrel Alternative — Under the Barrel Alternative, the height of the waste rock and tailings piles in the canyon would almost entirely obscure the existing foreground, middle ground, and background views and would dominate the view. The form, color, texture, and line contrasts with the surrounding landscape would be very strong and would be highly visible because of the height and lateral extent of the waste rock and tailings slopes in the foreground and middle ground and because of the proximity of the piles to this viewpoint.

The tip of the cut slope mine pit face would be visible, creating additional adverse color contrasts. The terraced, fine, unweathered rock coloring on the waste rock and tailings slopes would contrast strongly with the surrounding landscape in the long term but would diminish in time (within a permanent timescale) from weathering and revegetation to an adverse but minor degree; however, the impacts would irretrievably degrade scenic quality until sufficient rock weathering and vegetation coverage muted these contrasts. Mature, but sparse, vegetation coverage of the rock slopes would likely take approximately 50 to 100 years to become established. Vegetation would likely grow

heavier on the horizontal benches, which would result in unnatural horizontal landscape patterns. The impacts to the scenic landscape would, however, be adverse and major in the permanent timescale, as views of the Santa Rita Mountains would be irreversibly hidden behind the waste rock and tailings piles.

The impacts to scenic quality caused by processing facility contrasts would be the same as discussed above for "Viewpoint 1 – Barrel Alternative," for the same reasons.

Barrel Trail Alternative — The Barrel Trail Alternative would have the same impacts as the Barrel Alternative because the size and locations of the waste rock and tailings piles would be similar. Compared with the Barrel Alternative, under this alternative, the Santa Rita Mountains ridgeline in the background view would be obscured to a slightly greater degree, and more foreground landscape would be adversely disturbed by waste rock because of the increased height of the waste rock and tailing piles and their increased footprint.

Scholefield-McCleary Alternative — Under this alternative, the impacts to scenic quality from form, line, color, and texture contrasts with the surrounding landscape would be permanent, adverse, and major. From this perspective along the scenic road, the major mine features within the project area would be visible to passing motorists in the long term and permanently. Views of the mine would consist of two waste rock and tailings piles separated by a highly visible processing facility, with unobstructed views of the upper pit face, east access road cut slopes, and internal mine access roads.

Highly visible pit face slope cutting (to create sufficiently wide ore haul roads) and cut-and-fill access roads in the foreground and middle ground would create strong line and color contrasts. Line contrasts along the waste rock and tailing slope terraces would be increased, on a permanent timescale, by dense vegetation growing on the terraces, which would create unnatural landscape patterns visible until vegetation maturity.

Color contrasts on the slopes would be created by waste rock until sufficient weathering or vegetation coverage reduced these contrasts. Similarly, strong color contrasts would be created on the pit face and along the access roads by exposed, unweathered rock and soil on a permanent timescale until weathering reduced the contrasts. Pit face contrasts would cause scenic quality along the upper Santa Rita Range to be reduced and irretrievably lost until the exposed rock had weathered to reduce color contrasts and until the haul road terraces were removed to reduce color and line contrasts.

The mine processing facility would be visible in the long term, with major, adverse impacts to scenic quality because of the rectangular, simple, regular structural form contrasts with the surrounding undulating, complex landscape forms. Structural color contrasts would be moderate and adverse because color mitigation would reduce processing facility color contrasts. Facility impacts would be adverse in the long term until facility removal during mine closure. The height and lateral extent of the waste rock and tailings piles would irreversibly obscure the existing views of the Santa Rita Mountains, with permanent, adverse, major impacts to scenic quality.

Viewpoint 3

This viewpoint is located along the Arizona National Scenic Trail, and the proposed Rosemont Copper Mine features would lie within the foreground and middle ground of hikers and other visitors seeking dispersed recreational opportunities along the trail. The mine features and contrasts would be visible to hikers, bikers, and equestrians using the trail, both northbound and southbound. This viewpoint is unique because trail users move slowly and would be viewing the project impacts for

long periods of time. It should be noted that this viewpoint would not be affected by the proposed trail realignments, as it lies approximately 1.4 miles beyond the south end of the trail realignment segments. Impacts caused by the trail rerouting for all of the action alternatives are discussed above in the "Arizona National Scenic Trail" part of this section.

Proposed Action Alternative — Under the proposed action, the southern portion of the waste rock pile would extend across the foreground, partially obscuring existing views of the Santa Rita Mountain landscape in the middle ground because of the height and length of the waste rock. Strong form contrasts would be created by the uniformly level, graded rock piles with the more complex, rough, rugged surrounding topography. A strong line contrast would be created by the flat top and monolithic form of the piles with the undulating ridgeline behind it. The highly visible, unweathered, uniformly colored, terraced waste rock and tailings pile slopes would create strong color contrasts with the variably colored, darker, weathered ridge slope rock and soil in the middle ground and low slopes in the foreground. However, these contrasts would gradually diminish in the permanent timescale as rock weathered and the slopes became revegetated.

Dense vegetation growing along the terrace tops around the attenuation and sediment ponds would increase landscape line contrasts until vegetation maturity. Similarly, the pit face and pit diversion channel visible in the middle ground would create a strong color and line contrast for the same reasons: uniformly colored, exposed, and unweathered rock along the cut slopes of the pit diversion channel and pit haul roads would create strong contrasts with the existing mottled vegetation and dark, weathered rock.

The impacts of pit face contrasts would cause scenic quality along the upper Santa Rita Mountain ridges to be reduced and irretrievably lost until the exposed rock had weathered and revegetated to reduce color contrasts and until the haul road terraces were removed to reduce color and line contrasts. Texture contrasts would be strong, produced by the smooth, uniform, sparsely vegetated slopes with patchy shrubs and conifers and dense grasses in the foreground. The waste rock piles would also create strong texture contrasts with mottled, dark vegetation patterns on the ridgetops and slopes adjacent to these mine features. The impacts to scenic quality along this section of the trail would be major and adverse in the long term because of the close proximity of the mine features to the trail and trail users, with irreversible adverse losses of scenic quality caused by permanently obscured views of the Santa Rita Mountains.

The impacts to scenic quality caused by processing facility contrasts would be the same as discussed above for "Viewpoint 1 – Proposed Action Alternative" for the same reasons.

Phased Tailings Alternative — The impacts of the Phased Tailing Alternative would be the same as for the proposed action, except that the degree of adverse impacts to existing scenic quality by the waste rock and tailings piles would be increased because the rock would be stacked higher. The additional height of the piles would further reduce the lower and upper slope visibility of the Santa Rita Mountains in the middle ground and would cause irreversible losses of existing scenic views of the mountain range.

The impacts to scenic quality caused by processing facility contrasts would be the same as discussed above for "Viewpoint 1 – Phased Tailings Alternative," for the same reasons.

Barrel Alternative — The impacts of the Barrel Alternative would be similar to those of the proposed action, except that the degree of adverse impacts to existing scenic quality caused by the waste rock and tailings piles would be increased because of their increased height. More of the

middle ground views of the Santa Rita Mountains would be irreversibly blocked from view by the rock piles, causing major adverse impacts to existing scenic quality. The impacts to scenic quality caused by processing facility contrasts would be the same as discussed above for "Viewpoint 1 – Barrel Alternative" for the same reasons.

Barrel Trail Alternative — The impacts under this alternative would be the same as those of the Barrel Alternative because the dimensions of the waste rock piles would be similar. However, under the Barrel Trail Alternative, the waste pile would be reduced in its lateral extent, when compared with the Barrel Alternative, which would irreversibly obscure less of the existing middle ground views of the Santa Rita Mountains when viewed from this point along the trail. It would cause major, adverse impacts to existing scenic quality for the same reasons as discussed under the proposed action.

Scholefield-McCleary Alternative — Under this alternative, most of the waste rock and tailings piles would be screened from view by foreground topography, but strong, adverse form, line, and color contrasts would still be created by the visible portions of these mine features. The pit face and pit diversion channel would also be highly visible from this location, and along with the exposed portions of the waste rock piles, they would also be in view of hikers and sightseers on the trail for long periods. The waste rock slope terraces and horizontal pit haul road cut slopes would create permanent, strong, adverse linear contrasts.

Dense vegetation growing along the slope terraces would permanently increase the adverse linear contrasts on the waste rock slopes until vegetation matures. Permanent strong, highly visible, adverse color contrasts would be created on the pit face by unweathered, exposed rock contrasting with the surrounding dark rock and vegetation; permanent strong, adverse color contrasts would be created on the waste rock slopes by unweathered waste rock contrasting with the surrounding vegetation.

These color and line contrasts would have permanent, adverse, major, irretrievable impacts on scenic quality until rock weathering of the pit face and removal of the pit haul roads because of the strong contrasts they would create and the likelihood that these contrasts with the surrounding landscape would be a focus of viewer attention. Scenic quality would be irreversibly lost under this alternative because middle ground views of the Santa Rita Mountains would be partially blocked by the waste rock and tailings piles.

Impacts to the Arizona National Scenic Trail Experience — As discussed above for State Route 83 (scenic road), a linear assessment along the Arizona National Scenic Trail, in which the viewer perspective is continuously changing while hiking north or south, would provide a more complete analysis of the impacts to scenic quality from the perspective of forest visitors hiking and sightseeing along the trail. A brief qualitative linear assessment is provided below.

Under all action alternatives, the views of the proposed mine site would increase in visibility and in degree of adverse impacts on scenic quality as hikers traveled from south to north (see the "Impacts Common to All Action Alternatives" and "Arizona National Scenic Trail" parts of this section above).

As seen from viewpoint 3, intervening topography and distance would obscure portions of the mine site from view; however, as hikers proceed north, the trail would approach and eventually lie along the project area boundary and perimeter fence. The trail would approach and/or abut the State Route 83 right-of-way boundary (see the Arizona National Scenic Trail realignment figures in chapter 2).

Under the Barrel, Barrel Trail, and Scholefield-McCleary Alternatives, the trail reroute would lie adjacent to both the perimeter fence and the State Route 83 right-of-way fence. Permanent, adverse,

major impacts would be caused by the approach and increasing proximity to the waste rock and tailings piles, along with their increasing visibility, which would eventually dominate the view. Scenic quality and opportunities to experience the existing views along the trail would be adversely and irretrievably lost in the long term during the life of the project. Scenic quality would be irretrievably lost until rock weathering had reduced color contrasts and until vegetation coverage on the waste rock and tailing piles was sufficiently dense to reduce line, form, and texture contrasts with the surrounding landscape.

As noted above under the "Arizona National Scenic Trail" part of this section, surface disturbances to accommodate Forest Service trail requirements and trail standards along the narrow areas between State Route 83 and the project area would create permanent, adverse visual impacts until vegetation regrowth obscured the earthwork, erosion controls, and slope recontouring. The close proximity of automobiles, trucks, dust, highway travelers, exposed rock and soil, and soil denuded of vegetation at the narrow trail chokepoints would degrade the trail's scenic quality.

Viewpoint 4

This viewpoint was intended to provide views of the project from the perspective of wilderness or back-country users within Mount Wrightson Wilderness. As discussed above in the "Affected Environment" part of this section, no acceptable photographic data were obtained from this viewpoint. From high elevations in the Mount Wrightson Wilderness (and also from similar aspects in Saguaro Wilderness in the Rincon Mountains), visitors would see nearly all of the mine features, including the pit, waste rock and tailings piles (and tops of tailings), processing facility, and roads. Most of the mine features would be light colored and would contrast sharply with landscape colors.

The nearest trails in the Mount Wrightson Wilderness are approximately 5 miles from the project, and trails in the Saguaro Wilderness are nearly 20 miles away. Because of the long viewing distances, vegetation screening along these high-elevation trails, wind-blown dust, atmospheric haze, heat shimmer, and numerous other visible surface disturbances caused by highways, communities, and other development throughout the valleys, impacts from the Rosemont Copper Mine would be moderately adverse for views within Mount Wrightson Wilderness. The mine may attract the attention of the casual viewer and be a focus of attention, but it would not dominate the view for the abovementioned reasons.

The impacts on views from trails within Saguaro National Park would be adverse but minor. A viewshed analysis and simulated views from Rincon Peak and from the Tanque Verde Trail show that the long viewing distances, intervening atmospheric dust, haze, and heat shimmer would obscure the views of the mine. The simulations also showed that Mount Fagan and the topography surrounding that mountain would partially hide the mine when viewed from the top of Rincon Peak; the mine would be nearly completely obscured from view along the Tanque Verde Trail (National Park Service 2011).

Viewpoint 5

This viewpoint is situated at the intersection of State Routes 82 and 83 (the Patagonia-Sonoita Scenic Road).

Proposed Action Alternative — From this perspective, the visible mine features would be the upper pit face, the pit diversion channel, and the uppermost levels of the waste rock piles. The processing facility would not be visible at any time because it would be hidden behind middle ground and background topography. The large area of visibly exposed rock on the vertical mine face and the cut

slope of the pit diversion channel would create strong color contrasts with the surrounding darker rock and vegetation on the Santa Rita Mountain upper slopes. Strong form and line contrasts would be created by the horizontal pit haul roads, which would also be visible along the upper pit face. A strong line contrast would also be created by the exposed rock of the pit diversion channel with the surrounding landscape.

These color and line contrasts would create moderate, adverse, permanent impacts to scenic quality because the mine features would be a focus of viewer attention for motorists traveling north or northeast on State Routes 82 or 83. The waste rock piles would create minor, adverse impacts to scenic quality because of their limited visibility from this perspective, but the impacts would be permanent until rock weathering and vegetation regrowth reduced the color contrasts along the upper waste rock and tailings slopes. The impacts of pit face contrasts would cause scenic quality along the upper slopes of the Santa Rita Mountains to be reduced and irretrievably lost until the exposed rock had weathered and revegetated to reduce color contrasts and until the haul road terraces were removed to reduce form and line contrasts.

The impacts to scenic quality would be permanent and adverse to a moderate degree because the mine features would attract viewer attention and would be a focus of attention, but they would not likely dominate the view at this viewing distance. It should be noted that if motorists continued north on State Route 83, the impacts would progressively and adversely increase to a major degree because the mine features would eventually dominate the view as motorists approach the mine. There would be no viewing time from this viewpoint for southbound motorists because they would be traveling away from the mine; viewing time for motorists traveling north or northeast would be extended because the mine would be clearly in view to the side.

Phased Tailings Alternative — The impacts under the Phase Tailings Alternative would be the same as discussed for the proposed action for the same reasons. It should be noted that because of topographic hiding and viewing distance to the project area, the landscape contrasts and visible mine features would be very similar for all of the action alternatives as seen from this viewpoint.

Barrel Alternative — Under this alternative, the impacts would be similar to the proposed action, except that the height and lateral extension of the waste rock pile under this alternative would obscure more of the upper pit face. This would reduce the visible area of color contrasts associated with this mine feature and, thus, reduce its adverse impacts to scenic quality. The increased height of the waste rock piles would increase their visibility.

The impacts to scenic quality would be moderate because the color contrasts created by the upper pit face would likely be a focus of viewer attention, viewing distance would tend to reduce waste rock color and form contrasts, and the laterally extended, horizontal form would conform to the surrounding landscape topography. There would be an irretrievable loss of scenic quality to the existing view of the Santa Rita Mountains caused by the pit face color contrasts until permanent timescale rock weathering reduced this contrast.

Barrel Trail Alternative — The impacts under the Barrel Trail Alternative would be the same as for the Barrel Alternative, except that the different waste rock and tailings pile dimensions would expose more of the upper pit face to view, when seen from this viewpoint, and adversely increase its visual contrasts with the surrounding landscape.

Scholefield-McCleary Alternative — The impacts under this alternative would be the same as for the proposed action, for the same reasons.

Viewpoint 6

This viewpoint is along a roadside within the Bureau of Land Management Las Cienegas National Conservation Area, to the east of State Route 83. The viewpoint is approximately 6 miles from the proposed project area near a Bureau of Land Management visitor kiosk, where opportunities for lengthy views of the mine site would be available.

Proposed Action Alternative — Under the proposed action, the distance and intervening topography obscure many of the mine features from the viewpoint 6 perspective. As discussed under viewpoint 5, the processing facility would not be visible because of the intervening landscape topography. The most visible mine feature would be the upper mine pit face, where the light colored exposed rock would create moderately strong color contrasts with the surrounding dark, vegetated ridge slopes.

The tailings and waste rock piles would be visible, but form and line contrasts would be weak because of the long distance, low-angle view and intervening topography, which would mitigate the contrasts. The impacts to scenic quality would be moderately adverse in the long term because the strong mine face contrasts would attract casual viewer attention and would be a focus of attention.

Phased Tailings Alternative — The impacts would be the same as for the proposed action for the same reasons.

Barrel Alternative — Under this alternative, the impacts would be similar to those for the proposed action, except that the lateral extension of the waste rock piles would obscure most of the upper pit face and substantially reduce the visible color contrasts of that mine feature. The impacts would be moderately adverse because the increased visibility of the waste rock piles from this perspective would attract viewer attention and would likely be a focus of viewer attention.

Barrel Trail Alternative — The impacts would be the same as for the proposed action for the same reasons.

Scholefield-McCleary Alternative — The impacts would be the same as for the proposed action for the same reasons.

Viewpoint 7

Viewpoint 7 is located at a point along Hilton Ranch Road, approximately 7 miles northeast of the proposed mine site.

Proposed Action Alternative — From this perspective, mine features would have permanent, adverse, major impacts to scenic quality. The uniform height and uniformly graded, monolithic slopes of the waste rock and tailings piles would create strong form contrasts with the complex, undulating middle ground and background topography along the lower slopes of the Santa Rita Mountains. A strong linear and permanent edge-effect contrast would be created by the prominent, uniformly level waste rock and tailings piles with the background landscape and sky; permanent strong, linear contrasts would also be created by the horizontal slope terraces. Slope terracing contrasts would be increased, on a permanent timescale, by increasingly dense vegetation growth on the terraces, which would remain until vegetation matured.

The highly visible and uniformly light coloring of unweathered waste and tailings rock along the slopes and on the exposed upper pit face would contrast strongly with the darker, mottled vegetation and darker exposed rock outcrops in the background and middle ground. The processing facility would be partially in view in the long term until hidden by waste rock, creating long-term form and

color contrasts, as discussed under "Viewpoint 1 – Proposed Action Alternative." The height and length of waste rock and tailings piles would create permanent, adverse, irreversible losses of scenic quality by obscuring background views of the Santa Rita Mountains; the piles and exposed pit face would attract viewer attention and dominate the view because of their size, strong contrasts, and high visibility.

On a permanent timescale, color and texture contrasts would diminish from rock weathering and slope revegetation, but color and texture contrasts would have irretrievable adverse impacts on scenic quality until this occurred. In the long term, the processing facility would eventually become hidden from view by construction of a waste rock ridge. However, currently proposed mitigation would not sufficiently reduce the mine site impacts to less than a major adverse impact to scenic quality.

Phased Tailings Alternative — The impacts for the Phased Tailings Alternative would be similar to the proposed action because the contrasts would be the same, except that scree slopes would be constructed that would introduce additional adverse line, color, and texture contrasts and impacts as discussed under "Viewpoint 1 – Phased Tailings Alternative."

Barrel Alternative — The impacts for the Barrel Alternative would be similar to the proposed action because the contrasts would be similar, except that the pit diversion channel would be visible and more of the upper pit face would be visible. The increased visibility of these mine features would create additional major adverse color and line contrasts with the surrounding Santa Rita Mountain landscapes.

These additional adverse impacts would be major because the large area of exposed pit face (with strong color and line contrasts), along with the adjacent diversion channel cut slope, would likely be a focus of viewer attention and would dominate the view. The impacts of pit face and pit diversion channel contrasts would cause scenic quality along the upper Santa Rita Mountain Range to be reduced and irretrievably lost until the exposed rock had weathered and revegetated to reduce color contrasts and would be irretrievably lost until the pit face haul roads were removed to reduce their color and line contrasts.

Barrel Trail Alternative — The impacts to scenic quality under this alternative would be the same as for the Barrel Alternative because the visible height, extent, and form of the waste rock and tailings piles would be similar, which would create similarly exposed views of the upper pit face and diversion channel cut slope.

Scholefield-McCleary Alternative — Under this alternative, the impacts to scenic quality would be very similar to those discussed under "Viewpoint 1 – Scholefield-McCleary Alternative." The combined waste rock and tailings piles north of the mine pit would irreversibly obscure existing background views of the Santa Rita Mountains; a smaller heap leach pad to the south would have minor adverse line and color impacts.

There would be major, adverse, long-term to permanent impacts to scenic quality caused by the highly visible pit face, pit diversion channel, internal mining roads, and views of the processing facility. Under this alternative, the terraced waste rock and tailings slopes would be more fully exposed to view, with an increase in the permanent adverse line and color contrasts caused by the more visible dense vegetation growth on the terraces and stronger color contrasts of unweathered slope rock.

Viewpoint 8

Viewpoint 8 is located at the off-highway vehicle trailhead parking lot along Forest Road 231, just north of Box Canyon Road.

Proposed Action Alternative — Under the proposed action, strong form, color, and line contrasts would be permanently created by the highly visible, and visually intrusive, waste rock and tailings piles in the foreground and middle ground, with major adverse impacts to scenic quality because of their close proximity to viewers traveling and recreating along Box Canyon Road and Forest Road 231 and using the trailhead and parking lot there.

On a permanent timescale, rock weathering and revegetation establishment and growth on the waste rock slopes would reduce the adverse color and texture contrasts to a moderate degree: the slopes would remain visible and attract viewer attention but would not dominate the view. However, increasingly dense vegetation regrowth along the terraced slopes would produce adverse line contrasts until vegetation maturity.

A proposed transmission line right-of-way would lie within the foreground and middle ground of this area. In the long term, the line would contribute to the adverse scenic quality impacts caused by mine operations. The long-term impacts from power line construction along the southern route in the vicinity of Box Canyon Road would be adverse and major because of the proximity of the transmission line to viewers traveling and recreating along this scenic travel way.

The proposed line would be built along a right-of-way that would approach and intersect Box Canyon Road from the north, cross the roadway, then continue south to the southern substation. The proposed transmission line alternatives that would impact Box Canyon scenic quality would be the TEP Preferred Route, TEP Alternative 1, TEP Preferred Sub Alternative, and TEP Sub Alternative 1. The TEP Alternative 2 alignment would also intersect and cross Box Canyon Road approximately 1 mile to the west of the TEP Preferred Route, with similar scenic quality impacts. Tourists, motorists, and off-highway vehicle users traveling along the sightseeing route within Box Canyon would likely experience diminished scenic quality from the transmission line form and color contrasts where it crosses Box Canyon Road overhead.

Mitigation to reduce visual impacts would include the use of nonreflecting wire and monopoles that weather to a dark, nonreflective surface. However, the degree of contrast created by highly visible overhead power line and roadside power poles, and line and power poles advancing and receding across the landscape would have major, adverse, long-term impacts to scenic quality because of the line's close proximity to travelers, the strong line contrasts created by the horizontal power lines and vertical power poles, and line and color contrasts created by tree and dense vegetation clearing within the transmission line right-of-way.

There would be no permanent power line impacts to scenic quality because the lines would be removed during mine closure, and the power line right-of-way surface disturbances and vegetation losses created would be reclaimed. However, there would be an irretrievable loss of scenic quality along the travel way until the power lines were removed.

Phased Tailings Alternative — The impacts under the Phased Tailings Alternative would be the same as for the proposed action for the same reasons.

Barrel Alternative — The impacts caused by the Barrel Alternative would be the same as for the proposed action because the power line would be potentially located along the same alignments, with similar visibility of the waste rock piles from Forest Road 231 and Box Canyon Road.

Barrel Trail Alternative — The impacts under the Barrel Trail Alternative would be the same as for the proposed action for the same reasons.

Scholefield-McCleary Alternative — Under this alternative, the waste rock and tailings piles would be constructed north of the pit and would not be clearly visible from Box Canyon Road. Thus, there would be no impacts to scenic quality caused by the waste rock and tailings piles; however, the impacts to scenic quality caused by the power line would be the same as for the proposed action.

Viewpoint 9

This viewpoint is located at a point along Sahuarita Road, approximately 11 miles northwest of the proposed mine site. The results of the geographic information system calculated viewshed analysis show that from this viewpoint, only the Scholefield-McCleary Alternative impacts would be visible. Thus, no simulations were produced and no analyses were conducted for the proposed action, Phased Tailings, Barrel, or Barrel Trail Alternatives from viewpoint 9.

Scholefield-McCleary Alternative — Under this alternative, the Rosemont Copper Mine's landscape impacts would be visible west of the Santa Rita Mountains, with a visibility area that includes Sahuarita, Tucson, Coronado de Tucson, and Interstates 19 and 10. It should be noted that the long viewing distances to these metropolitan areas, towns, and major thoroughfares would reduce the visible impacts caused by the Scholefield-McCleary Alternative.

Moderate line and form contrasts would be created, caused by the height of the tailings and waste rock piles, which would be visible above the surrounding landscape. The unnaturally level, uniformly colored rock piles would create moderate contrasts with the surrounding undulating, rugged ridgelines and with the variable vegetation and exposed rock colors along the western slopes of the Santa Rita Mountains.

The existing scenic quality from this perspective would be irretrievably lost until waste rock weathering and vegetation regrowth on the pile slopes reduced these contrasts (on a permanent timescale) to blend in with the rocks and vegetation of the surrounding upper slopes of the Santa Rita Mountains. The impacts on scenic quality would be moderately adverse in the long term because although the viewing distance is long, there are few intervening landscape features to obscure the view, and the viewing time of the range (which naturally attracts the motorists' attention because of its scenic quality) along this travel way would be very long for eastbound motorists.

As discussed above, viewshed analyses and the alternative simulation show that the Scholefield-McCleary Alternative would be visible from the town and surrounding communities, including the town of Sahuarita and its general planning area. Visual impacts to the town of Sahuarita would be adverse and permanent.

Mitigation measures to reduce the visual contrasts of mine construction and operation would not be sufficient to obscure impacts visibility to residents, visitors, and travelers in the planning area. Mine related landscape impacts would not comply with the town's land use planning goals, objectives, and policies "to improve visual and aesthetic appearance of the town" (Town of Sahuarita and General Plan Advisory Committee 2002).

Quantitative Impacts to Viewsheds

A geographic information system based computation of potentially affected important scenic quality areas within the Santa Rita Mountains portion of the Coronado National Forest was conducted to quantitatively assess the impacts of the proposed action and action alternatives on scenic viewsheds. The miles of impacted concern level 1 and 2 travel ways (roads and trails) and acres of areas designated with very high and high scenic integrity objectives were calculated using the viewshed analysis data of project area visibility for each alternative. The following comparison tables (tables 121 and 122) show the acres of potentially impacted landscapes within the Coronado National Forest for the proposed action and action alternatives, as seen from areas within the region from which the project would be potentially visible.

Table 121. Santa Rita Ecosystem Management Area and regional visibility impacts by alternative

Alternative	Very High and High Scenic Integrity Visibility within Project Area (Acres)	Very High and High Scenic Integrity Visibility on Santa Rita Ecosystem Management Area (Acres)	Impacts to Concern Level 1 and 2 Roads and Trails within Project Area (Miles)	Impacts to Concern Level 1 and 2 Roads and Trails on Santa Rita Ecosystem Management Area (Miles)	Project Area Visibility within Analysis Area (Acres)*
Proposed Action	6,175	13,742	15	40	187,893
Phased Tailings	6,071	13,427	15	40	245,038
Barrel	6,808	14,773	18	42	264,795
Barrel Trail	6,808	21,170	18	59	260,589
Scholefield-McCleary	7,166	21,903	14	52	763,295

* Note that the small discrepancies in acreage for regional visibility between this table and the viewshed analysis figures are the result of geographic information system landownership coverage data errors and the geographic information system calculations based on that coverage. Graphic depiction of viewshed analyses for the proposed action and action alternatives are shown in figures located in appendix D on a CD in the sleeve of the DEIS.

Table 122. Visibility impacts to State Route 83, Box Canyon Road, and Arizona National Scenic Trail by alternative

Alternative	Patagonia-Sonoita Scenic Road (State Route 83) (miles)	Box Canyon Road (miles)	Arizona National Scenic Trail (miles)
Proposed Action	3.4	1.0	7.7
Phased Tailings	3.5	1.0	7.6
Barrel	3.9	1.5	8.9
Barrel Trail	4.9	3.3	12.8
Scholefield-McCleary	3.5	1.3	12.9

In addition, a geographic information system based viewshed (or visibility) analysis was also conducted to define the visual resources analysis area and to determine where the project area and mine features would be potentially visible within the region. For the proposed action and each of the action alternatives, the regionwide areas from which mine features would potentially be visible were calculated for several locations along the highest contour line of the pit (which is the highest mine feature) and tops of the waste rock and tailings piles. This ensured that most, if not all, of the highest mine features would be used in the geographic information system visibility calculations and that the

visibility analyses would be calculated from the outer edges of these mine features (where there would be maximum visibility to viewers) and not from the interior of the features.

The results of the regional viewshed analyses are shown in figures located in appendix D on a CD in a sleeve of the DEIS. Figure 71, to provide an example of the regional viewshed analyses, depicts results for the proposed action (preliminary MPO). The figure shows the areas within the visual analysis area from which the proposed action would be visible. The acreage and mileage tables shown above were derived from the data obtained from these analyses.

It should be noted that although these quantitative measurements can help disclose project impacts and compare alternatives, the impacts analysis is primarily focused on qualitative analysis (including descriptions and simulations). Scenic quality impacts must be considered in the context of the degree of landscape contrasts that are produced, the visibility of the impacts to viewers, viewshed sensitivity, and changes to scenic integrity (as discussed in the "Methodology" part of this section).

Acreage and mileage impacts are shown for each of the action alternatives in table 121. The first column shows the acres of impacts to existing scenic integrity within the project area fence line, and the second column shows the acreage within the Santa Rita Ecosystem Management Area from which the scenic quality impacts would be potentially visible to viewers. The third column shows the miles of sensitive roads and trails within the project area fence line that would be impacted, and the fourth column shows the miles of sensitive roads and trails within the Santa Rita Ecosystem Management Area from which project related scenic quality impacts would be visible. The fifth column shows the number of acres within the analysis area from which project related scenic quality impacts would be visible.

A geographic information system based calculation was also conducted to quantify the impacts to selected major travel ways within the region where scenic quality and scenic values are important to the travel experience. Table 122 depicts the miles of roadways and trails from which the project area and mine features would potentially be visible.

Arizona Department of Transportation

As shown above in table 122, the impacts to scenic quality along the Arizona Department of Transportation's Patagonia-Sonoita Scenic Road, from which project related impacts would be visible, would range from approximately 3.5 miles for the proposed action to 5 miles under the Barrel Trail Alternative. As discussed in the analysis above for viewpoints 1, 2, and 5, the most visible mine features from the scenic road would be the mine pit face, tailings and waste rock piles, and mine processing facility, with impacts to scenic road quality as discussed under each of the alternatives for those viewpoints. Based on an assessment of potential impacts from mine construction and operation, the Arizona Department of Transportation does not anticipate changing the road's designation because the overall effect of mine surface disturbances and structures on the road's scenic quality is expected to be minimal.

Secondary roads beyond the boundaries of the Coronado National Forest would also be affected by Rosemont Copper Mine construction and operation. The impacts to travelers viewing the Santa Rita Mountains along Sahuarita Road are discussed in the "Viewpoint 9" part of this section. The impacts to views along Santa Rita Road and Helvetia Road, east of the town of Sahuarita, are discussed in the "Power Line Transmission" part of this section. The viewshed analysis for the Scholefield-McCleary Alternative (the only alternative clearly visible west of the project area) shows that there would be no

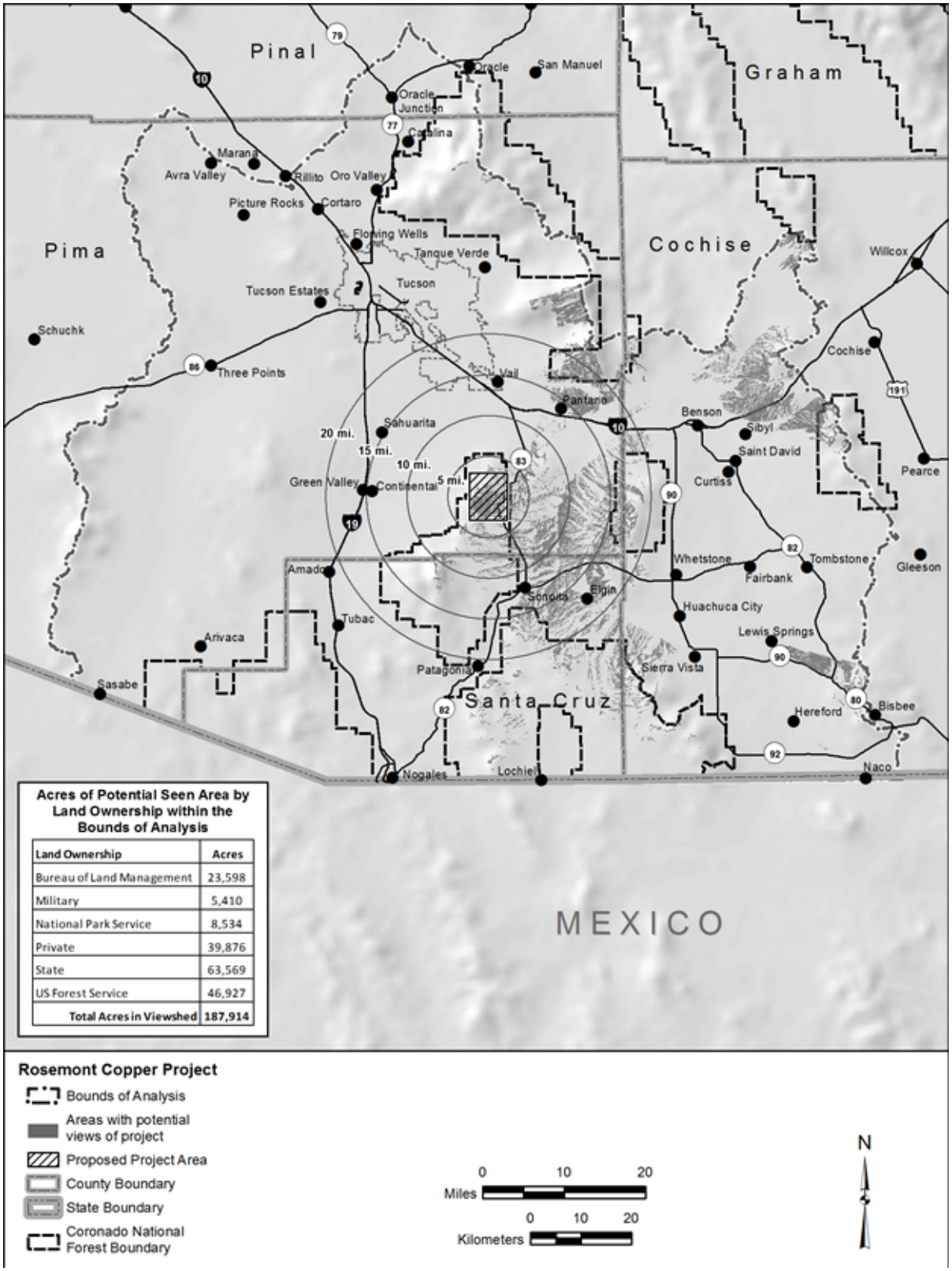


Figure 71. Proposed action (preliminary MPO) regional visibility. These regional visibility figures are located in appendix D on a CD in a sleeve of the DEIS.

view of the mine tailings piles and pit face along secondary roads generally south of the town of Green Valley.

Pima County

The Pima County Code (18.61.041) stipulates that construction mitigation be considered and applied to designated protected peaks and ridges within the county. The mitigation includes selection of building colors, building height, site grading, revegetation plant species, and site lighting to reduce the scenic quality impacts to protected peaks and ridges.

Under the proposed action and all of the action alternatives, mitigation would be applied, as previously discussed, for the lifetime of the project. However, it is likely that mitigation would not preserve the scenic quality of Pima County designated protected peaks and ridges.

Project area revegetation mitigation would occur under a permanent timescale, in which color and linear contrasts would be visible on waste rock and tailings slopes for 50 to 100 years, when vegetation begins to mature and partially screen these contrasts. Color mitigation would be applied to mine structures, but the structures would be visible from regional travel ways and use areas.

Mine site lighting would be mitigated to reduce or minimize sky glow and light pollution; however, mine safety and security requirements would render the mine visible. As shown through viewshed analyses conducted for the proposed action and action alternatives, these impacts would be visible regionally and would have regional adverse impacts on scenic quality beyond the mine footprint, including adverse impacts to Pima County designated protected peaks and ridges.

Lighting and Night Sky

As discussed in the “Affected Environment” part of this section and in the “Dark Skies” section of this DEIS, there are presently few artificial light sources and no developed artificially lit areas near the proposed mine site that would affect night sky views or the visual setting at night. Construction and operation of the proposed mine would, under the proposed action and all of the action alternatives, adversely affect night sky viewing in the short and long term.

High-intensity lighting systems would likely be used throughout the project area to provide light for nighttime operations at the processing facility, for mine safety, and to ensure that the project area was adequately lit for mine site security. Lighting mitigation would result in a minor reduction in light pollution and sky glow (e.g., low-height lighting fixtures, light shielding, and low-scatter light bulbs).

However, the size and elevation of the project area above the surrounding landscape, along with the lighting needs in many areas of the project, including the pit, processing plant, and roads, would likely create conditions under which project lighting would be adversely visible to Coronado National Forest visitors and to motorists. Night sky views would be impaired, and there would be adverse impacts to night sky conditions from light pollution and sky glow and distraction for State Route 83 travelers. Astronomy observatory viewing conditions would also be degraded. There would be no permanent impacts to night sky conditions: during mine closure the mine site facility lighting and power transmission lines would be removed, and the site would be restored to premining night sky conditions.

Comparison of Alternative Impacts

The Scholefield-McCleary Alternative would have the greatest impacts to visual quality because it has the most extensive regional visibility, the greatest impacts from numerous viewpoints and viewers, and is the most difficult to mitigate. If recommended additional mitigation is applied (see the "Additional Measures to Reduce Impacts" part of this section), the Barrel Trail Alternative would likely have the least impacts to visual quality because its more gentle slopes have the best opportunities for landforming and revegetation, and the waste rock piles would partially screen the plant and pit from some viewpoints.

Cumulative Effects

Introduction

Past, present, and reasonably foreseeable actions, in combination with the proposed project, that could cumulatively affect scenic quality are described below. These are the effects on scenic quality that would result from the incremental impact of a proposed action (in this case the Rosemont Copper Project) when added to other past, present, and future projects within the region. Prior to an analysis and discussion of cumulative impacts, several concepts should be noted.

First, impacts to scenic quality are often cumulative. Projects that create permanent changes to landscape character and scenic integrity tend to be progressive, with landscapes seldom returning to their preconstruction character unless facilities are removed and preconstruction topography and vegetation restored.

Second, boundaries for evaluating cumulative effects are not easily defined because viewers, as they travel through a landscape, experience a sequence of viewsheds. Thus, looking at the effects of one or several projects may show local visual impacts but not regional impacts. A regional scale of analysis is needed to fully analyze cumulative impacts to scenic quality.

Third, even relatively small projects with small footprints can have large-scale impacts on scenic quality, and several small project impacts can have cumulatively large impacts. For example, an astronomy observatory on a mountaintop may occupy only a few acres, but its potential impacts to visual quality could affect the viewshed for many miles around it because of its potentially high visibility.

Scale of Analysis Area

For the proposed project, a regional-scale analysis of cumulative impacts is appropriate because of the high visibility of past and present activities in and surrounding the Santa Rita Mountains and across southeastern Arizona, and because numerous public comments on the Rosemont Copper Project expressed concern for the region's incremental loss of scenic quality.

Cumulative Trends

As discussed above in the "Affected Environment Scenic Integrity" and "Regional Trends" parts of this section, numerous ongoing activities and regional trends contribute to cumulative impacts to scenic quality in southeastern Arizona. These include regional population growth and an associated increase in infrastructure such as roads, residential housing and commercial development, utility lines, and wireless telecommunication towers (some of these impacts abut the Coronado National Forest boundary).

Other external activities exacerbating the trend toward loss of forest scenic landscapes include border control activities and illegal border crossing impacts, mining activities (including the large mines near Green Valley), construction of astrophysical facilities on mountaintops, and the development of privately owned forest inholdings.

On the Coronado National Forest, the increasing demand for recreational opportunities on the forest is creating recreation area overuse in some areas, where recreation users are meeting and exceeding the carrying capacity of recreation areas and causing scenic resource damage. The increasing popularity of off-highway vehicle use on Forest Service roads and trails, particularly in the Santa Rita and nearby Huachuca Mountains, is causing scenic resource degradation.

As discussed in the "Air Quality and Climate Change" section of the DEIS, research suggests that climate change will have several effects on the project area. Temperature levels in the Southwest are anticipated to rise as a result of global climate change. By the end of the 21st century, they could rise by 5 °F to 8 °F. Overall precipitation levels in the Southwest are anticipated to fall by as much as 10 percent as a result of global climate change.

The effects of these changes on the project are expected to be an increased risk of drought and wildfire. This increased risk of drought and fire could indirectly and adversely affect the success of revegetation efforts and lengthen the time required to meet revegetation goals. At present, it is projected that 50 to 100 years would be required to achieve partial coverage of mature vegetation on the waste pile slopes. Drought and/or wildfire could extend that time.

Reasonably Foreseeable Future Actions

Future actions include continued mineral exploration, Sahuarita Road construction, and processing at the Stakaer Parsons concrete plant.

Foreseeable future activities along the Arizona National Scenic Trail would include those described above in the "Other Scenery Management Plans and Guidance—The Arizona Trail" part of this section. Activities would include power transmission line construction and operation, possible gravel and rock pit development, fuel reductions by the Forest Service to reduce wildland fire risks, and land restoration and reclamation within the forest.

Foreseeable future actions that could affect trail scenic quality are as follows:

- Flagstaff to Pinnacle Peak Transmission Line – The line would run from Fossil Creek north by Winona to the northern boundary of the Coconino National Forest. Construction and operation of the line, which would cross the trail, would expand vegetation management, including tree removal, for a distance of up to 150 feet on either side of the existing 345-kilovolt line traversing the Coconino National Forest.
- APS Sandvig-Young Power Line – This action would expand the existing power line's 40-foot-wide corridors to allow construction of a new 69-kilovolt power line east of Flagstaff. The line crosses the Flagstaff equestrian bypass in the Mount Eldon section of the trail.
- Rock and gravel pit development in the Kaibab and Coconino National Forests would affect trail scenic quality. There would be a total of 39 rock pits, affecting a total of 434 acres on forest lands.

- Marshall Fuel Reduction and Forest Restoration Project – Coconino National Forest fuel load reduction and land restoration efforts on approximately 12,000 acres southeast of Flagstaff would affect trail scenery as the trail passes through this area. The project would include thinning, prescribed burning, road closures and/or realignments, and realignment of a portion of the Arizona National Scenic Trail.
- Clint's Well Forest Restoration Project – Fuel reduction and land restoration on approximately 16,809 acres within the Coconino National Forest would affect trail scenery. The trail passes through the project area. The project would include timber thinning and prescribed burning to reduce wildland fire risks and improve wildlife habitat.
- Four Forests Restoration Initiative – A regional, 750,000-acre restoration project encompassing the Coconino, Kaibab, and Tonto National Forests would be a collaborative, landscape-scale initiative designed to restore fire-adapted ecosystems in the Southwestern Region. The size of this initiative would likely affect trail scenic quality.
- Hart Prairie Restoration Project – located in the Coconino National Forest, land restoration would require intense tree thinning, including 0.6 mile of the trail. There would be severe short-term visual effects along the trail during the 3 to 5 weeks in the fall of 2012, when the forest stands are scheduled to be thinned.
- ASARCO State Land Sale – Under consideration by the State Land Department, this potential sale would transfer Arizona State Trust land to ASARCO for future mine tailings disposal site west of Kelvin. The tailings disposal would require approximately 11 miles of the trail to be rerouted to less scenic locations, and a new bridge over the Gila River would be needed for the trail crossing.
- SunZia Southwest Transmission Project – Located within Bureau of Land Management administered lands, the 460-mile cross-state project would consist of two side-by-side 500-kilovolt power lines. The project utility corridor would cross the trail and would affect scenic quality.
- Centennial West Clean Line Project – This 900-mile-long power line project would cross the trail and would affect scenic quality.

Summary

The proposed project, when added to past, present, and future actions and combined with regional trends that impact visual quality, would result in cumulatively adverse, permanent impacts on scenic quality within the region because of the surface disturbances and landscape contrasts associated with these activities. Additionally, fugitive dust production from the proposed mine, when added to ongoing mining related surface disturbances and existing dust production from concrete and cement operations and road construction, would increase the adverse impacts to long-distance scenic viewing of the Santa Rita Mountains and other scenic mountain ranges within the region in the short and long term.

This project would contribute to the ongoing and incremental loss of natural open spaces and wild places across southeastern Arizona, and because it would be a large, new impact inside one of the remaining pieces of intact, natural landscapes (the Santa Rita Mountains) and is located near the growing metropolitan Tucson area, the cumulative effects would be considerable.

To ensure long-term sustainability of scenic resources, additional mitigation of the Rosemont Copper Mine would be needed, including measures described below in the "Additional Measures to Reduce

Impacts" part of this section. These measures could minimize short-term, long-term, and permanent impacts from the project and ultimately reduce cumulative effects.

Mitigation Effectiveness

The proposed action and all action alternatives would include mine reclamation and mitigation during mine operations and following mine closure to reduce some impacts to scenic quality (discussed below). Project reclamation and mitigation measures for the proposed action and the action alternatives are described in chapter 2. These reclamation and mitigation measures and their likely effectiveness to mitigate scenic quality impacts are discussed below.

Reclamation and Mitigation Common to the Proposed Action and Action Alternatives

As described in chapter 2, Rosemont Copper's reclamation and mitigation would involve three major phases: concurrent reclamation and mitigation during mining operations; mine closure reclamation and mitigation; and postclosure reclamation and mitigation.

During concurrent reclamation, as the waste rock and tailings piles, buttresses, facility screening ridge, and heap leach pad are being constructed during mine operations, slope terracing and seeding of the waste rock and tailings slopes would commence and continue during mine operations. Water retention and attenuation ponds would be constructed as the slope terraces are completed to control stormwater flow and reduce downslope erosion and sedimentation.

The impacts of these measures would have minor beneficial impacts to scenic quality in the short or long term because the time required to reduce color, form, texture, and line landscape contrasts through revegetation coverage, rock weathering, and gradual reduction of the slope terraces and artificial contouring would extend beyond the 25-year mine life and beyond mine closure. It is estimated that 50 to 100 years would be required to achieve partial, mature vegetation coverage on the recontoured, terraced waste rock and tailings piles (Lefevre 2010).

Sediment and dust control would include use of water sprayers and binding materials to reduce fugitive dust production. These efforts would reduce, but likely not eliminate, the adverse effects that fugitive dust would have on long-distance viewing and on dispersion of light pollution during the nighttime in the short and long term, until mine closure.

During mine operations, the color of the processing plant buildings would be painted or stained in earth tones or in a color designed to reduce color contrasts with the surrounding landscape. Because many of the mine buildings are very large (and some are 160 feet tall), this would be very important to lessen visual impacts. A dark, neutral color, such as the Bureau of Land Management Standard Environmental Color called "Carlsbad Canyon," is recommended, and assuming that it or another appropriate building color is applied, the short- and long-term impacts to scenic quality would be beneficial (note that this color was used in the visual simulations where the processing facility would be visible in the long term).

During mine closure, the mine processing facility and its foundations would be removed, and the project area internal access roads would be reclaimed (with the exception of the primary and secondary access roads). Removal and reclamation of the plant site and internal roads would mitigate scenic quality impacts by recreating natural slopes and contours and allowing vegetation to grow in these disturbed areas.

Final capping and seeding on the upper waste rock and tailings piles and construction of the attenuation ponds would be completed, and as discussed throughout this section, reclamation vegetation growing on the rock slopes would create visual contrasts along the slope terraces but would permanently reduce color, form, texture and line contrasts after sufficient regrowth and surface coverage.

For the waste rock and tailings piles, the mitigation effects on scenic quality would be similar to those discussed above: minor reduction or lessening of potentially adverse impacts to scenic quality caused by mine construction and operation. The mine closure mitigation would have minor impacts because of the very long time required to reduce existing rock and slope form contrasts and produce sufficient vegetation coverage to reduce color, line, and texture contrasts.

During mine closure, fugitive dust generation would be reduced by applying and spreading capping material to prevent or minimize the dispersion of windblown waste rock and tailings material. This would have direct, beneficial impacts to scenic quality, particularly at night, by reducing the effects of fugitive dust obscuring long-distance viewing and by reducing night lighting dispersion. The removal of mine night lighting during mine closure would have a permanent direct, beneficial impact on night sky scenic quality by greatly reducing mine related sky glow and night sky brightening.

Postclosure reclamation would include monitoring revegetation success on the waste rock and tailings slopes and ensuring that the stormwater drainage structures are intact and functioning (see the “Soils” section of the DEIS for revegetation success criteria). If minimal revegetation success criteria are not met at specified intervals during mine operation and after mine closure, then additional reseeding and soil/growth media work would be conducted. The impacts to scenic quality would be similar to the long-term operation and mine closure impacts: minimal beneficial impacts to scenic quality because of the period required to produce sufficient landscape and vegetation changes to cover the mine slopes and exposed rock and soil contrasts.

In summary, the proposed reclamation and mitigation efforts would result in permanent, unacceptably low Forest Service scenic integrity for the landscape in the project area. Unacceptably low scenic integrity is defined as forest landscapes that appear extremely altered, with extreme deviations from the natural landscape character, and that borrow very little, if any, line, form, color, or texture patterns from the existing landscape character. It should be noted that this level is only used to inventory the existing landscape and is not used as a management objective (U.S. Forest Service 1995).

Reclamation and Mitigation Common to the Action Alternatives

Visual mitigation applicable to the action alternatives (proposed action, Phased Tailings, Barrel, Barrel Trail, and Scholefield-McCleary) would be to darken exposed rock faces in the mine pit. The applicability of procedures to darken or “weather” exposed rock faces where exposed rock is lighter than adjacent weathered rock will be determined. Areas would be limited to those that are visible at time of closure. If the light-colored rock in the upper pit and pit diversion channel were to be darkened, this mitigation would be beneficial because it would reduce color contrasts.

Barrel Trail Alternative

Alternative-specific mitigation to reduce visual impacts would be the construction of more variable topography to replicate natural landforms. The short- and long-term impacts would be beneficially minor impacts to no beneficial impacts because the exposed waste rock and tailings piles, terraces, and stormwater structures would dominate the view. On a permanent timescale, once sufficient

vegetation coverage has reduced pile related color, form, texture, and line contrasts, the artificially constructed variable topography would beneficially reduce mine site visual contrasts.

Additional Measures to Reduce Impacts

The Barrel Trail or a similarly designed alternative probably has the best opportunities for landforming on the waste rock and tailings piles (shaping the outer surface to mimic natural forms to visually blend into the surrounding landscape). As proposed, none of the action alternatives meet scenic quality objectives in the forest plan or mitigate visual impacts well.

Visual impacts from the proposed action and action alternatives could be reduced through inclusion of measures that would result in the open pit and tailings and waste rock facilities that help the mine features better blend into the surrounding landscape. These measures could include the following: (1) topographic land forming and slope recontouring on the waste rock and tailings piles to recreate or mimic the surrounding natural topography and landscape forms; (2) planting of trees and shrubs on the waste rock and tailings piles; and (3) treatment (e.g., painting, staining, or desert varnish) of the visible areas of the mine pit and terraced slopes, along with the pit diversion channel, to darken the exposed and unweathered rock, to mimic the surrounding landscape colors. Treatment of light-colored rock with a desert varnish has reduced visual impacts on several projects on the Coronado National Forest. However, these methods are not currently incorporated into the proposed action or action alternatives.

The Forest Service is investigating the feasibility of geomorphic design (sometimes called landforming) and construction of the Rosemont Copper Mine waste rock and tailings piles. Landforms of geomorphic design can create more stable, natural functioning, and natural looking topography than conventionally designed landforms, which could mitigate some impacts to water quality and quantity, visual quality, recreation settings, and wildlife habitat. The Forest Service plans to explore the status of geomorphic landform design in the mining industry. If these investigations show that geomorphic landform deign is feasible for the proposed project, we will then apply geomorphic principles to at least one alternative. This investigation and potential design work will take place between the DEIS and FEIS.

In combination, exploring and implementing these measures could substantially reduce scenic quality impacts in the long term by reducing the form, color, line, and texture contrasts created by surface disturbances and exposure of unweathered subsurface rock and soil. The mitigation effects would reduce landscape contrasts by blending the mine disturbances with the surrounding landscape, encouraging denser revegetation and surface coverage along more natural patterns of plant development and succession, and reducing the number of engineered drainage structures (Golder Associates Inc. 2010). Under this reclamation and mitigation regime, it is possible that postmine closure impacts would be more rapidly reduced and that portions of the mine would more quickly meet low to moderate scenic integrity objectives (see table 117).

Some mitigation measures mentioned in chapter 2 do not yet have sufficient information or commitment for consideration in this analysis. Although planting vegetation (and in some cases, watering) is mentioned, no details about species, sizes, locations, or availability has been provided. Compensatory land mitigation is also mentioned, but no details about land locations or potential scenic benefits have been provided.

Mitigation mentioned in chapter 2 includes the intent to reduce or eliminate future development of private lands currently owned by Rosemont Copper that would eventually be located on top of waste rock and tailings piles (i.e., Rosemont Ranch). Rosemont Copper and the Coronado will work together to reduce or eliminate future development of these lands that could compromise reclamation of waste rock and tailing areas over the long term. This analysis assumes that these efforts will limit future development and that future impacts to visual resources will not occur.

Further mitigation of the Rosemont Copper Mine would be beneficial to protect visual resources, including measures described here. These measures would minimize short-term, long-term, and permanent impacts from the project and would ultimately reduce cumulative effects on scenic quality in southeastern Arizona.

Two additional mitigation measures are recommended. First, as proposed in the "Reclamation Concept Update" (Tetra Tech 2010f), the postmine processing plant site-grading plan (Tetra Tech 2010f) does not eliminate the artificial landforms related to building pads and roads. Grading to restore a natural-appearing topography would reduce impacts and encourage more natural revegetation in
this area. Second, breaking up the horizontal benches in the visible portions of the upper pit is recommended. There are several ways to accomplish this, including double benching, postmine bench blasting, and randomized benching. A combination of these is recommended.

Irretrievable and Irreversible Commitment of Resources

For all action alternatives, there would be an irretrievable loss of scenic quality from increased access roads and commuter and truck traffic during the operating phase of the mine. There would be an irretrievable loss of scenic quality to the existing view of the Santa Rita Mountains caused by the upper pit face, pit haul roads, and pit diversion channel cut slope color contrasts until permanent timescale rock weathering has reduced these contrasts. The size and extent of the waste rock and tailings piles would create irretrievable losses of scenic quality until rock weathering and slope revegetation reduced color, form, line, and texture contrasts to a degree that they blend in with the surrounding landscape.

However, owing to the geological time frame necessary for these processes to occur, the loss of scenic quality associated with the waste rock and tailings piles would effectively be irretrievable. There would be an irretrievable loss of scenic quality along Box Canyon Road, State Route 83, Santa Rita Mountain ridgetop trails, and Santa Rita west slope rural routes until the power lines were removed. Segments of the existing Arizona National Scenic Trail would be irretrievably lost.

Under all of the action alternatives, existing views of the Santa Rita Mountains would be irreversibly lost behind the waste rock and tailings piles because of the height and extent of the piles.

Recreation and Wilderness

Introduction

Local, State, and Federal agencies provide a number of recreation opportunities in southeastern Arizona and on lands within and adjacent to the project area. Recreation activities include casual or dispersed uses, as well as organized events. Typical recreation activities in the project area consist of motorized vehicle touring, wildlife observation, nature study, bird watching, recreational prospecting, hunting, rock and mineral collection, picnicking, mountain biking, hiking, and horseback riding.

Issues, Cause and Effect Relationships of Concern

Issue 9: Impact on Recreation

This issue focuses on the effects of the mine operation on recreation on National Forest System and Bureau of Land Management administered lands, including loss of access and recreation opportunities, and loss of or reduction in solitude, remoteness, rural setting, and quiet. The mine operation may lead to permanent changes to recreation settings (Recreation Opportunity Spectrum) and/or the type of recreation available and may result in increased pressure on public and private lands in other places to compensate for lost opportunities.

Issue 9 Factors for Alternative Comparison

- Area that would no longer meet current forest plan Recreation Opportunity Spectrum designations (acres)
- Area of the Coronado National Forest that would be unavailable for recreational use (acres) and public roads lost (miles)
- Qualitative assessment of potential for noise to reach recreation areas: audio "footprint"
- Qualitative assessment of impacts to solitude in designated Wilderness and other backcountry areas
- Hunter days lost (quantity based on percentage of Forest Service land lost under each alternative)
- Length of Arizona National Scenic Trail relocated (miles)
- Qualitative assessment of increased pressure on other areas, including roads and trails/trailheads

A summary of these issues of concern by alternative is provided in table 123.

Summary of Direct Effects by Issue Measures by Alternative

Table 123. Summary of effects

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
9: Recreation Opportunity Spectrum Setting Impacted and Area No Longer Available for Recreational Use (total acres)	0.0	6,211.2	6,107.3	6,844.6	6,844.6	7,193.9
9a: Semiprimitive Nonmotorized (acres)	0.0	0	0	0	0	119.2
9b: Semiprimitive Motorized (acres)	0.0	5,973.0	5,868.4	6,054.0	6,054.0	6,874.0
9c: Roaded Modified (acres)	0.0	170.0	170.0	170.0	170.0	0
9d: Roaded Natural (acres)	0.0	68.2	68.9	620.6	620.6	200.7
9: Annual Hunter Days Lost (per year)*	0	776	757	702	886	905
9: Percent of Hunt Unit 34A on Forest Lands Affected	0.0%	4%	4%	4%	5%	5%
9: Public Roads Lost (miles)	0.0	30.4	30.5	32.6	32.6	30.7
9: Arizona National Scenic Trail Relocated (miles)	0.0	3.79	3.68	5.30	5.30	3.79

* Only considers hunter days lost for white-tailed deer, javelina, and Mearn's quail (Heffelfinger n.d. (2011)).

Analysis Methodology, Assumptions, Uncertain and Unknown Information

This chapter presents the anticipated environmental consequences that would result from implementation of the proposed action and each alternative. For the analysis, existing data and professional judgment were used. The analysis also takes into account elements and mitigation measures identified in chapter 2. This analysis was completed using the best available information, including State and Federal agency information and recreation visitation numbers. Impacts that occur under more than one alternative are discussed under the first applicable alternative and are then referenced under other pertinent alternatives.

The analysis area is defined as follows: the active project area; the forest unit encompassing the Santa Rita Mountains of the Coronado National Forest, including the Mount Wrightson Wilderness and the Las Colinas section of the Arizona National Scenic Trail; the Bureau of Land Management managed Las Cienegas National Conservation Area east of the forest unit; Santa Cruz County; and eastern Pima County (figure 72). The forest unit encompassing the Santa Rita Mountains was chosen based on the assumption that recreational users affected by mining activity would move to forest lands nearby that would provide similar recreation opportunities. Outside the forest unit boundary, additional recreation activities, areas, and opportunities were identified to describe the indirect and cumulative impacts of the alternatives. The temporal bounds of analysis consists of four phases: construction, operation, closure, and postclosure. Potential impacts would occur throughout and following the active mine life. As such, the temporal bounds of analysis for recreation would include all four phases of the proposed action and action alternatives. Because changes to the recreation setting would be the primary direct impact of the proposed action and action alternatives, the relative impacts of each alternative to the recreation setting have been assessed by comparing what would result from the construction and operation of the Rosemont Copper Mine.

The analysis provides a quantitative or qualitative comparison (depending on available data and the nature of the impact) between alternative impacts and establishes the severity of those impacts in the context of the existing environment. Impacts to recreation are determined by changes to the recreation setting, recreation activities, and desired recreation experience brought about by the implementation of the proposed action and action alternatives. Impacts to wilderness characteristics are determined by changes to naturalness and opportunities for solitude and/or primitive recreation.

Short-term impacts to recreation and wilderness characteristics are those impacts that would occur during the construction phase of mine operations. Long-term impacts are those impacts that would occur during the operation, closure, or postclosure phases.

Although southeastern Arizona is a popular recreation destination and offers diverse opportunities for outdoor recreation activities throughout the analysis area, there is little quantitative information available on recreation use levels and trends. It is assumed that the displacement of the public from the project area would result in increased visitation to nearby lands, including Madera Canyon, the Mount Wrightson Wilderness, the Las Cienegas National Conservation Area, and the remaining roads and trails within the Santa Rita Backcountry Touring Area. Because the exact numbers regarding use of the recently designated Arizona National Scenic Trail are currently unknown, observations of volunteers with Arizona Trail Association are presented as an approximation of use occurring on the Arizona National Scenic Trail through the analysis area.

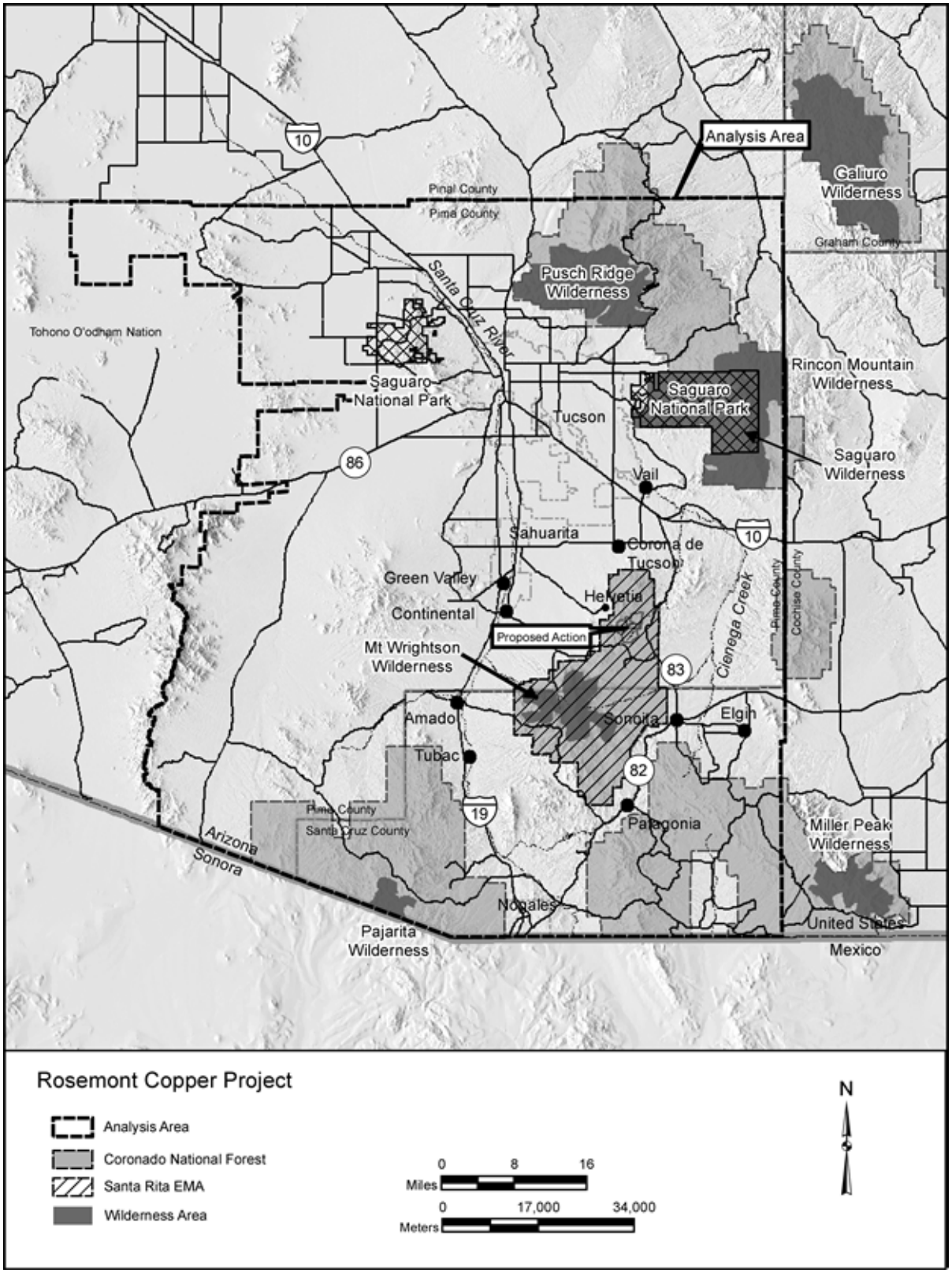


Figure 72. Analysis area for recreation and wilderness resources

As described in chapter 2, a section of the Arizona National Scenic Trail would need to be rerouted under all of the action alternatives because the current trail alignment would lie within the project area boundary. Although the exact routes of the proposed trail realignments are currently unknown, conceptual realignments have been developed and are presented in chapter 2. It should be known that no on-the-ground trail feasibility determination has been completed, and no verification that the realignments would meet Forest Service trail standards (U.S. Forest Service 2008c) has been completed. The conceptual reroutes for the Arizona National Scenic Trail pass very close to a parcel of private land northeast of the project area. Although the parcel is currently owned by Rosemont Copper, it could be sold and developed in the future. A general qualitative analysis of impacts to the recreation setting and opportunities along the portions of the Arizona National Scenic Trail reroutes is possible using the conceptual realignments.

Uncertain or unknown information regarding the proposed action and alternatives that would affect the analysis of impacts to recreation resources includes the following:

- Although the perimeter fence is planned to be removed postmine, some areas may remain fenced for the protection of resources during reclamation activities. These postmine fences would limit recreation access, but it is currently unknown where those fences would be located.
- The postmine treatment around the edge of the pit to protect the public from hazards is not yet determined. The barbed wire fence that is currently proposed may not provide sufficient long-term protection for recreation users.
- It is unknown whether public access across Lopez Pass will be possible postmine.

Affected Environment

Relevant Laws, Regulations, Policies, and Plans

Management of recreation opportunities and resources is guided by a number of Federal, State, and local laws, regulations, and policies.

Federal

- The Wilderness Act of 1964 (16 United States Code 1131–1136), as amended by the Arizona Wilderness Act of 1984 (Public Law 98-406), designated certain national forest lands in the State of Arizona as Wilderness and for other purposes.
- The “National Forest Special Areas; Roadless Area Conservation Final Rule, 2001” (36 Code of Federal Regulations 294) prohibits road construction, road reconstruction, and timber harvesting in inventoried roadless areas on Forest Service lands.
- The National Scenic Trail Act of 1968 (16 United States Code 1244(a)), as amended by the Arizona National Scenic Trail Act, designates the scenic nonmotorized trail through some of the most renowned mountains, deserts, canyons, and forests in Arizona.
- National Trails System Act (Public Law 90-543), as amended, states, “Provide for . . . the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which such trails may pass.”
- Executive Order 13195 of January 18, 2001, directs Federal, State, and local government agencies to protect, connect, promote, and assist trails of all types throughout the United States, including national scenic trails.

- The Multiple-Use Sustained-Yield Act of 1960, as amended (16 United States Code 528), establishes the policy of Congress that national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes.
- The objectives described in Forest Service Manual 2300, "Recreation, Wilderness and Related Resource Management," chapter 2330, "Publicly Managed Recreation Opportunities," are to maximize opportunities for visitors to enjoy and experience nature while engaging in outdoor recreation; to develop and manage sites consistent with the available natural resources and provide a safe healthful, aesthetic, nonurban atmosphere; and to provide a maximum contrast with urbanization at National Forest System sites (U.S. Forest Service 2006).
- Forest Service Manual 2350, "Recreation, Wilderness, and Related Resource Management: Trail, River, and Similar Recreation Opportunities," states that trail, river, and similar recreation opportunities occur over broad expanses of land or water in natural settings and accommodate recreation activities that involve relatively low-density use and limited infrastructure. These activities include hiking, caving, rock climbing, mountaineering, over-snow vehicle use, cross-country skiing, horseback riding, bicycling, off-highway vehicle use, driving for pleasure, boating, hunting, and fishing (U.S. Forest Service 2009b).
- Forest Service Manual 2353, "National Forest System Trails," states that national trails are located so that they provide for maximum outdoor recreation potential and for conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which these trails pass. Management of each trail in the National Trails System addresses the nature and purposes of the trail and is consistent with the applicable land management plan (16 United States Code 1246(a)(2)). A segment of a national scenic or national historic trail corridor may be relocated to preserve the nature and purposes for which the trail was established and to promote sound multiple-use management. Relocation requires the consent of the agency with jurisdiction over the underlying land.
- The objectives of the forest plan (U.S. Forest Service 1986), as amended, are to maintain the current spectrum of developed, dispersed, and primitive recreation opportunities and increase those opportunities within the capability of the resources and the framework of this plan as needs and funds develop.
- Title 36 Code of Federal Regulations 228 Subpart A, "Locatable Minerals," Part 228.8, "Environmental Protection," states, "Operators shall, to the extent practicable, harmonize operations with scenic values through such measures as the design and location of operating facilities, including roads and other means of access, vegetative screening of operations, and construction of structures and improvements which blend with the landscape."
- Title 36 Code of Federal Regulations Part 212, referred to as the "Forest Service Travel Management Rule," requires that roads, trails, and areas open to motorized vehicle use be designated on all forest management lands.

State

- Arizona Game and Fish Rules and Laws, 2011–2012 edition, issued by the Arizona Game and Fish Department, establishes regulations for hunting and trapping in Arizona (Arizona Game and Fish Department 2011a).
- The Corridor Management Plan for the Patagonia-Sonoita Scenic Road, approved by the Arizona Department of Transportation in 2003, describes strategies to preserve and enhance the qualities that attract visitors to the scenic road (Wheat Scharf Associates 2003).

Existing Conditions

General Setting

Major recreational attractions in the Santa Rita Mountains include the Santa Rita Backcountry Touring Area, Mount Wrightson Wilderness, Arizona National Scenic Trail, Patagonia-Sonoita Scenic Road, and Madera Canyon. A number of developed and semideveloped campgrounds, picnic areas, day-use areas, trailheads, roads, and trails exist for recreation use in the area. Dispersed and developed recreation in the analysis area is managed by the Forest Service, Bureau of Land Management, State of Arizona, and Pima County.

The Coronado National Forest consists of 1,780,000 acres in southeastern Arizona and southwestern New Mexico. Elevations range from 3,000 to 10,720 feet in 12 separate mountain ranges or "sky islands," one of which is the Santa Rita Mountains. The forest unit encompassing the Santa Rita Mountains consists of 148,431 acres south of Tucson. The rich ecological diversity of the sky islands makes this area unique and provides for diverse year-round recreation. The Santa Rita Mountains extend approximately 26 miles from the northwest to the southeast. The highest point is Mount Wrightson, at 9,453 feet. The northern Santa Rita Mountains are a 30-minute drive from the Tucson metropolitan area, which currently has a population of more than 1 million people. There is a total of 331 miles of designated forest roads in the Santa Rita Mountains.

Recreation Opportunity Spectrum Settings

The Recreation Opportunity Spectrum is a system used by the Forest Service to inventory and classify National Forest System lands in terms of the range of recreation experiences, opportunities, and settings. Although recreation activities, areas, and opportunities occur outside the forest unit boundary within the analysis area, Recreation Opportunity Spectrum settings only apply to Forest Service lands and are only described here for Forest Service lands in the Santa Rita Mountains.
The Recreation Opportunity Spectrum represents a process in which the following occurs:
(1) the recreation opportunities in an area are identified based on the area's setting and activities; and (2) the area is then assigned to one of seven categories that define management objectives. Recreation Opportunity Spectrum settings within the Santa Rita Mountains are primitive, semiprimitive nonmotorized, semiprimitive motorized, roaded modified, roaded natural, rural, and urban (figure 73). Table 124 summarizes the Santa Rita existing Recreation Opportunity Spectrum classifications.

Table 124. Recreation Opportunity Spectrum classifications within the Santa Rita Mountains

Recreation Opportunity Spectrum Setting	Acreage
Primitive	22,118
Semiprimitive nonmotorized	9,094
Semiprimitive motorized	90,060
Roaded modified	16,634
Roaded natural	10,174
Rural	148
Urban	203
Total	**148,431**

Source: (U.S. Forest Service 1986).

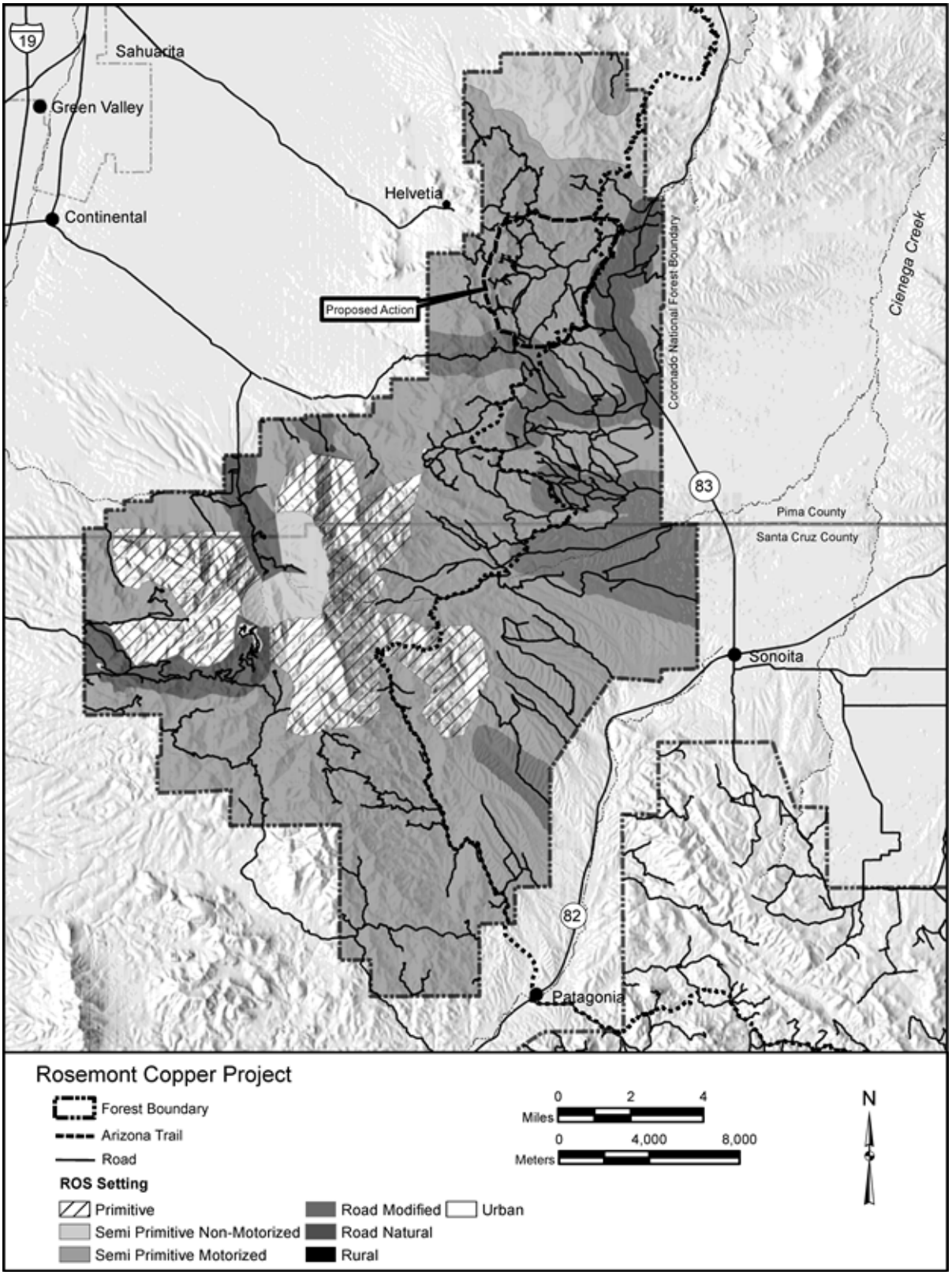


Figure 73. Recreation Opportunity Spectrum with proposed action

The characteristics of the seven different Recreation Opportunity Spectrum settings as described below are maintained based on how the following “setting indicators” are managed: access, remoteness, naturalness, facilities and site management, social encounters, visitor impact, and visitor management (U.S. Forest Service n.d. (1986)).

Primitive settings are large wilderness or wilderness-like areas where people can enjoy a natural setting, challenge, and solitude. These areas have no facilities other than trails and rarely have large numbers of visitors. Primitive areas must total at least 5,000 acres and are usually at least 1 mile away from all roads. Because the Coronado National Forest is mountainous and rugged, primitive feelings and solitude are usually experienced at much shorter distances from roads. Primitive Recreation Opportunity Spectrum settings are managed to be essentially free of human-made structures. Motor vehicles and other motorized equipment are not permitted. The primitive setting within the Santa Rita Mountains occurs entirely within the Mount Wrightson Wilderness and is characterized by a largely unmodified natural environment. The potential for interaction between visitors is low, and evidence of other people is minimal.

Semiprimitive nonmotorized settings are areas without motorized roads that people use for a wide variety of activities but primarily for dispersed recreation. These areas have no facilities other than trails and are similar to primitive areas except they can be smaller, are closer to roads, and can have large numbers of visitors. Typically, semiprimitive nonmotorized areas occur outside the Mount Wrightson Wilderness, but in the heavily visited areas of the wilderness the setting is classified as semiprimitive nonmotorized. Semiprimitive motorized settings are areas with primitive roads (i.e., high-clearance and/or 4-wheel drive). People use these areas for a wide variety of recreation activities, including scenic touring, solitude, hunting, off-highway vehicle use, dispersed camping, hiking, horseback riding, mountain biking, rock collecting, and firewood cutting. Typically, the only facilities in these areas are primitive roads and trails. Semiprimitive motorized settings are characterized as having motorized access into a predominantly natural or natural-appearing environment that is moderate sized to large (generally greater than 2,500 acres). Interaction between users is low, but there is often evidence of other users. Motorized use is permitted on designated roads and trails. In this setting, there is a moderate probability of experiencing isolation from the sights and sounds of humans and self-reliance through the application of outdoor skills in an environment that offers challenge and risk. The majority (90,000 acres, or 61 percent) of the Santa Rita Mountains is managed under the semiprimitive motorized Recreation Opportunity Spectrum setting.

On the Coronado National Forest, roaded modified applies to areas along roads that are passable by low-clearance vehicles and usually have not been altered by management activities. There may be trails, dispersed campsites, historic sites, and mining and ranching facilities along the route. The natural setting is the focus, and visitors are often looking for a place to drive off-road, set up their own camp, explore the backcountry, or find solitude. This setting provides the visitor with opportunities for a high degree of interaction with the natural environment and moderate challenges and risks in using outdoor skills. The roaded modified setting in the Santa Rita Mountains consists of Box Canyon Road, Big Casa Blanca Canyon Road, Forest Road 92, the first 4 miles of Forest Road 4104, Forest Road 624 to the Florida Work Center, and roads to the Kentucky Camp. Additionally, roads that access private parcels are considered roaded modified.

Roaded natural settings are road corridors where people drive to enjoy the scenery and are often on their way to a developed site, such as a campground, picnic area, or visitor center (including both Forest Service and other recreation sites). The natural setting is the focus, but nodes of Recreation Opportunity Spectrum urban and rural settings are commonly found along these corridors. Roads are

passable by low-clearance vehicles. Individual buildings and structures (such as small administrative sites or individual summer homes) are occasionally encountered within these corridors. The roaded natural setting is characterized by a natural-appearing environment with increasing evidence of the sights and sounds of people. Interaction between users may be low to moderate, but evidence of other users is prevalent. Opportunities for both motorized and nonmotorized forms of recreation are available. The roaded natural setting in the Santa Rita Mountains consists of Madera Canyon Road, Whipple and Mount Hopkins Road, and State Route 83.

Rural settings include most developed recreation areas (such as campgrounds), as well as many other developed areas. The natural setting is the attraction, but there are facilities such as buildings, roads, walkways, and picnic tables. Rural areas are generally very small and constitute a very small percentage (<1 percent) of the forest. The rural setting in the Santa Rita Mountains consists of the campgrounds, picnic areas, a lodge along Madera Canyon Road, and Kentucky Camp.

Urban settings are areas of concentrated use and areas where facilities dominate the natural setting. Urban areas are generally very small and constitute a very small percentage (<1 percent) of the Santa Rita Mountains. Characteristics include intensive use, costly facilities, large numbers of people, and specialized activities. Urban settings in the Santa Rita Mountains include the Mount Hopkins astrophysical facilities (including the Smithsonian Visitor Center) and the Melendrez Pass electronic site.

Designated Wilderness

General Description and Characterization

Of the seven wilderness areas shown in figure 72, only the Mount Wrightson Wilderness and Saguaro Wilderness are discussed below because of their close proximity to the project area and the potential direct and indirect impacts to these wilderness areas.

The Mount Wrightson Wilderness was designated under the Arizona Wilderness Act of 1984 and is managed by the Forest Service as part of the National Wilderness Preservation System. Wilderness characteristics are cumulatively identified by the Wilderness Act of 1964 as being untrammeled by humans, natural, and undeveloped and as having outstanding opportunities for solitude or primitive settings, unconfined forms of recreation, and other supplementary characteristics such as scientific, educational, scenic, and historic values. The Mount Wrightson Wilderness is managed to preserve and protect wilderness characteristics in accordance with the Arizona Wilderness Act of 1988 and the Wilderness Act of 1964.

The Mount Wrightson Wilderness occurs within the Santa Rita Mountains forest unit. Mount Wrightson is the highest point in the area around Tucson. At 9,453 feet, the peak is 7,000 feet higher than the surrounding savanna and desert. Mount Wrightson's distinctive pyramid-shaped profile is visible from much of southeastern Arizona and adjoining areas in Mexico. There is a total of approximately 50 miles of trails leading into the Mount Wrightson Wilderness, ranging from well-used pathways to primitive routes. Major trails in the wilderness include Old Baldy, Super, Florida Canyon, Crest, Agua Caliente, East Sawmill Canyon, Cave Canyon, Walker Basin, Josephine Canyon, and Temporal Gulch. These trails cross diverse landscapes, including forests, canyons, and ridgelines, and provide hikers with panoramic views of the surrounding area. From the summit of Mount Wrightson, there is a 360-degree view of all of southern Arizona and into Mexico. Additionally, the project area is clearly visible from the summit of Mount Wrightson (see the "Visual Resources" section of this DEIS).

The Saguaro Wilderness, managed by the National Park Service, is in the Rincon Mountain District of Saguaro National Park, east of Tucson and approximately 25 miles north of the project area. The Saguaro Wilderness was designated in 1976 and is managed to preserve and protect wilderness characteristics in accordance with the Wilderness Act of 1964. Although views of the project area would be in the background from portions of the Saguaro Wilderness, this is an area where high quality scenic views could be affected (see the "Visual Resources" section of this DEIS).

In addition to designated wilderness, the Forest Service Roadless Rule (U.S. Forest Service 2001) conserves roadless values while allowing for current public access and recreation opportunities, including hiking, camping, hunting, and fishing. The 6,077-acre Santa Rita Inventoried Roadless Area is in the north end of the Santa Rita Mountains, north of the project area, and no new road construction or reconstruction is permitted there. Additionally, the Whetstone Mountains, including the 7,711-foot Apache Peak, located east of the Santa Rita Mountains, constitute another inventoried roadless area in which no new road construction or reconstruction is permitted.

Visitation

The Coronado does not maintain quantitative visitor counts for the Mount Wrightson Wilderness; however, the organization Friends of Madera Canyon operates a road counter at the entrance to Madera Canyon. In 2008, approximately 199,599 visitors entered Madera Canyon (West 2009). Because of Tucson's proximity, milder temperatures, and ease of access through Madera Canyon, hikes into the Mount Wrightson Wilderness, including the climb to Mount Wrightson, are some of the most popular hikes in the analysis area.

Access

Primary access to the Mount Wrightson Wilderness is through the Madera Canyon Recreation Area along paved Forest Road 70. Forest Road 183 is a dirt road suitable for most passenger vehicles and leads to the Agua Caliente trailhead. Additional wilderness trailheads are at the end of Forest Roads 62A, 4084, 92, 165, 785, and 72. The nonmotorized Arizona National Scenic Trail also crosses the east arm of the wilderness.

Recreation Places

In addition to dispersed recreation and Recreation Opportunity Spectrum settings, there are a number of developed recreation resources and permitted activities within the analysis area. These are described further below and shown in figure 74.

Patagonia-Sonoita Scenic Road

In 1985, the Parkways, Historic, and Scenic Roads Advisory Committee designated the 52-mile-long Patagonia-Sonoita Scenic Road (Wheat Scharf Associates 2003). The committee's goal was to designate the Arizona roads that have unique scenic or historic resources and whose resources were most at risk (Wheat Scharf Associates 2003). The Patagonia-Sonoita Scenic Road traverses landscapes and terrain representative of southern Arizona, with its sweeping, open vistas and semidesert grasslands. The scenic road also winds east and south of developing areas along Interstate 10 east of Tucson.

The Patagonia-Sonoita Scenic Road begins at Interstate 10 and follows State Route 83 south from Vail to Sonoita, where it intersects with State Route 82, leading to Patagonia and on to Nogales. The highest point of the Scenic Road occurs where it crosses the pass between the Empire Mountains to the east and the Santa Rita Mountains to the west. Lands of the Coronado National Forest through

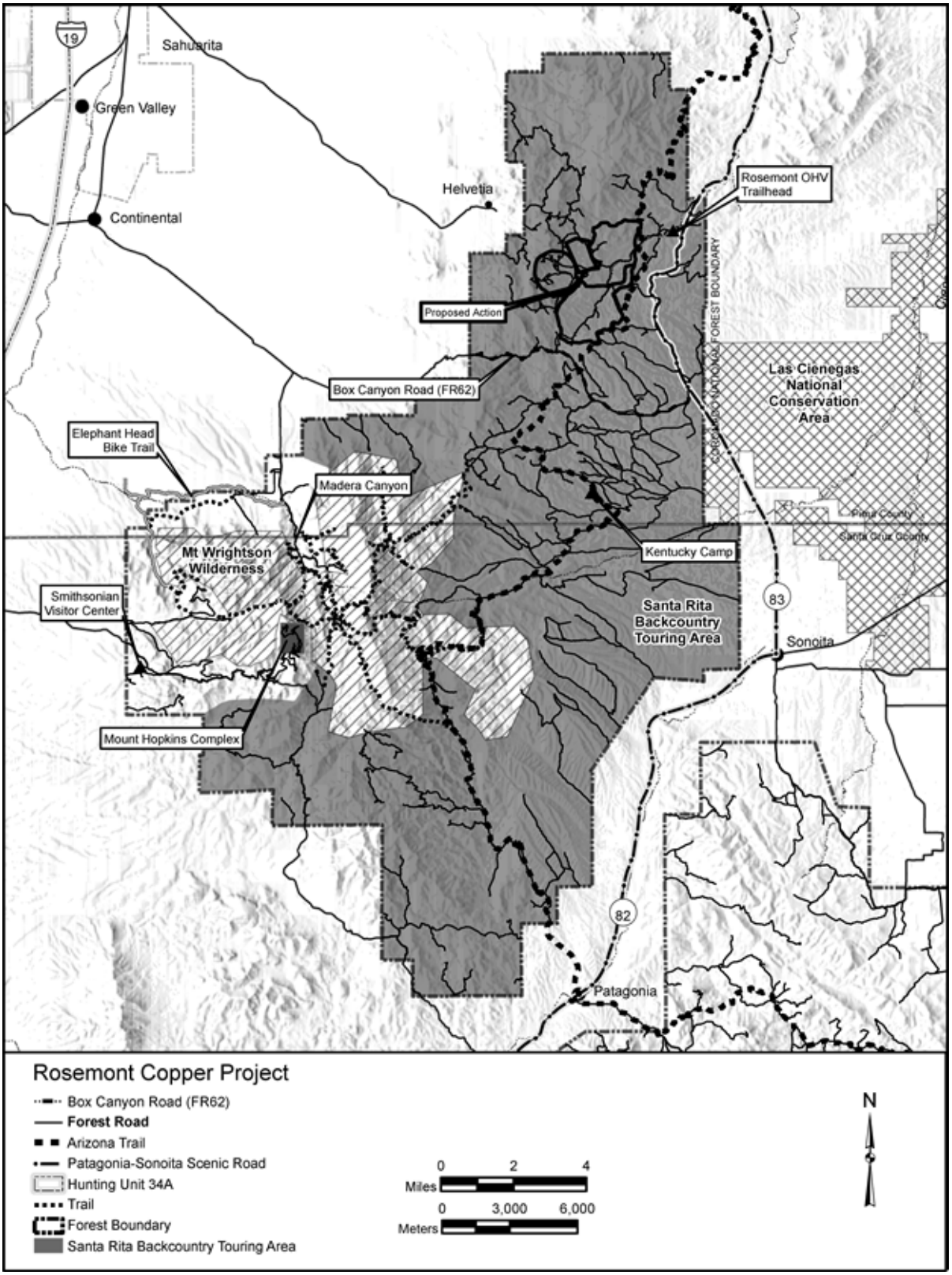


Figure 74. Recreation sites

which the scenic road travels are identified as having extremely high public value (Wheat Scharf Associates 2003).

From the Patagonia-Sonoita Scenic Road, motorists can visit several natural destination points, including the Las Cienegas National Conservation Area, Patagonia Lake State Park, and Sonoita Creek Preserve (Arizona Scenic Roads 2009). This is part of a very popular day trip for motorists in the analysis area and is discussed further in both the "Visual Resources" and "Socioeconomics and Environmental Justice" sections of this DEIS.

Arizona National Scenic Trail

On March 30, 2009, Congress passed the Omnibus Public Lands Bill, which included a national scenic trail designation for the 807-mile-long Arizona National Scenic Trail. The National Trails System Act of 1968, as amended, establishes scenic trails to provide maximum outdoor recreation potential and for the conservation and enjoyment of scenic, historic, natural, or cultural qualities of the areas through which they travel. The Arizona National Scenic Trail is an 807-mile-long nonmotorized, multiple-use recreation trail that stretches from the Mexico border to the Utah border. The trail is enjoyed by equestrians, hikers, and mountain bikers. The Santa Rita and Las Colinas passages of the Arizona National Scenic Trail are approximately 26 miles long through the Santa Rita Mountains (Arizona Trail Association 2009).

The original vision for the Arizona National Scenic Trail is to "provide opportunities to experience and reflect upon Arizona's diverse cultural and natural heritage along the trail corridor" (Arizona State Parks 1995). The current trail route has evolved over time to connect scenic settings representative of Arizona and to include areas of scenic beauty to enhance visitor experiences. In order to manage for those opportunities and for a more scenic and primitive experience along the Arizona National Scenic Trail, the Forest Service, Bureau of Land Management, National Park Service, and Arizona State Parks identified the need for a 1,000-foot wide corridor along the trail to serve as a buffer from incompatible activities (Arizona State Parks 1995).

There are a number of actions that have occurred or are planned along the trail that have affected, or could eventually affect, recreation opportunities and the overall scenic settings for which the trail was designated. These include power transmission line and utility corridor construction and right-of-way clearing, prescribed burning to reduce wildland fire risks, naturally occurring fires, rock quarrying, and forest restoration projects. Specifically, the actions currently affecting the settings along the trail are as follows:

- The Warm Fire – In June 2006, the Kaibab National Forest wildland fire burned more than 7 miles of the trail, with long-term losses of scenic value.
- The Willow Fire – In June 2011, this wildland fire burned more than 60 miles of the trail, with long-term losses of scenic value in the Tonto National Forest.
- The Schultz Fire – In June 2010, this fire on the Coconino National Forest resulted in a 5-mile section of the Arizona National Scenic Trail being closed and rerouted.
- The Monument Fire – In 2011, this fire on the Coronado National Forest and Coronado National Memorial burned 7.75 miles along the Arizona National Scenic Trail.
- Numerous transmission line and utility corridors on Forest Service, Bureau of Land Management, and State Trust lands along the trail.

Santa Rita Backcountry Touring Area

Backcountry motorized touring has become increasingly popular throughout the Southwest and southeastern Arizona. The majority (90,060 acres, or 61 percent) of the Santa Rita Mountains is managed under the semiprimitive motorized Recreation Opportunity Spectrum setting. The Coronado has further classified much of this setting as the Santa Rita Backcountry Touring Area, which is managed for motorized recreation. There is a network of 285 miles of designated roads and trails for motorized travel throughout the Santa Rita Backcountry Touring Area. The use of motorized vehicles in the Santa Rita Mountains is restricted to existing roads (U.S. Forest Service 1986). The topography and rugged soil surfaces in the Rosemont off-highway vehicle area of the Santa Rita Backcountry Touring Area help discourage unauthorized off-road travel.

The Rosemont off-highway vehicle trailhead (staging area) for 4-wheel-drive, all-terrain vehicles and motorcycle touring is just north and east of the project area and west of State Route 83 (see figure 74). The Rosemont off-highway area is one of the primary and most popular off-highway vehicle riding areas in the Santa Rita Backcountry Touring Area. The Coronado has encouraged motorized recreation in this area over time through recreational trail grants, management direction, and enforcement efforts (Arizona State Parks 2010). Many dispersed campsites are available along Forest Road 231, where forest visitors can camp and ride. By managing for motorized recreation in the Rosemont off-highway vehicle area, the Coronado has taken motorized use pressure off of areas such as Gardner Canyon, Louisiana and Ophir Gulches, and Greaterville (Elek 2010).

The Box Canyon off-highway vehicle staging area is south of the project area. The 4-wheel-drive road that connects Box Canyon with the Rosemont off-highway vehicle staging area crosses the project area.

Other Sites

Other recreation sites in the Santa Rita Mountains include Kentucky Camp Historic Site, Elephant Head Mountain Bike Trail, and the Mount Hopkins Complex (Smithsonian Visitor Center, Whipple Picnic Area, and telescope tours). Because of the distance and topographic screening from the project area, recreation opportunities at these sites are expected to be minimally impacted.

Hunting is an important traditional recreational activity across Arizona and within the Santa Rita Mountains. In addition to being a recreational activity; hunting is also considered to be an important part of the heritage and culture of participants across Arizona. The Santa Rita Mountains are within Arizona Game and Fish Department hunt unit 34A. Species for hunting in this unit include black bear, javelina, mule deer (*Odocoileus hemionus*), white-tailed deer, cottontail rabbit (*Sylvilagus audubonii*), mourning dove (*Zenaida macroura*), Mearn's quail (*Cyrtonyx montezumae*), and Gambel's quail (*Callipepla gambelii*). Mearn's quail, in particular, is limited to Madrean oak savannah habitat, which can be found within the area of analysis.

Hunting is permitted throughout most of the forest under Arizona Game and Fish laws and rules, established in Arizona Revised Statutes, Title 17, Chapter 3, "Game and Fish," Article 17-309. It is unlawful for a person to discharge a firearm within 0.25 mile of an occupied farmhouse or other residence, cabin, lodge, or building without permission of the property owner or resident. Specifically, hunting is not permitted within 0.25 mile of Madera Canyon or occupied private parcels throughout the hunt unit.

The annual average number of permits issued for white-tailed deer on Forest Service lands in hunt unit 34A is 1,940, and the annual average number of permits for javelina on Forest Service lands in

hunt unit 34A is 1,100 (Heffelfinger n.d. (2011)). This is not inclusive of all hunting activity that has occurred on Forest Service lands within hunt unit 34A and does not represent permits issued for other species, or for general hunting permits.

The Las Cienegas National Conservation Area and Acquisition Planning District in southeastern Arizona was designated on December 6, 2000. The 42,000-acre National Conservation Area consists entirely of public lands managed by the Bureau of Land Management's Tucson Field Office and was designated "in order to conserve, protect, and enhance the unique and nationally important aquatic, wildlife, vegetative, archaeological, paleontological, scientific, cave, cultural, historical, recreational, educational, scenic, rangeland and riparian resources and values of the public lands within the National Conservation Area, while allowing livestock grazing and recreation to continue in appropriate areas" (Bureau of Land Management 2003).

The Las Cienegas National Conservation Area offers opportunities for dispersed and permitted recreation activities consisting of hiking, camping, mountain biking, picnicking, horseback riding, bird watching, backcountry road touring, hunting, and photography. Additionally, a 10.5-mile-long stretch of Cienega Creek has been rated eligible for national wild and scenic river designation (Bureau of Land Management 2003).

Madera Canyon is on the western slopes of the Santa Rita Mountain range, southwest of the project area. The main corridor through Madera Canyon is managed by the Coronado as Recreation Opportunity Spectrum roaded natural, with nodes of rural. The higher elevations of Madera Canyon provide relief to the residents of southeastern Arizona during the hot summer months and allow access to snow during the winter.

Madera Canyon is a popular staging area for the many hiking trails throughout the Santa Rita Mountains. A world-renowned location for bird watching, Madera Canyon is a major resting place for migrating species, while the extensive trail system of the Santa Rita Mountains is easily accessed from the canyon's campground and picnic areas. More than 230 species of birds have been recorded in the canyon, including 15 different hummingbird species (Friends of Madera Canyon 2009). The vegetation, combined with the perennial streams that carved out this canyon, helps to sustain the diverse wildlife species that breed and visit here.

Existing Use Levels and Trends

At statehood in 1912, Arizona's population was approximately 200,000. In 2005, the population had increased to more than 6,000,000 (Arizona State Parks 2007). As such, Arizona can no longer be considered a sparsely populated state, and the population of southeastern Arizona continues to grow. In 2009, the population of Pima County, including the Tucson metropolitan area, was 1,048,796 residents. The population of southeastern Arizona is projected to increase to 1,271,912 by 2020 (Arizona Department of Commerce 2006). This growth is partially attributable to southeastern Arizona's appeal as a year-round recreation destination that offers diverse opportunities for outdoor recreation activities.

As a result of increasing population and increasing interest in natural resource based outdoor recreation opportunities, the demands for outdoor recreation activities and opportunities are expected to continue to grow (Recreation Technical Advisory Team 2003). The Patagonia-Sonoita Scenic Road is a very popular day trip for motorized touring. Traffic on the road includes both scenic touring and daily commuting. In 2008, the average annual daily traffic count recorded on State Route 83 from Sahuarita Road to Interstate 10 was 2,800 vehicles (Arizona Department of Transportation 2011b).

As the population of Arizona is expected to continue to grow over time, it is assumed that traffic on the scenic road will increase as a result of tourism and outdoor recreation. According to the Arizona Department of Transportation's 20-year daily traffic forecast, traffic between Sahuarita Road and Interstate 10 is projected to increase to 3,400 by 2028, a 21 percent increase (Arizona Department of Transportation 2011a).

Although no trail counters are currently in place for the Arizona National Scenic Trail, volunteers with the Arizona Trail Association report observing an increase in hiking, mountain biking, and equestrian use of the Las Colinas Passage since the recent national scenic trail designation. Furthermore, volunteers expect that use is likely to increase over time (Arizona Trail Association 2009).

In addition, there has been a recent increase in club and organized mountain bike rides along the Arizona National Scenic Trail in the vicinity of the project area. An unofficial mountain bike challenge, called Arizona Trail 300, has taken place since 2006 and follows portions of the Arizona National Scenic Trail near the project area. From Box Canyon Road, the unofficial event course continues on to Oak Tree Canyon. At Oak Tree Canyon, the route follows the trail to Rosemont Junction Road. In 2010, 25 riders participated in Arizona Trail 300 (Racing the Arizona Trail 2010). As knowledge of the Arizona National Scenic Trail grows and the population of southern Arizona increases, participation in this unofficial event and similar group ride opportunities is expected to grow.

In addition to the popularity of nonmotorized recreation activities in southeastern Arizona, the popularity of motorized recreation and use of off-highway vehicles has rapidly grown over the past decade. Off-highway vehicles are four times as popular as they were a decade ago, and in the West, off-highway vehicle sales are double the national average (Arizona State Parks 2007). Off-highway use is an increasingly popular activity in many areas on the Coronado National Forest (especially in Redington Pass and the northern Santa Rita Mountains), and off-highway recreation is one of the fastest growing activities on public lands in the nation (Arizona State Parks 2007). Based on a 2008 random household survey conducted for the 2010 Arizona Trail Plan, motorized trail users represent 1,027,191, or 22 percent, of adult Arizona residents (Arizona State Parks 2009).

The Friends of Madera Canyon operate a visitor information station and road counter at the entrance to Madera Canyon on most weekends throughout the year. Madera Canyon's proximity to Tucson, cooler temperatures, and diverse recreation opportunities make it one of the more popular recreation destinations in southeastern Arizona. The Friends of Madera Canyon recorded 66,533 vehicles entering the canyon in 2008. The Coronado assumes an average of three visitors per vehicle, for a total of 199,599 visitors to Madera Canyon in 2008 (Friends of Madera Canyon 2009). Because of increasing population and increasing interest in natural resource based outdoor recreation opportunities, visitation at Madera Canyon is expected to grow in the future.

The Tucson Sector of the U.S. border with Mexico is considered the busiest sector of the border; the sector covers 262 miles from the Yuma county line to the Arizona/New Mexico state line.
The Nogales U.S. Border Patrol Station within the Tucson sector is now the largest U.S. Border Patrol station in the United States. U.S. Border Patrol agents patrol 1,100 square miles, including 32 miles of the border. The Coronado National Forest makes up a large portion of the western sector of the Nogales Station's responsibility. Undocumented immigration, drug smuggling, and increased U.S. Border Patrol activities have led to increased potential for dangerous encounters to recreation visitors on the Coronado National Forest.

The Forest Service Travel Management Rule (36 Code of Federal Regulations Parts 212, 251, 261, and 295) requires the designation of roads, trails, and areas open to motorized vehicle use on all Forest Service managed lands. Although the Coronado already has a designated network for motorized travel in place, they have recently completed a transportation analysis plan and are in the process of developing recommended changes to the existing travel system that would close some routes to provide for resource protection while also designating other unauthorized routes to ensure continued recreation access to hunting and dispersed camping opportunities.

Commercial Outfitter and Guide Use

Federal law requires a permit for special uses, such as commercial or group activities, on national forests. Commercial activities may consist of outfitter and guide services, filming, photography, or campground management. Additionally, group recreation events may also require a special use permit.

Four to five outfitter and guide services for hunting are currently permitted to operate throughout the forest, including the Santa Rita Mountains. Additionally, up to 20 different bird-watching guides are permitted to operate in the Madera Canyon and Gardner Canyon areas. Currently, one all-terrain-vehicle touring service operates in the project area, and one equestrian tour service is known to make use of the Arizona National Scenic Trail. Hang gliding and hang-gliding instruction and guiding are permitted by the Forest Service in Box Canyon, south of the project area.

Other special uses are considered on a case-by-case basis as applications are received. Two annual recreation event permits are currently issued for clubs in the Fish Canyon area off of Gardner Canyon Road. One permit is for an archers' and bow hunters' club, and one is for a muzzleloaders' club.

Environmental Consequences

Direct and Indirect Effects of Each Alternative

No Action Alternative

Under the no action alternative, the project would not be developed and existing recreation uses would continue under current conditions. The settings, landscape, recreation sites, roads, and trails within the analysis area would continue to be affected by current conditions and ongoing actions. The recreation setting and experience would remain largely the same (no change from current conditions) under this alternative.

Recreation Opportunity Spectrum

Under the no action alternative, recreation opportunities in the analysis area would continue to be managed consistent with the Recreation Opportunity Spectrum setting indicators and objectives of the Forest Service. The semiprimitive motorized setting, which makes up the majority of the project area, would continue to be affected by existing conditions under the no action alternative.

Designated Wilderness

Designated wilderness and Forest Service roadless areas would continue to be affected by existing conditions under the no action alternative. Additionally, there would be no change to visitor experiences within designated wilderness or Forest Service roadless areas as a result of the no action alternative.

Recreation Places

There would be no restrictions on current access to recreation places and opportunities under the no action alternative. Recreation places in the analysis area would remain available for recreation activities such as motorized touring, hunting, and other types of dispersed recreation. Hunting opportunities in the analysis area under the no action alternative would continue to be maintained by the wildlife game inventory, monitoring, translocation, and actions to increase game animal population numbers. The Las Colinas section of the Arizona National Scenic Trail would remain the same, and no reroutes would be required.

Existing Use Levels and Trends

There would be no change to recreation use levels and trends in the Santa Rita Mountains under the no action alternative.

Impacts Common to All Action Alternatives

Impacts that would occur under each of the alternatives are first presented here and then described in detail as appropriate under each of the alternatives. Impacts to recreation are closely tied to visual quality. The "Visual Resources" section of this DEIS includes a detailed analysis and visual simulations of the project from recreation sites (including the Patagonia-Sonoita Scenic Road and Arizona National Scenic Trail). Where appropriate in the following analysis, the "Visual Resources" section is referenced for a more detailed description of the analysis of impacts.

Recreation Opportunity Spectrum

A direct loss of acreage available for recreation activities would occur under all action alternatives. In addition to the direct loss of acreage available for recreation activities and opportunities, a change from the existing undeveloped, semiprimitive setting of the project area and surrounding area to a more developed, industrialized setting would occur under all action alternatives. Evaluating the specific effect of each of the alternatives on the Recreation Opportunity Spectrum setting is related to how the "setting indicators" are met both during and after mine operations.

During mine operations, none of the affected areas would be compatible with the established setting indicators for any of the Recreation Opportunity Spectrum settings present. Because the semiprimitive motorized setting makes up a majority of each alternative action area (88 to 96 percent), table 125 summarizes the semiprimitive motorized indicators both during and after mine operations (U.S. Forest Service n.d. (1986)).

Table 125. Semiprimitive Motorized Setting Indicators

Recreation Opportunity Spectrum Setting Indicator	During Mine	Postmine
Access	Inconsistent/Unacceptable. There would be no public access into mine site.	Normal/Fully compatible. There would be fewer roads and less access.
Remoteness	Unacceptable. Area would be dominated by sights and sounds of human activities.	Inconsistent. There would be few sounds of human activities, but sights of mine would dominate until long-term reclamation is successful.
Naturalness	Unacceptable. Mine site would not be natural (see the "Visual Resources" section).	Unacceptable. Mine site would not be natural (see the "Visual Resources" section).

Recreation Opportunity Spectrum Setting Indicator	During Mine	Postmine
Facilities and Site Management	Not applicable. There would be no public facilities.	Normal. There would be few site facilities (limited roads, signs, etc.).
Social Encounters	Not applicable. There would be no public access in mine site. Note: Indirect effects from crowding in other nearby Recreation Opportunity Spectrum settings may occur.	Fully compatible/Normal. Some visitor use is expected to occur.
Visitor Impacts	Not applicable. There would be no visitors.	Normal. Visitor impacts are expected to be few if visitor use is low and reclamation is successful.
Visitor Management	Unacceptable. Visitor controls would be obvious and numerous.	Normal to Inconsistent, depending on controls that would be needed to ensure reclamation success.

The industrialized setting of the mine would also consist of increased industrial noise from blasting, mine related traffic, and equipment operation (including back-up alarms). Traffic, construction, and equipment operation within the project area would result in increased noise, ranging from 80 A-weighted decibels near the plant site within the project area to 30 to 40 A-weighted decibels at the fenceline surrounding the project area. A noise level of 80 A-weighted decibels is comparable to the sound of a forklift or front-end loader from 50 feet away. A noise level of 30 to 40 A-weighted decibels is comparable to the sound of a quiet suburban area at night.

Intermittent blasting within the pit in the project area would result in a maximum blast noise for recreation users ranging from 30 to 40 A-weighted decibels west of the Santa Rita Mountains to 50 to 60 A-weighted decibels immediately south of the project area (see the “Noise” section). Although these increased noise levels associated with operations would not be readily apparent to motorized recreation users over the sound of their personal vehicles, they would be apparent to campers, hikers, mountain bikers, and equestrians from the fence line surrounding the edge of the project area, along the conceptual realignments of the Arizona National Scenic Trail, and out to the scenic highway. In particular, campers using dispersed sites throughout the area would be impacted by increased noise levels resulting from nighttime facility operations.

New facility nighttime lighting would result in changes to the nighttime recreational setting on lands surrounding the project area by increasing sky glow and direct visible glare (see the “Visual Resources” section). These changes would contribute to displacement of recreation activities and opportunities from lands surrounding the project area.

Development of the Rosemont 138-kilovolt transmission line would be the same under all action alternatives. There are four alternative alignments for the transmission line and two alternative locations for the substation being evaluated (see figure 6 and the “Utility Line Alignment Alternatives” section in chapter 2). The presence of a new transmission line and substation would contribute to diminishing the undeveloped, semiprimitive area along each of the three utility alternative alignments being considered.

Designated Wilderness

There would be no direct impact to designated wilderness or roadless areas as a result of any of the action alternatives. Visitors to the Mount Wrightson Wilderness, Santa Rita Inventoried Roadless Area, and Saguaro Wilderness would have distant views of the Rosemont Copper Mine from trails

and overlooks (see the “Visual Resources” section). Although the location and size of the different elements of the project vary by alternative, because of the distance and angle of views, the impacts to the public visiting the wilderness and roadless areas would be similar for all action alternatives. Views of the Rosemont Copper Mine would contribute to a diminished sense of solitude and primitive setting for some wilderness visitors (see the “Visual Resources” section).

Recreation Places

Because public access would be restricted within each of the action alternative areas, the public would be displaced from each action alternative area for 25 years (mine construction, operation, and reclamation. In addition, for safety purposes, both the primary and secondary access roads for each alternative would be closed to the public, and there would be a direct loss of acres of the Santa Rita Backcountry Touring Area and of existing forest roads used for motorized recreation under all action alternatives. East-west access over the Santa Rita Mountains at Gunsight Pass and Lopez Pass would be unavailable to the public. After mining operations have ceased, the primary and secondary access roads may be used to reestablish an east-west route over the Santa Rita Mountains through Lopez Pass.

Construction and operation associated with each alternative would result in increased mine related traffic (including large trucks) on State Route 83 (the Patagonia-Sonoita Scenic Road), which would diminish the experience of some visitors driving on the scenic road and affect visitor safety (see the “Transportation/Access” section). Copper concentrate shipments would be the largest number of routine truck shipments, with approximately 56 round trips per day, 7 days per week. This increase in heavy-truck traffic would also contribute to increased noise and intermittent traffic slowdowns 7 days per week on the scenic road, primarily between Interstate 10 to the north and Sonoita to the south (see the “Transportation/Access” section). Cyclists who currently ride State Route 83 and the Patagonia-Sonoita Scenic Road would be discouraged to continue using these roads because of the existing narrow paved roadway shoulders and the increase in large-truck traffic.

Each of the action alternatives would result in the relocation of a portion of the Arizona National Scenic Trail and adverse impacts to Arizona National Scenic Trail users and their experience for 25 years and postclosure as a result of the diminished undeveloped, semiprimitive setting and loss of scenic landscapes along the trail.

The realignments as described in chapter 2 are conceptual and not the only routes the Forest Service is willing to consider, or what it deems as feasible; other trail realignments would likely involve other Federal and State agency land management jurisdictions. Any relocation would occur prior to ground-disturbing activities that would impact the trail.

All of the conceptual routes described in chapter 2 would closely parallel the project area fenceline and would allow long viewing times of waste rock and tailings piles, slope terraces, the pit face, drainage features, access and perimeter roads, and ore processing infrastructure during the long-term construction and operation of the mine to all trail users. Although the new alignment would attempt to meet the scenic and recreational values for which the current alignment was chosen, this may not be fully possible. Any relocation would add miles to the total length of the trail in order to circumvent and/or minimize views of the waste rock and tailings piles and would need to consider the relocation’s impacts to biological and cultural resources prior to choosing a final alignment.

Unavoidable adverse impacts to recreation that would result from the action alternatives include long-term displacement from the project area.

Existing Use Levels and Trends

Southeastern Arizona is a popular recreation destination and offers diverse opportunities for outdoor recreation activities throughout the analysis area. It is assumed that recreationists displaced from the project area would increase visitation to nearby lands, including Madera Canyon, the Mount Wrightson Wilderness, the Las Cienegas National Conservation Area, and the remaining roads and trails within the Santa Rita Backcountry Touring Area.

The increase in mine related traffic, including heavy trucks, could discourage some users from traveling along the Patagonia-Sonoita Scenic Road under all action alternatives. Additionally, noise and dust from equipment operation under all action alternatives would further impact trail users and could result in long-term decreased use of this portion of the Arizona National Scenic Trail. Although the public may continue to use this area for recreation purposes, the recreation experience would be diminished as a result of the mine and associated activities.

Proposed Action Alternative

Recreation Opportunity Spectrum

The proposed action would result in the direct removal of up to 6,211 acres from public entry, which represents the area that would be enclosed by perimeter fencing for public safety purposes.
The primary and secondary access roads would be closed to the public for safety concerns during the construction and operation phases; therefore, the current east-west roads that connect State Route 83 to the west side of the Santa Rita Mountains through Lopez Pass would not be accessible.

Within the project area, there would be direct disturbance from the mine pit, waste rock storage areas, dry-stack tailings, mine facilities and infrastructure, and heap leach pad associated with the proposed action. There would be additional disturbances outside the project area as a result of the primary and secondary access roads and the utility corridor. Fencing of the project area is the primary issue leading to a reduction in acres available for recreation opportunities.

Up to 5,973 acres of the project area would occur within the semiprimitive motorized setting.
In addition, 68 acres of roaded natural and 170 acres of roaded modified areas would be directly disturbed under the proposed action. Figure 73 shows the Recreation Opportunity Spectrum settings that would be impacted by the proposed action. The ground disturbance and installation of facilities associated with the proposed action would result in a change from the existing undeveloped, semiprimitive recreation setting on lands surrounding the proposed action to a developed, industrialized setting.

Designated Wilderness

There would be no direct impact to designated wilderness or roadless areas as a result of the proposed action. Visitors to the Mount Wrightson Wilderness, Santa Rita Inventoried Roadless Area, and Saguaro Wilderness would have distant views of the proposed action from trails and overlooks (see the “Visual Resources” section). These impacts would contribute to a diminished sense of solitude and primitive setting for some wilderness visitors.

Recreation Places

Because access would be restricted within the project area, the public would be displaced from the project area for 25 years. It is assumed that all 6,211 acres would be unavailable for recreation use over the life of the mine. Recreationists who had previously made use of the project area would be

displaced onto nearby or other lands for similar recreation opportunities; therefore, increased recreation use of surrounding areas and facilities would occur as a result of this displacement.

The project area lies within the Santa Rita Backcountry Touring Area. There is currently an estimated 30.4 miles of Forest Service off-highway vehicle routes within the project area (figure 75). One of these routes (the primary and secondary access roads over Lopez Pass) would be unavailable to the public during mining activity and might be available to the public postmine. Most would be permanently obliterated, and all would be inaccessible to the public for 25 years.

The loss of these routes represents a 10 percent reduction in the overall mileage available for off-highway use in the Santa Rita Backcountry Touring Area, which currently has 285 miles of designated forest roads. Although it is only a 10 percent reduction in the total mileage, this area, especially Forest Road 231 and the Rosemont off-highway vehicle staging area, has historically been intensively managed by the Coronado for motorized recreation. Furthermore, the Rosemont area is one of the more popular and traveled off-highway vehicle riding areas, the loss of which would be more intense than the loss of roads in other portions of the Santa Rita Backcountry Touring Area.

In addition to the direct loss of forest roads available for motorized recreation, the experiences of off-highway vehicle users traveling along the forest roads that have views of the project would be modified from one characterized by an undeveloped, semiprimitive setting to one characterized by increased development and an industrialized setting (see the “Visual Resources” section). The proposed action would result in a reduction in the Forest Service’s ability to continue providing motorized recreation opportunities in the Santa Rita Backcountry Touring Area.

Other visitors to the area engage in sightseeing when traveling to known destinations such as Madera Canyon, the Mount Wrightson Wilderness, and the Las Cienegas National Conservation Area and along the Patagonia-Sonoita Scenic Road (see the “Visual Resources” section). The proposed action would have an adverse effect on those users and their sightseeing experiences through the permanent loss of natural and scenic landscapes.

As a result of the displaced recreation use, other recreation sites in the Santa Rita Mountains, including Kentucky Camp Historic Site and Elephant Head Mountain Bike Trail, are expected to receive increased visitation. Displaced motorized recreation use from the project area may result in increased motorized activity in locations less suitable for motorized recreation, such as Gardner Canyon, the Louisiana and Ophir Gulches, the Las Cienegas National Conservation Area, and the Greaterville area, as well as in increased conflicts between user groups (especially motorized and nonmotorized recreation user groups). Because of the distance and topographic screening from the project area, areas such as the Mount Hopkins complex (Smithsonian Visitor Center, Whipple Picnic Area, and telescope tours) are not expected to be impacted.

The proposed action would occur adjacent to and within view of a portion of the 12-mile-long Las Colinas section of the Arizona National Scenic Trail. The proposed action would result in the relocation of approximately 4 miles of the Arizona National Scenic Trail (see figure 73). The conceptual realignment of the Arizona National Scenic Trail presented in chapter 2 under the proposed action is likely to be feasibly designed and constructed to meet Forest Service trail standards. Prior to designating a final trail reroute, all potential trail realignments and design elements will be needed to further reviewed and refined to meet Forest Service trail specifications (U.S. Forest Service 2008c).

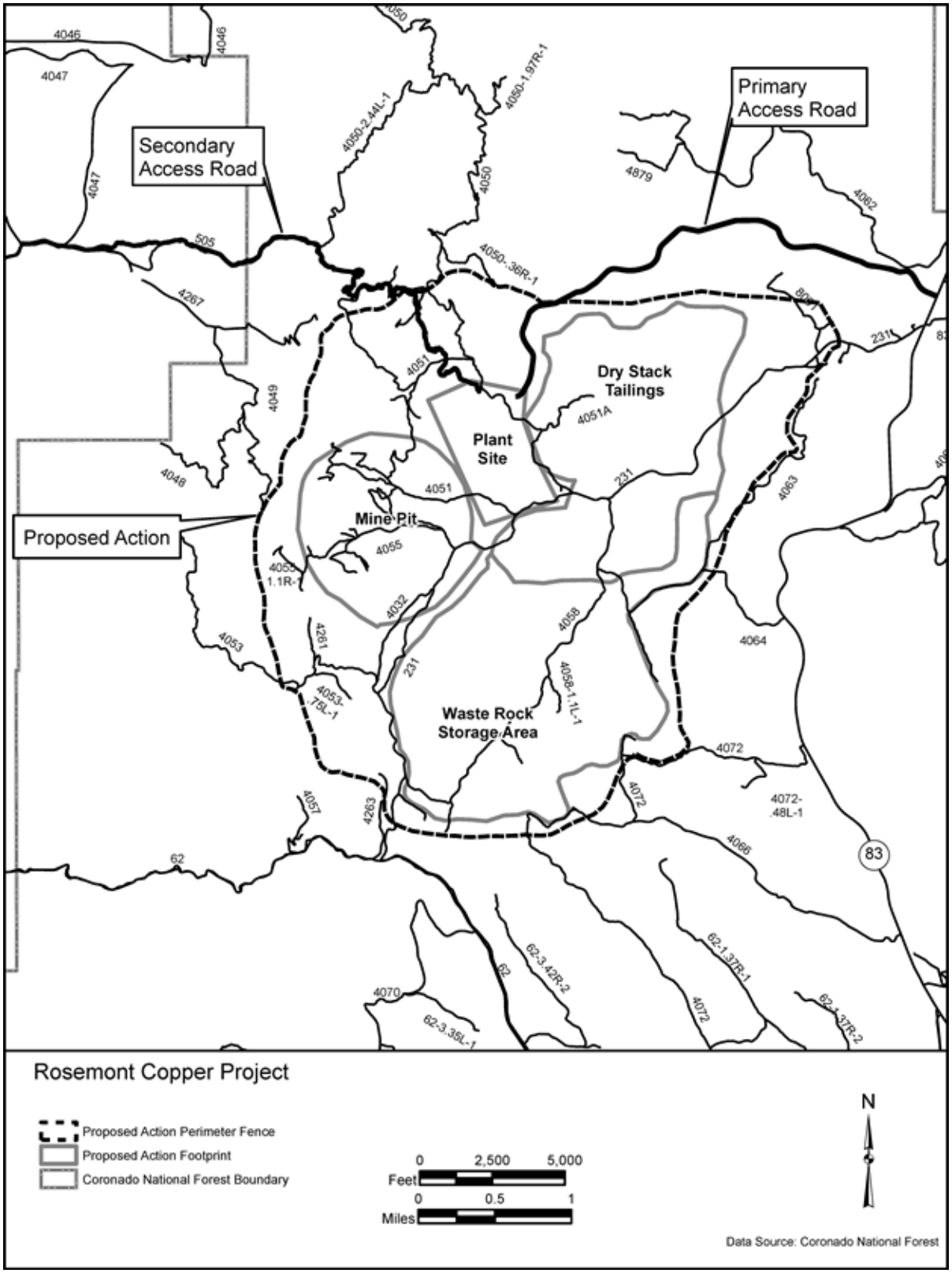


Figure 75. Roads within the perimeter fence of the proposed action

Should the conceptual realignment move forward, it is expected that decreased use of the Arizona National Scenic Trail would occur during mine operations and beyond the 25-year mine life as a result of the change in the undeveloped, semiprimitive setting and scenic landscapes for which the trail was designated. Additionally, noise and dust from equipment operation would further impact trail users and could result in further decreased use of the Las Colinas section of the Arizona National Scenic Trail.

The proposed action would exclude hunters from 6,211 acres of Arizona Game and Fish Department hunt unit 34A and would result in the loss of as many as 776 hunter days per year. This represents 4 percent of the Forest Service lands that occur within hunt unit 34A. Although this is only 4 percent of the Forest Service lands within the hunt unit, impacts include qualitative losses such as the loss of areas with a tradition and history of hunting activity. There would also be a loss of hunter opportunities outside the project footprint as a result of increased mortality of game species from vehicle collisions on access roads to the mine, increased noise, light, vibration, traffic and general industrial activities, and loss of native vegetation available to game species during the mine operation and postmine closure (see the “Biological Resources” section).

Conditions of the two annual recreation event permits issued for an archers’ and bow hunters’ club and a muzzleloaders’ club in the Fish Canyon area off of Gardner Canyon Road would likely be affected by the proposed action. Other commercial permit holders may be displaced from the project area, but because those permits are issued for broader areas within the Coronado National Forest, their overall operations would not be affected.

Existing Use Levels and Trends

Although southeastern Arizona is a popular recreation destination and offers diverse opportunities for outdoor recreation activities throughout the analysis area, there is little quantitative information available on recreation use levels and trends. It is assumed that the displacement of the public from the project area would result in increased visitation to nearby lands, including Madera Canyon, the Mount Wrightson Wilderness, the Las Cienegas National Conservation Area, and the remaining roads and trails within the Santa Rita Backcountry Touring Area.

Phased Tailings Alternative

Recreation Opportunity Spectrum

The Phased Tailings Alternative would result in the direct removal of up to 6,107 acres from public entry (94 acres less than the proposed action), which represents the area that would be enclosed by perimeter fencing for public safety purposes. Within the project area, there would be direct disturbance as a result of the mine pit, waste rock storage areas, dry-stack tailings, mine facilities and infrastructure, and heap leach associated with the Phased Tailings Alternative. There would be additional disturbances outside the project area as a result of the primary and secondary access roads and the utility corridor. Fencing of the project area is the primary issue leading to a reduction in acres available for recreation opportunities.

Up to 5,868 acres of the project area is within the semiprimitive motorized setting. In addition, just like under the proposed action, 69 acres of roaded natural and 170 acres of roaded modified areas would be directly disturbed under the Phased Tailings Alternative. Figure 76 shows the Recreation Opportunity Spectrum settings that would be impacted by the Phased Tailings Alternative.
The ground disturbance and installation of facilities associated with the Phased Tailings Alternative

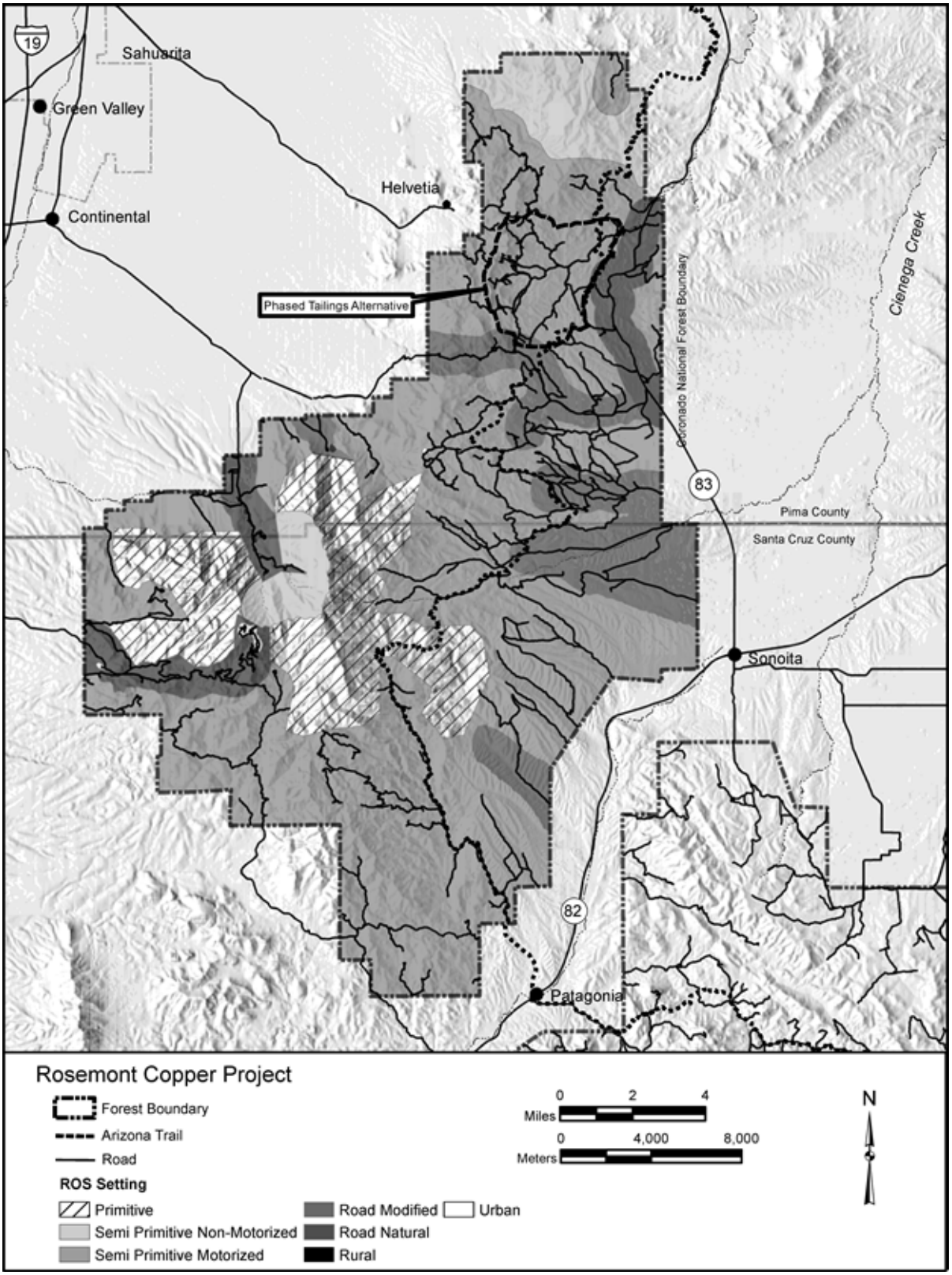


Figure 76. Recreation Opportunity Spectrum with Phased Tailings Alternative

would also result in a change from the existing undeveloped, semiprimitive recreation setting on lands surrounding the project area to a developed, industrialized setting.

Although the McCleary Canyon drainage would remain free of mine waste material for an additional 10 years, it would be within project area of the mine during this time and unavailable for public recreation. The Phased Tailings Alternative would contribute to the displacement of recreation activities and opportunities from lands surrounding the project area, just like the proposed action.

Designated Wilderness

There would be no direct impact to designated wilderness or roadless areas as a result of the Phased Tailings Alternative. Visitors to the Mount Wrightson Wilderness, Santa Rita Inventoried Roadless Area, and Saguaro Wilderness would have distant views of the Phased Tailings Alternative from trails and overlooks (see the "Visual Resources" section). Although tailings would be placed within the McCleary Canyon drainage up to 10 years later in the mining process than under the proposed action, impacts would contribute to a diminished sense of solitude and primitive setting for some wilderness visitors in the long term.

Recreation Places

Impacts to recreation places as a result of the Phased Tailings Alternative would be similar to those for the proposed action. Public access would be restricted and the recreating public would be displaced from the 6,107-acre Phased Tailings Alternative area for 25 years. The primary and secondary access roads would be closed to the public for safety concerns during the construction and operation phases; therefore, the current east-west roads that connect State Route 83 to the west side of the Santa Rita Mountains through Lopez Pass would not be accessible.

There are currently an estimated 30.5 miles of Forest Service off-highway vehicle routes within the project area (0.5 mile less than the proposed action). Most of these routes would be removed as a result of mining activity, and all would be inaccessible to the public for 25 years (figure 77). The loss of these routes represents a 10 percent reduction in the overall mileage available for off-highway vehicle use in the Santa Rita Backcountry Touring Area, which currently has 285 miles of designated forest roads. The Phased Tailings Alternative would result in a reduction in the Forest Service's ability to continue providing for motorized recreation opportunities in the Santa Rita Backcountry Touring Area.

The Phased Tailings Alternative would occur adjacent to and within view of a portion of the 12-mile-long Las Colinas section of the Arizona National Scenic Trail. This alternative would result in the relocation of 4 miles of the Arizona National Scenic Trail (see figure 75). Both the relocation of 4 miles of the trail and the direct and indirect impacts to trail users would be the same as those described for the proposed action.

The Phased Tailings Alternative would exclude hunters from 6,107 acres of Arizona Game and Fish Department hunt unit 34A and would result in the loss of as many as 757 hunter days per year. Impacts to hunting would be the same as those described for the proposed action.

Existing Use Levels and Trends

Changes in use levels and trends that would result from the Phased Tailings Alternative would be the same as those described for the proposed action.

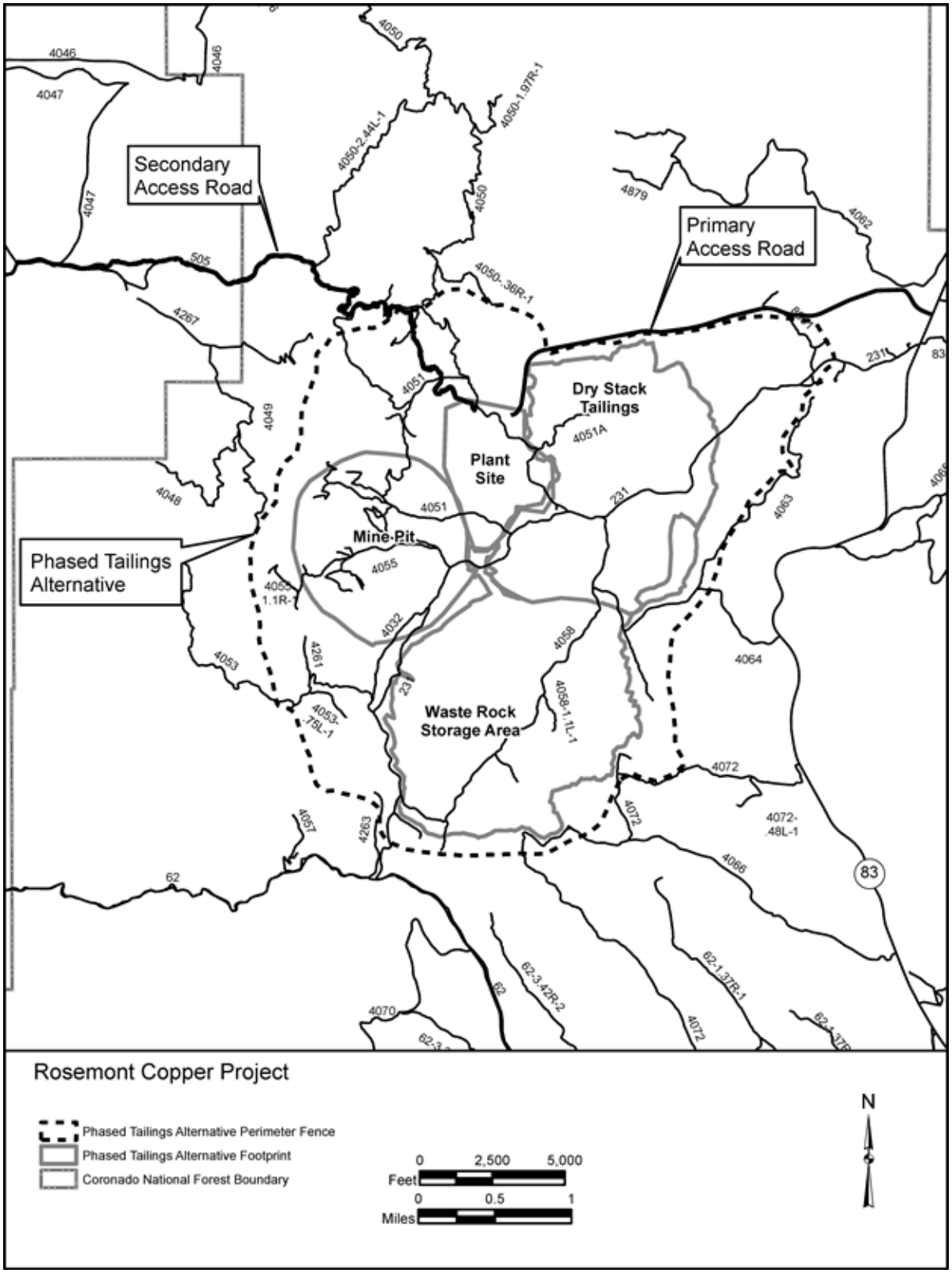


Figure 77. Roads within the perimeter fence of the Phased Tailings Alternative

Barrel Alternative

Recreation Opportunity Spectrum

The Barrel Alternative would result in the direct removal of up to 6,844 acres from public entry (633 acres more than the proposed action), which represents the area that would be enclosed by perimeter fencing for public safety purposes. Within the project area, there would be direct disturbance as a result of the mine pit, waste rock storage areas, dry-stack tailings, mine facilities and infrastructure, and heap leach facility associated with the Barrel Alternative. There would be additional disturbances outside the project area from the primary and secondary access roads and the utility corridor. Fencing of the project area is the primary issue leading to a reduction in acres available for recreation opportunities. The primary and secondary access roads would be closed to the public for safety concerns during the construction and operation phases; therefore, the current east-west roads that connect State Route 83 to the west side of the Santa Rita Mountains through Lopez Pass would not be accessible.

Up to 6,054 acres of the disturbance area would occur within the semiprimitive motorized setting. In addition, 620 acres of roaded natural (552 acres more than the proposed action) and 170 acres of roaded modified (same as the proposed action) would be directly disturbed under the Barrel Alternative. Figure 78 shows the Recreation Opportunity Spectrum settings that would be impacted by the Barrel Alternative. The ground disturbance and installation of facilities associated with the Barrel Alternative would also result in a change from the existing undeveloped, semiprimitive recreation setting on lands surrounding the project area to a developed, industrialized setting. The Barrel Alternative would contribute to the displacement of recreation activities and opportunities from lands surrounding the footprint, just as for the proposed action.

Designated Wilderness

There would be no direct impact to designated wilderness or roadless areas as a result of the Barrel Alternative. Visitors to the Mount Wrightson Wilderness, Santa Rita Inventoried Roadless Area, and Saguaro Wilderness would have distant views of the Barrel Alternative from trails and overlooks (see the “Visual Resources” section). Although dry-stack tailings and waste rock would be confined to the Barrel Canyon drainage, impacts would contribute to a diminished sense of solitude and primitive setting for some wilderness visitors in the long term.

Recreation Places

Impacts to recreation places as a result of the Barrel Alternative would be similar to those for the proposed action. Public access would be restricted and the recreating public would be displaced from the 6,844-acre Barrel Alternative area for the 25-year mine life.

There is currently an estimated total of 32.6 miles of Forest Service off-highway vehicle routes within the Barrel Alternative area (2.2 miles more than the proposed action). Most of these routes would be removed as a result of mining activity, and all would be inaccessible to the public for 25 years (figure 79). The loss of these routes represents a 10.5 percent reduction in the overall mileage available for off-highway vehicle use in the Santa Rita Backcountry Touring Area, which currently has 285 miles of designated forest roads.

The Barrel Alternative would result in a reduction in the Forest Service’s ability to continue providing for motorized recreation opportunities in the Santa Rita Backcountry Touring Area.

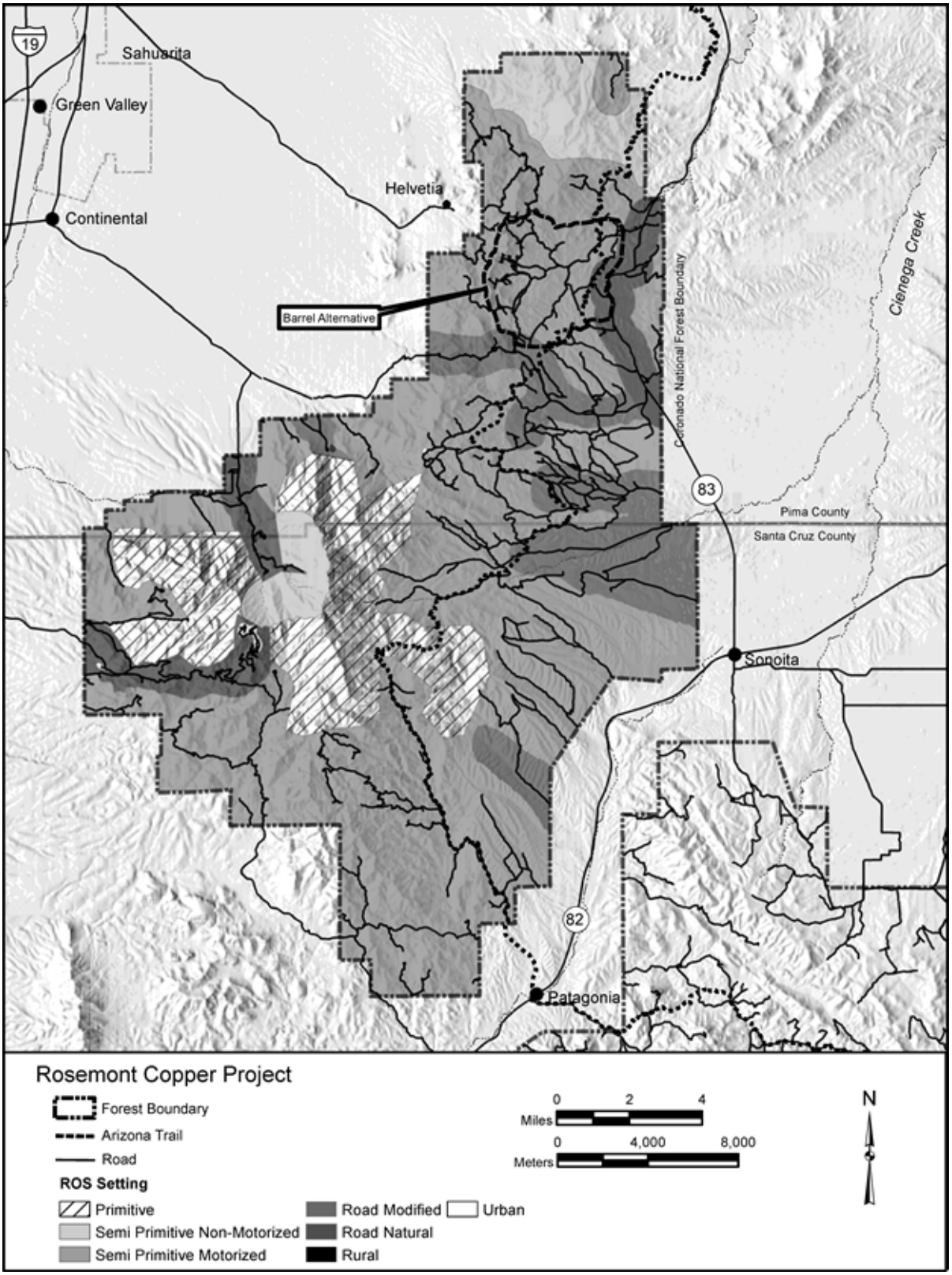


Figure 78. Recreation Opportunity Spectrum with Barrel Alternative

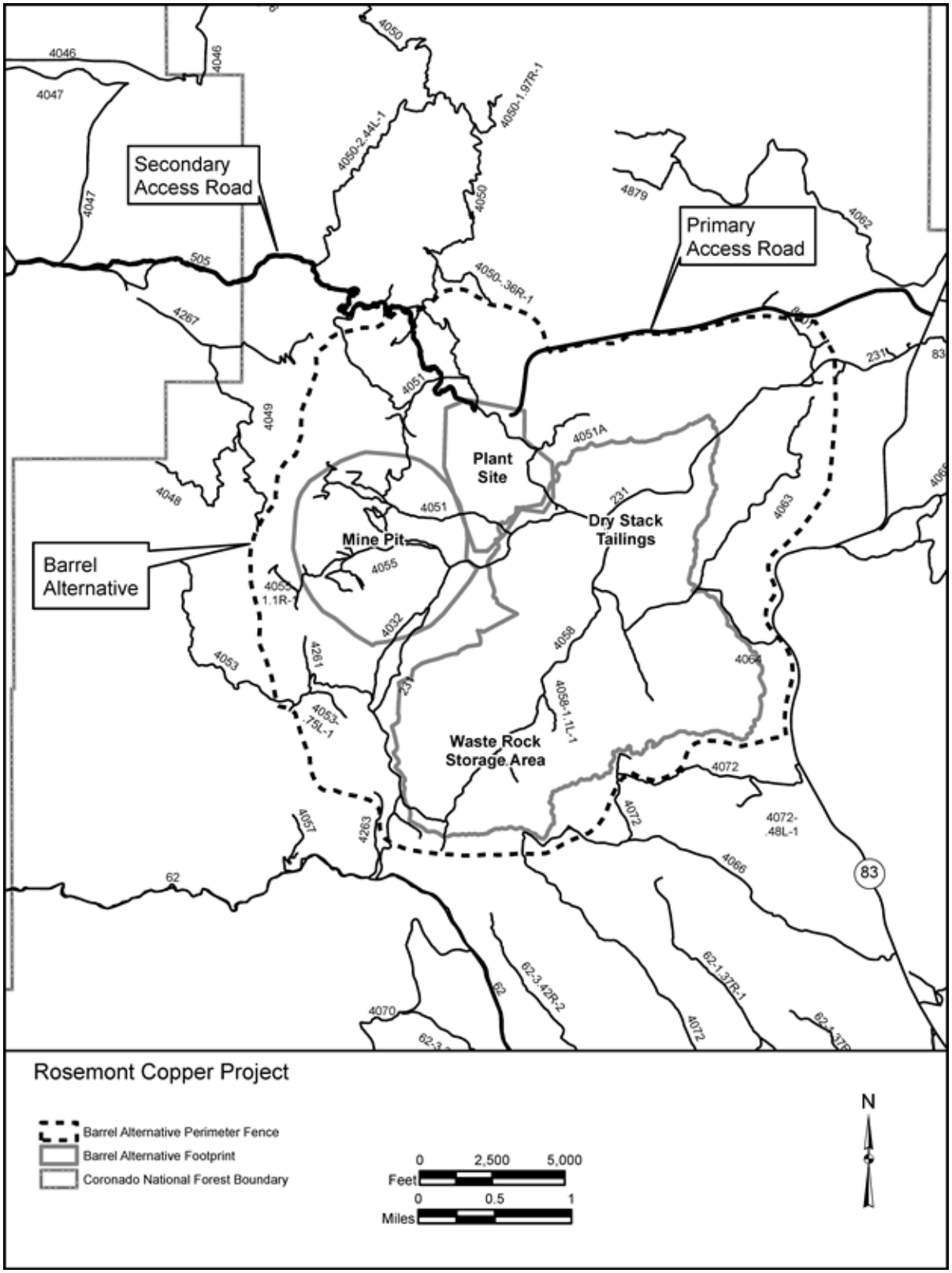


Figure 79. Roads within the perimeter fence of the Barrel Alternative

The Barrel Alternative would be adjacent to and within view of a portion of the 12-mile-long Las Colinas section of the Arizona National Scenic Trail. The Barrel Alternative would result in the relocation of 5.3 miles of the Arizona National Scenic Trail (1.5 miles more than the proposed action) (see figure 73). As a result of the Barrel Alternative footprint, the conceptual reroute segment for the Barrel Alternative would closely parallel State Route 83. The proximity of the trail reroute to the highway would have permanent, adverse impacts to the recreational and scenic setting for which the trail was designated. Views to the east would include extended viewing times of the highway and shoulder, automobile and truck traffic, and rest stops and highway travelers.

In the long term, construction and operation of the mine and mine related traffic along the highway would result in increased impacts to trail users from diminished scenic quality and increased noise. Because of the narrow corridor available between the Barrel Alternative footprint and the State Route 83 right-of-way, it will be difficult or impossible to design and construct the reroute to meet Forest Service trail requirements and trail users would experience excessively steep grades in places for up to 1.78 miles. The inability to construct trail reroutes to Forest Service specifications and the proximity to State Route 83 and the mine is expected to result in decreased use of the reroute by all users: hikers, mountain bikers, and equestrians.

The Barrel Alternative would exclude hunters from 6,844 acres of Arizona Game and Fish Department hunt unit 34A (633acres more than the proposed action) and would result in the loss of as many as 702 hunter days per year. Impacts to hunting would be similar to those for the proposed action.

Existing Use Levels and Trends

Changes in use levels and trends that would result from the Barrel Alternative would be the same as those for the proposed action.

Barrel Trail Alternative

Recreation Opportunity Spectrum

The Barrel Trail Alternative would result in the direct removal of up to 6,844 acres from public entry (633 acres more than the proposed action), which represents the area that would be enclosed by perimeter fencing for public safety purposes. Within the project area, there would be direct disturbance from the mine pit, waste rock storage areas, dry-stack tailings, mine facilities and infrastructure, and heap leach facility associated with the Barrel Trail Alternative. There would be additional disturbance outside the project area as a result of the primary and secondary access roads and the utility corridor. Fencing of the project area is the primary issue leading to a reduction in acres available for recreation opportunities. The primary and secondary access roads would be closed to the public for safety concerns during the construction and operation phases; therefore, the current east-west roads that connect State Route 83 to the west side of the Santa Rita Mountains through Lopez Pass would not be accessible.

Up to 6,054 acres of the project area is within the semiprimitive motorized setting. In addition, 620 acres of roaded natural (552 acres more than the proposed action) and 170 acres of roaded modified (same as the proposed action) would be directly disturbed under the Barrel Trail Alternative. Figure 80 shows the Recreation Opportunity Spectrum settings that would be impacted by the Barrel Trail Alternative. The ground disturbance and installation of facilities associated with the Barrel Trail Alternative would also result in a change from the existing undeveloped, semiprimitive recreation setting on lands surrounding the project area to a developed, industrialized setting. The Barrel Trail

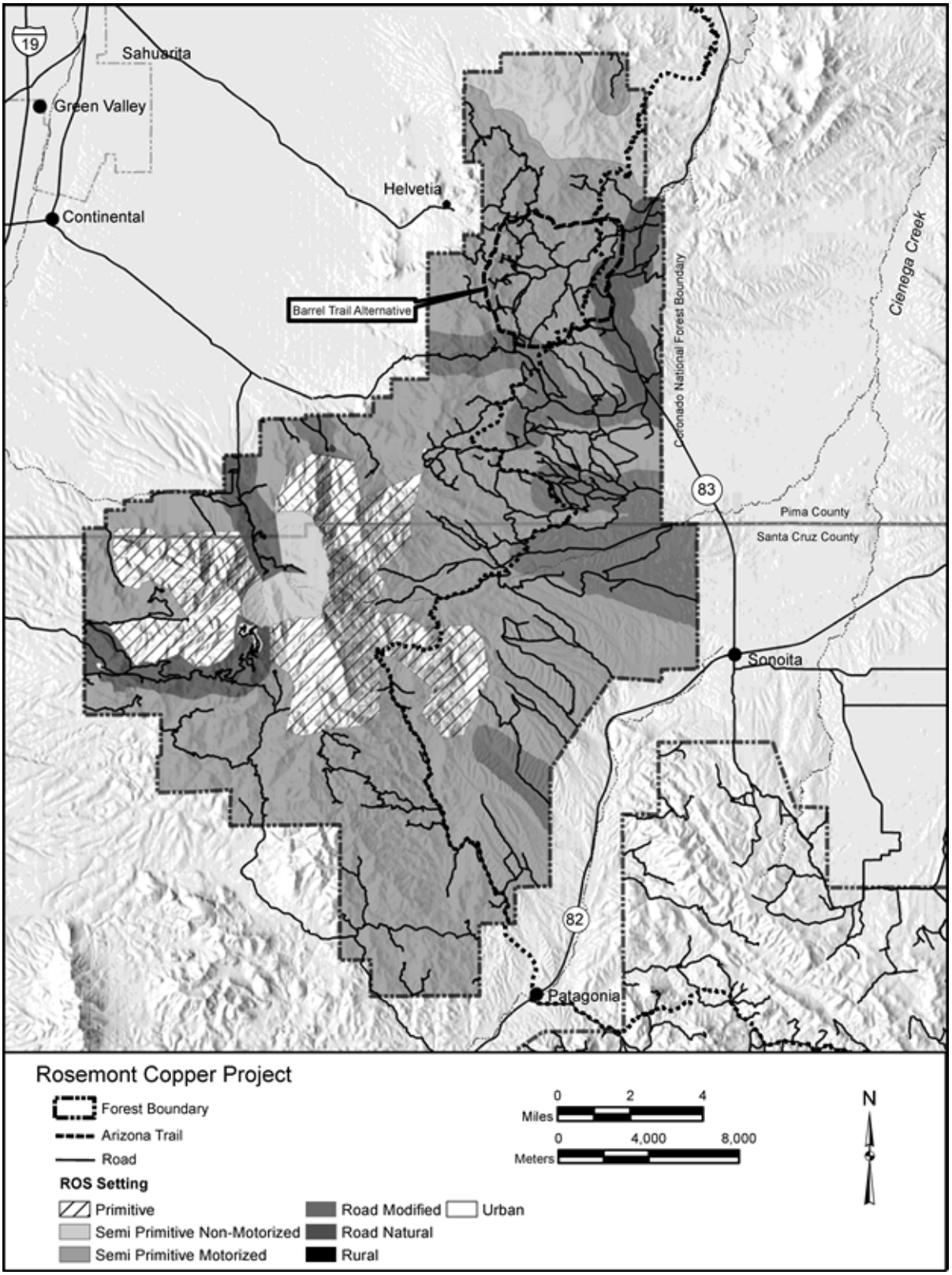


Figure 80. Recreation Opportunity Spectrum with Barrel Trail Alternative

Alternative would contribute to the displacement of recreation activities and opportunities from lands surrounding the footprint, just as for the proposed action.

Designated Wilderness

There would be no direct impact to designated wilderness or roadless areas as a result of the Barrel Trail Alternative. Visitors to the Mount Wrightson Wilderness, Santa Rita Inventoried Roadless Area, and Saguaro Wilderness would have distant views of the Barrel Trail Alternative from trails and overlooks (see the "Visual Resources" section). Although dry-stack tailings and waste rock would be confined to the Barrel Canyon drainage, impacts would contribute to a diminished sense of solitude and primitive setting for some wilderness visitors in the long term.

Recreation Places

Impacts to recreation places as a result of the Barrel Trail Alternative would be similar to those for the proposed action. Public access would be restricted and the recreating public would be displaced from the larger 7,100-acre project area for 25 years.

There is currently an estimated total of 32.6 miles of Forest Service off-highway vehicle routes within the Barrel Trail Alternative area (2.2 miles more than the proposed action). Most of these routes would be removed as a result of mining activity, and all would be inaccessible to the public for 25 years (figure 81). The loss of these routes represents a 10.5 percent reduction in the overall mileage available for off-highway vehicle use in the Santa Rita Backcountry Touring Area, which currently has 285 miles of designated forest roads. The Barrel Trail Alternative would result in a reduction in the Forest Service's ability to continue providing for motorized recreation opportunities in the Santa Rita Backcountry Touring Area.

The Barrel Trail Alternative would be adjacent to and within view of a portion of the 12-mile-long Las Colinas section of the Arizona National Scenic Trail. The Barrel Trail Alternative would result in the relocation of 5.3 miles of the Arizona National Scenic Trail east of State Route 83 (1.5 miles more than the proposed action) (see figure 73). Both the relocation of 5.3 miles of the trail and the indirect impacts to trail users would be similar to those for the Barrel Alternative.

The Barrel Trail Alternative would exclude hunters from 6,844 acres of Arizona Game and Fish Department hunt unit 34A (633 acres more than the proposed action) and would result in the loss of as many as 702 hunter days per year. Impacts to hunting would be similar to those for the proposed action.

Existing Use Levels and Trends

Changes in use levels and trends that would result from the Barrel Trail Alternative would be the same as those for the proposed action.

Scholefield-McCleary Alternative

Recreation Opportunity Spectrum

The Scholefield-McCleary Alternative would result in the direct removal of up to 7,194 acres from public entry (983 acres more than the proposed action), which represents the area that would be enclosed by perimeter fencing for public safety purposes. Within the project area, there would be direct disturbance from the mine pit, waste rock storage areas, dry-stack tailings, mine facilities and infrastructure, and heap leach facility associated with the Scholefield-McCleary Alternative. Dry-stack tailings and most of the waste rock would be confined to Scholefield Canyon. The heap leach

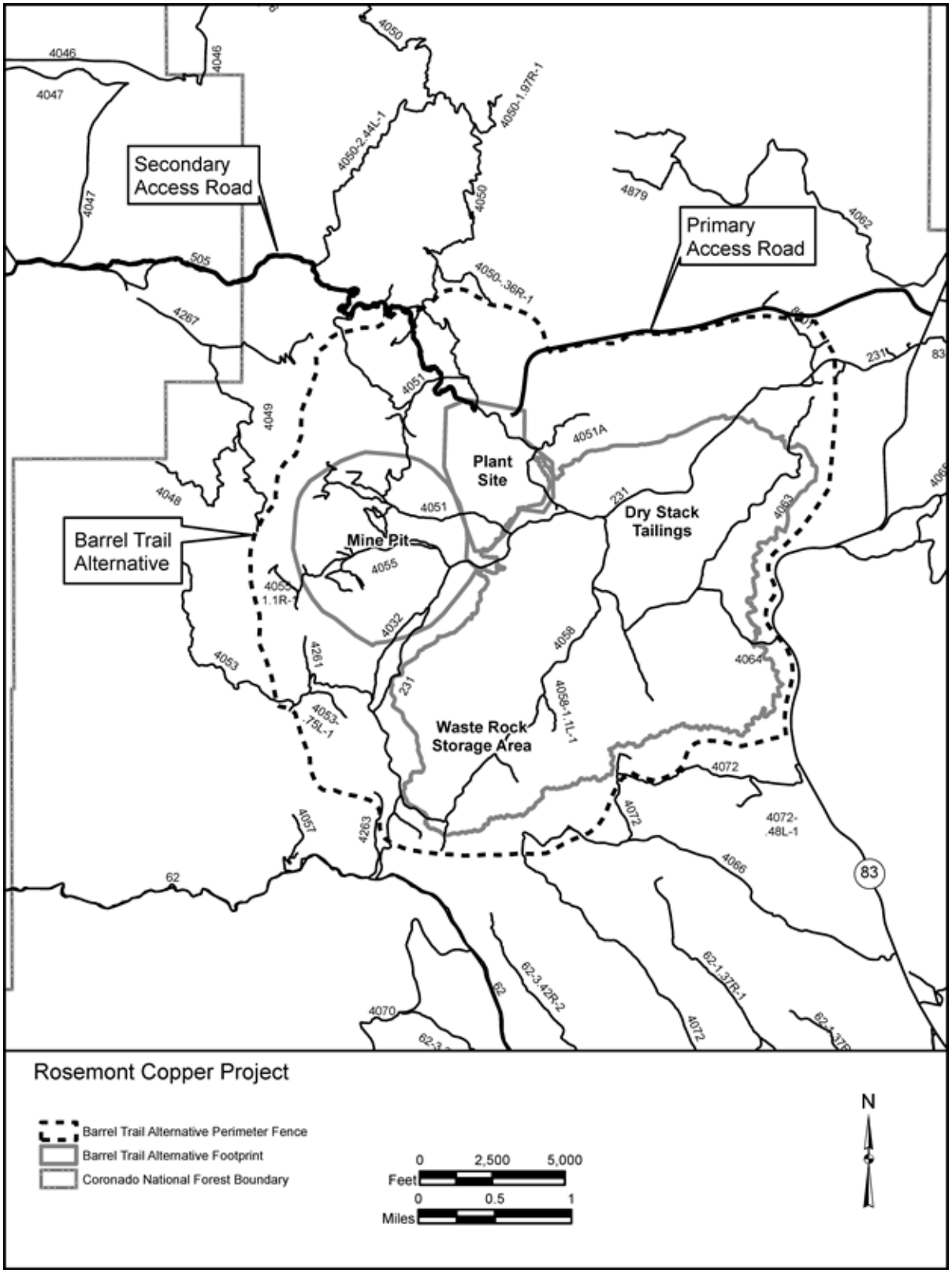


Figure 81. Roads within the perimeter fence of the Barrel Trail Alternative

and remaining waste rock storage area would be located in the Barrel Canyon Area. There would be additional disturbances outside the project area as a result of the primary and secondary access roads and the utility corridor. Fencing of the project area is the primary issue leading to a reduction in acres available for recreation opportunities. The primary and secondary access roads would be closed to the public for safety concerns during the construction and operation phases; therefore, the current east-west roads that connect State Route 83 to the west side of the Santa Rita Mountains through Lopez Pass would not be accessible.

Up to 6,874 acres of the project area is within the semiprimitive motorized setting. In addition, 119 acres of the semiprimitive nonmotorized setting and 200 acres of the roaded natural setting would be directly disturbed under the Scholefield-McCleary Alternative. Figure 82 shows the Recreation Opportunity Spectrum settings that would be impacted by this alternative. The Scholefield-McCleary Alternative is the only alternative that would result in a direct loss of acres of the semiprimitive nonmotorized setting.

The ground disturbance and installation of facilities associated with the Scholefield-McCleary Alternative would also result in a change from the existing undeveloped, semiprimitive recreation setting on lands surrounding the area to a developed, industrialized setting. Although the Scholefield-McCleary Alternative would continue to contribute to the displacement of recreation activities and opportunities from lands surrounding the project footprint, postmine opportunities in Barrel Canyon would be maintained more than under the other action alternatives.

Designated Wilderness

There would be no direct impact to designated wilderness or roadless areas as a result of the Scholefield-McCleary Alternative. Visitors to the Mount Wrightson Wilderness, Santa Rita Inventoried Roadless Area, and Saguaro Wilderness would have distant views of the Scholefield-McCleary Alternative from trails and overlooks (see the “Visual Resources” section). Although dry-stack tailings and waste rock would be confined to Scholefield Canyon, views would continue to contribute to a diminished sense of solitude and primitive setting for some wilderness visitors in the long term.

Recreation Places

Impacts to recreation places as a result of the Scholefield-McCleary Alternative would be similar to those for the proposed action. Public access would be restricted, and the recreating public would be displaced from the 7,194 acres of the Scholefield-McCleary Alternative area for the more than 25-year mine life.

There is currently an estimated 31 miles of Forest Service off-highway routes within the Scholefield-McCleary Alternative area (1 mile more than the proposed action). Most of these routes would be removed as a result of mining activity, and all would be inaccessible to the public for 25 years (figure 83). The loss of these routes represents a 10 percent reduction in the overall mileage available for off-highway vehicle use in the Santa Rita Backcountry Touring Area, which currently has 285 miles of designated Forest Service routes. The Scholefield-McCleary Alternative would result in a reduction in the Forest Service’s ability to continue providing for motorized recreation opportunities in the Santa Rita Backcountry Touring Area.

The Scholefield-McCleary Alternative would occur adjacent to and within view of a portion of the 12-mile-long Las Colinas section of the Arizona National Scenic Trail (see figure 82).

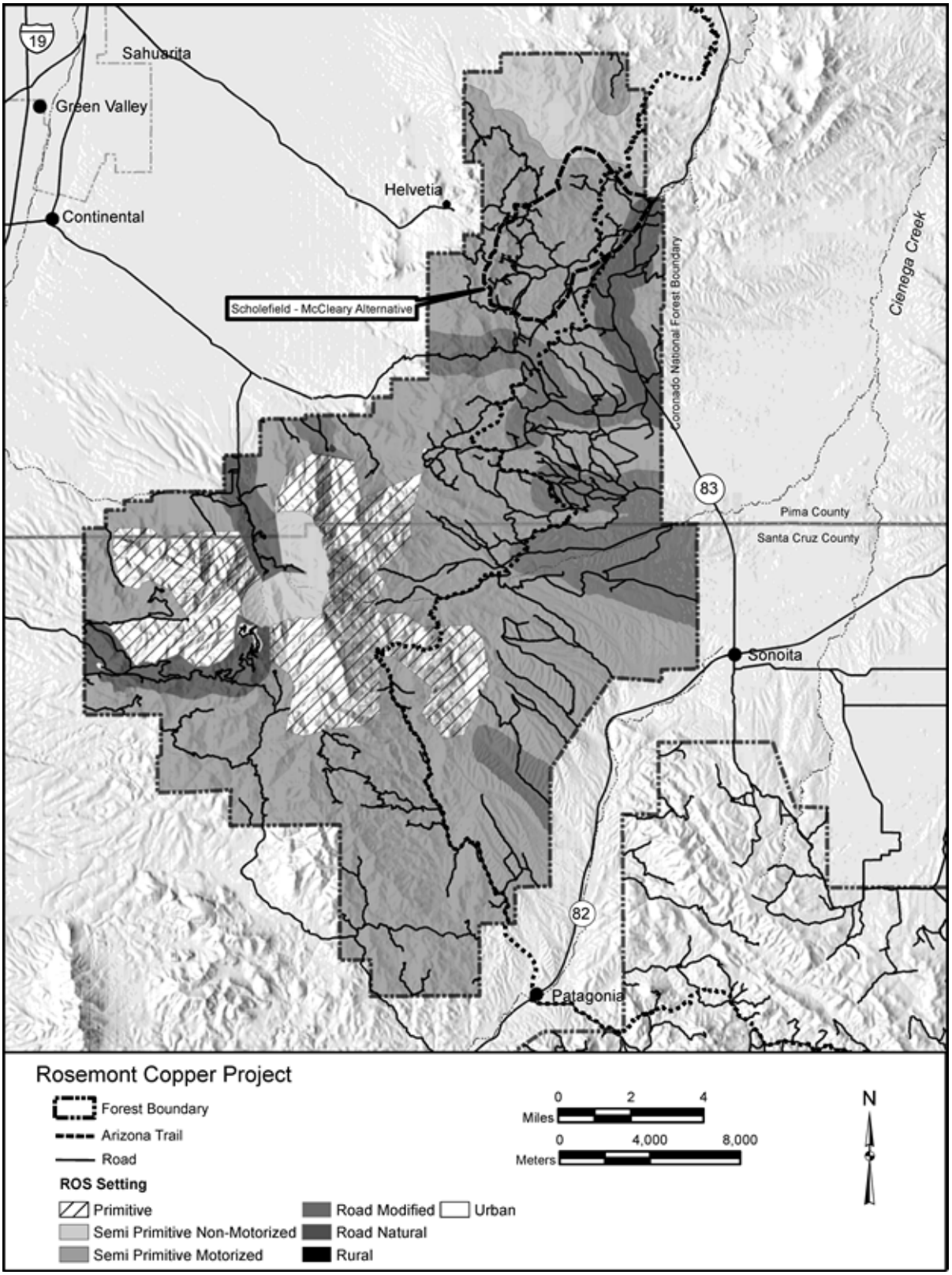


Figure 82. Recreation Opportunity Spectrum with Scholefield-McCleary Alternative

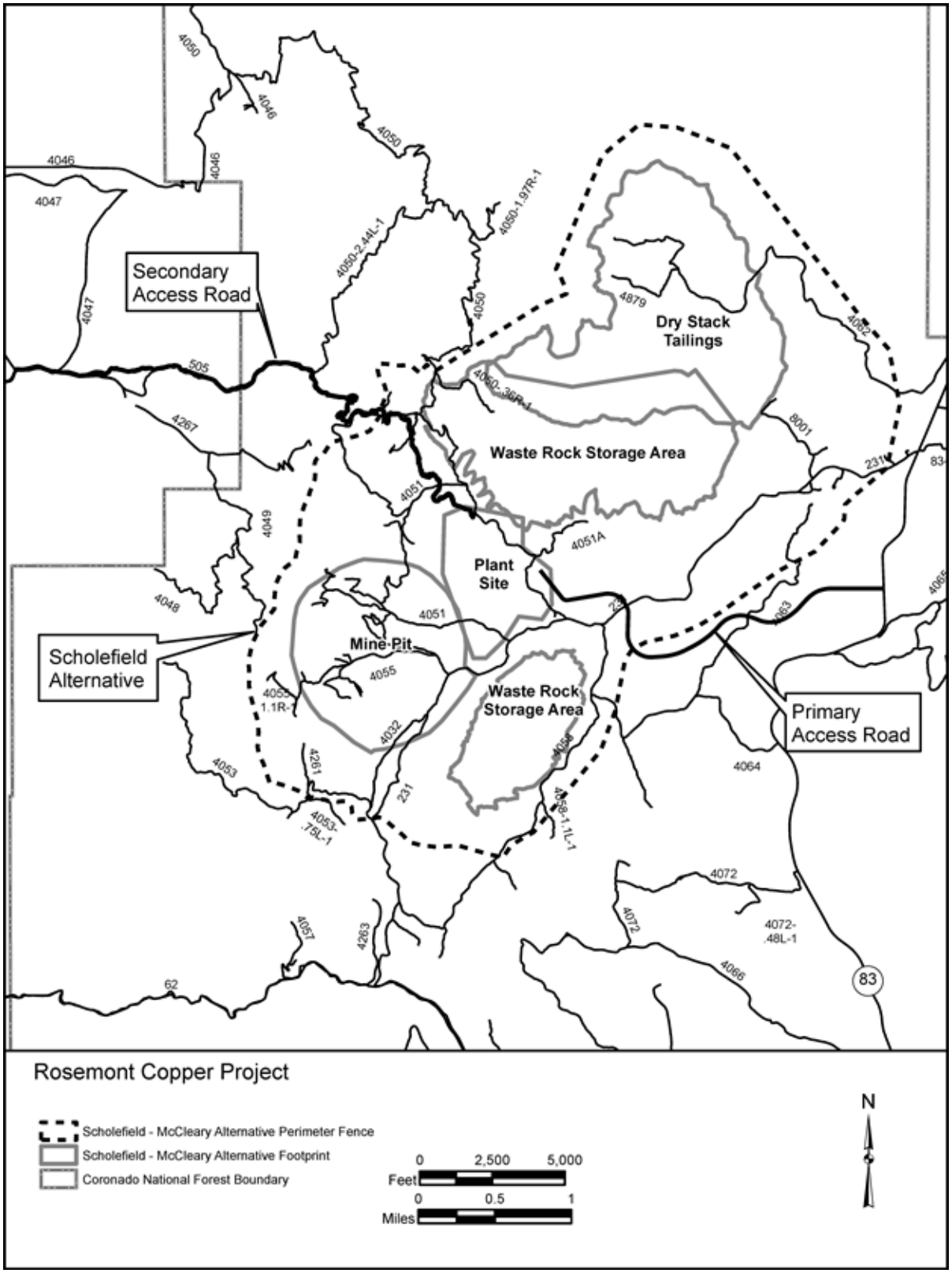


Figure 83. Roads within the perimeter fence of the Scholefield-McCleary Alternative

The Scholefield-McCleary Alternative would result in the relocation of 4 miles of the Arizona National Scenic Trail. Both the relocation of 4 miles of the trail and the indirect impacts to trail users would be similar to those for the Barrel Alternative.

The Scholefield-McCleary Alternative would exclude hunters from 7,194 acres of Arizona Game and Fish Department hunt unit 34A (983 acres more than the proposed action) and would result in the loss of as many as 905 hunter days per year. Impacts to hunting would be similar to those for the proposed action.

Existing Use Levels and Trends

Changes in use levels and trends that would result from the Scholefield-McCleary Alternative would be the same as those for the proposed action.

Comparison of Alternatives Impacts

The Scholefield-McCleary Alternative would result in the greatest amount of acreage removed from public access and no longer available for recreational use. This alternative would also result in the greatest mine visibility from recreation sites in the area of analysis. The Barrel Alternative would have the next greatest overall impact as a result of the extensive visibility of mine features from recreation sites within the area of analysis. The proposed action and Phased Tailings Alternative would result in similar impacts, both somewhat less than the Scholefield-McCleary and Barrel Alternatives. Although views of some mine features would be screened by waste rock piles, those waste rock piles would be more clearly visible from recreation areas in the area of analysis.

Cumulative Effects

The Council on Environmental Quality defines a cumulative impact as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions” (40 Code of Federal Regulations 1508.7). As outlined in the chapter 3 introduction, cumulative impacts of past and present actions are identified and analyzed in the “Affected Environment” part of each resource section, including for “Recreation.” This cumulative effects discussion addresses the cumulative impacts of the action alternatives and any applicable reasonably foreseeable actions as identified on the Coronado ID team’s list of reasonably foreseeable future actions, provided in the chapter 3 introduction. The following reasonably foreseeable actions from that list were determined to contribute to a cumulative impact to recreation:

- Pavement preservation of State Route 83 from Sonoita to milepost 43
- Maintenance of forest roads in support of grazing activities
- Closure of up to 35 abandoned small mines in Santa Rita Mountains
- Implementation of a conservation plan by Pima County that may include acquisition of archaeological and historical sites and traditional use sites

Road repairs to State Route 83 and ongoing maintenance of existing forest roads would contribute cumulatively to reduced access to recreation opportunities in the analysis area in the short term. Once repair and maintenance activities are completed, there would be improved access and enhanced recreation opportunities for those seeking scenic driving experiences and dispersed recreation opportunities.

The closure and reclamation of up to 35 abandoned small mines in the Santa Rita Mountains is also expected to limit access to recreation opportunities in the short term, as public access to Forest Service lands would be limited while reclamation activities take place. Once reclamation is completed, it is expected that opportunities for dispersed recreation would be safer.

Implementation of a conservation plan that would conserve archaeological resources and provide for heritage education opportunities would also result in new recreation opportunities for individuals seeking heritage tourism opportunities.

Implementation of the Forest Service Travel Management Rule would result in changes to the established system of roads and trails in the Santa Rita Mountains. It is anticipated those changes would include closure of unauthorized roads and existing system roads, prohibitions on motor vehicle use, and adding new roads to the current system. The Santa Rita Mountains will continue to be closed to cross country motorized vehicle travel. Road closures and vehicle prohibitions would contribute to a decrease in access for motorized recreation opportunities in the analysis area in the long term. The designation of unauthorized roads that are currently used for hunter access, hiking, and dispersed camping as part of the system would enhance recreation opportunities by ensuring maintenance and management of those roads as part of the Forest Service system of motorized travel.

There are a number of past and present actions that have contributed to the existing conditions and influenced the current route designation of the 807-mile-long Arizona National Scenic Trail. These consist of existing road crossings, utilities, restoration activities, wildfires, and mining activities. There is also the potential for future actions along the trail that can be reasonably expected to occur. These reasonably foreseeable future activities are described below and consist of power transmission and distribution lines, forest restoration activities, including fuels reduction projects, wildfires, and wildfire restoration activities.

Foreseeable future actions that could affect the settings along the trail are as follows:

- Flagstaff to Pinnacle Peak Transmission Line – The line is proposed to run from Fossil Creek north by Winona to the northern boundary of the Coconino National Forest. Construction and operation of the line would cross the trail and would result in expanding vegetation management, including tree removal, for a distance up to 150 feet on either side of the existing 345-kilovolt line traversing the Coconino National Forest.
- APS Sandvig-Young Power Line – This action would expand the existing power line 40-foot-wide corridors to allow construction of a new 69-kilovolt power line east of Flagstaff. The line is proposed to cross the Flagstaff equestrian bypass in the Mount Eldon section of the trail.
- Rock and gravel pit development in the Kaibab and Coconino National Forests would affect trail scenic quality. There would be a total of 39 rock pits, affecting a total of 434 acres on forest lands.
- Marshall Fuel Reduction and Forest Restoration Project – Coconino National Forest is proposing forest restoration and fuels reduction treatments on approximately 12,000 acres southeast of Flagstaff that would affect trail scenery. The project is being proposed to improve the health of forest and associated habitats and to reduce the risks of wildfires. The trail passes through this area. In addition, the Coconino National Forest is proposing that sections of the Arizona Trail with a steepness of greater than 20 percent for 50 feet would be realigned to mitigate current soil and watershed concerns.

- Clint's Well Forest Restoration Project – The Mogollon Rim Ranger District is proposing a restore fire adapted ecosystems and reduce the potential for life-threatening wildfires on approximately 16,809 acres within the Coconino National Forest. The trail passes through the project area.
- Four Forests Restoration Initiative – A regional, 750,000-acre restoration project encompassing the Coconino, Kaibab, and Tonto National Forests, this would be a collaborative, landscape-scale initiative designed to restore fire-adapted ecosystems in the Southwestern Region. The size of this initiative would likely affect trail scenic quality.
- ASARCO State Land Sale – Under consideration by the State Land Department, this potential sale would transfer Arizona State Trust land to ASARCO for future mine tailings disposal site west of Kelvin. The tailings disposal would require approximately 11 miles of the trail to be rerouted to less scenic locations, and a new bridge over the Gila River would be needed for the trail crossing.
- SunZia Southwest Transmission Project – Located within Bureau of Land Management administered lands, the 460-mile cross-state project would consist of two side-by-side 500-kilovolt power lines. The project utility corridor would cross the trail and would affect scenic quality.
- Centennial West Clean Line Project – This 900-mile-long power line project would cross the trail and affect scenic quality.
- The Coconino National Forest is proposing to complete the Hart Prairie Fuels Reduction and Forest Health Restoration project on 12,775-acre area approximately 20 miles north of Flagstaff, Arizona. The proposed project would include tree removal and prescribed fire to restore fire-adapted ecosystems and reduce the potential for life-threatening wildfires. This would result in closure of approximately 0.6 mile of the trail during the fall of 2012.

These actions would result in the potential need for both temporary and long-term trail reroutes and a more developed setting, which would change the existing semiprimitive setting of the trail and would not meet the original vision for the trail. Each of the alternatives would contribute cumulatively to a gradual decline in the desired scenic and recreational setting of the trail.

Mitigation Effectiveness

Implementation of mitigation measures would partially mitigate the loss of recreation opportunities, trails and trailheads, and public access. Mitigation would consist of removal of the perimeter fence after mining operations. The removal of the perimeter fence would allow for public access to the area, and the east-west road over the Santa Rita Mountains through Lopez Pass may be reestablished.

Traffic on State Route 83 varies annually. In 2008, the average annual daily traffic count from Sahuarita Road to Interstate 10 was 2,800 vehicles. During year 20 of operations, there would be a total of 457 daily round-trip commuting trips on State Route 83 from mine related traffic. Development of a "park and ride" program as part of transportation mitigation could reduce some of the increased traffic levels on State Route 83 (the Patagonia-Sonoita Scenic Road) by encouraging carpooling.

At the end of mine operations, all unneeded facilities (plant site and roads) would be removed, and these areas would be naturalized by having their contours restored and by being revegetated with native grasses, trees, and shrubs. This would mitigate the effects from these facilities. Treating the light-colored upper pit rock would help mitigate visual impacts to recreation settings (see the "Visual

Resources" section). However, the tailings and waste rock piles would be large and industrial looking (with engineered slopes, numerous horizontal benches, and drop structures) and would have vegetation patterns that would not restore recreation settings for a century or more. This is why mitigation measures would not fully mitigate recreation impacts. Moreover, as noted in the "Air Quality and Climate Change" section, climate change research indicates that temperatures in the Southwest will rise and precipitation will decrease over the next 100 years, which would reduce the success rate of revegetation efforts.

The Forest Service is investigating the feasibility of geomorphic design (sometimes called landforming) and construction of the Rosemont Copper Mine waste rock and tailings piles. Landforms of geomorphic design can create more stable, natural functioning, and natural-looking topography than conventionally designed landforms, which could mitigate some impacts to water quality and quantity, visual quality, recreation settings, and wildlife habitat. The Forest Service plans to explore the status of geomorphic landform design in the mining industry. If these investigations show that geomorphic landform deign is feasible for the Rosemont Copper Project, the Forest Service will then apply geomorphic principles to at least one alternative. This investigation and potential design work will take place between the DEIS and FEIS.

Unavoidable adverse impacts to recreation that would occur as a result of all action alternatives include changes from the existing semiprimitive, natural setting to a developed, industrial setting and the loss of public access roads throughout the project area. Because of the area's topography and the change in setting, there would be limited opportunities to develop new routes, loops, or trail connections directly around the project area of any action alternative during mine operations.

Mitigation mentioned in chapter 2 includes the intent to reduce or eliminate future development of private lands currently owned by Rosemont Copper that will eventually be located on top of waste rock and tailings piles (i.e., Rosemont Ranch). Rosemont Copper and the Coronado will work together to reduce or eliminate any future development of these lands that could compromise reclamation of waste rock and tailing areas over the long term. This analysis assumes that these efforts will limit future development and that future impacts to recreation will not occur.

Irretrievable and Irreversible Commitment of Resources

The mitigation measures outlined in chapter 2 require reclamation of the disturbed areas after the 25-year life of the project, which would partially mitigate impacts to recreation. However, it would take decades or centuries before the project footprint is no longer apparent. Even when vegetation is established during reclamation efforts, the composition of plant species in a recovery area is often different from the original plant community. Typically, grasses establish early on, whereas shrubs and trees take much longer to reestablish. There would be irretrievable and irreversible impacts as a result of displaced recreation users and adverse effects on recreation experiences and activities.

There would be irretrievable and irreversible impacts to recreation along the Arizona National Scenic Trail. The mitigation measure to relocate the Arizona National Scenic Trail may only partially mitigate the impacts to the trail owing to the possibility that the relocation will not fully meet the scenic and recreational values for which the current location was chosen.

Each action alternative would result in the permanent removal of between 29 and 33 miles of Forest Service off-highway routes, resulting in a permanent loss of recreation opportunities and activities. Although an east-west route through the project area might be reestablished via the primary and

secondary access roads after mining operations have ceased, the possibility of reestablishing a north-south route and other routes destroyed by mining operations through the reclaimed area would be difficult. This is because of topography, suitable lands, and resource impacts. Therefore, the impacts to off-highway vehicle routes are considered irretrievable and irreversible.

For each action alternative, the visual contrasts that would result from the introduction of facilities associated with the project would be an irretrievable and irreversible loss of the undeveloped, semiprimitive setting until the project is closed and full reclamation is complete. Even after full reclamation is complete, because the waste rock and tailings piles would be so steep, the postmine topography of the project area would limit the recreation value and potential for future recreation opportunities.

Hazardous Materials

Introduction

This section discusses hazardous materials in the project area and in the analysis area. Hazardous materials include fuels, chemicals, and explosives that are used for mine equipment and operations. These materials must be transported to the project area, stored, and if not consumed by the process, properly disposed of.

Issues, Cause and Effect Relationships of Concern

Storage, transportation, use, and disposal of hazardous materials carry the potential that those materials can be accidentally released to the environment, which can cause long-term contamination of soils, surface water, and groundwater. No significant issues were specifically identified during scoping regarding hazardous materials, except for impacts to public health, which are specifically covered in the “Public Health and Safety” section of this DEIS.

Even though impacts from hazardous materials were not identified as major issues, the following section addresses the alternatives’ impacts from the storage, transportation, use, and disposal of hazardous materials in order to provide a full impact analysis as well as to provide the background information that will be used in the analysis of impacts to other resources, such as public health and safety. The issues analyzed in this section include the following:

- Amount, type, and location of storage, use, or disposal of hazardous materials and the potential for release to the environment;
- Transportation of hazardous materials to the project area and the potential for release to the environment; and
- Fate and transport of hazardous materials once they have entered the environment.

Analysis Methodology, Assumptions, Uncertain and Unknown Information

The analysis area for hazardous materials is intended to encompass the temporal and spatial extent necessary to describe any environmental impacts that may result from the transport, storage, use, and disposal of hazardous materials by the proposed project.

Temporally, any potential impacts to the soils, surface waters, and aquifers, both within and adjacent to the project area, would occur from initial construction of mine facilities through reclamation. Furthermore, the potential for accidental leaks, spills, or releases of process fluids, petroleum-based

fuels, and other hazardous materials into the environment could result in not only short-term but also long-term or permanent contamination. Therefore, the temporal bounds of analysis for hazardous materials encompasses the construction, operation, and reclamation phases, as well as postclosure.

The analysis area for hazardous materials encompasses the operational areas of the proposed project (i.e., mine process facilities, fuel storage tanks, processing fluid pipelines, tailings, and waste rock facilities), where hazardous materials could be released into the environment (i.e., soils, vegetation, wildlife, aquifers, surface water drainages). The analysis area also includes areas with the potential to receive hazardous materials through migration in either groundwater or surface water.

The analysis for hazardous materials also encompasses the temporal and spatial extent necessary to describe any environmental impacts that may result from transportation of hazardous materials to the mine. Temporally, the potential impacts associated with transporting petroleum fuels, explosives, sulfuric acid, and other hazardous materials to the mine would occur primarily during the construction phase and the 25-year life of active mine operations. Therefore, the temporal bounds of analysis for transportation of hazardous materials encompasses construction and operation. However, as with hazardous materials used at the mine, the potential for long-term contamination extends the temporal bounds of analysis to include postclosure as well.

The analysis area for transportation of hazardous materials encompasses the highway transportation system and adjacent environmental receptors, which may be impacted by transportation of hazardous materials to the project area. The analysis area for transportation of hazardous materials is defined as State Route 83 between Interstate 10 and the proposed primary access road to the mine. The analysis area for hazardous materials is depicted in figure 84. Utility corridors were not considered in the analysis area, as the use and risk of release of hazardous materials in these areas were considered negligible.

Specific information concerning the use, storage, and disposal of hazardous materials/hazardous waste onsite, as well as transportation of hazardous materials to the mine, is provided in two technical reports (Arnold and Henderson 2007; WestLand Resources Inc. 2007a). These reports provide details on the amount, type, and location of hazardous materials used, as well as handling techniques and contingency plans for accidental releases.

Impacts associated with the storage, use, and disposal of hazardous materials are measured quantitatively by the amount, type, and location of various hazardous materials used. Impacts to the environment in the event of an unplanned release are assessed qualitatively based on the type and amount of hazardous material, handling techniques, locations of use and contingency plans, risk of accidental release, and exposure pathways to potential sensitive receptors.

Analysis of potential releases requires an objective assessment of risk, based on the type of release and quantity of material. The following categories are used to define the risk of release:

- Catastrophic. Release of a large quantity of hazardous material, greater than a single drum or bag, occurring all at once.
- Major. Release of a large quantity of hazardous material, greater than a single drum or bag, not occurring all at once or released slowly.
- Minor. Release of a small quantity of hazardous material, greater than 1 liter/1 kilogram but less than a single drum or bag.
- Negligible. Release of very small quantity of hazardous material, less than 1 liter/1 kilogram.

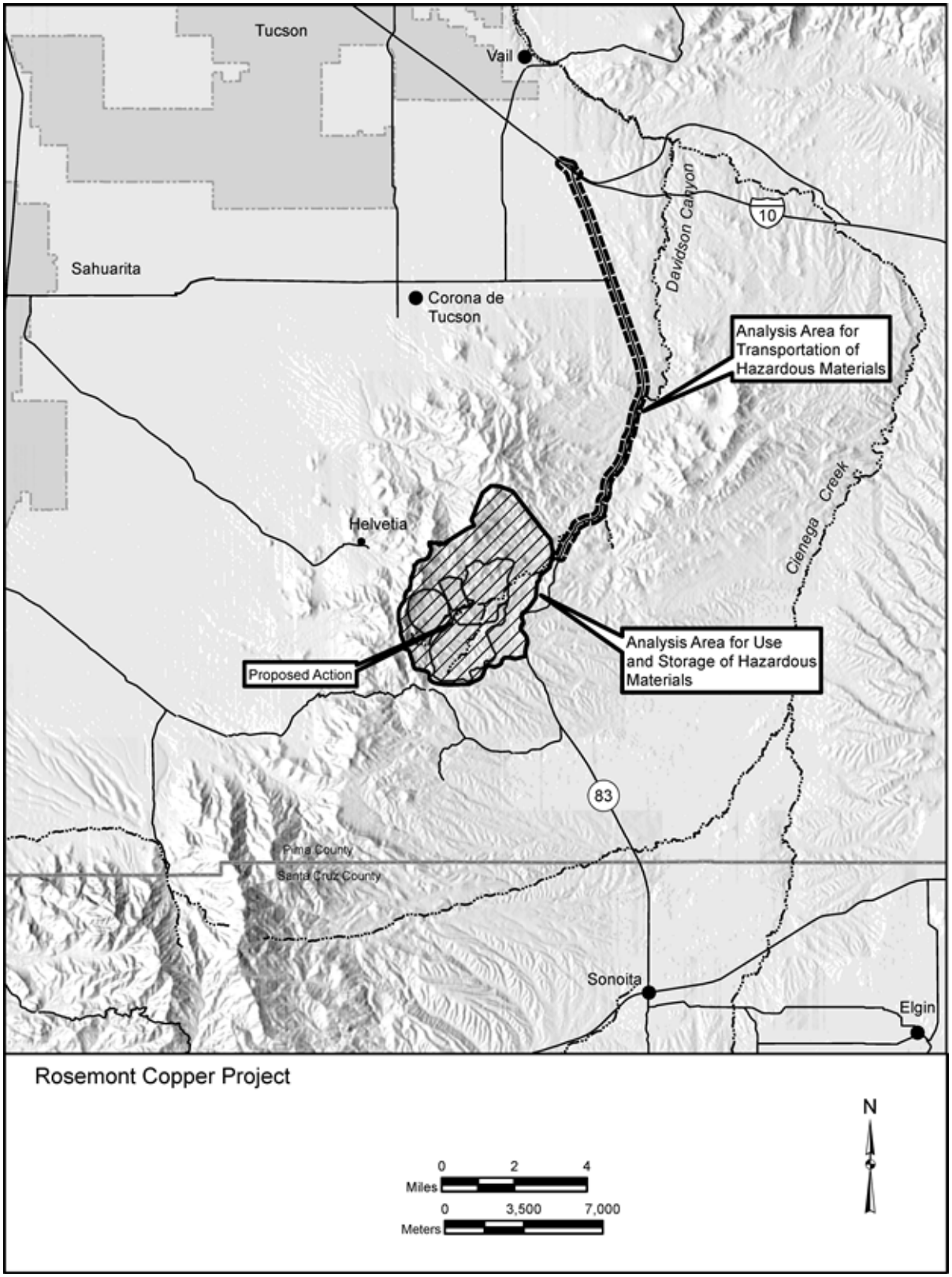


Figure 84. Analysis area for hazardous materials

Adequate information was found to analyze hazardous materials impacts. No uncertain or unknown information was identified.

Summary of Effects by Issue Measures by Alternative

Table 126 presents the summary comparison of impacts from each alternative.

Table 126. Summary of effects

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
Other Effects Considered						
Potential for release of ammonium nitrate and fuel oil during use	None	Materials used up during detonation; negligible risk to environment	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
Potential for release of laboratory reagents during storage or use	None	Materials used in small quantities in controlled setting; negligible risk to environment	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
Potential for release of cleaning fluids during storage or use	None	Materials used in small quantities in controlled setting; negligible risk to environment	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
Potential for release of reagents during solvent extraction and electrowinning	None	Except for kerosene and sulfuric acid, all reagents used up in process or used in small amounts; negligible risk to environment	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
Potential for release of ammonium nitrate from risk of explosion during storage	None	In dry form presents little risk for release or migration; by itself and properly stored does not present an unusual risk of fire or explosion; negligible risk to environment	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
Potential for release of hazardous waste	None	When stored, transported, and disposed of properly does not pose risk of accidental release; petroleum products described separately; negligible risk to environment	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
Potential for catastrophic release of sulfuric acid or petroleum product during transportation	None	Direct impacts to plants, wildlife, and/or soil in immediate vicinity of spill; possible migration into surface waters with indirect downstream effects on vegetation, aquatic species, and/or wildlife; some risk of groundwater contamination	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
Potential for catastrophic or major release of sulfuric acid or petroleum product within the mine	None	Direct impacts to soil and wildlife and if long-term release, high potential for groundwater contamination; unlikely to migrate beyond the boundaries of the mine as a result of hydrologic gradients; direct impacts to birds and wildlife from pit contamination	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
Potential release of contaminants from failure of leach pad	None	Direct impacts to groundwater from sulfuric acid; unlikely to migrate beyond the boundaries of the mine as a result of hydrologic gradients; direct impacts to birds and wildlife from pit contamination	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action

Affected Environment

Relevant Laws, Regulations, Policies, and Plans

Federal, State, and Local

Under Arizona Revised Statutes 49-99, 49-929, and 49-930, the State refers to the requirements to establish a hazardous waste program equivalent to and consistent with the Federal hazardous waste program promulgated under subtitle C of the Resource Conservation and Recovery Act. This subtitle establishes reporting requirements for the generation, storage, handling, transport, and disposal of hazardous waste. Certain waste materials generated at mining sites, however, are excluded from subtitle C under the Bevill Amendment of 1980. Although the Bevill Amendment exempts much of the waste generated at mining facilities, hazardous waste generation activities that are “not unique” to the mining industry are subject to the Resource Conservation and Recovery Act, Subtitle C, such as hazardous waste generated from equipment servicing and repair and laboratory wastes that meet the criteria for hazardous waste under 40 Code of Federal Regulations 262. Onsite accumulation in excess of the requirements under 40 Code of Federal Regulations 262.34 would require a storage permit. In some cases, onsite treatment or disposal would require a hazardous waste permit.

Table 127 summarizes the permits or regulatory actions and the laws and statutes related to the production, transportation, storage, and disposal of toxic or hazardous materials in Arizona that may apply to the proposed project.

Table 127. Permits, laws, and regulatory codes related to facilities that produce, transport, store, or dispose of toxic or hazardous materials in Arizona

Permit or Regulatory Action	Regulatory Mechanism
Hazardous Waste Permit	Arizona Revised Statutes (ARS) 49-921 Arizona Administrative Code R18-8-260
U.S. Environmental Protection Agency Identification Number	ARS 49-922
Stormwater Pollution Prevention Plan	ARS 49-961 through 49-973
Hazardous Waste Management Facility – Annual Registration	ARS 49-929 ARS 49-930

Permit or Regulatory Action	Regulatory Mechanism
Emergency and Community Right to Know	42 United States Code 11001 et seq. 40 Code of Federal Regulations 372
Toxic Data Report	ARS 49-963 ARS 49-964 ARS 49-971 ARS 49-973
Solid Waste Annual Report	ARS 49-860
Solid Waste Special Waste Facilities Plan Approval	ARS 49-761 et seq. for Solid Waste ARS 49-851 et seq. for Special Waste ARS 49-857.01 ARS 49-241 et seq. governs the Aquifer Protection Permit program

Forest Service Guidance

General Management Direction for Hazardous Materials on the Coronado National Forest

According to Forest Service Manual 2100, "Environmental Management," chapter 2160, "Hazardous Materials Management" (U.S. Forest Service 1994),

> The major objectives of the Forest Service's hazardous materials management program are to protect the safety and health of the public and Forest Service employees from hazardous materials; to minimize future agency and personal liabilities related to hazardous materials; and to protect and/or restore, from the impact of hazardous materials, the natural resources and the environment on:
>
> 1. National Forest System lands;
> 2. Lands outside the National Forest System that are affected by actions authorized on National Forest System lands; and
> 3. Lands leased by the Forest Service
>
> Policies to address these objectives include the following:
>
> 1. Provide the appropriate level of training to employees on the potential safety and health risks from hazardous materials in accordance with the employee's duties.
> 2. Incorporate pollution prevention in all aspects of hazardous materials management. Emphasize source reduction as the primary means of maintaining compliance with applicable Federal, State, and local environmental regulations.
> 3. Ensure proper handling, storage, transportation, and disposal of hazardous materials in all activities. Prior to disposal of any material, consider reuse and recycling of that material.
> 4. Consider need, employee risk of exposure, effectiveness environmental impacts, economic efficiency, and availability of less hazardous alternatives when deciding whether and which hazardous materials to use.
> 5. Ensure appropriate and timely response to release or threats of release of hazardous materials.

According to Forest Service Manual 1400, "Controls," chapter 1480, "Environmental Compliance Program" (U.S. Forest Service 2007a), the objective of the Forest Service Environmental Compliance Program is to ensure compliance with applicable Federal, State, departmental, and agency

environmental requirements that affect National Forest Service lands, facilities, operations, and the uses thereof. This includes integrating environmental accountability into agency day-to-day decisionmaking and long-term planning processes across all Forest Service activities and functions.

Existing Conditions

Historic Land Use

Existing conditions associated with hazardous materials are related solely to the historic use of the land. According to Ayres (1984), the project area consists of public and private lands that have been used historically for various activities, including mining, ranching, and recreation. Historical accounts indicate that mining activity occurred in the area from 1879 through 1894 and that there was a settlement at Old Rosemont that housed more than 200 people. A copper smelter, hotel, store, school, warehouse, and office were located on the property. In 1915, mine production resumed because of the high price of copper; however, by 1918, financial troubles and low-grade ore had forced closure of the mine. A total of approximately 34,300 dry tons of copper ore was processed during this period. Ranching has also occurred throughout the area; in the early 1900s, approximately six ranches were located at or near Rosemont. By 1902, the Santa Rita Forest Reserve was created, with the Forest Service headquarters on Forest Road 231.

Current infrastructure in the project area includes unpaved roads, wells, and utility lines to support existing ranching and recreational uses. Structures are few in number; there is a ranch house and maintenance area, stock tanks, groundwater wells, and fencing. Past mining activity has left behind horizontal shafts, mine adits, a smelter slag pile, and a masonry leaching tank on the west side of the Rosemont Ranch property (Ezzo et al. 2011).

Overall, the natural condition of the project area is relatively intact, and there are no apparent significant lingering effects on the natural environment from past land use activities, including historic mining activities. The disposition of historic mine workings is focused solely on safely closing and securing access to sites; no reclamation for use of hazardous materials is expected to be necessary (Sturgess 2007).

Environmental Consequences

Proposed mining activities described in the preliminary MPO have the potential to release hazardous materials into the environment and affect the natural condition of soils, vegetation, wildlife, surface water and groundwater resources, and air quality. The issues considered under this section are as follows: (1) the use, storage, and disposal of hazardous materials within the mine; (2) the transportation of hazardous materials to the project area; and (3) the potential for those materials to enter the environment in an uncontrolled manner, such as by accidental spill.

Impacts associated with the storage, use, and disposal of hazardous materials are measured quantitatively by the amount, type, and location of use. Impacts to the environment in the event of an unplanned release are assessed qualitatively based on the type and amount of hazardous material, handling techniques, locations of use and contingency plans, risk of accidental release, and exposure pathway to potential sensitive receptors.

An accidental release or significant threat of a release of hazardous chemicals into the environment could result in direct and indirect harmful effects on or threat to public health and welfare or the environment. The environmental effects of a hazardous chemical release would depend on the

substance, quantity, timing, and location of the release. A release event could range from a minor diesel fuel spill within the boundaries of the mine, where cleanup would be readily available, to a severe spill of sulfuric acid into a stream or populated area during transportation. Some hazardous chemicals could have immediate destructive effects on soils and vegetation, and there also could be immediate degradation of aquatic resources and water quality if spills were to enter surface water. Spills of hazardous materials could potentially seep into the ground and contaminate the groundwater system over the long term.

An accidental spill of hazardous materials in close proximity to populated areas could affect human health. Potential human health effects of hazardous materials are addressed in the "Public Health and Safety" section.

Direct and Indirect Effects of Each Alternative

No Action Alternative

Under the no action alternative, the project area would remain in its present condition. The potential impacts from hazardous materials would not occur, and there would be no risk of a potential accident or spill involving hazardous materials from the proposed project activities.

Impacts Common to All Action Alternatives

The impacts from the proposed action and all action alternatives are identical with respect to the type and quantity of hazardous materials used, stored, disposed of, and transported. Slight variations in the location of use may occur among alternatives, such as the exact location of the heap leach facility, but these changes are considered insignificant for assessing impacts.

Impacts are assessed in the following manner:

- Information is presented detailing the type and quantity of hazardous materials needed for mine operation;
- Information is presented detailing the type, quantity, and methods of transportation of hazardous materials to the project area;
- Information is presented detailing the use and storage of hazardous materials within the boundaries of the mine;
- Information is presented detailing hazardous waste management and disposal;
- The fate and transport of potential releases are assessed for each hazardous substance; and
- The potential direct and indirect effects from accidental releases are qualitatively assessed for each hazardous substance, including the risk of release, hazardous effects in the environment, and potential receptors.

Overview of Hazardous Material Type, Quantity, and Location

Based on the preliminary MPO, large quantities of potentially hazardous materials, including petroleum products, processing fluids, and reagents and explosives, would be transported to and stored within the boundaries of the mine in large quantities for use in various operational components of the mine. Table 128 summarizes potentially hazardous materials and petroleum products and their anticipated quantities. Brief descriptions of each category of hazardous material are provided in the following sections. Transportation of hazardous materials is discussed separately.

Table 128. Summary of potentially hazardous materials and their anticipated quantities

Reagent	Received or Shipped	Usage	Storage	Location
Oxide Plant				
Sulfuric Acid (93%)	Liquid by tank truck	73,200 short tons per year (stpy)	Two 1,200-ton storage tanks	Location A – Acid Storage
Diluent (Kerosene)	Liquid by tank truck	6.2 stpy	In 12,000-gallon storage tank	Location B – Solvent Extraction Tank Farm
Extractant (Acorga M5774)	Liquid by drums	0.9 stpy	Drums on pallets in warehouse	Location C – Main Warehouse
Cobalt Sulfate	Dry crystals in bags or super sacks	1.7 stpy	Bags on pallets in warehouse	Location C – Main Warehouse
Guar	Dry powder in bags or super sacks	42.7 stpy	Bags on pallets in warehouse	Location C – Main Warehouse
Mist Suppressor (FC-1100)	Liquid by drums	1.1 stpy	Drums on pallets in warehouse	Location C – Main Warehouse
Diatomaceous Earth	Dry powder in bags or super sacks	171 stpy	Bags on pallets in warehouse	Location C – Main Warehouse
Clay	Dry powder in bags or super sacks	171 stpy	Bags on pallets in warehouse	Location C – Main Warehouse
Diesel Fuel for EW Boiler	Liquid by tank truck	200 stpy	In 12,000-gallon storage tank	Location D – Electrowinning Diesel Fuel Storage
Sulfide Plant				
Allyl Alkyl Thionocarbamate (Aero 8944, Promoter)	Liquid by drums	465 stpy	Drums on pallets in reagent storage	Location E – Reagent Storage
Sodium Isobutyl Xanthate (SIBX, Collector)	Dry in drums	1,725 stpy	Drums on pallets in reagent storage	Location E – Reagent Storage
Downfroth 250 (Frother)	Liquid by drums	766 stpy	Drums on pallets in reagent storage	Location E – Reagent Storage
Methyl Isobutyl Carbinol (MIBC, Frother)	Liquid by drums	150 stpy	Drums on pallets in reagent storage	Location E – Reagent Storage
Pebble Lime (CaO, pH Modifier)	Bulk by truck	37,200 stpy	Dry in 500-ton silo and as Milk of Lime (reagent storage)	Location E – Reagent Storage
Sodium Met-Silicate (Dispersant)	Dry powder in bags or super sacks	2,423 stpy	Bags or sacks on pallets in reagent storage	Location E – Reagent Storage
No. 2 Diesel Fuel (Collector)	Liquid by drums	150 stpy	Drums on pallets in reagent storage	Location E – Reagent Storage
Sodium Hydrosulfide (NaHS, Copper Depressant)	Dry powder in bags or super sacks	2,053 stpy	Bags or sacks on pallets in reagent storage	Location E – Reagent Storage

Reagent	Received or Shipped	Usage	Storage	Location
Flomin D-910 (Copper Depressant)	Liquid by drums	192 stpy	Drums on pallets in reagent storage	Location E – Reagent Storage
Flocculent	Dry powder in bags or super sacks	2,053 stpy	Bags or sacks on pallets in reagent storage	Location E – Reagent Storage
Mine				
Ammonium Nitrate	Bulk by truck	20,100 stpy	Dry in three 75-ton storage silos (by mine truck shop)	Location F – Ammonium Nitrate Storage
Blasting Powder	Dry in boxes	1,170 stpy	Boxes in powder magazine	Location L – Powder Magazine Storage
Miscellaneous				
Diesel Fuel – Mine Use	Liquid by tank truck	9,000,000 gallons per year (gal/yr)	In two 100,000-gallon tanks near mine truck shop	Location G – Mine Truck Fuel Storage
Diesel Fuel – Light Vehicles	Liquid by tank truck	100,000 gal/yr	In one 10,000-gallon tank by light truck shop	Location H – Light Truck Shop Area
Gasoline	Liquid by tank truck	100,000 gal/yr	In one 10,000-gallon tank by light truck shop	Location H – Light Truck Shop Area
Antifreeze – Mine Truck Shop	Liquid by tank truck	10,000 gal/yr	In a 1,200-gallon tank at truck wash and lube facility at mine truck shop area	Location J – Truck Wash and Lube
Engine Oils – Mine Truck Shop	Bulk by truck	30,000 gal/yr	In a 5,800-gallon tank at truck wash and lube facility at mine truck shop area	Location J – Truck Wash and Lube
Gear Oil – Mine Truck Shop	Bulk by truck	20,000 gal/yr	In a 3,000-gallon tank at truck wash and lube facility at mine truck shop area	Location J – Truck Wash and Lube
Automatic Transmission Fluid – Mine Truck Shop	Bulk by truck	20,000 gal/yr	In a 3,000-gallon tank at truck wash and lube facility at mine truck shop area	Location J – Truck Wash and Lube
Hydraulic Fluid – Mine Truck Shop	Bulk by truck	20,000 gal/yr	In a 3,000-gallon tank at truck wash and lube facility at mine truck shop area	Location J – Truck Wash and Lube
Waste Oil Storage – Mine Truck Shop	Liquid by tank truck	30,000 gal/yr	In a 5,800-gallon tank at truck wash and lube facility at mine truck shop area	Location J – Truck Wash and Lube
Waste Antifreeze – Mine Truck Shop	Liquid by tank truck	10,000 gal/yr	In a 5,800-gallon tank at truck wash and lube facility at mine truck shop area	Location J – Truck Wash and Lube
Waste Oil Storage – Light Vehicle Shop	Liquid by tank truck	1,000 gal/yr	In a 2,300-gallon tank at light vehicle shop	Location K – Light Vehicle Shop
Waste Antifreeze – Light Vehicle Shop	Liquid by tank truck	1,000 gal/yr	In a 2,300-gallon tank at light vehicle shop	Location K – Light Vehicle Shop

Source: Arnold and Henderson (2007).

Gasoline, Diesel Fuel, and Kerosene

Bulk quantities of gasoline, diesel fuel, and kerosene would be stored in aboveground storage tanks on the mine to support daily operation of mining equipment. Gasoline would be used to fuel small vehicles and construction equipment, diesel fuel would be used to fuel haul trucks and heavy

construction equipment, and kerosene would be used as a diluent in the solvent extraction and electrowinning plant. These materials would be stored at strategic locations around the mine in large steel storage tanks or 55-gallon drums. Fuel would be dispensed to mobile equipment from a stationary filling station, and remote equipment may be refueled using portable dispensing equipment.

Lubricants and Solvents

Various lubricants and solvents, including antifreeze, engine oils, gear oil, and hydraulic fluid, would be used for cooling and lubricating mining equipment. These materials would be stored in aboveground bulk storage tanks located in the maintenance and truck shop areas.

Mine Processing Fluids and Reagent

Proposed mineral processing activities would require large quantities of sulfuric acid to leach copper from oxide ore and extract the metallic copper in the solvent extraction and electrowinning process.

The dilute acid solution would be sprayed on top of the heap leach facility, collected in a series of pipes and ponds at the base of the leach pad, and circulated to the processing facility in a closed-loop system. Some of the acid would be lost to the atmosphere as mist, and some would be consumed during the leaching process.

Solvent Extraction and Electrowinning Electrolyte and Processing Reagents

Extractant (Acorga M5774), sulfuric acid, kerosene, cobalt sulfate, guar, and mist suppressor (FC-1100) are the primary reagents that would be used in the solvent extraction and electrowinning process. In this process, copper would be extracted from the heap leach solution using the above-mentioned reagents in a closed-loop system.

Ammonium Nitrate

Ammonium nitrate would be used for blasting in the open-pit area. This material would be shipped as a dry powder in bulk to the mine by truck and stored in three silos near the mine truck shop. Each silo would have a capacity to store 75 tons of powder. Ammonium nitrate is a strong oxidizer; however, by itself, it does not represent an unusual risk of fire or explosion.

Ammonium Nitrate and Fuel Oil Mixture

The primary blasting agent that is proposed for the Rosemont Copper Mine is a mixture of ammonium nitrate and fuel oil. Because these materials by themselves are not explosive, they would be stored separately and mixed only in the quantities necessary for each blasting episode. While the ammonium nitrate would be stored in silos, the fuel oil would be stored in an on-board storage tank on the ammonium nitrate and fuel oil truck. To prevent spills, the ammonium nitrate and fuel oil truck would travel to the blasting site, and the ammonium nitrate and fuel oil would be mixed as it is being loaded into the predrilled blasting holes.

Laboratory Reagents

Analytical reagents would be stored in a controlled environment at the onsite laboratory, used in laboratory quantities, and managed specifically to ensure that there is no outside contact with personnel or the environment. Depending on the material, reagents would be reused in the process or properly disposed of as hazardous waste.

Table 129 lists the chemicals that would be used at the Rosemont Copper Mine laboratory.

Table 129. List of analytical reagents

Chemical	Container Size	Chemical	Container Size
1,1,2,2, Tetrabromoethane	0.6 pound	Manganese Standard	17 fluid ounces
Acetic Acid	1.3 gallons	Methanol	1.1 pounds
Acetone	4.2 gallons	Molybdenum	1 gallon
Acetylene	Cylinder	Nickel Standard	0.2 pound
Alcohol	34 fluid ounces	Nitric Acid	17 fluid ounces
Ammonium Bromide	1.1 pounds	Oxalic Acid	17 fluid ounces
Ammonium Nitrate	1.1 pounds	Phenolphthalein, Methyl Orange	1.1 pounds
Ammonium Hydroxide	34 fluid ounces	Phosphorous AA Standard	34 fluid ounces
Antimony and Antimony Standard	17 fluid ounces/ 1.1 pounds	Potassium Chloride	17 fluid ounces
Argon	Cylinder	Potassium Iodine	1.1 pounds
Arsenic Standard	17 fluid ounces	Potassium Oxalate Monohydrate	17 fluid ounces
Ascarite	1.1 pounds	Potassium Permanganate	0.6 pound
Barium Chloride	0.4 pound	Potassium Sulfate	34 fluid ounces
Bismuth Standard	17 fluid ounces	Potassium Thiocyanate	1.1 pounds
Buffer Solution	17 fluid ounces	Propane	0.2 pound
Cadmium Standard	17 fluid ounces	Quinhydrone	Cylinder
Chloride Standard	17 fluid ounces	Selenium Standard	1.1 pounds
Chromium Standard	17 fluid ounces	Silicon Standard	17 fluid ounces
Cobalt Standard	17 fluid ounces	Silver and Silver Standard	3 fluid ounces
Cobalt Sulfate (heptahydrate)	1.1 pounds	Silver Chloride Electrode Solution Mixture	17 fluid ounces
Conductivity Standards	17 fluid ounces	Silver Nitrate	4 fluid ounces
Copper Standard	17 fluid ounces	Sodium Carbonate (anhydrous)	17 fluid ounces/ 1.1 pounds
Cupric Sulfate (anhydrous)	1.1 pounds	Sodium Hydroxide	1.1 pounds
Ferric Chloride	1.1 pounds	Sodium Hypochlorite	34 fluid ounces
Ferric Sulfate	1.1 pounds	Sodium Oxalate	34 fluid ounces
Ferrous Ammonium Sulfate	1.1 pounds	Sodium Sulfate	1.1 pounds
Ferrous Sulfate (heptahydrate)	17 fluid ounces	Sodium Thiosulfate	1.1 pounds
Glycerol	34 fluid ounces	Stannous Chloride	34 fluid ounces
Gold Chloride	0.02 ounces	Starch Indicator	1.1 pounds
Hexane	17 fluid ounces	Sulfur Standard	34 fluid ounces
Hexone	34 fluid ounces	Sulfuric Acid	34 fluid ounces
Hydrochloric Acid	17 fluid ounces	Tellurium Standard	34 fluid ounces
Hydrofluoric Acid	1 pound	Thiourea	17 fluid ounces
Hydrogen Peroxide	17 fluid ounces	Tin and Tin Standard	1.1 pounds
Iron Standard	17 fluid ounces	Urea	17 fluid ounces
Lanthanum Oxide	0.6 pound	Yttrium Standard	1.1 pounds
Lead Oxide	5.5 pounds	Zinc and Zinc Standard	17 fluid ounces
Lead Standard	17 fluid ounces	Zobell's Solution	17 fluid ounces
Light's Solution	17 fluid ounces		

Source: Arnold and Henderson (2007).

Cleaning Fluids

Cleaning fluids would be used for a variety of housekeeping activities at various mining facilities. These materials are not anticipated to be stored or used in large quantities. Furthermore,

manufacturers' directions should be followed to ensure that no potentially hazardous cleaning fluids are disposed of improperly.

Transportation of Hazardous Materials

Transportation of Hazardous Materials to the Mine

All hazardous materials and petroleum products would be transported to and from the project area by commercial trucks, in accordance with 49 Code of Federal Regulations and 28 Arizona Revised Statutes. The main transportation route for these hazardous materials into and out of the project area would be along Interstate 10 and State Route 83. No rail access is proposed for moving hazardous materials to the mine.

Transporters must be properly licensed and inspected, in accordance with Arizona Department of Transportation guidelines. Hazardous materials must be properly labeled, and shipping papers must include information describing the substance, health hazards, fire and explosion risk, immediate precautions, fire-fighting information, procedures for handling leaks or spills, first aid measures, and emergency response contact information. Because of the quantity and number of daily deliveries, sulfuric acid and petroleum fuels are of the greatest concern.

Waste that may be classified as hazardous, such as grease, unused chemicals, paint and related materials, and various reagents, would be shipped to an offsite disposal facility licensed to manage and dispose of hazardous waste. Prior to disposal, Rosemont Copper would be required to characterize the waste and properly mark and manifest each shipment.

Transportation of Hazardous Materials within the Mine

Transportation of hazardous materials within the boundaries of the mine would occur on the primary and secondary access roads, in-plant roads between facilities, and haul roads. Hazardous materials would enter and exit the plant along the primary access road. Once inside, all hazardous materials would be delivered to their appropriate storage location. Detailed descriptions of storage locations are included in the "Storage of Hazardous Materials" part of this section below.

All materials and supplies delivered in dry form in bags or sacks and liquid form in drums on pallets would be received and stored at the main warehouse. Satellite warehouse space would be provided in the mine truck shop and light vehicle repair shop for common and high-use items. Delivery from the main warehouse to the satellite warehouse would be by Rosemont Copper operations and maintenance personnel. This would minimize traffic inside the plant.

Most reagents would be stored at the main warehouse temporarily and then transported to other locations for additional storage and use. Reagents used in the solvent extraction and electrowinning process and received in dry form would be stored in the main receiving warehouse and transferred to the solvent extraction tank farm for mixing and metering into the process. Extractant (Acorga M5774) received in drums at the main receiving warehouse would be transferred to the solvent extraction area for adding to the process.

Deliveries of sulfuric acid, diesel fuel and gasoline, and ammonium nitrate would be direct to storage locations. The plant layout would be designed so that these delivery trucks would remain in the right-hand traffic lanes.

Frequency of Shipments of Hazardous Materials

Hazardous materials would be transported to the project area during the construction and operation phases of the mine. With the exception of sulfuric acid, the delivery of hazardous material to the plant would remain consistent throughout the 25-year mine life. The sulfuric acid requirements would be reduced significantly after year 6, when it is anticipated that the majority of the oxide ore will have been processed. Table 130 shows the estimated shipment of hazardous material in large quantities to and from the plant, along with the expected quantities and number of trips. A trip is a round trip for one truck entering the plant to pick up or leave a load and leaving the plant empty or with the load. The most sensitive times of the day are considered to be around shift change and early weekday mornings and afternoons during school bus hours on State Route 83.

Table 130. Estimated frequency of shipments of hazardous materials to the project area

Material	Quantity per Year	Trips per Week	Trips per Day	Trips per Hour
Sulfuric Acid (tons)	73,190	64	9	3
Pebble Lime (tons)	37,200	33	5	2
Diesel Fuel (gallons)	9,000,000	29	4	2
Ammonium Nitrate (tons)	20,075	18	4	1
Miscellaneous Reagents (tons)	3,750	6	1	1
Wear Parts and Explosives (tons)	3,250	5	1	1
Fuels and Oils (gallons)	105,000	1	–	–

Source: WestLand Resources Inc. (2007a).

Sulfuric acid would require the largest daily delivery to the mine. Each day, up to nine acid tank trucks would deliver aqueous sulfuric acid (93 percent) to the mine. Acid deliveries would be scheduled to avoid high-traffic hours and shift changes for safety. During the first 6 years, the annual acid requirements are estimated to be about 73,190 tons.

Diesel and miscellaneous fuels and lubricants, such as gasoline, motor oil, lubricants, and antifreeze, would require daily delivery to the mine. Diesel fuel would be received in tank trucks with a capacity of approximately 6,000 gallons. At a peak capacity of 9 million gallons per year, approximately 29 trips per week, or four trips per day, would be required. Miscellaneous fuels and lubricants would be shipped to the plant in bulk by tanker trucks with capacities of 2,000 to 6,000 gallons or in barrels. All miscellaneous fuels and lubricants would average 2,000 gallons per week, or one trip per week. Used oils and waste antifreeze would also be transported out of the plant for recycling. Consumption of all miscellaneous fuels and lubricants is estimated at 105,000 gallons per year.

Pebble lime would arrive from local sources in bulk in bottom-discharge tank trucks with a capacity of 22 to 24 tons. The pebble lime would be pneumatically conveyed from the truck to a storage silo. At an annual requirement of about 37,200 tons, approximately 33 trips would be required per week, or about five trips per day. The plant would receive and unload about two trucks of lime per hour, which would require about 3 hours per day. Pebble lime receipts would be scheduled 7 days per week during the day and evening and would avoid high-traffic times on State Route 83.

Ammonium nitrate would be received from local sources in bulk by tank truck and pneumatically conveyed into storage silos near the mine. The truck capacity is about 22 to 24 tons. The consumption of ammonium nitrate would be about 20,075 tons per year, which would require about 18 trips per week, or four trips per day, based on a 5-day week. Each truck of ammonium nitrate would be received and unloaded into storage in about 1 hour for approximately 4 hours per day.

Miscellaneous quantifiable consumables would consist of reagents used in the process. Also included would be explosive powder and caps used by the mine. Reagents used in the flotation circuit would be Aero 242 collector, xanthates (SIPX), frother (MIBC), flocculants, sodium hydrosulfide, sodium silicate, burner oil, Dowfroth, and polyglycol. Reagents used in the solvent extraction and electrowinning circuit would be LIX extractant, diluent, diatomaceous earth, clay filter media, FC-1100 mist control, guar, and cobalt sulfate.

The total amount of reagents that would be used for the flotation plant and solvent extraction and electrowinning facility is estimated to be 7.5 million pounds per year (3,700 tons). The total quantity of explosive powder and caps used is estimated at 1,200 tons per year. Total miscellaneous reagents and consumables that can be quantified would total about 7,000 tons per year, or about 135 tons per week. All miscellaneous reagents and consumables would be shipped to the mine by small (10- to 15-ton) trucks. This would require about 10 trips per week, or two trips per day 5 days per week.

Storage and Use of Hazardous Materials

Storage of Hazardous Materials within the Mine

The proposed mining operation would store and use potentially hazardous materials within the boundaries of the mine. Arnold and Henderson (2007) describe the type of storage container, location, use, and quantity of these materials. A summary of reagent storage and location is provided in table 128 and is depicted in figure 85. A brief description of each storage location is provided below.

Location A—Acid Storage — Sulfuric acid would be received by tank truck and unloaded directly to two 1,200-gallon storage tanks near the solvent extraction plant.

Location B—Solvent Extraction and Electrowinning Tank Farm — The solvent extraction and electrowinning tank farm would be located next to the solvent extraction circuit and the electrowinning circuit. The tank farm would consist of a series of aboveground storage tanks.

Location C—Main Warehouse — The warehouse for mine and plant operations would be located next to the change house near the entrance of the plant. The warehouse would be a single-story preengineered steel building with corrugated metal roofing and siding. It would total approximately 6,600 square feet and would include an office, lunchroom, and restrooms.

Location D—Electrowinning Diesel Fuel Storage — Diesel fuel used in the electrowinning boiler would be stored in a 12,000-gallon storage tank adjacent to the electrowinning facility.

Location E—Reagent Storage — Reagent storage would be located within the analytical laboratory, which would be west of the warehouse near the entrance to the plant. The laboratory would also have a wet laboratory, balance rooms, analytical equipment, and facilities to collect and manage waste chemicals. Disposal of the chemicals and laboratory wastes would follow appropriate regulatory requirements, depending on the waste generated.

Location F—Ammonium Nitrate Storage — Three elevated ammonium nitrate silos, each with a 75-ton capacity, would be located at the end of the west perimeter plant road near the mine truck shop. This location would allow delivery trucks with ammonium nitrate to access the silos without entering the left-hand traffic area. This area would also be convenient for the mine drill trucks to be filled up with ammonium nitrate and diesel before going to the mine. The ammonium nitrate and diesel would not be mixed until ready to be placed in blast holes.

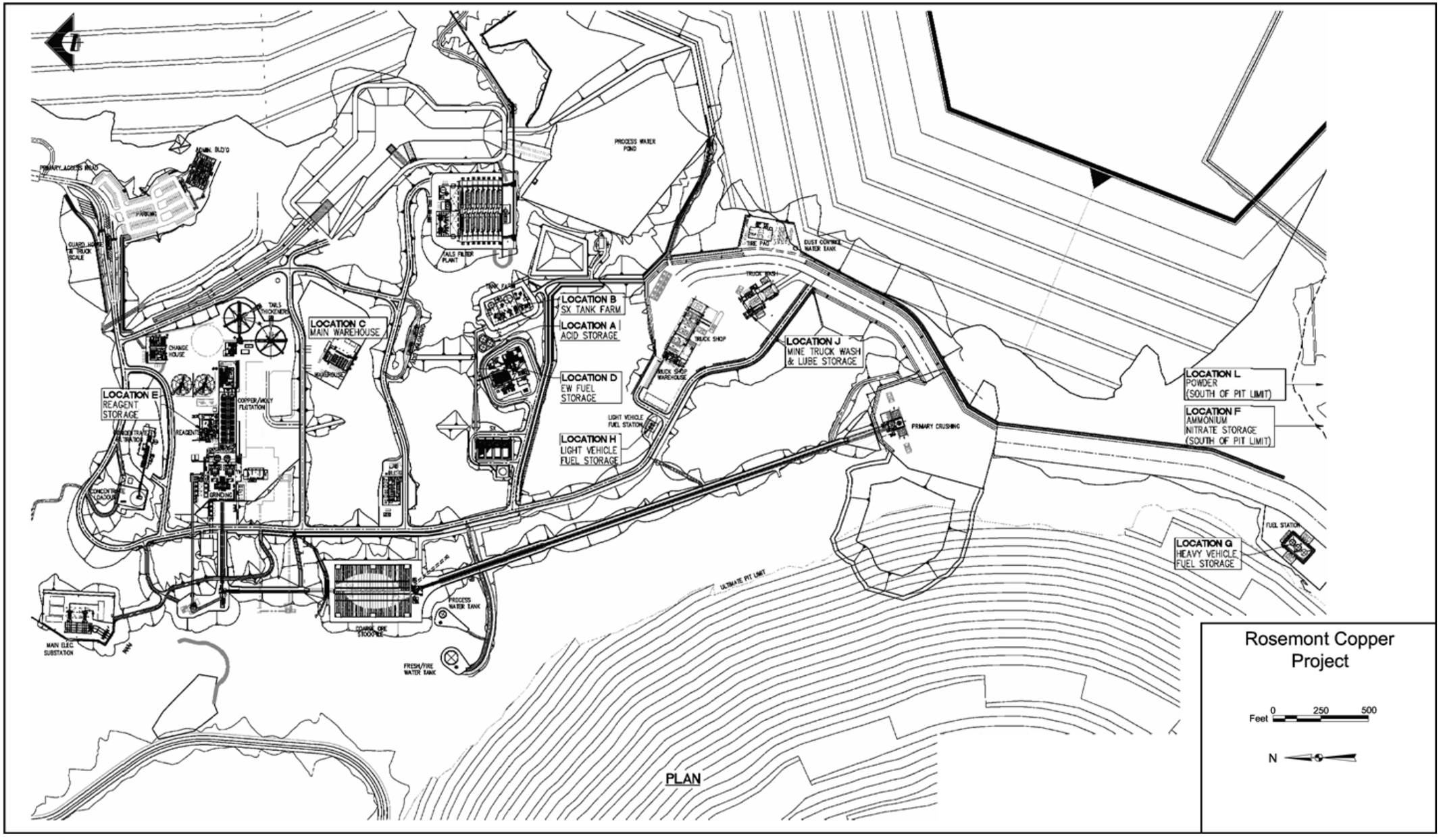


Figure 85. Hazardous materials storage

Location G—Mine Truck Fuel Storage — A mine truck fuel storage and dispensing facility would be located adjacent to and west of the truck shop. The facility would consist of two 100,000-gallon diesel storage tanks located within a concrete containment structure. Delivery trucks would unload on the west side of the storage tanks, and fuel dispensing stations for the mine trucks would be on the east side of the tanks. The west perimeter plant road would extend to the mine truck shop area to allow the fuel delivery trucks to access the tanks. Right-hand traffic would extend to the west side of the fuel oil storage tanks, and left-hand mine traffic would remain on the east side. There would be no need for the fuel delivery trucks to enter left-hand traffic lanes to deliver fuel to the mine area.

Location H—Light Vehicle Fuel Storage — A small-vehicle fuel station would be located south of the light vehicle repair building along the east perimeter plant road. The light fuel station would contain a 10,000-gallon diesel storage tank and a 10,000-gallon gasoline storage tank. The tanks would be located inside a concrete structure for secondary containment. Gasoline and diesel dispensing pumps would be provided on the west side of the storage tanks. A receiving station for fuel delivery trucks would be located on the east side of the storage tanks. Both the dispensing pumps and the receiving station would be on concrete pads, with any spills collected in a sump within the containment area. The fuel delivery trucks would travel on the east perimeter plant road only when delivering fuels and would not have to enter the process plant area.

Location J—Mine Truck Wash and Lube — A mine truck wash and lube facility would be to the east of the mine truck shop. The facility would consist of an open concrete pad with four high-pressure spray monitors for washing the undercarriage of the mine trucks. A steam generator and four house stations would also be provided for steam cleaning where necessary. The concrete pad would drain to a concrete settling pit to recover solids and recirculate the wash water back to a recycled-water tank. Water from the collection pit would overflow to an oil-skimming basin for oil recovery and then would be pumped to treatment equipment to remove residual oil and solids before being returned to the recycled-water storage tank. The wash water settling pit would contain an access ramp for a front-end loader to periodically reclaim the settled solids for disposal on the waste storage areas.

An enclosed lube bay would be located opposite the wash water collection pit. The lube bay would be an engineered steel structure with corrugated metal roofing and siding and would be open on the two ends for drive-through access. The eave height for this structure would be 55 feet to accommodate the haul trucks. The lube pad would contain embedded steel for track equipment and would also drain to the wash water collection pit. A tank farm for the various lubrication oils and antifreeze, as well as used oil and used antifreeze, would be located to the west of the lube oil bay. These tanks would be in a concrete containment structure for spill control. Used oil and antifreeze would be collected and returned to the suppliers for recycling.

Location K—Light Vehicle Shop — The light vehicle repair and process maintenance facility would be a single-story preengineered steel building located near the entrance to the plant, about 200 feet south of the warehouse. The light vehicle repair building would be approximately 4,950 square feet, with a 20-foot eave height. Two bays of the building would have floor hoists for light vehicle repairs, and two open bays would be used for plant maintenance. A fifth bay, separating the light vehicle repair and plant maintenance facilities, would contain offices, a lunchroom, a tool room, and restrooms. A contained concrete pad at the north end of the building would hold storage tanks for used oil; an air compressor would also be located in the contained area. Used antifreeze and used oil would be collected and returned to the supplier for recycling.

Location L—Powder Magazine Storage — Separate magazines would be provided for blasting powder and detonator caps. The powder magazine would be a masonry block building measuring 30 by 30 feet, with a 12.5-foot eave. The detonator cap magazine would be a masonry block building measuring 13 by 13 feet, with a 10.5-foot eave height. The hollow masonry blocks would be filled with dry-sand cement above the foundation level for bullet resistance. The storage capacity would be about 8,000 and 32,000 pounds for caps and explosives, respectively.

Security for the powder magazine would be multilayered. The magazine would be internal to the mine facility, and access to the mine facility would be only through the security gate. The powder magazines would themselves be behind an additional gate, and the magazines themselves would be locked. Keys would be held by the responsible people as designated by and registered with the Bureau of Alcohol, Tobacco, Firearms, and Explosives. Regulations require that the magazines be locked when left unattended.

The location of the magazines would be directly south of the ultimate pit limits and west of the Upper Barrel waste rock storage area. This area is remote and is shielded on the west by the Santa Rita Mountain Ridge, on the south and east by the waste rock storage area, and on the north by the pit. Access to the fenced compound would be through the mine haul road, running southwest from the primary crusher between the open pit and the waste rock storage area and heap leach pad.
The magazines would exceed code requirements and would be separated by at least 200 feet, with intervening separation berms. This distance is regulated by federal explosives laws, which ensure that the magazine is sufficiently far from other buildings or facilities to prevent injury or damage in the event of an explosion.

Analytical Laboratory

The analytical laboratory would be a single-story preengineered building with corrugated roofing and siding located west of the warehouse near the entrance to the plant. The laboratory would be approximately 8,400 square feet and would consist of a sample preparation area, a wet laboratory, a metallurgical laboratory, an environmental laboratory, offices, lunchroom, and restrooms. A 15-foot overhang would be provided at the north end of the building to receive materials into the sample preparation area. The sample preparation area would be isolated from the analytical laboratory by a wall. It would contain sample crushers, pulverizers, sample splitters, and a dust collection system to capture and contain any dust generated from this operation. The analytical laboratory would contain the wet laboratory, reagent storage area, balance rooms, and analytical equipment. Also included would be a facility to collect and manage waste chemicals in the laboratory. Disposal of the chemical and laboratory waste would follow appropriate regulatory requirements, depending on the waste generated.

Storage Phases of Hazardous Materials

Storage of hazardous materials would begin during the construction phase of the mine and continue through the proposed 25 years of active mine life. All hazardous materials storage facilities would be removed during the reclamation phase of the mine. The storage facilities would be maintained throughout this period.

Hazardous Waste Management and Disposal

A waste management plan was prepared for the preliminary MPO. The disposal of hazardous waste and petroleum products, along with the type of storage container, location, use, and quantity of these

materials, is described in technical memorandum document no. 205/07-114-320776-5.3, "Waste Management Plan" (Tetra Tech 2007f).

Many of the petroleum products and potential hazardous materials would be consumed during use by the various components of the mining operation and mineral processing circuits. However, potential hazardous waste that may be generated at the mine includes waste paint materials and thinners, chemical wastes such as acetone from the onsite laboratory, and residue wastes from containers or cans (WestLand Resources Inc. 2007a). As a generator of hazardous waste, Rosemont Copper would be required to file for a hazardous waste identification number from the U.S. Environmental Protection Agency and register as a hazardous waste generator with the Arizona Department of Environmental Quality and Pima County Department of Environmental Quality. Based on the proposed activities, the Rosemont Copper Mine would likely qualify as a conditionally exempt small quantity generator of hazardous wastes.

Other hazardous material produced as waste would include the following:

- used petroleum products such as grease and oil,
- batteries, and
- tires.

Grease

Grease associated with the hoisting, milling, and other operational equipment would be placed into drums or other bulk containers suitable for recycling. If the grease is not suitable for recycling, the contained waste would be sent offsite for disposal. While onsite, the containers would be managed in an area that would provide secondary containment.

Used Oil

Used oil from maintenance activities would be managed in bulk containers with secondary containment to ensure that there is no release to the environment. Only oil acceptable for recycling would be placed in bulk containers. Used oil not acceptable for recycling would be placed in drums for proper disposal.

Batteries

Lead acid batteries would be returned to the vendor for recycling or shipped offsite to a recycler. While they are stored onsite, they would be managed in an area protected from stormwater and would have secondary containment.

Nickel-cadmium batteries would be stored for recycling by a local vendor. While onsite, they would be managed in drums or boxes suitable for storage.

Lithium batteries also would be stored in appropriate containers for recycling.

Tires

There are two ways to dispose of tires from registered vehicles and tires that are less than 3 feet in diameter. The vendor would remove the waste tires from the property for appropriate disposal or recycling, or a waste handler would be contracted to remove the tires for appropriate disposal or recycling.

At mine sites, the vendors who supply the tires generally remove them for recycling or disposal. Rosemont Copper would contract with vendors or waste haulers who can appropriately manage waste tires smaller than 3 feet in diameter.

Tires that are greater than 3 feet in diameter are eligible for onsite disposal (18 Arizona Administrative Code 13). This code allows operators to bury mining waste tires in an onsite cell if they meet specific requirements. Once placed in the cell, the tires would be covered by a minimum of 6 inches of material within 50 days of placement. Once the cell is full, at least 3 feet of cover would be placed over the cell within 180 days. Rosemont Copper would file the required annual reports, keep records, and provide any needed certifications, as required by the regulations.

At this time, Rosemont Copper is investigating the potential for reuse of these tires and would continue to seek contracts for beneficial uses of mining tires. As appropriate, tires may also be used for erosion control or structural fill. If alternatives to burial exist, Rosemont Copper would review them and manage the tires accordingly.

Lead Flake and Anodes

The electrowinning process uses lead anodes to provide the necessary electrolytic conditions for copper plating. During this process, the anodes degrade, creating a lead flake that falls into the electrowinning cells. This flake and the degraded anodes are a valuable commodity when managed properly and recycled. Onsite management of these materials would consist of placing the flake into a roll-off or other container designed to contain the material for transport to a lead smelter for recycling. Anodes would also be stored in containers to facilitate shipment for recycling.

High-Density Polyethylene Materials

Piping and linear materials made from high-density polyethylene may be recycled if managed appropriately onsite. If high-density polyethylene piping and linear grade materials are not recyclable, Rosemont Copper would dispose of these materials in the onsite waste management facility.

Fate and Transport of Potential Releases

The potential impacts of accidental releases of hazardous materials or wastes depend on the nature of the material, the amount released, where in the environment the material or waste is released (soil, groundwater, or surface water), and the potential for migration of the material or waste.

Potential Releases to Soils or Surface Water within the Mine

Releases of hazardous materials within the boundaries of the mine could include accidental spills during use, rupture of storage tanks, release during emergency fire or explosion, or improper disposal. In almost all cases, hazardous materials would be released to soils. Release of hazardous materials into soils does not present a major environmental risk. Both wildlife and vegetation will be largely absent within the mine boundaries. Soils absorb and immobilize small amounts of hazardous materials, and within the controlled boundaries of the mine, it will be relatively easy to excavate and dispose of them.

The more significant risk is for hazardous materials, once within the soil matrix, to migrate to surface water or groundwater, either in dissolved phase or through erosion and movement of contaminated soil. With respect to stormwater, the mine stormwater management has been designed with two basic premises in mind: divert all possible stormwater away from the plant site to avoid the potential for contamination, and treat all stormwater within the plant site as potentially contaminated (Tetra Tech

2007d, 2010h). The following components of the mine are discussed below: pit, heap leach pad, plant site, dry tailings, waste rock, and access roads. In general, the potential for discharge to surface water is only a concern with dry tailings, waste rock, and access roads.

Open Pit — For the active life of the mine, the open pit is treated as a closed system. All precipitation and local runoff from the pit will be collected in a sump in the bottom of the pit and incorporated into process flows. No runoff from the open pit will be discharged to any surface water.

Heap Leach Pad — The heap leach pad is also treated as a closed system; this is primarily to collect and process the valuable leachate solution. However, additional capacity to account for direct precipitation and local runoff from the heap leach pad has been incorporated into the collection and drainage system. No runoff from the heap leach pad will be discharged to any surface water.

Plant Site — The plant site covers approximately 92 acres and consists of a wide variety of buildings, equipment, storage areas, and access roads; some of these areas present the potential for release of hazardous materials. This complexity makes separation of stormwater from areas of potential contamination difficult; for this reason, all direct precipitation and runoff from the plant site is collected and stored in a process water temporary storage pond. This pond is designed to contain 24 hours of process flows as well as the 100-year, 24-hour precipitation event. The process water temporary storage pond is a closed system, and all ponded water will be reused as plant process water. No discharge is anticipated to surface water from the process water temporary storage pond, and no runoff from the plant site will be discharged to any surface water.

Dry Tailings — Tailings will be dry-stacked in lifts, typically buttressed by waste rock. This design is partially to prevent stormwater runoff from contacting the dry tailings areas. However, direct precipitation onto the dry tailings is expected to be retained on the tailings stack and allowed to evaporate or be pumped into the process water temporary storage pond.

Waste Rock — The waste rock areas will receive direct precipitation, and runoff from the waste rock areas is expected to be retained on the waste rock benches, where it will primarily evaporate, although some infiltration may occur during low-frequency storm events.

Access Roads — All access roads will receive direct precipitation and will generate runoff for surface water drainages.

Potential Releases to Groundwater within the Mine

Any release of hazardous materials to soils presents the potential for release to groundwater, either directly if large enough quantities of hazardous materials are released, or indirectly through infiltration of precipitation or runoff through contaminated soils. In addition, the open-pit sump and the process water temporary storage pond would provide a concentration point for potentially contaminated runoff, and infiltration could occur directly to groundwater from these locations.

Once released to groundwater, migration of contaminants is the primary concern. Groundwater modeling indicates that once constructed, the open pit will likely have a permanent effect on groundwater flow in the area (Errol L. Montgomery and Associates Inc. 2010; Tetra Tech 2010g). The open pit will create a permanent hydraulic sink. Groundwater beneath the reclaimed mine will flow toward the pit in perpetuity. See the “Groundwater Quantity” and “Groundwater Quality” sections for further detail. The results of groundwater modeling indicate that any potential contaminated groundwater is unlikely to migrate to receptors beyond the boundaries of the mine,

including active wells or springs. Potentially contaminated groundwater would, however, be exposed in the open pit, where it would be dealt with as part of the process water.

Potential Releases during Transportation

Potential releases of hazardous materials during transportation could occur, but the fate and transport of those hazardous materials depend entirely on where the release occurs and the quantity of the release. In general, releases during transportation of hazardous materials on State Route 83 would, if sufficient quantities were released, migrate to Davidson Canyon and downstream to Cienega Creek, either directly or as a result of contact between surface runoff and contaminated soil.

Summary of Environmental Hazards and Receptors within the Mine

Table 131 summarizes the environmental hazards presented by the hazardous materials and wastes described above. This table does not include any hazardous materials used in negligible quantities (1 liter/1 kilogram or less). Analysis of potential receptors is based on type of material (liquid or dry) and amount used, where the material is stored or used, and the potential fate and transport into the environment from that location.

The following criteria were used to assess risk and potential transport into the environment:

- Liquids pose the greatest threat of migration;
- Dry materials generally do not generally pose a risk of migration if promptly cleaned up; and
- Minor quantities (greater than 1 liter/1 kilogram but less than a drum or bag) are assumed to be completely mitigated through cleanup procedures.

Table 131. Potential environmental hazards and potential receptors

Hazardous Material or Waste	Location	Effects in Environment	Environmental Media Potentially Impacted*	Potential Receptors
Sulfuric Acid (93%)	Storage – Location A within plant site Use – Heap leach pad Disposal – None	Highly toxic to aquatic organisms, plant life, and terrestrial organisms; some evidence that it may be a potential carcinogen	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters
Diluent (Kerosene)	Storage – Location B within plant site Use – Oxide plant Disposal – None	Toxic to aquatic and terrestrial organisms; potential carcinogen	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters
Extractant (Acorga M5774)	Storage – Location C within plant site Use – Oxide plant Disposal – None	Very toxic to aquatic organisms; potential endocrine disruptor; irritant to terrestrial organisms	Soils within the mine	None
Cobalt Sulfate	Storage – Location C within plant site Use – Oxide plant Disposal – None	Unknown ecological toxicity; possible carcinogen; irritant	Soils within the mine	None

Hazardous Material or Waste	Location	Effects in Environment	Environmental Media Potentially Impacted*	Potential Receptors
Guar	Storage – Location C within plant site Use – Oxide plant Disposal – None	Irritant; likely low ecological toxicity because of biodegradability	Soils within the mine	None
Mist Suppressor (FC-1100)	Storage – Location C within plant site Use – Oxide plant Disposal – None	Irritant; likely some ecological toxicity	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters
Diatomaceous Earth	Storage – Location C within plant site Use – Oxide plant Disposal – None	Irritant; low ecological toxicity	Soils within the mine	None
Clay	Storage – Location C within plant site Use – Oxide plant Disposal – None	Irritant; low ecological toxicity	Soils within the mine	None
Diesel Fuel	Storage – Locations D,E, G, and H within plant site Use – Oxide plant, sulfide plant, fueling in light truck and mine shops Disposal – None	Toxic to aquatic and terrestrial organisms; potential carcinogen	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters
Allyl Alkyl Thionocarbamate (Aero 8944, Promoter)	Storage – Location E within plant site Use – Sulfide plant Disposal – None	Harmful to aquatic organisms; long-term adverse effects in aquatic environment; irritant	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters
Sodium Isobutyl Xanthate (SIBX, Collector)	Storage – Location E within plant site Use – Sulfide plant Disposal – None	Irritant; low ecological toxicity	Soils within the mine	None
Dowfroth 250 (Frother)	Storage – Location E within plant site Use – Sulfide plant Disposal – None	Unknown	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters
Methyl Isobutyl Carbinol (MIBC, Frother)	Storage – Location E within plant site Use – Sulfide plant Disposal – None	Irritant; some ecological toxicity	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters
Pebble Lime (Calcium oxide) pH Modifier)	Storage – Location E within plant site Use – Sulfide plant Disposal – None	Irritant; low ecological toxicity	Soils within the mine	None
Sodium Met-Silicate (Dispersant)	Storage – Location E within plant site Use – Sulfide plant Disposal – None	Unknown	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters

Hazardous Material or Waste	Location	Effects in Environment	Environmental Media Potentially Impacted*	Potential Receptors
Sodium Hydrosulfide (NaHS, Copper Depressant)	Storage – Location E within plant site Use – Sulfide plant Disposal – None	Highly toxic to aquatic and terrestrial organisms; unlikely to linger in aquatic environment	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters
Flomin D-910 (Copper Depressant)	Storage – Location E within plant site Use – Sulfide plant Disposal – None	Unknown	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters
Flocculent	Storage – Location E within plant site Use – Sulfide plant Disposal – None	Low ecological toxicity	Soils within the mine	None
Ammonium Nitrate	Storage – Location F within plant site Use – Mine Disposal – None	Irritant; unknown aquatic toxicity	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters
Blasting Powder	Storage – Location L within mine Use – Mine Disposal – None	Some aquatic toxicity	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters
Gasoline	Storage – Location H within plant site Use – Fueling in light truck shop Disposal – None	Toxic to aquatic and terrestrial organisms; potential carcinogen	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters
Antifreeze	Storage – Location J within plant site Use – Truck wash and lube Disposal – Stored in light truck and mine shop	Toxic to terrestrial organisms; unknown toxicity to aquatic organisms	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters
Engine and Gear Oils	Storage – Location J within plant site Use – Truck wash and lube Disposal – Stored in light truck and mine shop	Irritant; low toxicity to aquatic organisms	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters
Automatic Transmission Fluid	Storage – Location J within plant site Use – Truck wash and lube Disposal – Stored in light truck and mine shop	Some toxicity to aquatic and terrestrial organisms	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters
Hydraulic Fluid	Storage – Location J within plant site Use – Truck wash and lube Disposal – Stored in light truck and mine shop	Some toxicity to aquatic and terrestrial organisms	Soils within the mine; groundwater within the mine; open pit	Wildlife or human contact with open-pit waters
Acetic Acid	Storage and Use – Laboratory within plant site Disposal – Stored in laboratory	Some toxicity to aquatic and terrestrial organisms	None†	None†

Hazardous Material or Waste	Location	Effects in Environment	Environmental Media Potentially Impacted*	Potential Receptors
Acetone	Storage and Use – Laboratory within plant site Disposal – Stored in laboratory	Some toxicity to aquatic and terrestrial organisms; readily biodegradable	None†	None†
Lead oxide	Storage and Use – Laboratory within plant site Disposal – Stored in laboratory	Toxic to terrestrial organisms; unknown toxicity to aquatic organisms	None†	None†
Methanol	Storage and Use – Laboratory within plant site Disposal – Stored in laboratory	Toxic to aquatic and terrestrial organisms	None†	None†

* In the event of accidental or unplanned release only.

† Controlled laboratory use; not considered a risk for release.

Significance of Potential Releases

The following uses present little risk of release, or risk of minor releases only:

- Ammonium nitrate and fuel oil. Ammonium nitrate and fuel oil mixtures are formed on an as-needed basis and are considered to be completely used up during detonation.
- Laboratory reagents. Laboratory reagents are used in controlled conditions and in negligible or minor quantities.
- Cleaning fluids. Cleaning fluids generally are used in controlled conditions and in negligible or minor quantities.
- Solvent extraction and electrowinning electrolyte and processing reagents. Except for those mentioned specifically below (i.e., kerosene and sulfuric acid), these reagents are either used and stored in minor quantities or are dry ingredients, presenting little risk for accidental release or migration.
- Ammonium nitrate. While transported, stored, and used in large quantities, ammonium nitrate is used in dry form and presents little risk of accidental release or migration. Ammonium nitrate does not present an unusual risk of fire or explosion by itself.
- Hazardous waste. Hazardous waste such as batteries, tires, lead flakes and anodes, and high-density polyethylene materials do not present a high risk of accidental release when stored, transported, and disposed of properly. Used petroleum products (grease and oil) are described below.

Overall, the significant unmitigated risks of release of hazardous materials based on amount, storage, and use are as follows:

- Catastrophic release of sulfuric acid or petroleum product (i.e., gasoline, diesel, kerosene, new or used engine and gear oil, transmission fluid) during transportation.
- Catastrophic or major releases of sulfuric acid or petroleum product at storage tank locations within the mine.
- Major release of sulfuric acid through failure of the leach pad or closed-loop piping system.

Effects from Catastrophic Release during Transportation

The effects of a catastrophic release of sulfuric acid or petroleum product during transportation would depend on the specific location and amount of release. In general, there would be direct impacts to plants and wildlife in the immediate vicinity, direct impacts to soil in the immediate vicinity, and possible migration into surface water either directly or via stormwater runoff from contaminated areas. If migration occurs, there would be indirect effects downstream on vegetation, aquatic species, and wildlife. Along State Route 83, most downstream impacts would occur along Davidson Creek and its tributaries, with possible migration downstream to Cienega Creek.

There is also the potential for migration into groundwater, depending on the exact location of the release. Typically, a one-time accidental release, even if catastrophic, does not pose as large a risk for groundwater contamination as it does for contamination of surface water or soils, as product is often held up in soil or recovered during the emergency response before migration can occur.

Effects from Catastrophic or Major Releases within the Mine

Minor amounts of sulfuric acid or petroleum products accidentally released within the boundaries of the mine can often be completely mitigated. Major releases unable to be completely mitigated can come in two forms: catastrophic release and long-term undetected releases.

Catastrophic release would include damage to a storage tank and the immediate loss of most or all of the stored product. This type of release would differ from a similar catastrophic release experienced during transportation; within the mine there are fewer receptors, less potential for migration, and more opportunities to fully control any spill. In general, there would be immediate direct impacts to soil and vegetation, but there would be little potential for migration beyond the boundaries of the mine either in surface water or groundwater.

In the event of a long-term undetected release, quantities are small enough that there would be no immediate effects on plants or animals and little potential for migration via stormwater. There is a greater potential for direct effects on soil and groundwater in the immediate vicinity, as the minor releases migrate downward undetected. However, hydrologic modeling shows that there is little potential for groundwater impacts to migrate beyond the boundaries of the mine; the mine pit is expected to act as a hydrologic sink, with groundwater movement primarily toward the pit.

Hydrologic modeling shows that the water in the open pit would be present indefinitely, even after closure of the mine. Contaminants migrating to groundwater and then into the open pit would have long-term effects on any receptors. Receptors are likely to be birds and terrestrial wildlife.

Effects from Failure of Leach Pad

Failure of the leach pad containment and capture system could result in the release of large amounts of sulfuric acid to the groundwater system. Any such release would likely occur slowly, over time, rather than as a catastrophic release. This would have a direct effect on groundwater in the immediate vicinity. However, hydrologic modeling shows that there is little potential for groundwater impacts to migrate beyond the boundaries of the mine; the mine pit is expected to act as a hydrologic sink, with groundwater movement primarily toward the pit. Contaminants migrating to groundwater and then into the open pit would have long-term effects on any receptors. Receptors are likely to be birds and terrestrial wildlife.

Proposed Action and Action Alternatives

There are no impacts specific solely to a particular action alternative.

Cumulative Effects

The Council on Environmental Quality defines a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 Code of Federal Regulations 1508.7). As outlined in the chapter 3 introduction, cumulative impacts of past and present actions are identified and analyzed in the "Affected Environment" part of each resource section, including for "Hazardous Materials." This cumulative effects discussion addresses the cumulative impacts of the action alternatives and any applicable reasonably foreseeable actions as identified on the Coronado ID team's list of reasonably foreseeable future actions, provided in the chapter 3 introduction. The list was reviewed, and no reasonably foreseeable future actions are expected to have a cumulative effect on hazardous materials.

Mitigation Effectiveness and Remaining Effects

Several mitigation measures are proposed for hazardous materials. In order to reduce potential human health and environmental risks, hazardous materials and substances will be managed and contained within facilities that are designed, constructed, and maintained to meet applicable laws and regulations. These facilities will include leak containment and recovery systems as required and adequate stormwater management and drainage systems to prevent contamination of outside containment areas.

Mine Safety and Health Administration regulations require Rosemont Copper to maintain material safety data sheets and keep them available to workers. Material safety data sheets will be provided to appropriate emergency response departments and hospitals and will be available for employees and visitors entering the site.

Accidental releases of hazardous materials cannot be entirely prevented, but the implementation of these mitigation measures is intended to minimize the potential for releases, and in the event of a release, to minimize the effects on and threat to the environment. Of the three potential releases of concern—catastrophic release during transportation, major release within the mine, and failure of the leach pad—these mitigation measures would minimize effects from major releases. They are unlikely to moderate the effects of catastrophic releases resulting from transportation accidents or a leach pad failure.

Irretrievable and Irreversible Commitment of Resources

With respect to hazardous materials, there are not expected to be any irretrievable or irreversible changes to resources. Although there is the potential for contamination of surface water, groundwater, or soils in the event of a spill or accidental release, such an occurrence is not expected to occur, and environmental remediation is possible (and required by law) if it does occur.

Fuels and Fire Management

Introduction

This section discusses fuels and fire management in the project area and in the analysis area. Fuel means any vegetation that could sustain a wildfire, including grasses, shrubs, and trees. Fuels and fire management refers to the ability of the Coronado to maintain fuel levels and conduct other activities to prevent fires or control their occurrence or severity.

Issues, Cause and Effect Relationships of Concern

Mine operation would include activities that would change fuel loads in the area or increase the possibility of accidental ignition of a wildfire, which would result in increased risk of fire and change the severity and extent of fires that occur. No significant issues were specifically identified during scoping concerning fuels and fire management.

The following section addresses the alternatives' impacts to the fuel and fire management regime in order to provide a full impact analysis as well as to provide the background information that will be used in the analysis of impacts to other resources. The issues that are analyzed in this section include the following:

- Effect of activities increasing the risk of ignition, including blasting, increased vehicle traffic, storage and transportation of flammable materials, and construction activities; and
- Effect of activities increasing fuel loading, including clearing of vegetation, noxious weeds, and decreases in groundwater level.

Analysis Methodology, Assumptions, Uncertain and Unknown Information

The analysis area for fuels and fire management is intended to encompass the temporal and spatial extent necessary to describe the fire management hazards that may be impacted by the proposed project (figure 86). The temporal bounds of analysis for fire management includes the construction, operation, reclamation, and postclosure phases. The analysis area is limited to the project area and Forest Road 62 to the south and to the forest boundaries to the east, north, and west. This includes all National Forest System land north of Forest Road 62, Box Canyon Road. The analysis area also includes State Route 83 from Interstate 10 to the project area and the secondary access road to the west. Offsite utility corridors were not considered in the analysis area, as impacts on fuels and fire management were considered negligible.

Specific information concerning the potential to affect fuel loads and the types and locations of activities that could increase risk for fire is provided in two technical reports: Arnold and Henderson (2007) and WestLand Resources (2007a). These reports describe the proposed operations and the potential for storage and use of flammable materials.

Impacts associated with both fuel loading and fire risk are qualitatively assessed based on the types and locations of mining activities. Specific mine activities considered include blasting, increased vehicle traffic, storage and transportation of flammable materials, fuel loading owing to clearing of vegetation, impacts to vegetation from water use, introduction of noxious weeds, construction activities, and reduction in recreational use.

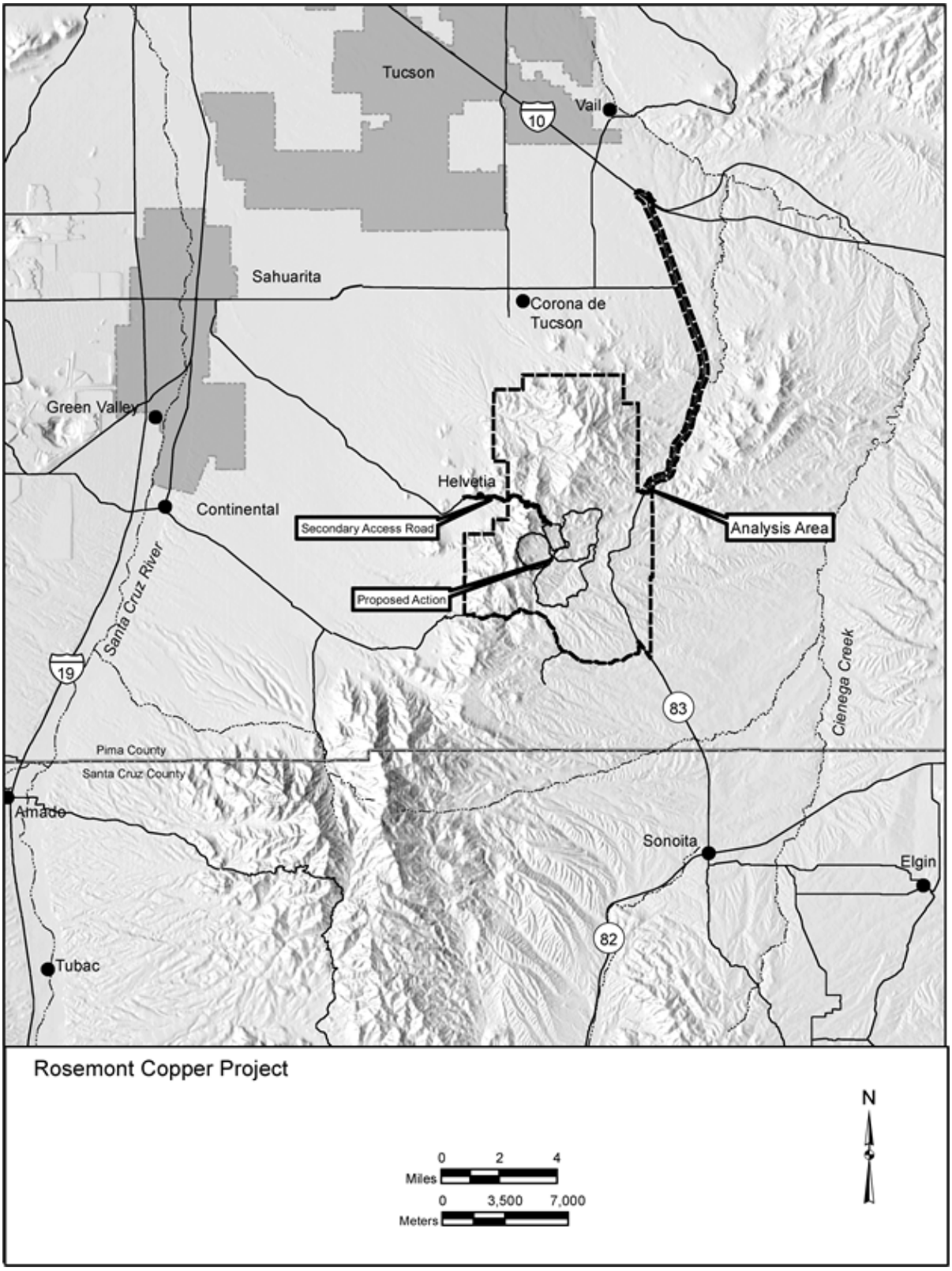


Figure 86. Analysis area for fire and fuels management

Adequate information was found to analyze fuel and fire management impacts. No uncertain or unknown information was identified.

Summary of Effects by Issue Measures by Alternative

Table 132 presents the summary comparison of impacts from each alternative.

Table 132. Summary of effects

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
Other Effects Considered						
Activities Increasing Risk of Ignition						
Blasting	None	None	None	None	None	None
Increased Vehicle Traffic	None	Increased risk of accidental ignition along transportation routes	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
Storage and Transportation of Flammable Materials	None	Increased risk of accidental ignition along transportation routes	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
Construction	None	None	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
Activities Increasing Fuel Loading						
Clearing of Vegetation	None	None	None	None	None	None
Noxious Weeds	None	Minor additional fuel loading after mitigation	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
Decrease in Groundwater Level	None	Minor	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action

Affected Environment

Relevant Laws, Regulations, Policies, and Plans

The U.S. Department of Agriculture and U.S. Department of the Interior administer many policies and guidelines for fire management activities under the national fire plan. The national fire plan is composed of various policies and guidelines to address five key points: firefighting, rehabilitation, hazardous fuels reduction, community assistance, and accountability. The 2001 Federal Wildland Fire Management Policy has become one of many policies and guidelines under the national fire plan to coordinate interagency fire management activities. It is composed of various documents, including the following: (1) “Managing the Impact of Wildfires on Communities and the Environment,” dated September 8, 2000, from the Secretaries of Agriculture and the Interior to the President of the United States in response to the wildland fires of 2000; (2) Congressional direction accompanying substantial new appropriations for wildland fire management for fiscal year 2001; (3) “Protecting People and Sustaining Resources in Fire-Adapted Ecosystems: A Cohesive Strategy,” released by the Forest Service in 1999 in response to the U.S. Government Accountability Office Report, “Western National Forests: A Cohesive Strategy Is Needed to Address Catastrophic Wildfire Threats” (GAO/RCED-99-65); and (4) several draft and approved strategies to implement all or parts of the national fire plan

(U.S. Forest Service 1986). Additional policies and guidance under the national fire plan include the Healthy Forest Restoration Act of 2003 and the Healthy Forest Initiative. The intent of these policies is to reduce the risks severe wildfires pose to people, communities, and the environment.

Several state regulations address wildland fires in Arizona. Under Arizona Revised Statutes 37-623, the state forester shall have the authority to prevent and suppress any wildfires on State and private lands located outside incorporated municipalities and, if subject to cooperative agreements, on other lands located in this state or in other states, Mexico, or Canada. Under authorization of the governor, Arizona Revised Statutes 37-623.02 allows the state forester to incur liabilities for suppressing wildland fires and responding to other unplanned risk activities from unrestricted monies in the State general fund, whether or not the legislature is in session. According to Arizona Revised Statutes 13-1706, it is unlawful for any person, without lawful authority, to intentionally, knowingly, recklessly, or with criminal negligence set or cause to be set on fire any wildland other than the person's own or to permit a fire that was set or caused to be set by the person to pass from the person's own grounds to the grounds of another person. Table 133 summarizes the permits, regulations, and guidance related to fuels and fire management in Arizona.

Table 133. Permits, laws, and regulatory codes related to fuels and fire management in Arizona

Federal	
Federal Wildland Fire Management Policy	
Healthy Forest Restoration Act of 2003	
Healthy Forest Initiative	
State	
Suppression of wildfires; powers and duties of state forester; entry on private lands	Arizona Revised Statutes (ARS) 37-623
Burning of wildlands; exceptions; classification	ARS 13-1706
Emergencies; prohibiting fireworks; liabilities and expenses; fire suppression revolving fund	ARS 37-623.02

General Management Direction for Fuels and Fire Management on the Coronado National Forest

The forest plan, approved in 1986 and amended over time, reflects the agency fire management policy of the time, that is, suppression of all fires (U.S. Forest Service 1986). Since the plan was approved, the fire management policy of the U.S. Department of Agriculture has evolved. In 2005, the plan was amended to incorporate the policies of the 2001 "Federal Wildland Fire Management Policy and Review" (Interagency Federal Wildland Fire Policy Review Working Group 2001).
The forest plan, as amended, now calls for an appropriate management response to wildland fires. This includes an appropriate suppression response and the ability to allow natural ignitions to play, as nearly as possible, their natural ecological role forest-wide (U.S. Forest Service 1986).

The amendment allows fire managers the forest-wide discretionary use of many fire response and management options. The amendment changes the goals, standards, and guidelines of the plan, expressed in chapter 4, "Management Direction," as applicable to wildland fire suppression and wildland fire use. Refer to the forest plan for more details.

Existing Conditions

Fire has played an important ecological role in the history of the grassland and woodland ecosystems of southeastern Arizona. Regular intervals of naturally occurring fire restrict the growth of shrubs in grasslands, thin forests of fire-intolerant trees, increase stream flows, and renew wildlife habitat. Since the beginning of the early 20th century, the frequency of natural fire has decreased dramatically. This decrease has been correlated with an increased demand for wildland fire suppression to protect life and property and has led to areas of dense, overgrown vegetation and the accumulation of fuel.

In southern Arizona, the fire season can start as early as February and run as late as November. The normal fire season in southeastern Arizona runs from April through July. On average, 150 fires occur each year on the Coronado National Forest, burning up to 9,000 acres. Fire occurrence for the Coronado National Forest from 1988 through 2009 resulted in 2,671 fires reported on National Forest System lands and lands protected by the Forest Service, totaling 585,619 acres burned. During this time, there were 1,405 human-caused fires for 297,003 acres and 1,266 lightning-caused fires for 288,616 acres burned. Forty-seven percent of all fires were lightning caused, and 53 percent of all fires were human caused. The human-caused fires burned 8,387 more acres than the lightning-caused fires. Figure 87 shows the locations of fires from 1988 through 2009 within the project area.

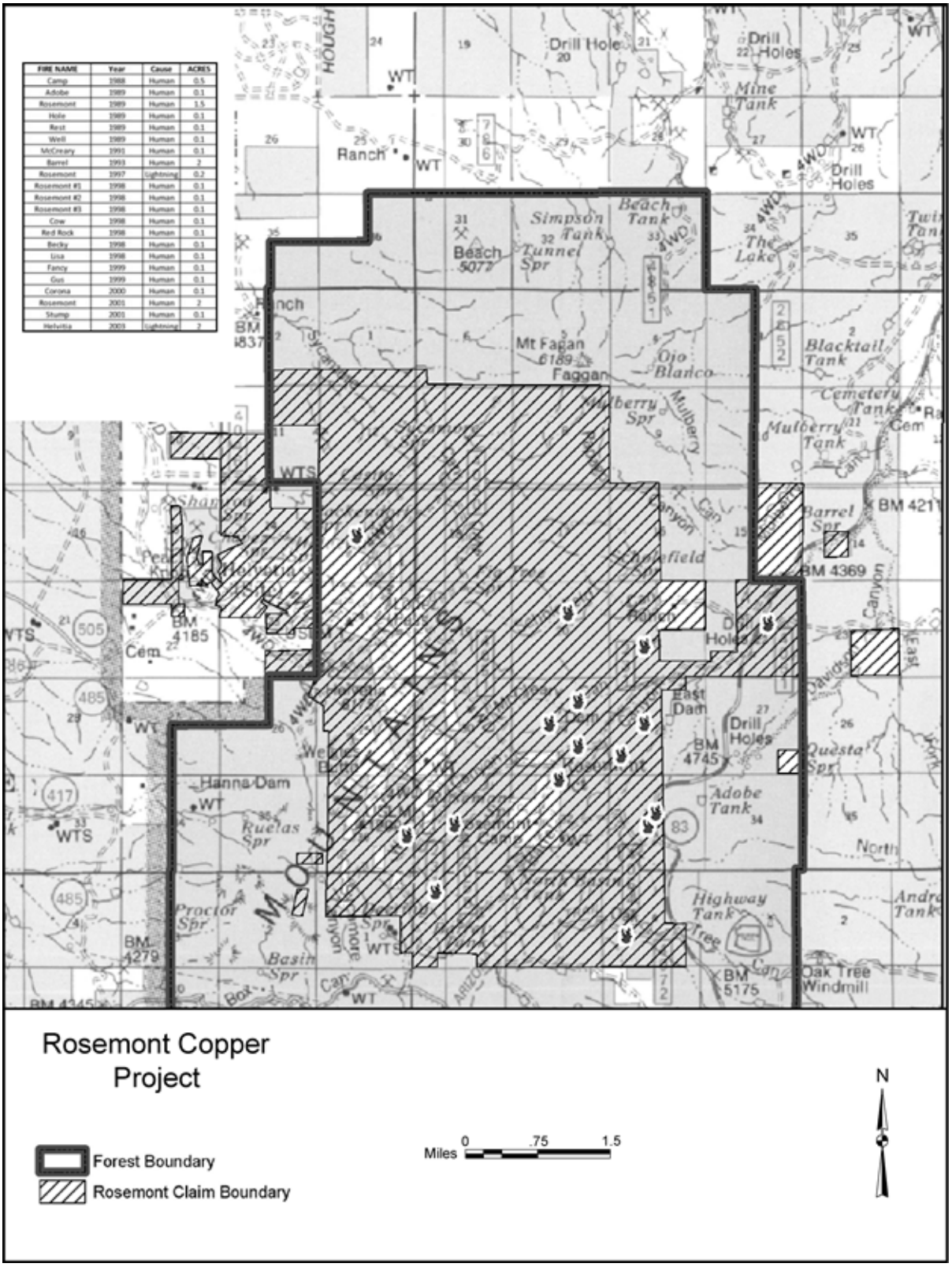
The height of fire season in southeastern Arizona occurs in late spring and early summer. Throughout the spring, increasing temperatures and negligible precipitation create extremely dry conditions across the Southwest. Prior to the onset of the summer rainy season (monsoon), around late June and early July, circulation patterns draw moisture from the southeast. Weak storm cells bring lightning but little rain. During this period, relatively few lightning fires occur, but those that do start often become large. As circulation patterns strengthen in July, storm cells transport more moisture and produce rain that reaches the ground, thereby reducing fire danger and activity. Statistics show a high frequency of lightning-ignited fires but less area burned in July, compared with June, when drier conditions prevail (U.S. Forest Service 2010b).

The project area is largely undeveloped, so available fuel for wildland fire comes from the vegetative communities. A summary of the vegetative communities is provided below, and additional details can be found in the “Biological Resources” section.

Vegetation Communities

The project area includes upland and riparian vegetation communities. The proposed project is primarily located in two upland vegetation communities: semidesert grassland and Madrean evergreen woodland (Brown 1994). Semidesert grassland, characterized by open grasslands with widely scattered shrubs and cacti, generally covers the lower elevations of the project area. Common species include acacia, yucca, prickly pear cacti, and cholla, as well as native grasses and non-native Lehmann lovegrass. Madrean evergreen woodland mostly covers the higher elevations of the property, generally in the western and southern areas, and is characterized by open woodlands or savanna, consisting of trees interspersed with grasses and forbs. This community is dominated by evergreen oaks, as well as the same shrubs and grasses found in semidesert grasslands.

There are two riparian vegetation communities present within the analysis area that are recognized by the Forest Service: interior riparian deciduous woodland and ephemeral fluvial systems. These vegetation communities are present along some of the major and smaller washes within the project area and along downstream portions of Cienega Creek, Davidson Canyon, and Barrel Canyon. Interior riparian deciduous woodland vegetation is found along rivers and streams at elevations



FIRE NAME	Year	Cause	ACRES
Camp	1988	Human	0.5
Adobe	1989	Human	0.1
Rosemont	1989	Human	1.5
Hole	1989	Human	0.1
Rest	1989	Human	0.1
Well	1989	Human	0.1
McCreary	1991	Human	0.1
Barrel	1993	Human	2
Rosemont	1997	Lightning	0.2
Rosemont #1	1998	Human	0.1
Rosemont #2	1998	Human	0.1
Rosemont #3	1998	Human	0.1
Cow	1998	Human	0.1
Red Rock	1998	Human	0.1
Becky	1998	Human	0.1
Lisa	1998	Human	0.1
Fancy	1999	Human	0.1
Gun	1999	Human	0.1
Corona	2000	Human	0.1
Rosemont	2001	Human	2
Stump	2001	Human	0.1
Helvitia	2003	Lightning	2

Figure 87. Fire occurrence within Rosemont Copper claim boundary on Forest Service land, 1988 to 2009

ranging from approximately 4,000 feet to approximately 9,000 feet. Common species include black walnut, willows, and cattail. Areas of ephemeral fluvial vegetation type are found along major and minor ephemeral washes that do not contain a perennial flow of water. This vegetation type is associated with an ephemeral or intermittent water supply and typically contains plant species also found in neighboring uplands, although riparian plants are typically larger and often occur at higher densities than those in uplands. In the project area, this vegetation community occurs in portions of Barrel, McCleary, and Scholefield Canyons (and numerous smaller named and unnamed washes within the project area), where the dominant plant species include oaks, juniper, acacia, and velvet mesquite.

Fire Regime

While wildland fire varies in its frequency, season, size, and prominent, immediate effects, general patterns occur over long periods. Fire regimes are defined by these patterns. Fire frequency and severity form the basis for the commonly referenced fire regime classifications, such as Kilgore (1981). The shrubland ecosystem in the project area is considered a stand-replacement regime, with a fire frequency of every 0 to 35 years. The woodland ecosystem in the project area is considered a mixed-severity regime, with a fire frequency of every 35 to 100 years. As described by Brown and Smith (Brown and Smith), in a stand-replacement regime, fire kills or topkills aboveground parts of the dominant vegetation, changing the aboveground structure substantially. Approximately 80 percent or more of the aboveground dominant vegetation is either consumed or killed as a result of fires in a stand-replacement regime.

Fuels Management Actions

In recent years, wildland fires within the Santa Rita Mountains have primarily been documented as being human caused (66 percent), rather than resulting from natural (lightning) ignition (U.S. Forest Service 2010b). In places where fuel loadings are high, the majority of wildland fires burn more intensely than historic, natural fires and are very difficult to control.

The disruption of the historic pattern of fires in frequent, mixed-severity, and stand-replacement fire regimes such as those on the Coronado National Forest has resulted in major ecological changes. These changes include wildfire events of increasing size and intensity. Fire exclusion and fire suppression policies have increased the potential for high-intensity fires.

One consequence of effectively removing fire from a fire-influenced, or even a fire-dependent, ecosystem is the steady accumulation of fuels and the general aging of vegetation. These processes can occur on relatively large, contiguous land areas unless a fire or other management action occurs that directly impacts the existing vegetation and fuel loads. Typical management actions are specified in the “Coronado National Forest Fire Management Plan” (U.S. Forest Service 2010b) and include suppression, mechanical treatment, hazardous fuel reductions, prescribed fire, pile burning, and monitoring and research. With the exception of wildfire response, none of these management activities are currently being undertaken within the project area.

Wildfire Response

The “Coronado National Forest Fire Management Plan” (U.S. Forest Service 2010b) identifies two fire management units on the Coronado National Forest. These units are managed in accordance with the management objectives, as outlined in the forest plan.

The project area is located within fire management unit 1. This fire management unit includes a full range of responses, from aggressive initial attack to managing natural ignitions to achieve desired forest plan objectives when risk is within acceptable limits (U.S. Forest Service 2010b).

Wildland Urban Interface

The wildland urban interface is an area in which houses meet wildland vegetation (interface wildland urban interface) or in which houses and vegetation are mixed together (intermix wildland urban interface). Thus, the wildland urban interface is a focal point for human-environment conflicts such as wildland fires, habitat fragmentation, invasive species, and biodiversity decline. Analysis shows that across the coterminous United States, wildland urban interface covers nearly 9 percent of the land area and contains 38 percent of all housing units (Radeloff et al. 2005). The Coronado National Forest is located next to rapidly expanding urban areas (Tucson, Oracle, Sierra Vista, Nogales, and Sonoita-Patagonia). Approximately 34,000 acres of the forest is in urban interface areas. In the Tucson area alone, there is approximately 60 miles of interface. A wildland urban interface does not exist within the immediate project area, although it does exist in nearby areas, such as along Singing Valley Road to the south and along Hilton Ranch Road to the north.

Environmental Consequences

Proposed mining activities have the potential to change fuel and fire management conditions. The issues considered under this section are as follows: (1) the type and location of activities that would change fuel loads; and (2) the type and location of activities that would increase risk for fire.

Impacts associated with both fuel loading and fire risk are qualitatively assessed, based on the type and location of mining activities.

Direct and Indirect Effects of Each Alternative

No Action Alternative

Under the no action alternative, the project area would remain in its present condition. There would be no change to fuel and fire management conditions.

Impacts Common to Action Alternatives

The action alternatives are identical with respect to the types and locations of activities. The location of certain mining activities may vary slightly by alternative, but these changes are considered insignificant for impact assessment.

Impacts are assessed in the following manner:

- Information is presented that details the type and general effect of various mining activities with respect to either fuel loading or fire risk.
- The potential direct and indirect effects from each activity on fuels and fire management are qualitatively assessed.

Overview of Activities Affecting Fuel and Fire Management

The proposed action is described in Rosemont Copper's preliminary MPO. The proposed action describes an increase in human-related activities that could impact either fuel loads or the frequency of wildland fire in the project area. Table 134 summarizes human related activities.

Effects of Blasting

Ammonium nitrate and fuel oil blasting agents will be used for nearly all rock breakage in dry ground, constituting an estimated 80 to 90 percent of the total explosive used. Ammonium nitrate emulsion will be employed in wet conditions. Based on a powder factor of about 0.31 pound per ton of rock broken, blasting agent use will average about 36 to 53 tons per day, or 13,000 to 19,000 tons per year. Details of the location, use, and storage of blasting materials are included in the "Hazardous Materials" section.

Blasting represents a potential source of ignition but will take place in areas devoid of vegetation, with little risk for spreading fire.

Table 134. Human related activities affecting fuel load or fire risk

Activity	Description
Blasting	Blasting agents that include ammonium nitrate and fuel oil would be used for nearly all rock breakage and present a potential ignition source.
Increased vehicle traffic	Vehicle traffic provides a potential ignition source, both from mechanical sources (sparks) and from human sources (smoking materials).
Transportation and storage of flammable liquids	Flammable liquid, such as diesel fuel, gasoline, ammonium nitrate, and fuel oil, would be transported to the project area and stored on-site. See the "Hazardous Materials" section for a complete list of flammable liquids. Accidental release presents a potential ignition source.
Generation of fuels from land clearing during construction	During the construction phase, land-clearing activities would generate large quantities of dead vegetation, which could increase fuel load.
Water use impacts to vegetation	If groundwater use lowers the local water table, vegetation in the surrounding area could die and increase fuel load.
Noxious weeds (new fuel types) introduction	An increase in vehicular traffic in the project area could introduce noxious weeds, such as buffelgrass (*Pennisetum ciliare*), which could increase fuel load.
Construction of buildings and facilities	The proposed action includes the construction of buildings and facilities. If a fire occurs in one of these buildings, it could spread to adjacent wildland areas.
Reduction in recreation use of the project area	Recreation activities would be reduced in the area, reducing one source of human-caused fires.

Effects of Increased Vehicle Traffic

Operation of the mine is expected to result in a substantial increase in vehicle traffic for personnel, incoming materials, and export of finished product. Vehicle traffic presents several possibilities for ignition of wildland fires. These include mechanical sources, including controlled sparking (engine ignition) and impact sparking (metal objects on rocks), as well as human sources, primarily the improper disposal of smoking materials.

The increased vehicle traffic would have a direct impact to fire risk along all transportation routes.

Effects of Storage and Transportation of Flammable Materials

All flammable materials would be transported to and from the project area by commercial trucks in accordance with 49 Code of Federal Regulations and 28 Arizona Revised Statutes. The main transportation route for these flammable materials into and out of the project area would be along

Interstate 10 and State Route 83. No rail access is proposed for moving flammable materials to the mine. Onsite transportation of flammable materials would occur on main and secondary access roads, in-plant roads between facilities, and haul roads. Flammable materials would enter and exit the plant along the primary access road. Once inside, all flammable materials would be delivered to their appropriate storage location.

A detailed description of storage locations is found in the "Hazardous Materials" section of this DEIS and in Arnold and Henderson (2007).

Routine use, transport, and storage of flammable liquids do not provide any potential risk for fire; however, the possible occurrence of an accidental release would increase the risk, not only for the ignition of a fire, but for the rapid spread of the fire to wildlands. Given the storage location of flammable liquids well within the mine, the potential for the spread of an accidental fire related to the release of stored flammable liquids to wildlands is unlikely. The primary risk in spread of fire due to flammable liquids is from transportation. In the event of an accident, flammable liquids (gasoline, diesel, kerosene) would have a direct impact, increasing fire risk along all transportation routes.

Effects of Generation of Fuel Loads by Clearing

Vegetation and trees cleared from lands during construction would be not be stockpiled but would be disposed of offsite. Increased fuel loads during construction are not likely to have an effect on fuel or fire management.

Effects of Decreasing Groundwater Levels

Hydrologic modeling indicates that groundwater levels are expected to decrease in the immediate vicinity of the mine, which would impact springs and riparian vegetation that might be currently supported. The vast majority of the vegetation in the project area, however, does not depend on groundwater; only vegetation in the riparian zones is likely to be affected. These effects are more fully described in the "Biological Resources" and "Groundwater Quantity" sections. There would be a direct impact from increased fuel loads in the event of vegetation loss, but the overall effect is likely to be minor because these riparian areas represent a relatively small percentage of the analysis area.

Effects of Noxious Weed Introduction

Any surface disturbance invites the spread of noxious and invasive species, as does the presence of trucks transporting materials from offsite. The spread of noxious weeds and the out-competition of native species would have a direct impact, increasing fuel loads in disturbed areas.

Effects of Construction

Construction would largely take place within cleared areas, with little risk for the spread of fire to nearby wildlands.

Effects of Recreational Use Reduction

Human-caused ignition of wildland fires, including campfires and off-highway vehicles, accounts for approximately one-third of wildland fires. Mine operations would reduce recreation use in the area, not only of public lands within the boundaries of the mine itself but also by reducing the favorability of nearby lands for recreation. This reduction in recreation use would have a direct impact, decreasing fire risk in the project area.

Proposed Action and Action Alternatives

There are no impacts specific solely to a particular action alternative.

Cumulative Effects

The Council on Environmental Quality defines a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 Code of Federal Regulations 1508.7). As outlined in the chapter 3 introduction, cumulative impacts of past and present actions are identified and analyzed in the "Affected Environment" part of each resource section, including for "Fuels and Fire Management." This cumulative effects discussion addresses the cumulative impacts of the action alternatives and any applicable reasonably foreseeable actions as identified on the Coronado ID team's list of reasonably foreseeable future actions, provided in the chapter 3 introduction. The list was reviewed, and no reasonably foreseeable future actions are expected to have a cumulative effect on fuels and fire management.

Mitigation Effectiveness and Remaining Effects

Several mitigation measures are expected to be pertinent to fuels and fire management.

Fire and Emergency Response Plans

Prior to construction, Rosemont Copper will prepare emergency response and contingency plans, including a fire plan. These plans will identify emergency preparedness and emergency contact protocols for fire response.

Noxious Weed Management

Rosemont Copper will monitor disturbed and revegetated areas associated with mine activities for noxious and invasive weeds and will take action to prevent, eliminate, or control weeds if they occur. Methods of control may include removal by hand, spray, mechanical, or other approved methods. An invasive species control plan will be developed that will contain specific measures to prevent, control, and reduce noxious weed introduction and control weeds throughout the project area.

Mitigation Effectiveness and Remaining Effects

Implementation of noxious weed management will prevent increased fuel loading, but overall, these mitigation measures will not mitigate the overall potential for a fire to occur as a result of mine activities. However, severity and extent of fires could be reduced by rapid implementation of fire control measures.

Irretrievable and Irreversible Commitment of Resources

With respect to fuels and fire management, there are not expected to be any irretrievable or irreversible changes to resources. Vegetation and fuels in the project area will be constantly changing as reclamation procedures are implemented. Eventually, reclamation is expected to return site vegetation to a sustainable state, although it would be different from current conditions.

Transportation/Access

Introduction

Access to the project site would be via two routes: a primary access road from the east, and a secondary access road from the west. The primary access road to the project site would extend from a proposed new intersection on State Route 83 at a point between mileposts 46 and 47. The primary access road would be used for all worker commutes, haul trucks, and commercial deliveries. Secondary access would be from the west over the ridge of the Santa Rita Mountains and would connect to the existing Santa Rita Road at Helvetia. The secondary access road would be used only to access the utility lines and water pipeline. Workers would not use the secondary access road to commute to the mine, and no haul trucks or deliveries would use the secondary access road. Therefore, mine related impacts to transportation and access would be limited to the roads within the mine perimeter fence and mine related traffic along State Route 83.

Issues, Cause and Effect Relationships of Concern

During the public scoping process, there were general comments regarding demands placed on the roads, additional costs for road maintenance, concerns regarding who would fund such needed work, and safety concerns related to additional project related traffic. However, no significant issues were identified. With additional vehicles and heavily laden trucks resulting from the proposed project, it is likely that there would be added road construction and maintenance costs for the various road management agencies affected by the project. These costs are analyzed further in the “Environmental Consequences” part of this section.

There are concerns about the loss of public motor vehicle access that could occur from the closure or restriction of Forest Service roads that are currently open to public use (i.e., from public use roads becoming private mine roads). Other transportation concerns that arose from the scoping process include the transport of hazardous materials on roads used by the public, potential impacts to school bus stops, and the potential increase in traffic congestion, which could also affect emergency response time; and road costs and maintenance.

Even though impacts to transportation and access were not identified as significant issues during the public scoping process, the following section addresses the alternatives’ known impacts to transportation and access in order to provide a full impact analysis as well as to provide the background information that will be used in the analysis of impacts to other resources, such as public health and safety. The issues that are analyzed in this section include the following:

- Change in traffic volume/level of service
- Change in transportation routes
- Changes in public access to forest lands
- Changes in public transportation

It is important to note that many roads in the analysis area are managed and maintained under different jurisdictions, such as the Forest Service, Pima County, and Arizona Department of Transportation, or are considered private. In many cases, these roads provide access to roads managed under other jurisdictions. For example, State Route 83 is important for accessing Forest Service lands but is managed by the Arizona Department of Transportation. These roads and the impacts that would

result from the proposed project are analyzed further in the "Environmental Consequences" part of this section.

Analysis Methodology, Assumptions, Uncertain and Unknown Information

The following resources organize and describe the transportation/access guidance of the project area, primarily using data from public sources. Federal, State, and local resources include the following:

- Forest Service Handbook 7709.59, "Road System Operations and Maintenance" (U.S. Forest Service 2009c)
- Forest Service Manual 7700, "Travel Management" (U.S. Forest Service 2010d)
- Arizona Department of Transportation
- Federal Highway Administration
- Pima Association of Governments 2040 Regional Transportation Plan
- "Traffic Analysis Report for the Rosemont Copper Project," April 2009 (Tetra Tech 2009e)
- "AZ-83 Roadway Assessment," July 2009 (Tetra Tech 2009b)
- "Rosemont Primary Access Road Intersection: Traffic Impact Analysis Report, Volumes 1 and 2," April 2011 (Tetra Tech 2011)

The analysis area for transportation/access encompasses a 2-mile buffer surrounding the proposed mine facilities footprint and includes State Route 83, roads that serve or are maintained by the Coronado, and county roads.

Temporary haul roads within the mine boundaries are incorporated as part of the total mine disturbance area calculations. Such roads will not be National Forest System roads and will not fall under the jurisdiction of the Forest Service. Impacts that result from the creation, use, and disposal of temporary and long-term nonforest haul roads are included in the total site disturbance acreage calculations and are not analyzed separately in this section.

Summary of Effects by Issue Measures by Alternative

Table 135 presents the summary comparison of impacts from each alternative.

Table 135. Summary of effects

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
Other Effects Considered						
Changes in Traffic Volume/Level of Service	No change in traffic volume/level of service (therefore no effect)	Decrease in level of service, but will not decrease to an unacceptable level of service. Mitigation measures would reduce the impacts of mine-related traffic.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
Changes in Transportation Routes	No change in transportation routes (therefore no effect)	Increase in number of roads to access the mine (primary and secondary access routes).	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
Changes in Access	No change in access (therefore no effect)	Existing Forest Service routes within project footprint currently open to the public would be closed. New public access via primary and secondary access routes after closure of mine.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
Changes in Public Transportation	No change in public transportation (therefore no effect)	Increase in mine related traffic may affect public transportation. Mitigation measures would reduce the affect of mine related traffic on public transportation.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action

Affected Environment

Relevant Laws, Regulations, Policies, and Plans

Forest Service Handbook 7709.59, “Road System Operations and Maintenance” (U.S. Forest Service 2009c), provides guidance for planning, traffic management, investment sharing (cost share), highway safety, traffic studies, road maintenance, and other road system operations and maintenance activities. Road system operations and maintenance is the process of managing forest roads and road uses to best meet land and resource management objectives.

According to the forest plan (U.S. Forest Service 1986), general management direction for roads and trails on Forest Service lands should address rights-of-way for public access; conflicts between users of both the trails and roads in the area; commitment of resources to construction and maintenance of roads, including signage; and degree of public access to special use areas. The Santa Rita Mountains Ecosystem Management Area Transportation Plan (Curiel Jr. 2006) indicates that about 87 percent of the roads managed by the Coronado are considered roads for high-clearance vehicle and passenger car access to recreation, forest facilities, resources, and safety or protection needs (Curiel Jr. 2006).

Before any roads are added to the National Forest System primary road system, they must undergo travel analysis, as described in Forest Service Manual 7703.26, “Adding Roads to the Forest Transportation System.” Travel analysis considers the values affected by new roads, including access to and use, protection, and administration of National Forest System lands; public health and safety; valid existing rights; and long-term road funding opportunities and obligations. Environmental analysis for new roads includes effects on associated ecosystems; introduction of invasive species; effects on threatened and endangered species and areas with significant biodiversity, cultural resources, fish and wildlife habitat, water quality, and visual quality; effects on recreation opportunities; and effects on access to National Forest System lands. Travel analysis will need to be conducted for portions of the primary and secondary access roads, as well as for any other roads constructed or modified for the project that may be added to the National Forest System primary road

system. At this time, insufficient engineering detail has been conducted to undertake travel analysis of these roads. Roads on private land and roads under the jurisdiction of entities other than the Forest Service are not required to undergo travel analysis.

Road width, surfacing, and grades for segments of the access roads that will be National Forest System roads must meet or exceed Forest Service standards or have appropriate professional engineering justification and Forest Service approval for deviations from Forest Service standards.

Existing forest uses occur with access provided by high-clearance vehicle roads meeting maintenance level 2 standards. Forest Service maintenance of maintenance level 2 roads occurs as needed, usually in response to damage caused by use and/or erosion. Should the proponent desire or require maintenance to a higher standard to reliably and comfortably allow standard passenger car use or highway-legal truck use of a National Forest System road, the proponent must be authorized in writing to perform such maintenance, or provide funding to the Forest Service sufficient to allow the Forest Service to perform or contract for the performance of the needed maintenance.

The Arizona Department of Transportation has exclusive jurisdiction over state highways, state routes, and State-owned airports, as well as over all State-owned transportation systems or modes. The Arizona Department of Transportation has the responsibility to contribute the most desirable design parameters consistent with safety, service, environment, and cost effectiveness and apply these parameters with sound engineering judgment on routes under State jurisdiction. The “Roadway Design Guidelines Manual” (Arizona Department of Transportation 2007) and the “Guidelines for Highways on Bureau of Land Management and U.S. Forest Service Lands” (Wheat Scharf Associates and ADOT/FHWA/BLM/USFS Steering Committee 2008) guide the roadway designer in exercising sound engineering judgment in applying design parameters. The 2007 manual is complementary to the American Association of State Highway and Transportation Officials’ “A Policy on Geometric Design of Highways and Streets” (American Association of State Highway and Transportation Officials 2004) and the “Roadside Design Guide” (American Association of State Highway and Transportation Officials 2006) and is to be used in conjunction with these documents. The American Association of State Highway and Transportation Officials’ policies reflect general nationwide practices and are not necessarily applicable to the conditions in Arizona. Where the design values provided in the Arizona Department of Transportation manual differ from those presented in the American Association of State Highway and Transportation Officials’ guidelines, the Arizona Department of Transportation manual takes precedence. The Arizona Department of Transportation’s “Guidelines for Highways on Bureau of Land Management and U.S. Forest Service Lands” (Wheat Scharf Associates and ADOT/FHWA/BLM/USFS Steering Committee 2008) are applicable only to Arizona Department of Transportation roads on Bureau of Land Management administered and Forest Service lands.

Existing Conditions

Existing Transportation/Access Management and Conditions

The project area, which is within the analysis area shown in figure 88, is served by a relatively sparse network of roadways, typical of much of rural Arizona. Interstate 10 is the primary east-west traffic artery across southeastern Arizona, connecting Phoenix and Tucson with Las Cruces, New Mexico, and El Paso, Texas, to the east and Los Angeles, California, to the west. Interstate 10 passes approximately 10 miles north of the project area at its nearest point. The major north-south route is Interstate 19 south from Tucson to Nogales and the border with Mexico. Interstate 19 passes

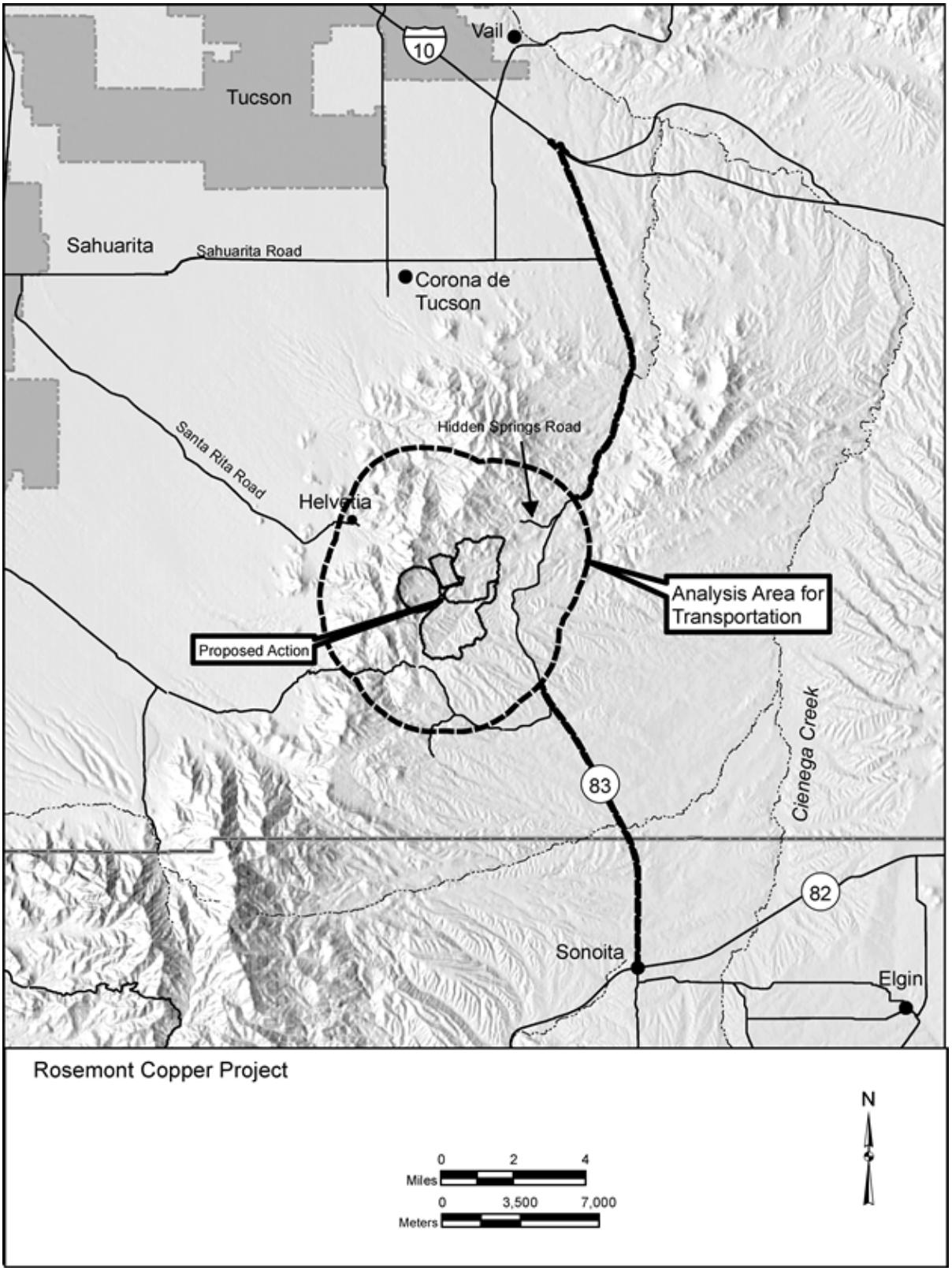


Figure 88. Transportation/access analysis area

approximately 20 miles west of the project area at its nearest point. Interstate highways are under State jurisdiction.

State Route 83, a designated state scenic highway, passes 0.75 mile from the eastern edge of the project area at its nearest point and provides the access route connecting the site with Tucson. State Route 83 connects with State Route 82 approximately 9.4 miles southeast of the site. State Route 82 runs approximately east-west from Tombstone to Nogales, passing through the communities of Sonoita and Patagonia near the Santa Rita Mountains. State routes are under State jurisdiction. County, Forest Service, and Bureau of Land Management roads—each generally (but not always) under their respective jurisdictions—serve as collector and local roads for the major State and Federal routes. Sahuarita Road, a county route, connects Interstate 19 with State Route 83 and passes approximately 8 miles north of the site.

State routes in the project vicinity are typically paved, all-weather, 2-way rural highways with 12-foot-wide travel lanes. Forest and county roads are more varied in quality and condition than state and federal highways. Forest roads in the project area include very rough, unsurfaced, high-clearance vehicle roads to annually maintained, unpaved, passenger car roads such as Box Canyon Road. Forest and county roads generally follow terrain rather than survey lines and are virtually all indigenous native surfaced with no imported surface material.

Highways and Roads Description

The following is a list of existing transportation systems within 2 miles of the project area. The systems described include state highways, county roads, private roads, and forest roads in the analysis area.

State Highways

As shown in figure 88, State Route 83 is a 2-lane state highway, stretching from its junction with Interstate 10 near Vail south to Parker Canyon Lake. The highway passes through sparsely populated areas of Pima, Cochise, and Santa Cruz Counties, including the town of Sonoita. It also provides access points for forest roads in the project area such as Greaterville and Singing Valley Roads.

The southern terminus of State Route 83 is located at Parker Canyon Lake. The highway heads northwest from the lake and passes through Sonoita before it reaches a junction with State Route 82. State Route 82 continues north from this junction to its northern terminus at an interchange with Interstate 10 near Vail, southeast of Tucson.

County Roads

Numerous county routes in the analysis area have been inventoried and mapped by the county, as shown in figure 89. These routes vary from gravel roads to native surfaces. The analysis area has more than 13 miles of County-inventoried roads. There is some overlap with Forest Service system roads, as many of the roads that are identified as county roads are also Forest Service primary system roads, including Box Canyon, Singing Valley, and Hidden Springs Roads. As previously stated, this is largely the result of county roads' providing important access to Forest Service lands and vice versa.

Forest Service Roads

Forest Service primary system roads are roads that fall under the jurisdiction of the Forest Service. These roads are inventoried and usually maintained and managed by the Forest Service. Additionally, the Forest Service may claim roads as National Forest System roads that are under the jurisdiction of

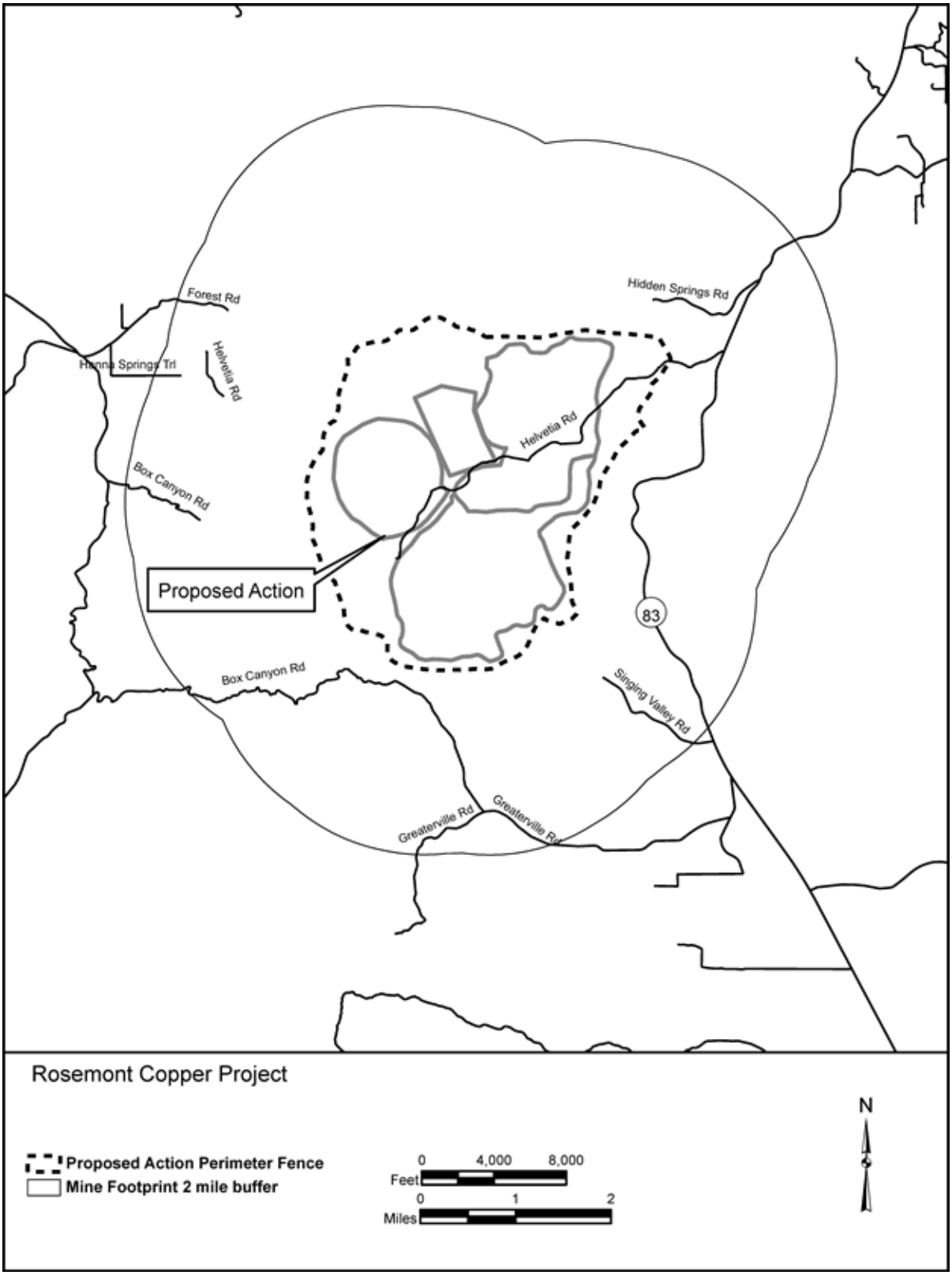


Figure 89. County and state roads

another public road agency, such as a county or the Arizona Department of Transportation. Broadly, both types of roads fall into the National Forest System road classification, although Forest Service primary system roads are generally maintained by, and under the jurisdiction of, the Forest Service, whereas other Forest Service system roads are generally maintained by, and under the jurisdiction of, other road management or private entities.

As shown in figure 90, numerous routes in the analysis area have been inventoried and mapped by the Forest Service. These routes vary from gravel roads to native surfaces. A total of more than 24 miles of roads inventoried by the Forest Service lies within the analysis area. As shown in figure 90, Santa Rita Road runs north-south, providing access to east-west county roads such as Box Canyon Road. State Route 83 has access points at Greaterville, Singing Valley, Hidden Springs, and Helvetia Roads. Box Canyon Road also connects with Greaterville Road in the southern portion of the analysis area, and much of it is on the Forest Service primary road system.

Highway and Road Usage

Traffic Volume/Counts

Traffic data collection was completed in 2008 and again in 2010 to examine the existing traffic conditions along State Route 83. The 2008 data are presented in “Traffic Analysis Report, Rosemont Copper Company” (Tetra Tech 2009e) and the 2010 data are presented in “Rosemont Primary Access Road Intersection: Traffic Impact Analysis Report, Volumes 1 and 2” (Tetra Tech 2011). For the purposes of this analysis, the 2010 data are used to identify current traffic conditions on State Route 83 and to determine mine related traffic impacts. The traffic analysis was prepared in accordance with the guidelines in two documents: “Traffic Analysis for Proposed Development” (Arizona Department of Transportation 1999); and the Institute of Transportation Engineers’ “Manual of Transportation Engineering Studies” (Robertson et al. 1994).

The analysis area included four intersections and one roadway segment along State Route 83. The four State Route 83 intersections analyzed included Interstate 10 westbound on- and off-ramps, Interstate 10 eastbound on- and off-ramps, Hidden Valley Road, and State Route 82. The roadway segment of State Route 83 analyzed was from the intersection of Interstate 10 to the intersection of State Route 82. Traffic vehicle counts were manually collected during a period of 1 weekday and 1 weekend. Furthermore, 1 week of traffic data was collected using Arizona Department of Transportation implemented roadway detectors located within the analysis area. Video recording was also performed simultaneously with manual data collection to address any potential traffic count errors.

In order to capture variations in highway usage, data collection was performed in the non-peak season (May to June) in May 2010 for morning peak hours (6:30 to 7:30 a.m.) and evening peak hours (5 to 6 p.m.) (table 136). A peak season factor provided by the Arizona Department of Transportation was applied to the data collected in May 2010 in order to determine the peak season traffic. During the data collection, vehicles were divided into five categories: motorcycles, light-duty vehicles, buses, medium-duty trucks, and heavy trucks. Results showed that heavy-duty vehicles, such as buses and trucks, accounted for 6 to 12 percent of the total traffic load between Interstate 10 and State Route 82. The vehicle counts for these categories were then calculated into a passenger car equivalent in order to convert a mixed traffic stream into a single input of total passenger cars. Generally, a single heavy truck will be converted into a count of many passenger cars, depending on the size and weight of the truck and highway conditions such as grade or number of lanes. The passenger car equivalent is used in transportation planning to determine traffic volume, level of service, lane requirements, and the

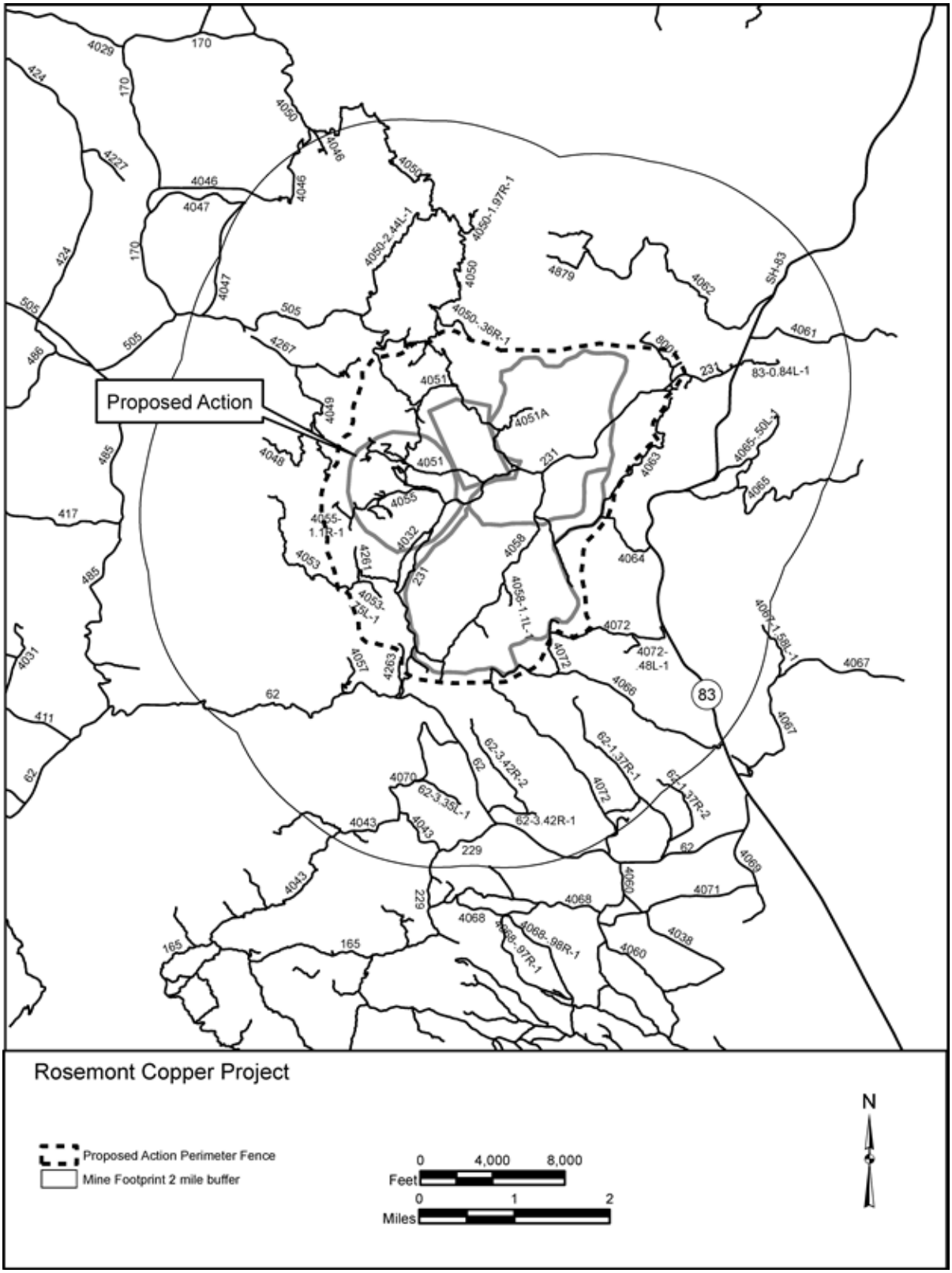


Figure 90. Coronado National Forest roads

effect of traffic on highways. For this project, the data collected were used as follows: to determine the current level of service on State Route 83 between Interstate 10 and State Route 82 and the intersections analyzed in detail (described in the section below); to model the predicted mine related traffic impacts; and to determine the applicability of potential mitigation measures.

In addition to the manual traffic counts described above, the Arizona Department of Transportation's Transportation Planning Division collected traffic volume counts of vehicles along the section of State Route 83 between State Route 82 and Interstate 10 in 2006 and 2008 (Arizona Department of Transportation 2011d), to arrive at an annual average daily traffic volume estimate for State Route 83, as shown in table 137 (Arizona Department of Transportation 2011d). The annual average daily traffic estimate was calculated by recording the volume of vehicles during a given year and dividing that by the number of days in a year. Traffic volume data were collected using an automatic traffic recorder, which collected data 24 hours per day, 365 days per year, for each lane. The equipment records traffic volumes, speed, and classification of vehicles. Between 2006 and 2008, the percentage of annual average daily traffic volume generated by trucks or commercial vehicles was 11 percent. Of that 11 percent, 7 percent consisted of light- to medium-duty trucks and buses, and 4 percent consisted of heavy-duty vehicles.

Table 136. 2008 traffic volumes

Intersection	Nonpeak Season Condition Weekend a.m. Peak Hour Vehicles per Hour (VPH)	Nonpeak Season Condition Weekend p.m. Peak Hour VPH	Nonpeak Season Condition Weekday a.m. Peak Hour VPH	Nonpeak Season Condition Weekday p.m. Peak Hour VPH	Peak Season Condition Weekend a.m. Peak Hour VPH	Peak Season Condition Weekend p.m. Peak Hour VPH	Peak Season Condition Weekday a.m. Peak Hour VPH	Peak Season Condition Weekday p.m. Peak Hour VPH
State Route 83 and Interstate 10 westbound	32 off-ramp 254 on-ramp	42 off-ramp 36 on-ramp	16 off-ramp 308 on-ramp	32 off-ramp 108 on-ramp	10 off-ramp 184 on-ramp	40 off-ramp 142 on-ramp	24 off-ramp 248 on-ramp	46 off-ramp 110 on-ramp
State Route 83 and Interstate 10 eastbound	54 off-ramp 18 on-ramp	189 off-ramp 23 on-ramp	64 off-ramp 26 on-ramp	162 off-ramp 14 on-ramp	62 off-ramp 22 on-ramp	188 off-ramp 24 on-ramp	66 off-ramp 16 on-ramp	52 off-ramp 18 on-ramp
State Route 83 and East Sahuarita Road	114 (NB) 52 (SB)	106 NB 56 SB	90 NB 42 SB	52 NB 94 SB	106 NB 50 SB	72 NB 88 SB	116 NB 38 SB	82 NB 130 SB
State Route 83 and Hilton Ranch Road	88 NB 74 SB	94 NB 58 SB	56 NB 46 SB	40 NB 60 SB	56 NB 68 SB	74 NB 72 SB	50 NB 44 SB	102 NB 76 SB
State Route 83 and Hidden Valley Road	82 NB 50 SB	82 NB 36 SB	96 NB 74 SB	66 NB 98 SB	64 NB 40 SB	76 NB 120 SB	62 NB 40 SB	92 NB 56 SB
State Route 83 and Rosemont Junction	72 NB 34 SB	90 NB 50 SB	74 NB 50 SB	54 NB 72 SB	78 NB 68 SB	84 NB 100 SB	80 NB 56 SB	88 NB 124 SB
State Route 83 and Greaterville Road	56 NB 70 SB	104 NB 88 SB	50 NB 42 SB	78 NB 92 SB	64 NB 46 SB	88 NB 80 SB	66 NB 44 SB	56 NB 104 SB

Source: Tetra Tech (2009e).

Table 137. State Route 83 annual average daily traffic volume, 2006 to 2008

Beginning Milepost	Ending Milepost	2006 Annual Average Daily Traffic (vehicles per day)	2007 Annual Average Daily Traffic (vehicles per day)	2008 Annual Average Daily Traffic (vehicles per day)	2009 Annual Average Daily Traffic (vehicles per day)	2010 Annual Average Daily Traffic (vehicles per day)
31.63	55.36	2,438	2,091	2,116	1,589	2,260
55.26	58.58	1,992	2,954	2,767	2,237	3,183

Source: Arizona Department of Transportation (2011d).

Traffic volume/Level of Service

Level of service is a measure used by traffic engineers to determine traffic volume and traffic operating conditions. The Transportation Research Board's (2000) "Highway Capacity Manual" and the American Association of State Highway and Transportation Officials' (2004) "A Policy on Geometric Design of Highways and Streets" list the levels of service on a letter scale from A to F, with A being the highest level of service and F being the lowest. For roadway segments such as State Route 83, the criterion used to determine level of service is the amount of time a vehicle spends following another vehicle. For unsignalized intersections, the criterion used to determine the level of service is the average amount of time a vehicle stopped at a stop sign must wait before the vehicle can safely turn onto the cross street. Table 138 shows the applicable criteria for determining the level of service along State Route 83 and the four unsignalized intersections analyzed in detail. At level of service A, traffic flows freely, traveling at desired speeds with ample passing opportunities. At level of service F, traffic flow is forced, the traffic volume has exceeded the capacity of the roadway, and there are no passing opportunities. Level of service D is generally considered to be the lowest acceptable level of service for roadways, prompting efforts at road upgrades.

Table 138. Level of service criteria

Level of Service	Level of Service Criteria	
	Unsignalized Intersection: Average Control Delay (seconds/vehicle)	Two-Lane Highway Segment: Percent Time Spent following
A	0 to 10	<40%
B	>10 to 15	>40 to 55%
C	>15 to 25	>55 to 70%
D	>25 to 35	>70 to 85%
E	>35 to 50	>85%
F	>50	Whenever flow rates exceed the segment capacity

As shown in tables 139 and 140, the State Route 83 segment between Interstate 10 and State Route 82 has acceptable levels of service during weekday and weekend a.m. and p.m. peak hours in both nonpeak and peak seasons, respectively. The intersections within the analysis area also operate at an acceptable level of service during nonpeak and peak seasons. Both weekday and weekend a.m. peak hour conditions show more congestion, compared with p.m. hours.

Table 139. State Route 83 segment and intersection level of service—existing year, nonpeak season condition

Segment/ Intersection	Weekday a.m. Peak Hour Level of Service	Weekday p.m. Peak Hour Level of Service	Weekend a.m. Peak Hour Level of Service	Weekend p.m. Peak Hour Level of Service
State Route 83 segment from Interstate 10 to State Route 82	B (52.7% time following)	B (48.7% time following)	B (52.8% time following)	C (55.9% time following)
State Route 83 intersection with Interstate 10 Westbound on- and off-ramps	B (10.4 seconds of maximum delay)	A (9.5 seconds of maximum delay)	A (9.9 seconds of maximum delay)	A (9.3 seconds of maximum delay)
State Route 83 intersection with Interstate 10 Eastbound on- and off-ramps	A (8.7 seconds of maximum delay)	A (9.5 seconds of maximum delay)	A (8.6 seconds of maximum delay)	A (9.8 seconds of maximum delay)
State Route 83 intersection with Hidden Valley Road	A (9.0 seconds of maximum delay)	A (9.2 seconds of maximum delay)	A (8.9 seconds of maximum delay)	A (9.4 seconds of maximum delay)
State Route 83 intersection with State Route 82	B (10.1 seconds of maximum delay)	B (10.2 seconds of maximum delay)	A (10.0 seconds of maximum delay)	B (10.8 seconds of maximum delay)

Source: Tetra Tech (Tetra Tech 2011).

Table 140. State Route 83 segment and intersection level of service—existing year, peak season condition

Segment/ Intersection	Weekday a.m. Peak Hour Level of Service	Weekday p.m. Peak Hour Level of Service	Weekend a.m. Peak Hour Level of Service	Weekend p.m. Peak Hour Level of Service
State Route 83 segment from Interstate 10 to State Route 82	B (54.7% time following)	C (55.4% time following)	B (50.6% time following)	C (59.0% time following)
State Route 83 intersection with Interstate 10 Westbound on- and off-ramps	B (10.7 seconds of maximum delay)	A (9.6 seconds of maximum delay)	B (10.1 seconds of maximum delay)	A (9.4 seconds of maximum delay)
State Route 83 intersection with Interstate 10 Eastbound on- and off-ramps	A (8.7 seconds of maximum delay)	A (9.7 seconds of maximum delay)	A (8.7 seconds of maximum delay)	B (10.0 seconds of maximum delay)
State Route 83 intersection with Hidden Valley Road	A (9.1 seconds of maximum delay)	A (9.4 seconds of maximum delay)	A (9.0 seconds of maximum delay)	A (9.5 seconds of maximum delay)
State Route 83 intersection with State Route 82	B (10.4 seconds of maximum delay)	B (10.9 seconds of maximum delay)	B (10.1 seconds of maximum delay)	B (11.0 seconds of maximum delay)

Source: Tetra Tech (Tetra Tech 2011).

Commercial Transportation

Commercial transportation typically includes interstate bus, local bus, air, and railroad services.

Bus Service

Interstate bus service and scheduled local bus service are not available in the project vicinity.

Air Service

The Tucson International Airport, which is approximately 25 miles northeast of the project area, provides commercial air service to the greater Tucson metropolitan area. The Benson Municipal Airport, which is approximately 20 miles northeast of the project area, is used for general aviation. The Continental Airport, a private airport located approximately 16 miles west of the project area, is owned by Farmers Investment Company.

Railroads

The Tucson rail yard is approximately 27 miles northwest of the project area. The facility provides commercial freight rail service to the greater Tucson metropolitan area.

Public Transportation

School Bus Service

School buses for the Vail School District pick up and drop off children along State Route 83. School bus stops are at the following eight locations: Hoffman – mileposts 52 and 51.3; Ghost Dance – mileposts 50.8 and 49.7; Hilton Ranch Road – milepost 49.1; Coronado Rest Area – milepost 46.9; Greaterville Road – milepost 42.6; and Yucca Ash Farms Road – milepost 37.6. The current school bus traffic pattern consists of two separate loops. One loop runs from Sahuarita Road to the rest stop at milepost 46.9 on State Route 83. The rest stop is just south of the proposed Rosemont Copper primary access road. The second loop runs from State Route 82 to Greaterville Road. Currently, the school bus pick-up and drop-off locations are located such that students do not have to cross State Route 83 to get to the bus stop. The buses do not have a pull-off area along State Route 83, and the buses must stop within the travel lanes of the highway. Traffic is delayed because vehicles must stop and cannot pass during student loading and unloading. At the Hilton Ranch Road bus stop, there is a wide, compacted dirt area on the east side of State Route 83 that allows the buses to pull off the highway.

Environmental Consequences

The analysis area for transportation and access consists of the project area and the primary and secondary access routes that would be used for the construction and operation of the project, as discussed in the “Affected Environment” part of this section. Despite some variations between the action alternatives, they would result in relatively similar impacts to transportation and access, which are further described below. As stated in the introduction, the secondary access road will only serve to access the utility lines and water pipeline for routine service. Worker commutes, haul trucks, and deliveries will be restricted to the primary access road that connects with State Route 83. Therefore, the traffic modeling only analyzed potential impacts to State Route 83.

Direct and Indirect Effects of Each Alternative

No Action Alternative

Traffic Volume/Level of Service

Under the no action alternative, the Rosemont Copper Mine would not be developed, and the existing transportation patterns and infrastructure in and around the project area would continue. The existing traffic and transportation patterns and infrastructure are detailed in the "Affected Environment" part of this section. Existing traffic on State Route 83 is considered to be level of service B, with low traffic volume and little to no transportation infrastructure improvements. There would be no direct, indirect, or cumulative effects on traffic volume or level of service as a result.

Transportation Routes

Under the no action alternative, existing transportation routes would continue as is. There would be no direct, indirect, or cumulative effects on transportation routes as a result.

Changes in Access

Public access to Forest Service land and transportation infrastructure would not be impacted under the no action alternative because there would be no new roads, upgrades to existing roads, or closures of existing roads under this alternative. There would be no direct, indirect, or cumulative effects on changes in access as a result. No new legal public access to or across private land held by Augusta Resource would occur.

Public Transportation

Under the no action alternative, there would be no mine related traffic that could potentially affect public transportation routes.

Mitigation Effectiveness

Under the no action alternative, mitigation measures would not be necessary.

Impacts Common to All Action Alternatives

Traffic Volume/Level of Service

All action alternatives would change the existing traffic conditions because of the increase in heavy-truck traffic, commercial deliveries, and daily commuter trips, resulting in a lower level of service during construction and operations phases on State Route 83. However, according to the "Traffic Impact Analysis Report," traffic forecasts predict the level of service on the segment of State Route 83 between Interstate 10 and State Route 82 and the four analyzed intersections would remain at acceptable levels even with the anticipated increase of vehicle use resulting from predicted population growth (Tetra Tech 2011). To determine the traffic impacts that the mine would generate, traffic forecasts were generated for 3 years of the mine life: (1) year 1 of the construction phase, (2) year 5 of the operations phase, and (3) year 20 of the operations phase.

The traffic forecasts were composed of two components: (1) background trips, and (2) project trips. Background trips were determined by using the May 2010 manual traffic counts as the traffic basis and applying an increase in traffic factor to account for population growth and subsequent increase of vehicular traffic. This factor was based on the average annual population growth for Pima County between 1990 and 2006. Project trips were based on the material delivery rates, truck schedules, and number of employees for the construction and operation phases, as identified in the preliminary MPO

and the "Rosemont Copper Feasibility Survey." The traffic model was run with a no-carpool scenario for the anticipated average of 457 employees in order to show a potential worst-case impact to traffic in the analysis area (even though the preliminary MPO states that construction crews would be bused in and the company would develop a carpooling system for the operation phase). Large trucks, including haul trucks and commercial delivery trucks, were converted to passenger car equivalents according for traffic analysis.

The traffic impact analysis (tables 141 and 142) shows the level of service for the State Route 83 segment and intersections at construction phase year 1 for peak and nonpeak seasons. The traffic impact analysis (tables 143 and 144) shows the level of service for the State Route 83 segment and intersections at operation phase year 5 for peak and nonpeak seasons. Tables 145 and 146 show the level of service for the State Route 83 segment and intersections at operation phase year 20 for peak and nonpeak seasons.

Tables 141 and 142 show a decrease in the level of service for the segment of State Route 83 during year 1 of the construction phase during peak and nonpeak seasons, compared with the existing traffic conditions, but the level of service remains at acceptable levels. These tables also show that although there will be decreases in the level of service for several of the intersections during peak and nonpeak seasons, all intersections will remain at acceptable levels of service during year 1 of the construction phase.

Table 141. State Route 83 segment and intersection level of service—construction phase year 1, no carpool, nonpeak season condition

Segment/ Intersection	Weekday a.m. Peak Hour Level of Service	Weekday p.m. Peak Hour Level of Service	Weekend a.m. Peak Hour Level of Service	Weekend p.m. Peak Hour Level of Service
State Route 83 segment from Interstate 10 to State Route 82	C (58.1% time following)	C (60.5% time following)	C (59.4% time following)	C (58.6% time following)
State Route 83 intersection with Interstate 10 Westbound on- and off-ramps	B (11.0 seconds of maximum delay)	B (10.1 seconds of maximum delay)	B (10.4 seconds of maximum delay)	A (9.9 seconds of maximum delay)
State Route 83 intersection with Interstate 10 Eastbound on- and off-ramps	A (9.3 seconds of maximum delay)	B (10.0 seconds of maximum delay)	A (9.2 seconds of maximum delay)	B (10.4 seconds of maximum delay)
State Route 83 intersection with Hidden Valley Road	B (10.9 seconds of maximum delay)	B (10.9 seconds of maximum delay)	B (10.6 seconds of maximum delay)	B (12.1 seconds of maximum delay)
State Route 83 intersection with State Route 82	B (11.2 seconds of maximum delay)	B (11.4 seconds of maximum delay)	B (10.8 seconds of maximum delay)	B (11.2 seconds of maximum delay)

Source: Tetra Tech (Tetra Tech 2011).

Table 142. State Route 83 segment and intersection level of service—construction phase year 1, no carpool, peak season condition

Segment/ Intersection	Weekday a.m. Peak Hour Level of Service	Weekday p.m. Peak Hour Level of Service	Weekend a.m. Peak Hour Level of Service	Weekend p.m. Peak Hour Level of Service
State Route 83 segment from Interstate 10 to State Route 82	C (59.4% time following)	C (57.6% time following)	C (60.5% time following)	C (60.4% time following)
State Route 83 intersection with Interstate 10 Westbound on- and off-ramps	B (11.5 seconds of maximum delay)	B (10.3 seconds of maximum delay)	B (10.7 seconds of maximum delay)	B (10.0 seconds of maximum delay)
State Route 83 intersection with Interstate 10 Eastbound on- and off-ramps	A (9.4 seconds of maximum delay)	B (10.3 seconds of maximum delay)	A (9.2 seconds of maximum delay)	B (10.6 seconds of maximum delay)
State Route 83 intersection with Hidden Valley Road	B (11.0 seconds of maximum delay)	B (11.1 seconds of maximum delay)	B (10.7 seconds of maximum delay)	B (11.4 seconds of maximum delay)
State Route 83 intersection with State Route 82	B (11.6 seconds of maximum delay)	B (11.9 seconds of maximum delay)	B (11.0 seconds of maximum delay)	B (11.6 seconds of maximum delay)

Source: Tetra Tech (Tetra Tech 2011).

Tables 143 and 144 show a decrease in the level of service for the segment of State Route 83 during year 5 of the operation phase during peak and nonpeak seasons, compared with the existing traffic conditions, but the level of service remains at acceptable levels. These tables also show that although there will be decreases in the level of service for several of the intersections during peak and nonpeak seasons, all intersections will remain at acceptable levels of service during year 5 of the operation phase.

Table 143. State Route 83 segment and intersection level of service—operation phase year 5, no carpool, nonpeak season condition

Segment/ Intersection	Weekday a.m. Peak Hour Level of Service	Weekday p.m. Peak Hour Level of Service	Weekend a.m. Peak Hour Level of Service	Weekend p.m. Peak Hour Level of Service
State Route 83 segment from Interstate 10 to State Route 82	C (62.0% time following)	C (61.4% time following)	C (59.2% time following)	C (63.1% time following)
State Route 83 intersection with Interstate 10 Westbound on- and off-ramps	B (12.3 seconds of maximum delay)	B (10.6 seconds of maximum delay)	B (11.4 seconds of maximum delay)	B (10.3 seconds of maximum delay)

Segment/ Intersection	Weekday a.m. Peak Hour Level of Service	Weekday p.m. Peak Hour Level of Service	Weekend a.m. Peak Hour Level of Service	Weekend p.m. Peak Hour Level of Service
State Route 83 intersection with Interstate 10 Eastbound on- and off-ramps	A (9.5 seconds of maximum delay)	B (10.9 seconds of maximum delay)	A (9.3 seconds of maximum delay)	B (11.5 seconds of maximum delay)
State Route 83 intersection with Hidden Valley Road	B (11.3 seconds of maximum delay)	B (11.5 seconds of maximum delay)	B (11.5 seconds of maximum delay)	B (13.8 seconds of maximum delay)
State Route 83 intersection with State Route 82	B (12.4 seconds of maximum delay)	B (12.7 seconds of maximum delay)	B (11.6 seconds of maximum delay)	B (12.6 seconds of maximum delay)

Source: Tetra Tech (Tetra Tech 2011).

Table 144. State Route 83 segment and intersection level of service—operation phase year 5, no carpool, peak season condition

Segment/ Intersection	Weekday a.m. Peak Hour Level of Service	Weekday p.m. Peak Hour Level of Service	Weekend a.m. Peak Hour Level of Service	Weekend p.m. Peak Hour Level of Service
State Route 83 segment from Interstate 10 to State Route 82	C (63.1% time following)	C (62.6% time following)	C (60.6% time following)	C (64.0% time following)
State Route 83 intersection with Interstate 10 Westbound on- and off-ramps	B (13.1 seconds of maximum delay)	B (10.9 seconds of maximum delay)	B (11.8 seconds of maximum delay)	B (12.4 seconds of maximum delay)
State Route 83 intersection with Interstate 10 Eastbound on- and off-ramps	A (9.6 seconds of maximum delay)	B (11.4 seconds of maximum delay)	A (9.4 seconds of maximum delay)	B (12.0 seconds of maximum delay)
State Route 83 intersection with Hidden Valley Road	B (11.6 seconds of maximum delay)	B (11.9 seconds of maximum delay)	B (11.2 seconds of maximum delay)	B (12.4 seconds of maximum delay)
State Route 83 intersection with State Route 82	B (13.1 seconds of maximum delay)	B (13.6 seconds of maximum delay)	B (12.0 seconds of maximum delay)	B (13.4 seconds of maximum delay)

Source: Tetra Tech (Tetra Tech 2011).

Tables 145 and 146 show a decrease in the level of service for the segment of State Route 83 during year 20 of the operation phase during peak and nonpeak seasons, compared with the existing traffic conditions, but the level of service remains at acceptable levels. The level of service for weekend p.m. peak hour during peak season is close to decreasing to level of service D (>70 to 85 percent time following), but mitigation measures described in the mitigation effectiveness section below would decrease the likelihood that this would occur. These tables also show that although there will be decreases in the level of service for several of the intersections during peak and nonpeak seasons, all intersections will remain at acceptable levels of service during year 20 of the operation phase.

Table 145. State Route 83 segment level of service—operation phase year 20, no carpool, nonpeak season condition

Segment/ Intersection	Weekday a.m. Peak Hour Level of Service	Weekday p.m. Peak Hour Level of Service	Weekend a.m. Peak Hour Level of Service	Weekend p.m. Peak Hour Level of Service
State Route 83 segment from Interstate 10 to State Route 82	C (63.0% time following)	C (63.1% time following)	C (60.4% time following)	C (67.1% time following)
State Route 83 intersection with Interstate 10 Westbound on- and off-ramps	B (13.5 seconds of maximum delay)	B (10.9 seconds of maximum delay)	B (12.3 seconds of maximum delay)	B (10.5 seconds of maximum delay)
State Route 83 intersection with Interstate 10 Eastbound on- and off-ramps	A (9.4 seconds of maximum delay)	B (11.7 seconds of maximum delay)	A (9.3 seconds of maximum delay)	B (12.7 seconds of maximum delay)
State Route 83 intersection with Hidden Valley Road	B (11.4 seconds of maximum delay)	B (11.6 seconds of maximum delay)	B (11.0 seconds of maximum delay)	B (12.1 seconds of maximum delay)
State Route 83 intersection with State Route 82	B (12.0 seconds of maximum delay)	B (13.7 seconds of maximum delay)	B (12.2 seconds of maximum delay)	B (14.0 seconds of maximum delay)

Source: Tetra Tech (Tetra Tech 2011).

Table 146. State Route 83 segment level of service—operation phase year 20, no carpool, peak season condition

Segment/ Intersection	Weekday a.m. Peak Hour Level of Service	Weekday p.m. Peak Hour Level of Service	Weekend a.m. Peak Hour Level of Service	Weekend p.m. Peak Hour Level of Service
State Route 83 segment from Interstate 10 to State Route 82	C (63.9% time following)	C (64.1% time following)	C (61.9% time following)	C (69.3% time following)
State Route 83 intersection with Interstate 10 Westbound on- and off-ramps	B (14.8 seconds of maximum delay)	B (11.3 seconds of maximum delay)	B (12.9 seconds of maximum delay)	B (10.8 seconds of maximum delay)
State Route 83 intersection with Interstate 10 Eastbound on- and off-ramps	A (9.6 seconds of maximum delay)	B (12.5 seconds of maximum delay)	A (9.4 seconds of maximum delay)	B (13.6 seconds of maximum delay)
State Route 83 intersection with Hidden Valley Road	B (11.7 seconds of maximum delay)	B (12.0 seconds of maximum delay)	B (11.2 seconds of maximum delay)	B (12.5 seconds of maximum delay)
State Route 83 intersection with State Route 82	B (14.1 seconds of maximum delay)	B (14.8 seconds of maximum delay)	C (15.3 seconds of maximum delay)	C (15.2 seconds of maximum delay)

Source: Tetra Tech (Tetra Tech 2011).

Changes in the level of service of State Route 83 may have impacts to other roadways, which may increase traffic on other routes, such as Sahuarita Road and Box Canyon Road, should commuters choose to alter their routes. This, along with population growth and subsequent development related to this growth, could result in a cumulative effect that would negatively impact other traffic volume over time.

Transportation Routes

All action alternatives would add new routes. Most would occur within the project's footprint, would be closed to the general public, and would be under the jurisdiction of and maintained by Augusta Resource. These routes would serve as internal roads authorized for Rosemont Copper Mine staff and authorized guests to access the plant site facilities, storage and tailings areas, and open pit.
The primary access route outside the perimeter fence would be open to the general public and would be under written authorization to Augusta Resource from the Forest Service for purposes of maintenance and operation.

As shown in figure 91, access to the project site would be via two routes: a primary access route from the east, and a secondary access route from the west. The primary access route to the project site would extend from State Route 83 at a point between mileposts 46 and 47 and would end at the main guard building at the entrance to the plant. This would either be a Rosemont Copper Project easement or a special use permit road. This road would be maintained by Augusta Resource at their expense. The primary access road's intersection to State Route 83 would be designed to the standards outlined in the "Arizona Department of Transportation Roadway Design Guidelines" and approved by the Arizona Department of Transportation through an encroachment permit process. Upon review of the intersection design, the Arizona Department of Transportation may determine that additional roadway features such as additional passing lanes and shoulders should be included in the design. Such features are designed to enhance roadway safety and address any traffic problems that the intersection may cause.

Secondary access to the project site would be to the west over the ridge of the Santa Rita Mountains and would connect the mine site via Lopez Pass to the existing Santa Rita Road at Helvetia Road on the western slope of the Santa Rita Mountains. This road would be maintained by Augusta Resource at their expense and not be open to the public. All action alternatives would include the construction of these routes, although the footprint would vary slightly between alternatives. The road would only be used to access the water and utility lines for maintenance purposes. Therefore, traffic impacts to the secondary access road and the connected Santa Rita Road would be negligible since workers would not use the route for commuting and no commercial deliveries or haul trucks would use the roadway.

The primary access route segment available to the public would have an indirect impact to recreationists or tourists who visit the area, as they would allow easier public access because of a higher level of road construction standard and maintenance. However, this would result in a negligible impact, primarily owing to the limited opportunity for motor vehicle travel off the primary access route. For impacts to recreation and tourism, refer to the "Recreation and Wilderness" and "Socioeconomics and Environmental Justice" sections.

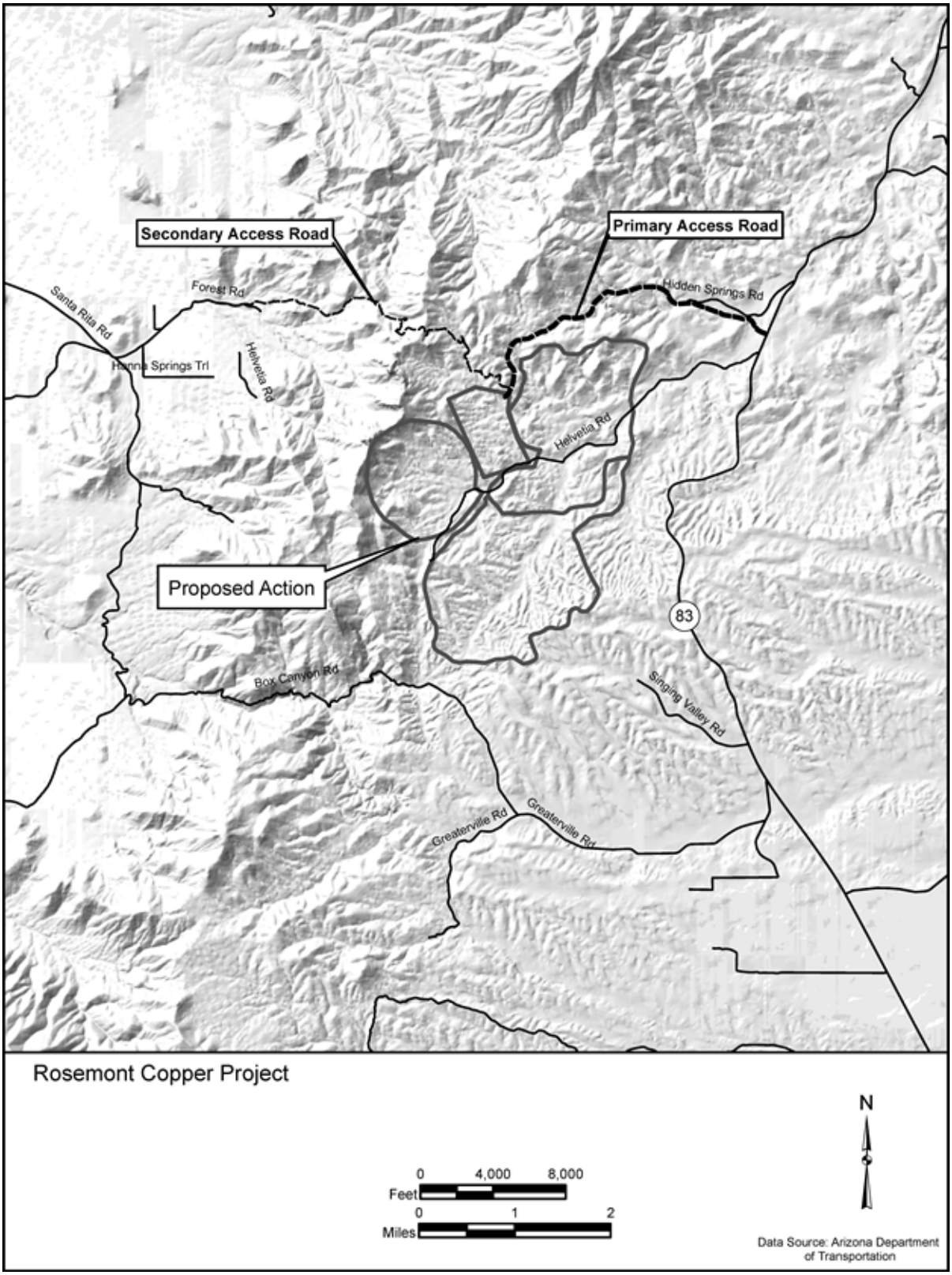


Figure 91. Access roads

Mine Related Traffic

Mine related traffic would have direct and indirect impacts to the local population who use State Route 83, as commute times would be longer.

As stated in chapter 2, construction and preproduction stripping at the mine pit would occur for 18 months prior to the start-up of mine and ore processing operations. During construction, shifts would be 10 hours per day, 5 days per week, with no major activity on weekends. The construction workforce would range from fewer than 100 people to a maximum of approximately 900 people, with the peak being in the middle 6 months of the construction phase. According to the preliminary MPO, crews would be bused from staging areas along Interstate 10 to the north and Sonoita to the south, totaling approximately 26 bus trips. The exact locations of the staging areas will be undetermined until the locations of the majority of the workers' homes are known. Equipment and construction material deliveries are estimated to total approximately 1,000 truck shipments to the site (an average of 2.6 deliveries per weekday over the 18-month construction phase).

As also stated in chapter 2, mine related traffic on State Route 83 during operations would primarily consist of trucks carrying supplies to the project area, trucks carrying concentrate and copper cathodes from the project area, and employee traffic. Approximately 88 round-trips of shipment related truck traffic would occur daily. Copper concentrate shipments would form the largest number of routine truck shipments, with approximately 56 round trips per day, 7 days per week.

The largest volume of mine traffic during a 24-hour period would occur during workforce shift change. Shift changes vary between 6 to 8 a.m. and 4 to 6 p.m. During the operations phase, with 75 to 80 percent of employees expected to commute from the Tucson area, there could be a total of 457 commute trips if carpooling does not take place, and 183 commute trips if only partial carpooling takes place. The reduction of traffic impacts as a result of carpooling is discussed below in the mitigation section. This would increase traffic on State Route 83, as described above, which would extend the commute times of drivers who use that route, resulting in a direct, adverse impact.

Indirect impacts resulting from mine related traffic would consist of the associated costs of maintaining the roads, as well as increased traffic noise. For information on impacts to road condition and maintenance and noise, refer to the "Socioeconomics and Environmental Justice" and "Noise" sections.

Changes in Access to National Forest System Roads

Under all action alternatives, the project site would be occupied by project components (e.g., the heap leach facility, mine pit) and would be fenced for safety and security purposes. This would eliminate numerous Forest Service primary system routes within the project footprint that are currently open for public access; this would conflict with the Coronado's travel management goals of maintaining forest roads for public use. Some of the primary and road would be closed to the public during construction and operation phases of the mine but would be open to the public after closure.

Recreationists using the Arizona National Scenic Trail may be directly impacted by the construction and use of the primary access road where the trail crosses it. For impacts to recreation users who visit the area and wildlife movement corridors, see the "Recreation and Wilderness" section.

It is not possible to predict the transportation conditions that would exist at the time of the project's decommissioning. Therefore, roadway decommissioning details would be developed and provided to the Forest Service when the time for permanent closure is closer and more information is available.

Public Transportation

Under all action alternatives, public transportation, including school buses, may be directly affected by mine related traffic along State Route 83. This, however, may be mitigated through scheduling by coordinating between the public transit system and Rosemont Copper. Cumulative effects on public transportation are not anticipated as a result of this project.

Proposed Action and Action Alternatives

There are no impacts that would be specific solely to a particular action alternative.

Cumulative Effects

The Council on Environmental Quality defines a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 Code of Federal Regulations 1508.7). As outlined in the chapter 3 introduction, cumulative impacts of past and present actions are identified and analyzed in the "Affected Environment" part of each resource section, including for "Transportation/Access." This cumulative effects discussion addresses the cumulative impacts of the action alternatives and any applicable reasonably foreseeable actions as identified on the Coronado ID team's list of reasonably foreseeable future actions, provided in the chapter 3 introduction. The following reasonably foreseeable actions from that list were determined to contribute to a cumulative impact to transportation/access:

- Continuing of road maintenance of both Forest Service and private roads for support of permitted Rosemont Copper grazing operations
- Pavement preservation of State Route 83 from Sonoita to milepost 43
- Sahuarita Road Phase II

These activities will maintain or improve roadway conditions for drivers on State Route 83, Sahuarita Road, and the Forest Service and private roads that receive continued maintenance. No further cumulative impacts to transportation and access conditions are anticipated beyond those already described above as direct and indirect impacts.

Mitigation Effectiveness

Mitigation measures are proposed to reduce the impacts mine related traffic would have on the level of service on the State Route 83 segment between Interstate 10 and State Route 82. Although the level of service is anticipated to be at acceptable levels throughout the life of the mine, the following mitigation measures would help assure that the level of service does not decrease to category D. These mitigation measures include the following:

- Developing a carpool system to reduce the amount of worker commute trips on State Route 83 for all phases
- Requiring truck traffic avoids times of high commuter or school bus traffic
- Constructing four new school bus pullouts on State Route 83

Of these proposed mitigation measures, the carpool system and the implementation of a truck delivery schedule to avoid times of high commuter and bus traffic were addressed in the "Traffic Impact

Analysis Report" (Tetra Tech 2011) to determine their effectiveness in decreasing mine related traffic impacts on the level of service to the State Route 83 segment. By following the carpool and truck delivery schedule presented in the preliminary MPO and Rosemont Copper Feasibility Study, a reduction of 50 to 70 trips would occur on the segment. Although the carpool and truck delivery schedule mitigation measures would be applied for the entire mine life, the analysis of these mitigation measures was only applied to the worst-case scenario traffic forecasts: operation year 20 weekend p.m. peak hour during the peak and nonpeak seasons. These forecasts predicted that traffic along State Route 83 would come close to decreasing the level of service to category D (greater than 70 percent time spent following). Table 147 shows the results of implementing these mitigation measures on operation year 20.

Table 147. State Route 83 segment level of service—operation phase year 20, with carpool and truck schedule mitigation measures

Analysis Year	Analysis Period	Level of Service Before Mitigation	Level of Service Before Mitigation	Improvement (%)
Operations Year 20	Nonpeak Season Weekend, P.M. Peak Hour	C (67.1% time spent following)	C (63.3% time spent following)	5.66
	Peak Season Weekend, P.M. Peak Hour	C (69.3% times spent following)	C (64.3% time spent following)	7.22

Source: Tetra Tech (Tetra Tech 2011).

As shown in table 147, the implementation of the carpool and truck schedule mitigation measures would reduce the percent time following and reduce the chance that mining related traffic would decrease the level of service of State Route 83 to the unacceptable level of D. Because these mitigation measures would be applied to all phases, a reduction in the time spent following would be expected for traffic in all phases.

Traffic would also be impacted less along State Route 83 by constructing four pullouts for school buses at locations to be determined through coordination with the Vail School District. As previously stated, buses currently stop within the travel lanes of State Route 83, causing all traffic on the highway to stop behind the bus. According to the "Traffic Impact Analysis Report," adding designated school bus turnout areas along State Route 83 would do the following:

- Improve traffic flow by allowing through traffic to proceed without being impeded
- Increase traffic safety by providing better sight distance for through vehicles
- Create safer student loading and unloading conditions
- Reduce the potential for rear-end crashes

As previously mentioned, the Arizona Department of Transportation would review and approve the primary access road intersection with State Route 83 as part of its encroachment permit process and may require additional mitigation measures to improve traffic flow and safety. The Arizona Department of Transportation has the legal authority to require reasonable highway improvements of a project proponent within 1 mile of a proposed intersection and can negotiate highway improvements with a project proponent beyond 1 mile of a proposed intersection. Mitigation measures under consideration include adding passing lanes and shoulders at the proposed primary access road intersection or elsewhere and improving the roadway pavement to accommodate heavy-truck use. A preliminary assessment of the roadway condition by the Arizona Department of Transportation on

State Route 83 indicates that at least a 2-inch asphaltic pavement overlay would be required to accommodate the increase of heavy-truck traffic that the mine would generate. These mitigation measures under consideration would be determined through negotiations between Rosemont Copper and the Arizona Department of Transportation.

Mitigation measures to minimize or reduce impacts to access include the following: (1) wherever practicable, the provision of public access to Rosemont Copper private lands not affected by mine related operations through the Arizona Game and Fish Cooperative Landowner Incentive Program, and (2) compliance with the Coronado travel management goals where feasible, and where Mine Safety and Health Administration regulations allow, on roads under Forest Service control or jurisdiction within the project area. The effectiveness of these mitigation measures would not be able to be determined until the project begins and the practicability and feasibility become apparent.

Irreversible and Irretrievable Commitment of Resources

Irreversible impacts to transportation and access would occur as a result of an increase of traffic on State, County, and public forest roads from mining operations within the analysis area and the reduction of public access to roads within the perimeter fence. Because mine related traffic would cease after mine closure, traffic impacts would not be considered an irretrievable commitment of resources. Existing public forest roads that would be destroyed within the perimeter fence of the mine would be considered an irretrievable commitment of resources.

Noise

Introduction

Noise impacts associated with the project can be divided into four distinct phases: (1) construction of the main pit and mining facilities; (2) operation of the mine; (3) closure of the mine; and (4) postclosure activities. Noise associated with mining activities will occur during the first three phases and will vary both spatially and temporally, as the location and duration of noise-generating project activities will change throughout the life of the project.

The construction phase of the mine will occur in the first 18 months of mine operations. The primary sources of noise during this phase will be from trucking in of mining equipment (including haul trucks, shovels, graders, drills, and water trucks); surface blasting as needed; and material hauling associated with assembly of the processing plant facilities. Increased traffic noise on State Route 83 from personnel commuting to and from the mine will also occur during this phase. The operational phase of the mine will occur approximately over the next 20 years following construction.
The primary sources of noise during this phase will be scheduled surface blasting to expand the open pit; operation of mining equipment and scheduled blasting within the open pit; hauling of waste rock and mine tailings; ore processing; trucking in of supplies; and peak commuter traffic. The closure phase of the mine will follow mine operations. The primary sources of closure noise will include reduced commuter traffic, trucking in of mine closure materials, and deconstruction of facilities.

No noise related activities are associated with postclosure activities, which would begin after closure of the mine and continue for an indefinite period of time.

Issues, Cause and Effect Relationships of Concern

Mine development and operation will include a variety of activities that generate noise, which has the potential to affect the quality of life of permanent residents as well as transient recreational users. Impacts resulting from noise and vibrations from mine operations are identified in Issues 9 and 11B.

Issue 9: Impact on Recreation

This issue focuses on the effects of the mine operation on recreation on National Forest System and Bureau of Land Management administered lands, including loss of access and recreation opportunities and loss of or reduction in solitude, remoteness, rural setting, and quiet. The mine operation may lead to permanent changes to recreation settings (Recreation Opportunity Spectrum) and/or the type of recreation available and may result in increased pressure on public and private lands in other places to compensate for lost opportunities.

Issue 9 Factors for Alternative Comparison

- Area that would no longer meet current forest plan Recreation Opportunity Spectrum designations (acres)
- Area of the Coronado National Forest that would be unavailable for recreational use (acres) and public roads lost (miles)
- Qualitative assessment of potential for noise to reach recreation areas: audio “footprint”
- Qualitative assessment of impacts to solitude in designated Wilderness and other backcountry areas
- Hunter days lost (quantity based on percentage of Forest Service land lost under each alternative)
- Length of Arizona National Scenic Trail relocated (miles)
- Qualitative assessment of increased pressure on other areas, including roads and trails/trailheads

In this “Noise” section, the only factor that will be analyzed is the potential for noise to reach recreation areas and expected noise level because it is the only factor relevant to this section.

Issue 11B: Rural Landscapes

The mine operation may not conform to the quality of life expectations as expressed by the forest plan and Federal, State, and local regulations and ordinances. Concerns have been expressed about modification of rural historic landscapes and local ranching traditions, which are important to local residents.

Issue 11B Factor for Alternative Comparison

- Qualitative assessment of the ability of alternatives to meet rural landscape expectations as expressed by Federal, State, and local regulations and ordinances

Note that noise impacts to wildlife are addressed in the “Biological Resources” section of this DEIS. This section addresses noise impacts to sensitive noise receptors within the analysis area in terms of the potential for noise to reach recreation areas (Issue 9) and quality of life concerns for rural residents (Issue 11B).

Analysis Methodology, Assumptions, Uncertain and Unknown Information

The temporal bounds of analysis for noise impacts includes construction, operation, and closure. The spatial analysis area for noise impacts is defined by the predicted noise contours of each mining activity category that would occur during the first three phases of the mine life cycle and the location of noise-sensitive areas within the project area. These contours were developed in a supplemental noise study prepared for Rosemont Copper by Tetra Tech (2009d). The results and conclusions of that study set the framework for discussion of the affected environment for noise and vibration in the project area and the analysis of environmental consequences. Offsite utility corridors were not considered in the spatial analysis area, as impacts on noise were considered to be negligible.

The noise contour boundaries for each mining activity category are encompassed by three activities: (1) surface blasting that would occur during construction and operational phases of the mine life cycle; (2) construction and demolition that would occur during construction and closure phases of the mine life cycle; and (3) equipment trucking and commuter traffic that would occur during construction and operational phases of the mine life cycle. Figure 92 depicts the overlapping contours for these three activities and the location of noise-sensitive land uses (receptors) in the project area.

Noise is generally defined as the undesired component of sound. Varying noise levels are often described in terms of the equivalent constant decibel level. Equivalent noise levels (L_{eq}) are used to develop single-value descriptions of average noise exposure over various periods of time. The mathematics of calculating equivalent noise level values give greater weight to the higher noise level values than the lower noise level values. Average noise exposure ratings often include additional weighting factors for potential annoyance due to time of day or other considerations. Average noise exposure over a 24-hour period is often presented as a day-night average sound level (Ldn). The day-night average sound level values are calculated from hourly equivalent noise level values, with the equivalent noise level values for the nighttime period (10 p.m. to 7 a.m.) increased by 10 decibels to reflect the greater disturbance potential from nighttime noises.

Statistical descriptions (expressed as Lx, where x represents the percentage of time during which noise levels exceed the specified decibel level) are also used to characterize noise conditions over specified periods. L1, L5, and L10 descriptors can be used to characterize peak noise levels, while L90, L95, and L99 descriptors can be used to characterize background (ambient) noise levels. Note that the L50 value (the sound level is exceeded 50 percent of the time) will seldom be the same as the equivalent noise level value for the period being analyzed because the equivalent noise level value is biased toward the high-decibel contributions.

For relatively continuous noise conditions, the equivalent noise level value is often between the L30 and L40 values for the measurement period. If brief loud noises are common, the equivalent noise level value may be close to the L10 value for the measurement period.

Typical noise levels experienced by humans range from 40 A-weighted decibels (equivalent to a quiet suburban area at night) to 85 A-weighted decibels (the approximate noise level occurring 5 feet from a gas engine lawn mower). A change in noise level of 3 A-weighted decibels may be perceptible to most listeners, whereas a change of 10 A-weighted decibels may be perceived as a doubling of the noise level. Table 148 provides a summary of the range of A-weighted decibel levels typically encountered in the environment and examples of various noise sources for each range listed.

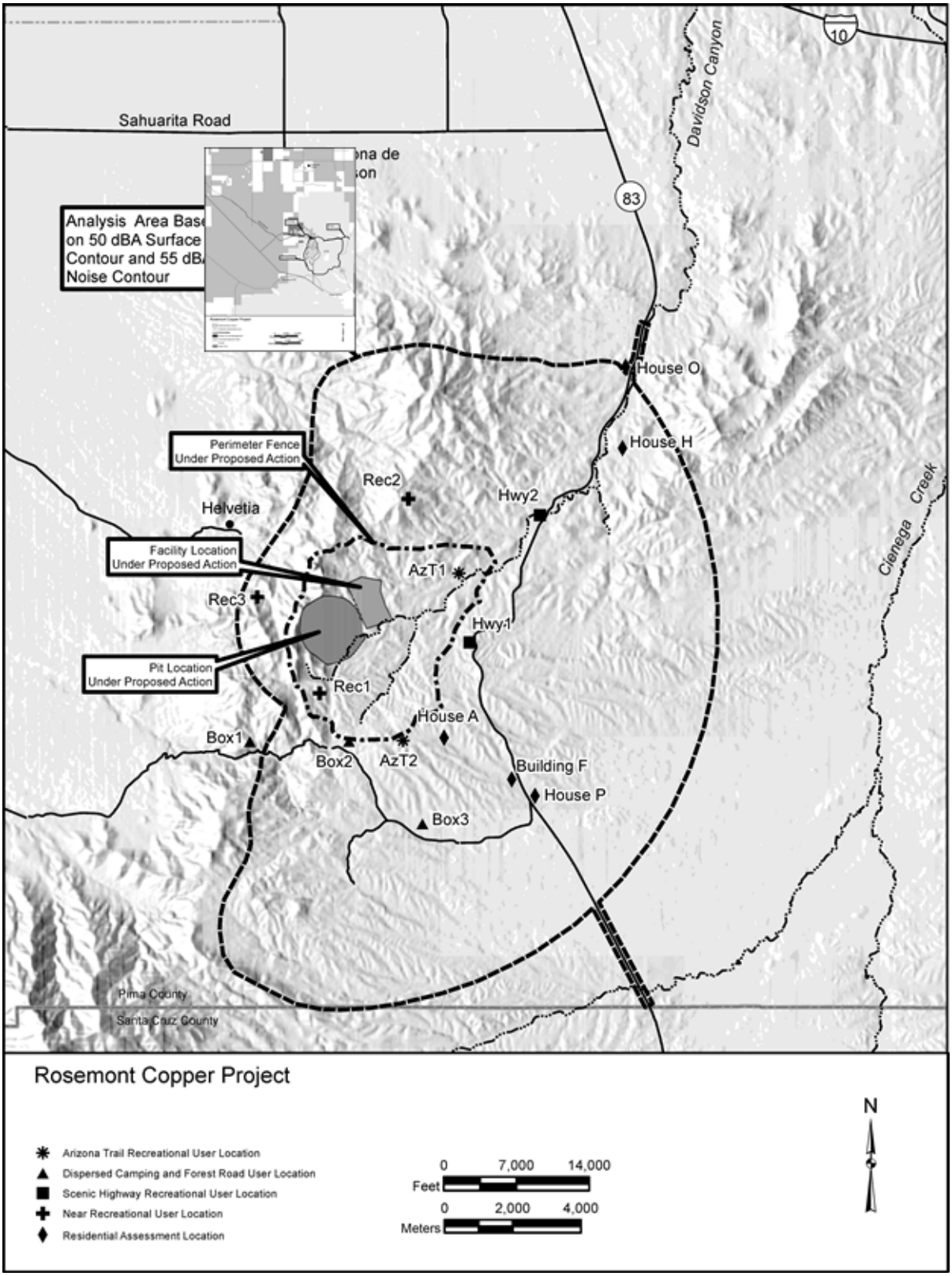


Figure 92. Analysis area and locations of noise receptors (Tetra Tech 2009d)

Table 148. Typical A-weighted decibel levels

Characterization	A-weighted Decibel	Example Noise Conditions
Threshold of pain	130	Surface detonation, 30 pounds of TNT at 1,000 feet. Peak noise 50 feet behind firing position, M-16 and M-24 rifles.
	125	Mach 1.9 sonic boom under aircraft at 11,000 feet.
Possible building damage	120	Air raid siren at 50 feet.
Threshold of immediate noise-induced permanent threshold shift (permanent hearing damage)	115	Commercial fireworks (5-pound charge) at 1,500 feet. F/A-18 aircraft takeoff with afterburners at 1,600 feet.
	110	Peak noise 50 feet behind firing position, .22 caliber rifle. Peak crowd noise, professional football game, inside open stadium.
	105	Emergency vehicle siren at 50 feet. Pile driver peak noise at 50 feet. Chainsaw (two-stroke gasoline engine) at 3 feet.
	100	Jackhammer at 10 feet. One-mile range fog horn at 30 feet.
Extremely noisy	95	Locomotive horn at 100 feet. 2-mile-range foghorn at 100 feet. Large wood chipper processing tree branches at 30 feet.
8-Hour Occupational Safety and Health Administration limit	90	Leaf blower at 5 feet. Jackhammer at 50 feet. Dog barking at 5 feet.
Very noisy	85	Gas engine lawn mower at 5 feet. Bulldozer, excavator, or paver at 50 feet. Personal watercraft at 20 feet. Pneumatic wrench at 50 feet.
	80	Forklift or front-end loader at 50 feet. Motorboat at 50 feet. Table saw at 25 feet. Vacuum cleaner at 5 feet.
Noisy	75	Idling locomotive at 50 feet. Street sweeper at 30 feet. Ocean beach with medium wind and surf.
	70	Leaf blower at 50 feet. 1-mile-range foghorn at 1,000 feet. 300 feet from busy six-lane freeway.
Moderately noisy	65	Typical daytime busy downtown background conditions. Typical gas engine lawn mower at 50 feet. Ocean beach with light wind and surf.
	60	Typical daytime urban mixed-use area conditions. Normal human speech at 5 feet. Typical electric lawn mower at 50 feet.
Moderately noisy	55	Typical urban residential area away from major streets. Low-noise electric lawn mower at 65 feet.
	50	Typical suburban daytime background conditions. Open field, summer night with numerous crickets.
Quiet	45	Typical rural area daytime background conditions. Suburban backyard, summer night with several crickets.
	40	Typical suburban area at night. Typical whispering at 1 to 2 feet.
	35	Quiet suburban area at night. Quiet whispering at 1 to 2 feet, low background noise conditions.

Characterization	A-weighted Decibel	Example Noise Conditions
Very quiet	30	Quiet rural area, winter night, no wind. Quiet bedroom at night, no air conditioner.
	25	Computer fan running.
Characterization	20	Empty recording studio. Remote area, no audible wind, water, insects, or animal sounds.
	10	Audiometric testing booth.
Threshold of hearing, no hearing loss	0	

Note: Indicated noise levels are average A-weighted decibel levels for stationary noise sources or peak noise levels for brief noises and noise sources moving past a fixed reference point. Average and peak A-weighted decibel levels are not 24-hour day-night average sound level values. Decibel scales are not linear. Apparent loudness doubles with every 10-A-weighted decibel increase, regardless of the initial A-weighted decibel level. Most adults have accumulated some hearing loss and have a threshold of hearing above 15 A-weighted decibels. In occupational hearing conservation programs, a threshold of hearing between 20 and 30 A-weighted decibels is considered normal.

Mine Blasting Vibrations

In addition to audible noise, blasting for open-pit mine construction and expansion generates low-frequency airborne vibrations that can induce vibrations in buildings or other structures. Peak airborne pressure levels occur at frequencies below the range of human hearing and thus do not create any audible noise.

The potential for damage to buildings from blast noise peak pressures has been studied for several decades. Airborne vibrations can sometimes be felt even when they occur at acoustic frequencies below the range of human hearing. At a high enough level, airborne vibrations can rattle loose objects or windows. At even higher intensities, the potential exists for cosmetic damage, such as cracks in stucco, paint, or plaster. Peak overpressures of 122 decibels (equivalent to a physical pressure of 0.037 pound per square inch or an approximately 13-mile-per-hour wind gust) can rattle loose objects or windows. Cosmetic damage in the form of cracks in stucco, paint, or plaster can occur at peak overpressures above 134 decibels (equivalent to a physical pressure of 0.0145 pound per square inch or an approximately 27-mile-per-hour wind gust). Peak overpressures above 152 decibels (equivalent to a physical pressure of 0.115 pound per square inch or an approximately 75-mile-per-hour wind gust) can break poorly mounted windows.

In addition to airborne vibrations, blasting will cause ground vibrations. Ground vibrations travel much faster than airborne vibrations but also dissipate much more rapidly than airborne vibrations. Whereas geological conditions have a strong influence on the distance at which ground vibrations can be felt, it is very rare for blasting operations to produce detectable ground vibrations at distances of more than 1 to 2 miles. Ground vibrations can be measured in various ways, but the “peak particle velocity” is the most commonly used measure.

Thresholds of Significance

No single regulatory agency or threshold is applicable to noise generated at the mine site.
The following guidelines are presented to establish an approximate framework within which appropriate thresholds can be selected. Land use compatibility thresholds of significance for mine construction and operation are most appropriately established with the 24-hour day-night average sound level, as determined by the 1980 Federal Interagency Committee on Urban Noise report (Federal Interagency Committee on Urban Noise 1980), because the duration and schedule for these

activities may vary from day to day. The U.S. Department of Housing and Urban Development, Federal Transit Administration, and Federal Aviation Administration use this metric to establish impacts. Local nuisance ordinances are often based on a 24-hour day-night average sound level threshold. Land use compatibility standards for transportation improvements that bring increased commuter and supply truck traffic to the mine site may be established with either the day-night average sound level or with the equivalent noise level metric. The equivalent noise level metric is well suited to activities with known peak periods such as morning and evening rush hour traffic to and from the mine site. The Federal Highway Administration and the Arizona Department of Transportation use this metric, whereas the U.S. Department of Housing and Urban Development applies the day-night average sound level metric to assess traffic noise impacts.

The Occupational Safety and Health Administration has established permissible noise exposure limits based on the amount of time a worker experiences a specified equivalent noise level. Similarly, the Mine Safety and Health Administration sets exposure limits for mine workers to noise sources of varying intensity. A brief discussion of noise thresholds of significance appropriate for mining activities follows.

U.S. Department of Housing and Urban Development Standards

Noise has two different types of effects on people: the direct physical effects such as hearing loss and the less direct effects of interference with activities such as sleep and conversation. The standards contained in the U.S. Department of Housing and Urban Development noise regulation are based on levels that cause interference effects, not levels that can cause hearing loss.

U.S. Department of Housing and Urban Development noise guidelines are based on a series of surveys compiled in the U.S. Environmental Protection Agency (1974) report titled “Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety.” Most of the surveys indicated that there were two breakpoints in reported interference and annoyance. Below 55 day-night average sound level, there was very little interference (for example, speech intelligibility was more than 99 percent) and very little resulting annoyance. Over 65 day-night average sound level, interference and annoyance both increase rapidly.

The U.S. Environmental Protection Agency set 55 day-night average sound level as the basic goal. But other federal agencies, including the U.S. Department of Housing and Urban Development, in consideration of their own program requirements and goals as well as the difficulty of actually achieving a goal of 55 day-night average sound level, have settled on the 65 day-night average sound level as their standard. At 65 day-night average sound level, activity interference is kept to a minimum, and annoyance levels are still low. It is also a level that realistically can be expected to be achieved. Following the federal lead, most local jurisdictions that have adopted noise standards have adopted 65 day-night average sound level as the breakpoint for acceptability. Table 149 summarizes the U.S. Department of Housing and Urban Development acceptability standards.

The U.S. Department of Housing and Urban Development standards are most appropriately applied in assessing the impacts of surface and pit blasting noise and noise from the operation of mining and construction equipment on residential land use in the project area. The standards may also be applied to commuter and supply truck traffic associated with the mine, although other Federal and State standards assess impacts using the equivalent noise level metric.

Table 149. Site acceptability standards

	Day-Night Average Noise Level (decibels (dB))	Special Approvals and Requirements
Acceptable	Not exceeding 65 dB*	None
Normally Unacceptable	Above 65 dB but not exceeding 75 dB	Special Approvals,† Environmental Review,† Attenuation‡
Unacceptable	Above 75 dB	Special Approvals,† Environmental Review,† Attenuation‡

* Acceptable threshold may be shifted to 70 dB in special circumstances pursuant to 24 Code of Federal Regulations 51.105(a), U.S. Department of Housing and Urban Development.

† See 24 Code of Federal Regulations 51.104(b), U.S. Department of Housing and Urban Development, for requirements.

‡ 5 dB additional attenuation required for sites above 65 dB but not exceeding 70 dB, and 10 dB additional attenuation required for sites above 70 dB but not exceeding 75 dB (24 Code of Federal Regulations 51.104(a)).

Office of Surface Mining Standards

In addition to audible noise, blasting generates low-frequency airborne vibrations that can induce vibrations in buildings or other structures. Peak airborne pressure levels occur at frequencies below the range of human hearing and thus do not create any audible noise. The general requirements of the Office of Surface Mining blasting performance standards (30 Code of Federal Regulations 816.67) state, “Blasting shall be conducted to prevent injury to persons, damage to public or private property outside the permit area, adverse impacts on any underground mine, and change in the course, channel, or availability of surface or ground water outside the permit area.”

Peak overpressure (airblast) levels from mine blasting may not exceed the maximum un-weighted decibel limits shown in table 150 at the location of any dwelling, public building, school, church, or community or institutional building outside the permit area, except at structures owned by the mining permittee or owned and leased by the permittee to another where a written waiver has been submitted. Flat response and C-weighting are used to capture the low-frequency noise levels associated with blasting.

Table 150. Peak overpressure (airblast) levels

Lower Frequency Limit of Measuring System, in Hertz (Hz) (±3 Decibels)	Maximum Level, in Decibels
0.1 Hz or lower – flat response*	134 peak
2 Hz or lower – flat response	133 peak
6 Hz or lower – flat response	129 peak
C-weighted – slow response*	105 peak C-weighted decibels

* Only when approved by the regulatory (permitting) authority.

The maximum ground vibration also may not exceed the limits on blast particle velocity shown in table 151 at the location of any dwelling, public building, school, church, or community or institutional building outside the permit area, except at structures owned by the mining permittee or owned and leased by the permittee to another where a written waiver has been submitted. The peak particle velocity in inches per second is the most commonly used metric to describe and quantify ground vibrations.

Table 151. Maximum peak particle velocity

Distance from the Blasting Site (feet)	Maximum Allowable Peak Particle Velocity for Ground Vibration (inches per second)*
0 to 300	1.25
301 to 5,000	1.00
5,001 and beyond	0.75

* Ground vibration shall be measured as the particle velocity. Particle velocity shall be recorded in three mutually perpendicular directions. The maximum allowable peak particle velocity shall apply to each of the three measurements.

Federal Highway Administration and Arizona Department of Transportation Standards

The Federal Highway Administration has issued regulations for noise evaluation in 23 Code of Federal Regulations 772, "Procedures for Abatement of Highway Traffic Noise and Construction Noise." The main objectives of 23 Code of Federal Regulations 772 are "to provide procedures for noise studies and noise abatement measures, to help protect the public health and welfare, to supply noise abatement criteria, and to establish requirements for information to be given to local officials for use in the planning and design of highways approved pursuant to Title 23, United States Code (U.S.C.)." According to Federal Highway Administration regulations, a traffic noise impact occurs when the predicted traffic noise level approaches or exceeds the Noise Abatement Criteria for the specified land use. In addition, an impact occurs when the predicted traffic noise level substantially exceeds the existing noise level.

Noise level impact criteria may be based on a threshold, the change in noise level from the existing noise level, or both. Table 152 summarizes the Federal Highway Administration Noise Abatement Criteria for various land use categories. The Noise Abatement Criteria for Category B, which includes homes, churches, schools, and parks, is 67 A-weighted decibels.

Table 152. Federal Highway Administration Noise Abatement Criteria

Land Use Category	Noise Level L_{Aeq1h}* (A-weighted decibels (dBA))	Description of Land Use
A	57 dBA (exterior)	Land on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is to continue to serve its intended purpose. Such areas could include amphitheaters, particular parks, or open spaces that are recognized by appropriate local officials for activities requiring special qualities of serenity and quiet.
B	67 dBA (exterior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, picnic areas, playgrounds, active sports areas, and parks.
C	72 dBA (exterior)	Developed lands, properties, or activities not included in categories A and B above.
D	–	Undeveloped lands.
E	52 dBA (interior)†	Residences, motels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: 23 Code of Federal Regulations 772.

* L_{Aeq1h} is the one-hour equivalent sound level.

† The interior sound level (activity) applies to (1) indoor activities for those parcels where an exterior noise sensitive activity is identified; and (2) situations in which the exterior activities will not be affected by the noise, but the interior activities will be affected.

The Federal Highway Administration allows each state to define the levels at which the noise "approaches" the criteria and when it "substantially exceeds" the existing noise level. The Arizona Department of Transportation (2005) "Noise Abatement Policy" determines the noise-level impact for Category B land uses when the noise level "approaches" within 3 A-weighted decibels of the Federal Highway Administration Noise Abatement Criteria, or 64 A-weighted decibels total, and considers mitigation for customer locations where the predicted highway traffic noise level is equal to or greater than 64 A-weighted decibels. The Arizona Department of Transportation also considers mitigation if the noise level from the transportation improvement project is predicted to increase substantially. A substantial noise level increase is equal to or greater than 15 A-weighted decibels.

According to the "Pima County Noise Abatement Procedure" (Pima County Department of Transportation 2008), noise abatement should be considered if noise levels reach 66 A-weighted decibels or higher at noise-sensitive properties. Additionally, mitigation measures will be considered for noise-sensitive properties if predicted traffic noise levels substantially exceed existing levels. "Substantially exceed" is defined as an increase of 15 A-weighted decibels between the existing noise levels and future noise levels, which is identical to the Arizona Department of Transportation definition.

These guidelines provide an alternate means of assessing noise impacts for commuter traffic to and from the mine site and for construction activities; however, because the duration and schedule for mining activities, including blasting and equipment operations, may vary from day to day, the U.S. Department of Housing and Urban Development day-night average sound level metric is more useful and provides a common method for assessing noise from all mine activities.

Occupational Safety and Health Administration

Occupational Safety and Health Administration guidelines state that worker protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in table 153 when measured on the A scale of a standard sound level meter at slow response. When employees are subjected to noise levels exceeding those listed in the table, feasible administrative or engineering controls shall be used. If such controls fail to reduce sound levels within the levels of table 153, personal protective equipment shall be provided and used to reduce sound levels to within the levels of the table.

Table 153. Occupational Safety and Health Administration permissible noise exposures

Duration per Day (Hours)	Noise Level A-weighted Decibel Slow Response
8	90
6	92
4	97
2	100
1½	102
1	105
½	110
¼ or less	115

Note: When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: C(1)/T(1) + C(2)/T(2) + … + C(n)/T(n) exceeds unity, then the mixed exposure should be considered to exceed the limit value. Cn indicates the total time of exposure at a specified noise level, and Tn indicates the total time of exposure permitted at that level. Exposure to impulsive or impact noise should not exceed the 140-decibel peak sound pressure level.

The Occupational Safety and Health Administration standards are most appropriately applied in assessing the impacts of surface and pit blasting noise and noise from the operation of mining and construction equipment on miners and mine personnel.

Mine Safety and Health Administration

The federal Mine Safety and Health Administration Occupational Noise Exposure standards delineate permissible exposure limits for 32 A-weighted noise levels, measured at slow-response, between 80 A-weighted decibels (32-hour duration) and 115 A-weighted decibels (0.25-hour duration). The mine operator must establish a system of monitoring that evaluates each miner's noise exposure sufficiently to determine continuing compliance with this part (30 Code of Federal Regulations 62) using a noise dosimeter. The noise determination must be made without adjustment for the use of a hearing protector, integrate all sound levels over the appropriate range, reflect the miner's full work shift, use a 90-decibel criterion level with a 5-decibel exchange rate, and use the A-weighting and slow response setting.

The exchange rate is a measure of how much the noise level would have to change to preserve a selected measure of the risk of hearing loss (90 decibels for mining activities) when the exposure duration is doubled (or halved). At no time can the noise level exceed 115 A-weighted decibels; therefore, a maximum noise level metric is appropriate in such cases.

The Mine Safety and Health Administration standards, as described in 30 Code of Federal Regulations 62, are applicable specifically to miners for the duration of their workday. The standards impose reporting requirements and maintenance of records on mine operators. They are most appropriately applied in assessing the impacts of surface and pit blasting noise and noise from the operation of mining and construction equipment on miners.

Selected Thresholds and Noise Receptors

No single regulation or standard provides pertinent thresholds for noise for the purposes of this analysis. Rather, the above agency guidance has been used as input for establishing reasonable thresholds for noise in order to assess impacts. The specific threshold of interest depends on the selected noise receptors.

Selected Noise Receptors

Thirteen locations were selected to represent noise receptors, covering both permanent residents and transient recreational users, as shown in figure 92.

- The nearest residence to the mine to the northeast (House H);
- The nearest residence to the mine to the southeast (House A);
- The nearest residences and structures along State Route 83 (House O, House P, Building F);
- Recreational use as close as possible to the perimeter fence, specifically Township 19 South, Range 15 East Section 1 (south of site, labeled REC1); Township 18 South Range 16 East, Section 17 (north of site, labeled REC2); and Township 18 South, Range 15 East Section 26 (west of site on west side of Santa Rita Mountains, labeled REC3);
- Recreational use along the Arizona National Scenic Trail at two locations, representing the northeast (labeled AZT1) and southeast (labeled AZT2) edges of mine footprint;

- Recreational use at common pullouts along State Route 83 at the westernmost overlook of the mine site (labeled HWY1) and at Hidden Springs Road (labeled HWY2); and
- Recreational use representing forest road travel and common dispersed camping sites, three locations along Box Canyon Road, specifically Township 19 South, Range 15 East, Section 11 (labeled BOX1), Township 19 South, Range 16 East, Section 7 (labeled BOX2), and Township 19 South, Range 16 East, Section 17 (labeled BOX3).

Selected Noise Thresholds

Residences – Noise. The selected threshold for noise at residences is a day-night average sound level of 65 A-weighted decibels. This is based primarily on U.S. Department of Housing and Urban Development Site Acceptability Standards. This selected threshold is also more restrictive than the 67-decibel level typically used for traffic noise impacts at residences.

Residences – Blasting Vibration. The selected thresholds for airborne (peak overpressure) and ground-borne (peak particle velocity) vibrations are 134 decibels for airborne vibrations and 0.75 inch per second peak particle velocity for ground-borne vibrations. These thresholds are based on Office of Surface Mining Reclamation and Enforcement Standards.

Recreational Users – Noise. The threshold for impacts by noise on recreational users is more difficult to define; none of the listed agencies offer pertinent guidance. For the purposes of this DEIS, several qualitative thresholds were selected based on the noise levels shown in table 148. For the recreational users who may be near the perimeter fence, along the Arizona National Scenic Trail, and along Box Canyon Road, a threshold of 40 A-weighted decibels was selected, which qualitatively represents “a typical suburban area at night, or typical whispering at 1 to 2 feet.” For the recreational users along State Route 83, a threshold of 65 A-weighted decibels was selected, which qualitatively represents “a typical daytime busy downtown.”

Noise modeling has not been conducted for the Barrel Alternative at this time; however, impacts from this alternative have been estimated from modeling of other alternatives.

Summary of Effects by Issue Measures by Alternative

Table 154 presents the summary comparison of impacts from each alternative.

Table 154. Summary of effects

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
9: Potential for noise to reach recreation areas and expected noise level	None	For all action alternatives: impacts to recreational users from blasting noise (construction and operational phases) and equipment operational noise (operational phase), resulting in likely decrease in recreational value in area	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
11B: Ability of alternatives to meet rural landscape expectations	Likely to meet expectations	For all action alternatives: no impacts to residents from construction, blasting, equipment operation, or traffic noise during any phases of mine life	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action

Affected Environment

Relevant Laws, Regulations, Policies, and Plans

The regulation of noise and vibration from mining activities is accomplished primarily at the Federal level, with States and Municipalities responsible for enforcement. Controls address worker exposure and environmental or land use compatibility.

Federal Regulations

The Noise Pollution and Abatement Act of 1970 (Title IV of the Clean Air Act, 42 United States Code 7627) established an Office of Noise Abatement and Control within the U.S. Environmental Protection Agency. The U.S. Environmental Protection Agency was directed to investigate and identify the effects of noise levels on public health and welfare, including psychological and physiological effects on humans; effects of sporadic extreme noise, compared with constant noise; effects on wildlife and property; effects of sonic booms on property; and such other matters as may be of interest in the public welfare. Title IV of the Clean Air Act also requires other federal agencies and departments to consult with the U.S. Environmental Protection Agency regarding methods for abating objectionable or nuisance condition noise impacts that result from activities they carry out or sponsor.

The Federal Noise Control Act of 1972 (42 United States Code 4901 et seq.) established a requirement that all Federal agencies must administer their programs in a manner that promotes an environment free from noise that jeopardizes public health or welfare. The U.S. Environmental Protection Agency was given the responsibility of providing information to the public regarding identifiable effects of noise on public health or welfare, publishing information on the levels of environmental noise that will protect the public health and welfare with an adequate margin of safety, coordinating Federal research and activities related to noise control, and establishing Federal noise emission standards for selected products distributed in interstate commerce (construction equipment; transportation equipment; motors and engines; and electrical or electronic equipment). States and political subdivisions of States retain the right to establish and enforce controls on environmental noise through the licensing, regulation, or restriction of the use, operation, or movement of products or combinations of products. The Federal Noise Control Act also directed all Federal agencies to comply with Federal, State, interstate, and local noise control and abatement requirements to the same extent that any person is subject to such requirements.

Although the U.S. Environmental Protection Agency can require other Federal agencies to justify their noise regulations with respect to the policy requirements of the Federal Noise Control Act, each Federal agency retains the authority to adopt noise regulations pertaining to agency programs.

Land Use Compatibility

The Federal Interagency Committee on Urban Noise was formed in 1979 to review various Federal agency programs related to noise impacts on land use. The committee included representatives of the U.S. Department of Transportation, U.S. Department of Housing and Urban Development, U.S. Environmental Protection Agency, Department of Defense, and Veterans Administration. The 1980 report issued by the Federal Interagency Committee on Urban Noise summarized federal agency noise policies and programs (Federal Interagency Committee on Urban Noise 1980). In addition, it identified the day-night average sound level noise metric as the most appropriate noise descriptor to use for evaluating noise in the context of land use compatibility issues. The 1980 Federal

Interagency Committee on Urban Noise report also included a chart of compatible and incompatible noise levels for various categories of land use.

The Federal Interagency Committee on Noise was formed in 1990 to review Federal agency policies concerning the assessment of airport noise issues. Participating agencies included the U.S. Department of Transportation, Department of Defense, Department of Justice, U.S. Department of Housing and Urban Development, U.S. Environmental Protection Agency, Veterans Administration, and Council on Environmental Quality. The 1992 report prepared by the committee confirmed the use of the day-night average sound-level noise metric as the primary basis for assessing land use compatibility issues but also recognized that supplementary noise descriptors could be useful to further explain noise impacts on a case-by-case basis.

Other Federal agencies, such as the Federal Highway Administration, Federal Transit Administration, and Federal Railroad Administration, have developed noise impact criteria that employ a sliding scale of noise levels, depending on both existing land use and noise levels. Some Federal agencies, such as the National Park Service, Bureau of Land Management, and Forest Service, have not adopted any specific noise impact and vibration criteria or standards.

The Surface Mining Control and Reclamation Act of 1977 sets general guidelines applicable to all surface coal mining and reclamation operations (Public Law 95-87). The performance standards also apply to blasting conducted for minerals mining. With the dissolution of the Bureau of Mines in 1995, regulatory authority was transferred to the Office of Surface Mining Reclamation and Enforcement. Performance standards established by the Office of Surface Mining Reclamation and Enforcement include a preblasting survey of all structures within 0.5 mile of a permitted area; blasting schedule, signs, warnings, and access control; control of adverse effects; and recordkeeping requirements (30 Code of Federal Regulations 816).

Worker Exposure

The Occupational Safety and Health Administration has primary authority for setting workplace noise exposure standards. Because of aviation safety considerations, the Federal Aviation Administration has primary jurisdiction over aircraft noise standards. In 1999, the Mine Safety and Health Administration published new "**Health Standards for Occupational Noise Exposure."** The purpose of these standards is to prevent the occurrence and reduce the progression of occupational noise-induced hearing loss among miners. Title 30 Code of Federal Regulations Part 62, Section 100, sets forth mandatory health standards for each surface and underground metal, nonmetal, and coal mine subject to the Federal Mine Safety and Health Act of 1977. The provisions of this part became effective on September 13, 2000. Title 30 Code of Federal Regulations 56 provides additional safety and health standards specific to surface metal and nonmetal mine operations.

State and Local Legislation

State regulations focus primarily on noise from motor vehicles and aircraft as well as equipment operation, with no specific provisions for mining operations. Title 28 Arizona Revised Statutes, Article 16, Section 955, regulates the use of mufflers on equipment and motor vehicles, including motorcycles. The Arizona Administrative Code does not contain any noise abatement language.

Local ordinances also primarily address noise generated by motor vehicles and aircraft. Pima County Development Services Ordinance 2008-119, "Noise Level Design and Construction Standards," sets minimum requirements for noise-level reduction of the building exterior within established noise

contour zones of the Tucson International Airport and the Davis-Monthan Air Force Base. The standards apply to noise-sensitive land uses, including all habitable areas of residential uses, all indoor areas where the primary purpose is to receive the public, office areas (with some exceptions), and all noise-sensitive indoor areas or indoor areas where the normal noise level is low, including libraries, schools, and religious facilities.

The Pima County Department of Transportation Procedure No. 03-5, "Traffic Noise Analysis and Mitigation Guidance for Major Roadway Projects," was developed to provide guidance for the development of noise mitigation for Pima County's major roadway projects (Pima County Department of Transportation 2008). It contains procedures for traffic noise abatement, noise analysis methodology, and requirements for noise reports and is commonly called the Pima County Noise Abatement Procedure.

Existing Conditions

Rural residential land uses are located northeast and southeast of the project site, as shown in figure 92. Eight residences are located northeast of the project area along State Route 83 in the Mulberry Canyon area, about 6 to 7 miles from the center of the proposed open-pit mine. Six residences are located southeast of the project site along Singing Valley Road, about 3 to 4 miles from the center of the proposed open-pit mine. Nine additional rural residences are located southeast of the project site, about 5 to 6 miles from the center of the open-pit mine, scattered along State Route 83, East Greaterville Road, Old Sonoita Highway, Beatty Ranch Road, and Singing Hills Trail. The Santa Rita Abbey is located along East Fish Canyon Road, 7.3 miles from the center of the proposed mine.

Ambient Noise Conditions in the Project Area

Figure 93 is an overview map showing locations used for ambient noise monitoring at the project area. Measurements were conducted by Tetra Tech and summarized in the technical report "Rosemont Copper Background Ambient Noise Study," prepared for Rosemont Copper (Tetra Tech 2008). The measurement results presented in the report are summarized in the following section.

Project Area Measurement Locations and Descriptions

Five locations in the southern part of the project area (monitoring sites L1 through L5) were monitored over the 2008 Memorial Day weekend with Larson Davis 820 sound-level meters for 72 consecutive hours. L6 was monitored for about 9 hours with a Center 322 sound-level meter. Monitoring site L1 was located about 1 mile from State Route 83 on the nose of a small side ridge downslope of the main ridge crest at the north of the end of Singing Valley Road. None of the residences along Singing Valley Road were visible from this location. Monitoring site L2 was located about 1 mile from the highway near the top of a ridge that faced west, with an open view of the project area to the northwest. Monitoring sites L3 through L5 were at different elevations in a valley, which is oriented east, toward State Route 83. Monitoring site L3 was located just under 1.00 mile from State Route 83, and monitoring site L4 was located about 0.64 mile from the highway. Monitoring site L5 was located relatively close to State Route 83 (0.11 mile). Monitoring site L6 was on a flat area 234 feet from State Route 83.

After the 2008 Memorial Day weekend, additional noise monitoring was conducted at the north end of the project area and at locations closer to the proposed mine. One Larson Davis sound-level meter and one Center 322 sound-level meter were placed at monitoring site L7, which was located near State Route 83 at the northeast corner of the proposed mining operations area, about 1.6 miles

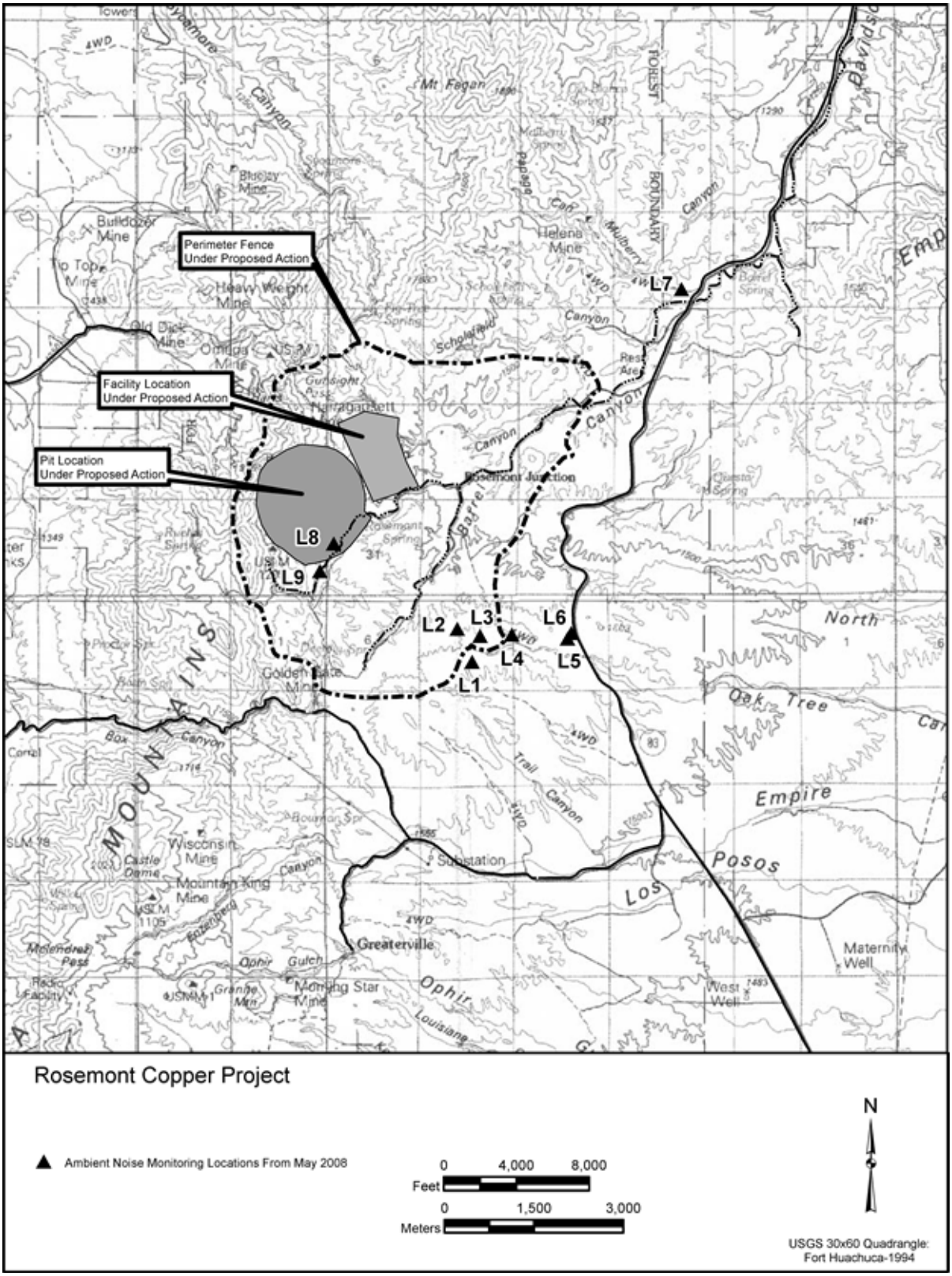


Figure 93. Ambient noise monitoring locations (Tetra Tech 2009d)

southwest of the Mulberry Canyon. There are scattered rural residences in the area. Two additional Larson Davis meters were placed along a ridge southeast of the proposed mine area (at monitoring sites L8 and L9). The additional monitoring locations are shown in figure 93. Table 155 presents a summary of noise-level data collected at monitoring sites L1 through L6 during the 2008 Memorial Day weekend and at monitoring sites L7 through L9 for the weekdays after Memorial Day weekend. The results of various ways of measuring the noise, such as maximum and minimum sound levels and average day-night sound levels, are shown.

Interpretation of Project Area Ambient Measurements

The monitoring data collected from the project area demonstrate the low ambient noise conditions typical of areas with limited development and few major roadways. All nine sites monitored had noise levels below 45 A-weighted decibels at least 70 percent of the time. Only monitoring sites L2 and L7 had 24-hour equivalent noise level values consistently above 45 A-weighted decibels. As indicated in table 155, all monitoring sites in the project area exhibited consistent minimum noise levels, with little day-to-day variation. Most sites showed a similar overall noise level range, with minimum noise levels of approximately 31 to 35 A-weighted decibels and maximum noise levels of approximately 71 to 77 A-weighted decibels. Noise graphs in appendix D of the "Background Ambient Noise Study" (Tetra Tech 2008) indicate somewhat higher noise levels during daytime hours than during nighttime hours. However, monitoring sites L8 and L9 showed little variation in noise levels between daytime and nighttime hours.

Distinct spatial patterns in background noise levels were not evident, except for the influence of State Route 83 at locations relatively close to the roadway. The influence of the traffic noise from State Route 83 is evident from the monitoring results at sites L5 through L7. These monitoring sites also exhibited reduced noise levels during nighttime and early morning hours, when traffic volumes on State Route 83 were reduced. Daytime traffic noise levels from State Route 83 became a low ambient noise component at distances more than 1,000 to 2,000 feet from the highway. Noise levels also tended to be somewhat higher on ridgelines than in valley areas, as would generally be expected as a result of terrain shielding by ridges and mountains. As shown in table 155, monitoring sites L1 and L2, which were located on or close to the tops of ridgelines, had day-night average sound level and 24-hour equivalent noise level values that were higher than those of monitoring sites L3 and L4, which were located in a valley below the surrounding ridgelines.

Data from locations monitored over the 2008 Memorial Day weekend generally showed higher noise levels on Saturday than on Sunday or Monday. All five sites showed somewhat higher day-night average sound level values on Saturday, compared with Sunday or Monday. Four of the five sites showed small variations in 24-hour equivalent noise level values over the 2008 Memorial Day weekend. Only monitoring site L1 showed a spread of more than 2.5 A-weighted decibels in 24-hour equivalent noise level values. Wind conditions did not appear to be a major factor in generating the higher noise levels on Saturday. Average wind speeds were slightly higher on Saturday than on the other days, but maximum hourly average wind speeds were the same each day over the weekend. Maximum hourly average wind speeds did not exceed 15 miles per hour, a speed at which wind may begin to inflate background noise conditions.

Table 155. Summary of noise levels at project area monitoring sites (A-weighted decibels)

	L_{dn}	L_{eq}	L_{max}	L05	L10	L33	L50	L90	L95	L_{min}
2008 Memorial Day Weekend										
L1	54.8 46.0 43.0	53.9 41.3 40.4	77.1 67.4 75.2	49.7	45.2	37.4	34.2	30.9	30.8	30.3 30.1 30.3
L2	55.2 50.6 51.8	49.6 49.5 47.4	77.8 78.3 80.1	54.7	50.6	41.2	38.3	36.3	36.2	35.7 35.7 35.8
L3	49.2 48.6 48.7	43.3 43.1 43.6	75.1 68.6 81.0	47.1	44.9	41.9	41.3	40.4	40.4	40.0 40.0 40.0
L4	43.3 42.0 42.1	38.0 37.2 38.4	72.2 68.1 75.6	41.3	39.2	35.7	34.3	32.6	32.5	32.1 32.1 32.2
L5	47.4 46.7 45.7	43.2 45.0 43.0	77.6 84.9 74.5	48.9	45.9	38.8	35.3	32.1	31.9	31.5 31.4 31.5
L6	NA	50.0	73.6	55.9	53.5	46.5	42.4	32.3	30.9	27.4
Weekdays after 2008 Memorial Day Weekend										
L7	55.2 54.6	50.7 49.7	82.4 77.0	56.0	52.3	43.1	41.4	40.5	40.4	39.9 40.1
L7B	NA	50.1	77.6	55.7	52.0	41.9	35.2	27.3	27.0	26.9
L8	43.4 44.3	39.0 39.6	71.0 67.2	43.8	41.0	36.6	35.2	33.5	33.1	32.3 32.3
L9	43.7 45.4	39.3 41.1	81.8 71.9	45.7	42.6	36.3	34.7	32.8	32.6	31.7 31.7

Notes:

L05 = sound level was exceeded 5% of the time (overall monitoring period).

L10 = sound level was exceeded 10% of the time (overall monitoring period).

L33 = sound level was exceeded 33% of the time (overall monitoring period).

L50 = sound level was exceeded 50% of the time (overall monitoring period).

L90 = sound level was exceeded 90% of the time (overall monitoring period).

L95 = sound level was exceeded 95% of the time (overall monitoring period).

L_{dn} = day-night average noise level, a 24-hour average with annoyance penalty of 10 A-weighted decibels for nighttime noise. L_{dn} values for each 24-hour period listed separately.

L_{eq} = equivalent continuous noise level, each 24-hour period listed separately.

L_{max} = maximum sound level (fast response setting), each 24-hour period listed separately.

L_{min} = minimum sound level (fast response setting), each 24-hour period listed separately.

NA = not applicable; monitoring duration not long enough to calculate L_{dn}.

Monitoring site L1 showed the greatest variation in day-to-day day-night average sound level and 24-hour equivalent noise level values, with noise levels on Saturday (May 24, 2008) noticeably higher than the day-night average sound level and equivalent noise level for Sunday (May 25, 2008) and Monday (May 26, 2008). The more pronounced variation in day-night average sound levels and 24-hour equivalent noise levels at site L1 may reflect variations in outdoor activity levels at the

homes along Singing Valley Road. These homes are the closest residences to the project site, approximately 3 miles from the open-pit mine area (which is identical for all action alternatives).

Monitoring site L2 may have been influenced by intermittent mechanical equipment noise. Although no such noise sources were evident when the monitoring site was established, L2 was the only site with day-night average sound-level values consistently above 50 A-weighted decibels and daily maximum noise levels consistently above 77 A-weighted decibels. Monitoring site L2 also had the second highest average 24-hour equivalent noise-level values to monitoring site L7 near State Route 83. In addition, L2 was the only site monitored over the 2008 Memorial Day weekend that had noise levels above 50 A-weighted decibels more than 10 percent of the time. A large vertical tank was noted about 300 feet southeast of monitoring site L2. Intermittent operation of a pump or other mechanical equipment might have accounted for the somewhat higher than average noise levels at monitoring site L2. This site had one daily maximum noise level value just over 80 A-weighted decibels. This may have been the result of a vehicle door closing near the noise meter. A dirt road was located fairly close to the meter location, and security personnel reported that they stopped at and investigated most monitoring sites.

Monitoring site L3 had the highest minimum noise levels (40 A-weighted decibels) among the five locations monitored over the 2008 Memorial Day weekend in the project area. The source of the relatively high minimum noise levels at monitoring site L3 is unknown. This site was in an upper valley location about 1 mile from State Route 83, more than 1,000 feet from the tank near monitoring site L2. Monitoring site L3 also had one daily maximum noise level value over 80 A-weighted decibels. The source of this relatively high noise event is unclear. The monitoring site was well removed from the nearest unpaved road, and there was no evidence of off-road vehicle use near the noise meter.

Monitoring site L4 had the lowest day-night average sound level and 24-hour equivalent noise-level values of any monitored locations within the project area. Noise levels at monitoring site L4 exceeded 45 A-weighted decibels less than 5 percent of the time. Monitoring site L4 was in a mid-valley location, about 3,390 feet (0.64 mile) from State Route 83.

Monitoring site L5 was somewhat influenced by traffic noise from State Route 83. The site was approximately 600 feet from State Route 83. The monitoring location was high enough on the side of the valley to have line of sight to a portion of State Route 83. However, actual day-night average sound-level values measured at monitoring site L5 were lower than those measured at monitoring sites L1 through L3. Monitoring site L5 had the highest daily maximum noise-level value of any of the nine sites monitored in the project area (84.9 A-weighted decibels). The maximum noise level at monitoring site L5 appears to have been a gunshot. This conclusion is plausible, since the meter was well off the nearest unpaved road, vegetation around the monitoring site showed no evidence of off-road vehicle activity, the site was located about 600 feet from State Route 83, and the noise lasted less than 0.1 second.

Monitoring site L6 was monitored for slightly less than 9 hours using a Center 322 meter. Monitoring site L6 was 235 feet from State Route 83. Monitoring began on a Friday afternoon and continued until the instrument memory was filled, shortly after midnight. While the duration and timing of monitoring at site L6 prevented an ideal comparison with the other monitoring sites, the data generally showed higher noise levels than those monitored at sites L1 through L5, as would be expected from a location closer to State Route 83. Minimum noise levels at monitoring site L6 were

lower than those measured by the Larson Davis meter at monitoring site L7, but average noise levels at site L6 were similar to those at site L7.

Monitoring site L7 had a relatively high minimum noise level of about 40 A-weighted decibels, which is attributable to periods with low traffic volumes on State Route 83. This site also had one daily maximum noise-level value above 80 A-weighted decibels, which was probably the result of a peak traffic period, possibly including an unusually noisy vehicle on State Route 83. Monitoring site L7 was about 190 feet from State Route 83.

Monitoring sites L8 and L9 were on a ridgeline in the interior portion of the project area. Both locations measured similar noise levels over a 2-day period. Only monitoring site L4 had 24-hour equivalent noise-level values lower than those measured at sites L8 and L9. Monitoring site L9 had one daily maximum noise level value above 80 A-weighted decibels. This may have been a vehicle door closing near the noise meter. Security personnel reported that they stopped at and investigated most monitoring sites.

The potential contribution from low-altitude military aircraft to monitored peak noise levels was investigated. The two closest military training routes, VR-259 and VR-260, are about 4 to 5 miles from the noise monitoring sites in the southern part of the project area (monitoring sites L1 through L6, L8, and L9). VR-259 is about 2.5 miles from monitoring site L7. These distances are too far from the noise monitoring locations in the project area to have contributed significantly to measured noise levels or to have caused the measured peak noises. Based on the U.S. Air Force Omega 10.8 aircraft noise model, peak F-16 military jet noise contributions at monitoring site L7 would be 66 A-weighted decibels or less, and peak noise contributions at the other monitoring sites would be 56 A-weighted decibels or less. Peak noise contributions from other types of military jet aircraft generally would be less than the noise levels from F-16 jets.

In summary, ambient noise levels in the project area do not exceed the noise thresholds of significance selected for this analysis with respect to residences (65 A-weighted decibels). However, they would exceed the selected threshold for recreational use at several locations (40 A-weighted decibels).

Noise Levels at an Active Copper Mine

In addition to noise monitoring in the vicinity of the project area, 1 day of noise monitoring was conducted at an active open-pit copper mine in May 2008. The results are presented in the report titled “Rosemont Copper Background Ambient Noise Study” (Tetra Tech 2008).

The active open-pit copper mine was chosen not only because it is in Arizona but because it has several similar terrain features for comparative analysis with the project area. The similar terrain includes ridges for terrain shielding and an open, down-sloping terrain with no intervening ridges to allow for mining activity noise dispersion.

Active Copper Mine Measurement Descriptions

Permission to monitor noise levels at this mine was granted on condition that the mine would not be identified. Three monitoring locations (L10 through L12) were planned at different distances from an active pit during the May 2008 monitoring period. Monitoring site L10 was on a completed waste rock pile overlooking the active pit area. Monitoring site L11, which was located along a haul road about 1 mile from the blast site, was shielded from the pit area by an intervening ridge. Monitoring

site L12, which was about 1.25 miles from the blast site, was located near the boundary of the mining operation. This location was separated from the pit area by downward-sloping terrain, without any intervening ridges, that bordered the remainder of the mining pit. An instrument problem at monitoring site L10 prevented the collection of noise data, but data were collected for more than 24 hours at two other locations.

Table 156 presents a summary of the noise monitoring data collected at sites L11 and L12. One large blast occurred during the noise monitoring period. However, the blast was not identifiable in the time history data from noise monitoring sites L11 and L12. This was the result of the combination of pit-wall shielding, other terrain shielding, and general ground absorption effects, which reduced peak blast noise to levels comparable to ambient background conditions at monitoring sites L11 and L12. Mine operations staff also reported that they do not normally hear blasts at the mine's office building complex, which is approximately 3.5 miles from the pit area across intervening ridges. Most brief noise peaks in the monitoring data represented vehicle traffic on nearby haul roads.

Additional noise monitoring was conducted at this same active mine in October 2008. The results are presented in the Supplemental Noise Study. Three locations were selected for monitoring. The first meter was located on a completed waste rock pile overlooking the active blast location (monitoring site L10), and the meter was set back about 100 feet from the edge of the pit. A second meter was located on the edge of a different completed waste rock pile overlooking the active pit with a direct line of sight to the blast location (monitoring site L13). The third location was along a haul road leading to the vehicle wash facility (monitoring site L14), with downward-sloping ground but no major ridgelines between the monitoring site and the blast location within the pit area. Monitoring site L14 was about 0.33 mile closer to the pit than the monitoring site L12 location used during the May 2008 monitoring period. One Larson Davis 820 sound-level meter and one Center Technology 322 sound-level meter were placed at each of the three locations. The Larson Davis meters ran for 47.8 hours at monitoring site L10, 42.8 hours at monitoring site L13, and 48.0 hours at monitoring site L14. The Center 322 meters provided backup and generally were set to collect 1-second time history data. Table 156 also presents a summary of noise monitoring data collected by the Larson Davis meters during the October 2008 monitoring period.

Two blasts occurred during the period of monitoring, one on the first day and another on the third day. A battery failure in the Larson Davis meter at monitoring site L13 prevented measurement of the second blast at the L13 site. The 1-second data logging interval for the Center 322 meter at this site was not fast enough to detect the true blast maximum noise level, but available data indicate that the second blast would have produced a maximum noise level similar to, or perhaps a little lower than, that of the first blast.

Interpretation of Active Copper Mine Measurements

Data from monitoring site L13 provided information on blast noise without any pit-wall or terrain shielding. Data from monitoring site L10 provided information on the effect of pit-wall shielding. Data from monitoring site L11 provided information on the effect of significant terrain shielding beyond the immediate pit area. Data from monitoring sites L12 and L14 provided information on noise levels at distances of about 1.1 miles and 0.8 mile, respectively, with no major intervening terrain shielding but with general ground absorption effects over irregular, downward-sloping terrain. Blast monitoring occurred at the pit area during both May 2008 and October 2008. Heavy equipment operations at the pit and on haul roads occurred at a lower intensity during the May 2008 monitoring period than during the October 2008 monitoring period.

Table 156. Summary of noise levels at active copper mine (in A-weighted decibels)

	L_{dn}	L_{eq}	L_{max}	L05	L10	L33	L50	L90	L95	L_{min}
May 2008										
L11	42.6	38.8	72.5	39.8	37.2	34.2	33.4	32.3	32.0	31.4
L12	41.8	39.4	70.8	41.4	38.4	34.2	33.2	29.4	29.3	29.0
October 2008										
L10	NA 51.7 NA	62.5 59.2 56.6	92.9 72.3 93.3	53.1	50.8	45.1	40.8	28.3	24.1	19.3 18.5 17.6
L13	NA 66.3 NA	62.5 59.2 56.6	111.0 95.1 73.4	65.4	62.9	57.0	53.5	41.9	34.0	20.7 19.3 23.5
L14	NA 59.6 NA	51.7 54.9 52.0	79.7 84.3 80.0	55.3	49.0	36.2	24.3	24.3	23.3	19.8 19.9 20.4

Notes:

L05 = sound level was exceeded 5% of the time (overall monitoring period).

L10 = sound level was exceeded 10% of the time (overall monitoring period).

L33 = sound level was exceeded 33% of the time (overall monitoring period).

L50 = sound level was exceeded 50% of the time (overall monitoring period).

L90 = sound level was exceeded 90% of the time (overall monitoring period).

L95 = sound level was exceeded 95% of the time (overall monitoring period).

L_{dn} = day-night average noise level, a 24-hour average with annoyance penalty of 10 A-weighted decibels for nighttime noise. L_{dn} values for each 24-hour period listed separately.

L_{eq} = equivalent continuous noise level, each 24-hour period listed separately.

L_{max} = maximum sound level (fast response setting), each 24-hour period listed separately.

L_{min} = minimum sound level (fast response setting), each 24-hour period listed separately.

NA = not applicable; monitoring duration not long enough to calculate L_{dn}.

Except for maximum noise levels from blasts or nearby heavy equipment operations, the noise monitoring data from the active copper mine were similar to the ambient noise levels measured in the project area. Minimum noise levels measured around the active mine were actually lower than the minimum noise levels measured in the project area. In addition, minimum noise levels measured in October 2008 were significantly lower than those measured at the active mine in May 2008. Minimum noise levels measured in October 2008 were about 20 A-weighted decibels at all three monitoring sites. By comparison, minimum noise levels measured in the project area generally were between 30 and 35 A-weighted decibels.

Two blasts were monitored at site L10 in October 2008. One blast occurred on a pit bench about 165 feet higher than monitoring site L10 but with intervening terrain shielding within the pit area. The blast location was about 1,790 feet (0.34 mile) from monitoring site L10. The second blast occurred within the pit at an elevation of about 350 feet below the elevation of monitoring site L10. This blast was about 1,390 feet (0.26 mile) from monitoring site L10. As indicated in table 156, both blasts generated similar maximum noise levels at monitoring site L10 (92.9 and 93.3 A-weighted decibels, respectively). By comparison with data from monitoring site L13, pit-wall shielding was estimated to be about 20 A-weighted decibels. The day-night average sound level measured at monitoring site L10 in October 2008 (51.7 A-weighted decibels) represents a day with heavy equipment operations in the pit area but no blasting. In addition, a drill rig was operating on a bench immediately above the waste rock pile, where monitoring site L10 was located. The day-night

average sound level and 24-hour equivalent noise level at monitoring site L10 were comparable to the corresponding values measured at monitoring site L2 in the project area.

Monitoring site L11 was monitored in May 2008. This site was within the active mine property about 1 mile from the pit and at about the same elevation as monitoring site L10. There were intervening hills and ridgelines between the pit and monitoring site L11. The May 2008 blast occurred in the pit at a distance of about 1 mile from monitoring site L11. The blast was not detectable in the time history data from monitoring site L11. The day-night average sound level for monitoring site L11 (42.6 A-weighted decibels) was comparable to that of monitoring site L4 in the project area. The maximum noise-level data from monitoring site L11 (72.5 A-weighted decibels) represent haul truck traffic near the monitoring site and were comparable to the maximum noise-level values from monitoring site L4 in the project area.

Monitoring site L12 was monitored in May 2008. The site was just outside the mine property, about 1.1 miles from the active portion of the overall pit area and at an elevation below that of the blast. There were no significant hills or ridgelines between the monitoring site and the pit area, although pit walls and benches within the pit provided shielding from the monitored blast. The May 2008 blast occurred in the pit, at a distance of about 1.25 miles from monitoring site L12. The blast was not detectable in the time history data from monitoring site L10. The day-night average sound level and maximum noise-level values at monitoring site L12 (41.8 and 70.8 A-weighted decibels, respectively) were slightly lower than those at monitoring site L11, although the overall equivalent noise-level value for monitoring site L12 was slightly higher than that for L11. In general, noise levels at monitoring site L12 were comparable to those at monitoring site L4 in the project area.

Monitoring site L13, at the edge of the active pit, was monitored in October 2008. This site had the highest noise levels, as would be expected for a location with line of sight into the pit. Monitoring site L13 was about 260 feet above the monitored blast location. As noted previously, a battery failure terminated monitoring by the Larson Davis meter before the second blast. The measured blast produced a maximum noise level of 111 A-weighted decibels. On the day between blasts, mining activity in the pit area produced a day-night average sound level of 66.3 A-weighted decibels, a 24-hour equivalent noise level of 59.2 A-weighted decibels, and a maximum noise level of 95.1 A-weighted decibels. As expected, these values were higher than the background noise levels measured in the project area.

Monitoring site L14 was monitored in October 2008. Monitoring site L14 was close to an onsite mine road and obtained data on passing heavy equipment noise levels and blast noise levels. The mine road provided access to the pit area and to a vehicle wash facility.

Monitoring site L14 was in the same general area as monitoring site L12, although somewhat closer to the pit area and about 60 feet from the edge of the mine road. Two blasts were monitored at monitoring site L14. The first was about 1 mile from monitoring site L14, and the second was about 0.7 mile from monitoring site L14. The elevation at monitoring site L14 was about 445 feet below the elevation of the first blast site and at about the same elevation as the second blast site. The first blast was not detectable in the time history data from monitoring site L14. The second blast was detectable in the maximum noise level and instantaneous peak time history data but not in the equivalent noise level time history data from monitoring site L14. The second blast generated a maximum noise level of 66.5 A-weighted decibels at monitoring site L14, which was less than the maximum noise-level values generated by trucks and heavy equipment on the mine road. On the day between blasts, measured day-night average sound level (59.6 A-weighted decibels), 24-hour equivalent noise level

(54.9 A-weighted decibels), and maximum noise level (84.3 A-weighted decibels) values at monitoring site L14 were the result primarily of heavy truck and other equipment operations on the adjacent mine road. These noise levels were slightly higher than comparable levels measured at monitoring site L7 in the project area.

Environmental Consequences

Direct and Indirect Effects of Each Alternative

No Action Alternative

The no action alternative would result in noise levels similar to those measured during the ambient noise level monitoring. Under ambient conditions, none of the various regulatory standards described above are exceeded.

Impacts Common to All Action Alternatives

Expected noise impacts under the proposed action alternative have been assessed (Tetra Tech 2009d). Subsequent noise modeling was also conducted for the Phased Tailings, Barrel Trail, and Scholefield-McCleary Alternatives (Sculley 2010a, 2010b, 2010c, 2010d, 2010e). Noise modeling has not yet been conducted for the Barrel Trail Alternative; however, noise impacts can be estimated from other modeling scenarios. Noise impacts during construction and closure phases (blasting, construction, and traffic noise) would be identical for all action alternatives. Noise impacts from traffic were modeled for a segment along State Route 83 from approximately milepost 52 to the north and the Pima/Cochise county line to the south. Noise impacts during the operational phase (equipment noise) would vary by alternative and are assessed separately. Airborne and ground vibrations during construction and operational phases would be identical for all action alternatives.

Results of Noise Modeling

Direct impacts from blasting, construction, operational, and traffic noise have been modeled for the project area (Tetra Tech 2009d). Noise modeling was conducted for seven parameters. The following five modeled parameters are pertinent to residential and recreational noise receptors:

- Maximum blast noise for surface blasting (A-weighted decibels);
- Maximum blast noise for in-pit blasting (A-weighted decibels);
- Maximum construction noise for plant site (A-weighted decibels);
- Maximum intermittent equipment noise at waste rock and tailings (A-weighted decibels); and
- 24-hour day-night average sound level for traffic noise (decibels).

For blasting impacts, the following two parameters were also assessed:

- Airborne vibrations through peak overpressure levels (decibels); and
- Ground vibrations through peak particle velocity (inches per second).

Construction Phase – Noise Impacts

Noise impacts during the construction phase consist of construction noise, traffic noise, and, potentially, blasting noise, although this is not considered to be largely necessary during construction. Noise impacts for the construction phase are shown in table 157.

Table 157. Noise impacts expected to occur during construction phase

Analysis Location	Threshold of Significance	Construction	Blasting*	Traffic
House A	65	<30	50 to 60	35 to 40
House H	65	<30	50 to 60	40 to 45
House O	65	<30	<50	53.4 to 55.5
House P	65	<30	50 to 60	52.7 to 54.8
Building F	65	<30	50 to 60	53.3 to 55.3
REC1	40	30 to 40	70 to 80	<30
REC2	40	30 to 40	60 to 70	<30
REC3	40	30 to 40	50 to 60	<30
BOX1	40	<30	40 to 50	<30
BOX2	40	<30	60 to 70	<30
BOX3	40	<30	50 to 60	30 to 35
HWY1	65	30 to 40	60 to 70	60 to 65
HWY2	65	<30	50 to 60	60 to 65
AZT1	40	30 to 40	60 to 70	35 to 40
AZT2	40	<30	60 to 70	<30

* Shaded cells indicate an exceedance of selected noise threshold.

Blasting was modeled for both surface blasting and in-pit blasting conditions. Surface blasting was generally found to have the greater impact of the two and therefore has been used in this analysis. Results for modeling of maximum surface blast noise range from more than 90 A-weighted decibels near the open pit to 60 to 70 A-weighted decibels at the edges of the mine facility. Maximum surface blast noise at residential receptors is not expected to exceed 60 A-weighted decibels, which does not exceed the selected threshold of 65 A-weighted decibels. However, maximum surface blast noise exceeds the selected threshold at almost all recreational locations.

Results for modeling of maximum construction noise range from more than 80 A-weighted decibels near the plant site to 30 to 40 A-weighted decibels at the edges of the mine facility. Maximum construction noise at all receptors is expected to be less than 40 A-weighted decibels and does not exceed the selected threshold at any location. Traffic noise at the peak of operations (20 years) was modeled along State Route 83 (this represents a worst-case scenario with respect to traffic volume). Immediately adjacent to the roadway, traffic noise peaks at more than 65 A-weighted decibels; however, none of the noise receptors are within this range. The nearest noise receptors fall within a modeled noise range of 50 to 55 A-weighted decibels; this noise level does not exceed the selected threshold at any location.

To summarize, blast noise during the construction phase is expected to affect recreational users in the area (although blasting would not be used frequently or regularly during construction). Noise levels would generally remain below 70 A-weighted decibels, which is considered moderately noisy to noisy, and would be similar in nature to a leaf blower at 50 feet or a 6-lane freeway at 300 feet. However, because blasting would not be used extensively during the construction phase, impacts to recreational users during this time are not likely to be significant.

Closure Phase – Noise Impacts

Noise impacts during the closure phase would consist of demolition noise (considered to be similar to construction noise and not separately modeled) and traffic noise. Noise impacts for the closure phase are shown in table 158.

Table 158. Noise impacts expected to occur during closure phase

Analysis Location	Threshold of Significance	Demolition	Traffic
House A	65	<30	35 to 40
House H	65	<30	40 to 45
House O	65	<30	53.4 to 55.5
House P	65	<30	52.7 to 54.8
Building F	65	<30	53.3 to 55.3
REC1	40	30 to 40	<30
REC2	40	30 to 40	<30
REC3	40	30 to 40	<30
BOX1	40	<30	<30
BOX2	40	<30	<30
BOX3	40	<30	30 to 35
HWY1	65	30 to 40	60 to 65
HWY2	65	<30	60 to 65
AZT1	40	30 to 40	35 to 40
AZT2	40	<30	<30

Noise levels during the closure phase do not exceed the selected threshold levels at any of the monitoring locations.

Construction and Operational Phases – Airborne and Ground Vibrations

Airborne and ground vibration caused by blasting were also modeled. Subsonic vibrations are of concern only with respect to property damage; therefore, results are compared only with the nearest residential receptor to the southeast (House A) and northeast (House H) and not with potential recreation users on the Coronado National Forest. Based on the modeling results, as shown in table 159, the modeled airborne and ground vibrations at the closest structures to the southeast and northeast do not exceed Office of Surface Mining Reclamation and Enforcement regulatory standards.

Table 159. Impacts from airborne and ground vibrations

Modeled Parameter	Nearest Receptors House A	Nearest Receptors House H
Airborne Vibration (Peak Overpressure (decibels (dB)))	106.5	98.8
Ground Vibration (Peak Particle Velocity (inches per second (in/sec)))	0.040	0.014
Office of Surface Mining, Reclamation, and Enforcement (OSM) Maximum Peak Overpressure 0.1 hertz (Hz) or lower (dB)	134	134
OSM Maximum Peak Overpressure 2 Hz or lower (dB)	133	133
OSM Maximum Peak Overpressure 6 Hz or lower (dB)	129	129
OSM Maximum allowable peak particle velocity (in/sec)	0.75	0.75

Proposed Action Alternative

Operational Phase – Noise Impacts

Noise impacts during the operational phase would include equipment operational noise, blasting noise, and traffic noise, as shown in table 160.

Table 160. Noise impacts expected to occur during operational phase under proposed action

Analysis Location	Threshold of Significance	Equipment	Blasting*	Traffic
House A	65	30 to 40	50 to 60	35 to 40
House H	65	<30	50 to 60	40 to 45
House O	65	<30	<50	53.4 to 55.5
House P	65	<30	50 to 60	52.7 to 54.8
Building F	65	<30	50 to 60	53.3 to 55.3
REC1	40	40 to 50	70 to 80	<30
REC2	40	40 to 50	60 to 70	<30
REC3	40	<30	50 to 60	<30
BOX1	40	<30	40 to 50	<30
BOX2	40	40 to 50	60 to 70	<30
BOX3	40	<30	50 to 60	30 to 35
HWY1	65	30 to 40	60 to 70	60 to 65
HWY2	65	<30	50 to 60	60 to 65
AZT1	40	40 to 50	60 to 70	35 to 40
AZT2	40	40 to 50	60 to 70	<30

Note: Shaded cells indicate an exceedance of selected noise threshold.

No residential receptors within the modeled analysis area are expected to experience noise levels above the selected thresholds. If the 55 decibel traffic noise contour on State Route 83 is extended to the north from milepost 52 (the approximate northern limit of the model) to Interstate 10, approximately 320 private parcels of land would be wholly or partially within the contour between Interstate 10 and the Pima/Cochise county line, according to the Pima County Assessor records. Whether these parcels have residential receptors within the contours is not known.

Recreational users would experience noise levels from blasting and from equipment operation above the selected threshold of 40 A-weighted decibels, particularly along the Arizona National Scenic Trail, in the forest areas near the perimeter fence, and in dispersed camping locations along forest roads.

During the operational phase, blasting operations would be conducted daily and would be limited to daylight hours, typically between 9 a.m. and 4 p.m. Blasting would typically occur once a day. There would likely be a reduction in recreation as a result of noise impacts under the proposed action alternative.

Phased Tailings Alternative

Noise impacts expected during the operational phase for the Phased Tailings Alternative are the same as for the proposed action.

Barrel Alternative

Operational Phase – Noise Impacts

Noise impacts during the operational phase would include equipment operational noise, blasting noise, and traffic noise, as shown in table 161.

Table 161. Noise impacts expected to occur during operational phase under Barrel Trail Alternative

Analysis Location	Threshold of Significance	Equipment	Blasting	Traffic
House A	65	40 to 50	50 to 60	35 to 40
House H	65	<30	50 to 60	40 to 45
House O	65	<30	<50	53.4 to 55.5
House P	65	<30	50 to 60	52.7 to 54.8
Building F	65	<30	50 to 60	53.3 to 55.3
REC1	40	<30	70 to 80	<30
REC2	40	<30	60 to 70	<30
REC3	40	<30	50 to 60	<30
BOX1	40	<30	40 to 50	<30
BOX2	40	<30	60 to 70	<30
BOX3	40	<30	50 to 60	30 to 35
HWY1	65	40 to 50	60 to 70	60 to 65
HWY2	65	<30	50 to 60	60 to 65
AZT1	40	40 to 50	60 to 70	35 to 40
AZT2	40	30 to 40	60 to 70	<30

Source: Sculley (2010b).

Note: Shaded cells indicate an exceedance of selected noise threshold.

No residential receptors are expected to experience noise levels above the selected thresholds. However, recreational users would experience noise levels from blasting above the selected threshold of 40 A-weighted decibels, particularly along the Arizona National Scenic Trail, in the forest areas near the perimeter fence, and in dispersed camping locations along forest roads. During the operational phase, blasting operations would be conducted daily and would be limited to daylight hours, typically between 9 a.m. and 4 p.m. Blasting would typically occur once a day. Equipment noise would be less noticeable to recreational users under the Barrel Trail Alternative, with the selected threshold being exceeded only at one location along the Arizona National Scenic Trail.

There would likely be a reduction in recreation as a result of noise impacts under the Barrel Trail Alternative.

Barrel Trail Alternative

While noise modeling for the Barrel Trail Alternative has yet to be conducted, the actions and activities that would contribute to noise are similar to the other action alternatives, and the effects of the Barrel Trail Alternative are expected to be similar to those for the other action alternatives.

Scholefield-McCleary Alternative

Operational Phase – Noise Impacts

Noise impacts during the operational phase would include equipment operational noise, blasting noise, and traffic noise, as shown in table 162.

Table 162. Noise impacts expected to occur during operational phase under Scholefield-McCleary Alternative

Analysis Location	Threshold of Significance	Equipment*	Blasting*	Traffic
House A	65	30	50 to 60	35 to 40
House H	65	<30	50 to 60	40 to 45
House O	65	<30	<50	53.4 to 55.5
House P	65	<30	50 to 60	52.7 to 54.8
Building F	65	<30	50 to 60	53.3 to 55.3
REC1	40	30 to 40	70 to 80	<30
REC2	40	40 to 50	60 to 70	<30
REC3	40	<30	50 to 60	<30
BOX1	40	<30	40 to 50	<30
BOX2	40	30 to 40	60 to 70	<30
BOX3	40	<30	50 to 60	30 to 35
HWY1	65	30 to 40	60 to 70	60 to 65
HWY2	65	<30	50 to 60	60 to 65
AZT1	40	40	60 to 70	35 to 40
AZT2	40	30 to 40	60 to 70	<30

Source: Sculley (2010d).

Note: Shaded cells indicate an exceedance of selected noise threshold.

No residential receptors are expected to experience noise levels above the selected thresholds. However, recreational users would experience noise levels from blasting above the selected threshold of 40 A-weighted decibels, particularly along the Arizona National Scenic Trail, in the forest areas near the perimeter fence, and in dispersed camping locations along forest roads. During the operational phase, blasting operations would be conducted daily and would be limited to daylight hours, typically between 9 a.m. and 4 p.m. Blasting would typically occur once a day. Equipment noise would be less noticeable to recreational users under the Scholefield-McCleary Alternative, with the selected threshold being exceeded only in the recreational location just north of Scholefield Canyon. There would likely be a reduction in recreation as a result of noise impacts under the Scholefield-McCleary Alternative.

Cumulative Effects

The Council on Environmental Quality defines a cumulative impact as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency (federal or nonfederal) or person undertakes such other actions” (40 Code of Federal Regulations 1508.7). As outlined in the chapter 3 introduction, cumulative impacts of past and present actions are identified and analyzed in the “Affected Environment” part of each resource section, including for “Noise.” This cumulative effects discussion addresses the cumulative impacts of the action alternatives and any applicable reasonably foreseeable actions as identified on the Coronado ID team’s list of reasonably foreseeable future actions, provided in the chapter 3 introduction. The following reasonably foreseeable actions from that list were determined to contribute to a cumulative impact to noise:

- Pavement preservation of State Route 83 from Sonoita to milepost 43
- Sahuarita Road Phase II
- Closure of approximately 35 abandoned small mines

None of these activities would involve sustained noise levels at the same location for any significant length of time. Therefore, no cumulative effects with respect to noise would be expected.

Mitigation Effectiveness and Remaining Effects

Noise for large-scale activities such as the proposed project typically cannot be effectively mitigated at the source. Rather, if needed, mitigation would be applied at the location of a noise receptor, usually through construction of sound walls or improvement of existing structures. No specific structural mitigation is proposed at this time.

Irretrievable and Irreversible Commitment of Resources

Irretrievable commitment of resources would consist of mine related noise during the construction and operation phases of the mine. Because the mine related noise would cease after closure of the mine, noise impacts would not be considered an irreversible commitment of resources.

Public Health and Safety

Introduction

The health and safety concerns present in the project area are both natural and human caused. Many of the health and safety issues described are themselves the topics of separate resource sections of this DEIS. Whereas those sections primarily address the effects on the environment, this “Public Health and Safety” section focuses on the potential impacts of those resources on humans. Analysis of health and safety is restricted to that of the general public not involved in mine operations. Health and safety risks to mine personnel are not addressed in this analysis.

Issues, Cause and Effect Relationships of Concern

Mine operations necessarily require increased traffic and commuter traffic on roadways, the use of hazardous materials and explosives, and landscape modifications, which can cause additional risk to the general public by affecting roadways, air quality, and noise levels and by changing geological conditions.

One significant issue was identified during scoping concerning public safety.

Issue 10: Impact on Public Safety

This issue focuses on the impact of increased traffic from the mine site on construction, operation, and maintenance of new and reconstructed roadways. Oversized vehicles and the transport of personnel, equipment, supplies, and materials related to the mine operation have the potential to increase traffic and reduce public safety. Hazardous materials would be transported, which may increase the risk of a spill or other public safety impact. Another aspect of this issue is human health risks to Coronado National Forest visitors if they accidentally come near the mine operations, tailings, or waste rock piles. Air quality impacts resulting from the operation may be harmful to public health.

Issue 10 Factors for Alternative Comparison

- Change in type and pattern of traffic by road and vehicle type
- Trip count per day for all hazardous materials and qualitative assessment of potential effects of accident
- Qualitative assessment of transportation conflicts
- Qualitative assessment of public health risk from mine operations and facilities
- Qualitative assessment of public health risk from geological hazards
- Qualitative assessment of public health risk from noise
- Quantitative assessment of ability to meet air quality standards for human health

Analysis Methodology, Assumptions, Uncertain and Unknown Information

The analysis for public health and safety is intended to encompass the temporal and spatial extent necessary to describe the public health and safety hazards that may be associated with the proposed project. The temporal bounds of analysis for public health and safety includes the construction, operation, reclamation, and postclosure phases. The analysis area encompasses the project area and planned transportation routes, including the area extending north to Interstate 10, south to State Route 82, west to Interstate 19, and east to State Route 83 (figure 94). Offsite utility corridors were not considered in the analysis area, as impacts on public health and safety were considered negligible.

Public health and safety conditions exist in the project area as a result of the natural and physical environment and current and previous public use activities. Impacts to public health and safety from these categories are assessed using the following criteria.

Traffic safety is assessed based on traffic modeling of the change in type and pattern of traffic by road and vehicle type and on a qualitative assessment of traffic conflicts.

Risks to public safety from the storage, use, and transportation of hazardous materials are assessed by trip counts and mode of transportation for all hazardous materials and by estimating the likely effects in the event of explosion, fire, or accident. The impact of these types of events is impossible to detail without knowing the exact conditions. Therefore, the potential effects of certain hazardous materials in “worst-case” scenarios are also presented, based primarily on case studies of similar incidents.

Risks of mine operations and facilities to the general public and recreation users are assessed qualitatively, based on the types and locations of hazards; the potential for geological hazards to occur, which may affect the stability of mine facilities; and the potential for noise to be immediately hazardous to the public.

Air quality impacts are assessed based on air quality modeling and the ability to meet numeric air quality standards for acute and chronic exposure.

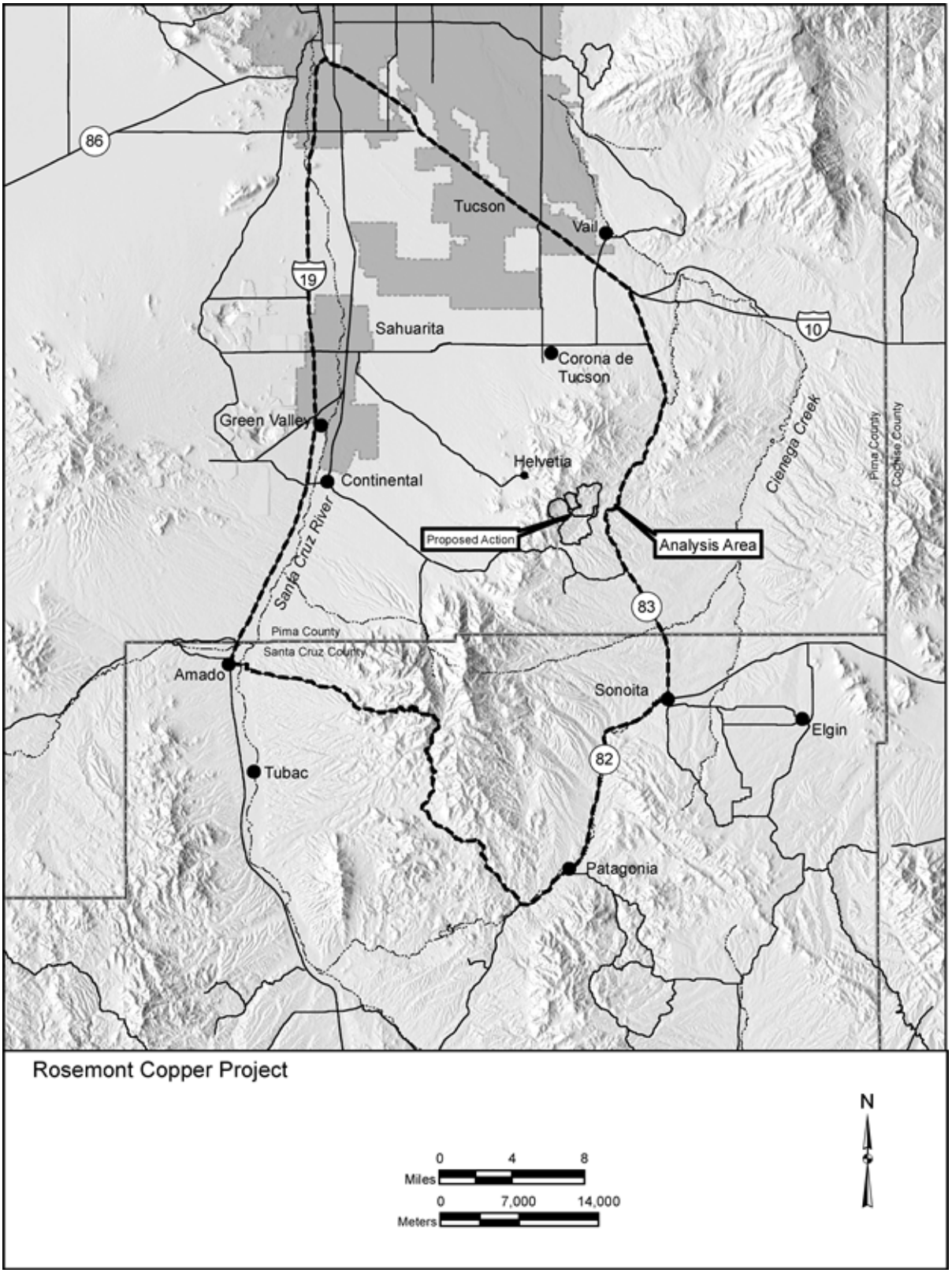


Figure 94. Analysis area for public health and safety

Summary of Effects by Issue Measures by Alternative

Table 163 presents the summary comparison of impacts from each alternative.

Table 163. Summary of effects

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
10: Change in type and pattern of traffic by road and vehicle type; qualitative assessment of transportation conflicts	None	For all action alternatives: traffic volumes to increase up to 356% by year 20 as a result of mine related traffic and anticipated population growth; with carpool mitigation measure traffic volumes to increase by up to 201% by year 20 as a result of mine related traffic and anticipated population growth	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
10: Trip count per day for all hazardous materials and qualitative assessment of potential effects of accident	None	For all action alternatives: direct impacts primarily from potential release of petroleum products, ammonium nitrate, or sulfuric acid. Onsite ammonium nitrate explosion would cause damage up to 2 miles away and release a plume of toxic gases. Onsite petroleum product fire or sulfuric acid release would cause a plume of smoke and/or toxic gases. Accident during transportation would affect a radius of up to 0.5 mile for sulfuric acid, fuels, and ammonium nitrate and a radius of up to 1 mile for explosives.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
10: Qualitative assessment of public health risk from mine operations and facilities	None	For all action alternatives: hazards to recreation are unlikely.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
10: Qualitative assessment of public health risk from geological hazards	None	For all action alternatives: geological hazards are unlikely, with the exception of land subsidence, which could be marginally increased by mine supply pumping.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
10: Qualitative assessment of public health risk from noise	None	For all action alternatives: acute noise hazards from construction, traffic, equipment, or blasting are unlikely.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
10: Quantitative assessment of ability to meet air quality standards for human health	None	For all action alternatives: two modeling scenarios indicate exceedance of hourly National Ambient Air Quality Standard for NO_x.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action

Affected Environment

Relevant Laws, Regulations, Policies, and Plans

Federal

Regulations specific to noise, air, recreation, and hazardous materials are detailed in those respective sections. The following laws and regulations are specific to public health and safety.

The Emergency Planning and Community Right-to-Know Act of 1986 (42 United States Code 11001–11050) requires the private sector to inventory chemicals and chemical products, report those in excess of threshold planning quantities, inventory emergency response equipment, provide annual reports and support to local and State emergency response organizations, and maintain a liaison with the local and State emergency response organizations and the public.

Title 30 Code of Federal Regulations Part 62 Section 100 sets forth mandatory health standards for each surface and underground metal, nonmetal, and coal mine subject to the Federal Mine Safety and Health Act of 1977. The provisions of Part 62 became effective on September 13, 2000. Also, 30 Code of Federal Regulations 56 provides further safety and health standards specific to surface metal and nonmetal mine operations.

The Pollution Prevention Act of 1990 (42 United States Code 13101–13109) encourages and requires prevention and reduction of waste streams and other pollution through minimization, process change, and recycling. It encourages and requires development of new technology and markets to meet the objectives.

Existing Conditions

Public health and safety conditions exist in the project area as a result of the natural and physical environment and current and previous public use activities. The existing conditions are categorized into six types of hazards to public health and safety: geological hazards, transportation and use of hazardous materials, noise, air quality, recreation hazards, and traffic safety.

Geological Hazards

Geological hazards generally include natural occurrences such as earthquakes, landslides, ground subsidence, and fissures. These geological factors need to be taken into consideration with regard to development in the area, in particular with respect to engineered structures. Ground subsidence and fissures are the most likely to be potential safety issues within the project area.

Seismic Faults

Potentially active faults that could generate earthquakes of magnitude 6.5 to 7.2 are scattered throughout southeastern and central Arizona. Earthquakes of this magnitude are considered strong to major events, with serious damage possible over a wide area. All of the potentially active faults in the Phoenix and Tucson areas have low slip rates and long intervals between ruptures and have had little historic activity. Because of this, the Arizona Geological Survey places these areas in the low to moderate hazard category. Tetra Tech (2007a) completed a regional seismological assessment, and the results indicate that 27 active faults lie within a 200-kilometer target radius surrounding the project area.

Soil Composition

Factors such as soil moisture, particle-size distribution, acidity, and electrical conductivity of soils in the project area can compromise some construction materials, including steel; therefore, construction materials and techniques need to be monitored. Some soils in the project area also may be susceptible to erosion from wind and water, which can affect soil stability.

Subsidence

Land subsidence is the lowering of the land surface resulting from changes that take place underground. The common causes of land subsidence from human activity are pumping water, oil, and gas from underground reservoirs; dissolution of limestone aquifers, causing sinkholes; collapse of underground mines; drainage of organic soils; and hydrocompaction caused by initial wetting of dry soils. Most subsidence in Arizona occurs as a result of compaction of alluvial materials resulting from withdrawal of groundwater from underground aquifers. Assessment of geological hazards indicated little risk of subsidence from historic mining operations or karst geology (Tetra Tech 2007a). Land subsidence as a result of groundwater withdrawal has been recorded in the Green Valley area of the Santa Cruz Valley (Carruth et al. 2007). A more detailed discussion of subsidence impacts from groundwater withdrawal is included in the “Groundwater Quantity” section.

Use and Transportation of Hazardous Materials

Hazardous materials, when released uncontrolled into the environment, can impact public safety. Direct exposure to hazardous materials can result in significant immediate health hazards; indirect exposure, such as contamination to groundwater or surface water, can result in long-term health hazards or destruction of natural resources used by the public. Further details of hazardous materials use, transportation, storage, and disposal are included in the “Hazardous Materials” section.

Although the project area has been used historically for various activities, including mining, overall, the natural condition of the project area is relatively intact. Current infrastructure in the project area includes unpaved roads, wells, and utility lines to support existing ranching and recreation uses. Structures are sparse; there is a ranch house and maintenance area, stock tanks, groundwater wells, and fencing. Past mining activity has left behind horizontal shafts, mine adits, a smelter slag pile, and a masonry leaching tank on the west side of the Rosemont Ranch property (Ezzo et al. 2011). The disposition of historic mine workings is focused solely on safely closing and securing access to sites; no reclamation from hazardous materials is expected to be necessary (Sturgess 2007).

Noise

Increasing noise levels can lead to non-auditory effects, speech interference, and sleep interference. Nonauditory effects can include hypertension and changes in blood pressure and heart rate. In 1974, the U.S. Environmental Protection Agency identified noise levels that could be used to protect public health and welfare, including prevention of hearing damage, sleep disturbance, and communication disruption. Any increase in noise levels in the project area would result from activities associated with the construction or operation of the open-pit mine.

Some areas have been identified as potential noise-sensitive receptors in the vicinity of the proposed Rosemont Copper Mine. Eight residences are located northeast of the project area along State Route 83 in the Mulberry Canyon area, approximately 6 to 7 miles from the center of the proposed open-pit mine. Six residences are located southeast of the project area along Singing Valley Road, approximately 3 to 4 miles from the center of the proposed open-pit mine. Nine additional rural

residences are located southeast of the project area, approximately 5 to 6 miles from the center of the open-pit mine, scattered along State Route 83, East Greaterville Road, Old Sonoita Highway, Beatty Ranch Road, and Singing Hills Trail. The Santa Rita Abbey is located along East Fish Canyon Road, 7.3 miles from the center of the proposed open-pit mine.

Background noise data collected from 10 locations in the vicinity of the project area in May 2008 demonstrate the low ambient noise conditions to be typical of areas with limited development and few major roadways. Most of these monitoring locations showed a similar overall noise level range, with minimum noise levels of approximately 31 to 35 A-weighted decibels and maximum noise levels of about 71 to 77 A-weighted decibels. Full details of ambient noise conditions are provided in the "Noise" section.

Air Quality

Air quality is regulated for two general classes of pollutants: criteria pollutants and hazardous air pollutants. Criteria pollutants are those pollutants for which National Ambient Air Quality Standards have been established in order to protect public health. These include CO, NO_2, O_3, $PM_{2.5}$ and PM_{10}, SO_2, and Pb. Hazardous air pollutants consist of almost 200 toxic compounds that have been shown to cause or possibly cause cancer in humans or that may cause adverse environmental and ecological effects.

Ambient air quality monitoring for PM_{10} has been conducted in the project area since 2006; ambient monitoring for all other criteria pollutants has been conducted in Pima County but not specifically in the project area. Ambient concentrations of PM_{10} in the project area are well below the National Ambient Air Quality Standards. Ambient concentrations of all other criteria pollutants are expected to be well below the National Ambient Air Quality Standards, based on monitoring conducted in Pima County. Ambient concentrations of hazardous air pollutants are also expected to be low; further details of expected concentrations of hazardous air pollutants, along with a complete list of hazardous air pollutants, are included in the "Air Quality and Climate Change" section.

Recreation Hazards

The project area consists of hundreds of acres of natural desert, areas that are typically exposed to off-highway vehicle traffic, campers, day-users, and hikers. A number of developed and semideveloped campgrounds, picnic areas, day-use areas, trailheads, roads, and trails exist for recreation use in the area. Off-highway vehicle use can pose potential safety concerns for those using the vehicles. Off-highway vehicle traffic can also contribute to potential air quality issues in the immediate area of use as a result of increased particulate matter, particularly O_3 and PM_{10}. Further details of recreation conditions are included in the "Recreation and Wilderness" section.

Traffic Safety

State Route 83

State Route 83 is a two-lane state scenic highway in southern Arizona, stretching from its junction with Interstate 10 near Vail south to Parker Canyon Lake. It passes through sparsely populated areas of Pima, Cochise, and Santa Cruz Counties, traversing the town of Sonoita. State Route 83 has a lack of school bus pullouts, a lack of sufficient guardrails, and a high frequency of accidents.

Further details of State Route 83 conditions are included in the "Transportation/Access" section. With respect to the analysis of public health and safety, two criteria are useful in assessing future conditions: accident history, and current traffic counts and level of service.

Annual Accidents along State Route 83

Based on analysis of accident frequency and accident rate, the top five accident-prone locations were identified to be mileposts 44 through 46, 55, and 58. The proposed primary access road for the project is located at milepost 46.9. The analysis shows that this location has a relatively low accident frequency and rate. At mileposts 44 and 45, there was a significantly higher accident frequency, compared with the rest of State Route 83. Of the total accidents that occur along State Route 83, 26 percent are at milepost 44. The analysis showed that the roadway between mileposts 44 and 46 has substandard tight, horizontal curves. This indicates that the roadway geometry has an influence on accident frequency.

Of the total accidents on State Route 83 between 2002 and 2008, approximately 49 percent were associated with passenger cars and 30 percent were associated with motorcycles. Accidents involving semi trucks showed a relatively low value, at approximately 3.8 percent. School bus accidents accounted for 0.54 percent of the total accidents. At milepost 44, the most common vehicle type was a motorcycle, and speeding was the major accident cause. Motorcycles accounted for 69 percent of the vehicle types involved in accidents at milepost 44, and passenger cars accounted for 19 percent. Of all the major causes of accidents along State Route 83, speeding was the major cause, accounting for 51 percent of the total accidents. Approximately 23 percent were not the result of improper driving, meaning that the driver's behavior was not the main cause of the accident; this indicates possible problems with the roadway geometry.

Of the accidents that occurred on State Route 83 between 2002 and 2008, 47 percent resulted in no injury and 24 percent resulted in non-incapacitating injuries. There were three fatal accidents at milepost 44, accounting for 1.6 percent of the total accidents. The Arizona Department of Transportation has recently completed a safety project between mileposts 44 and 46, and this will likely reduce the frequency of accidents in this area.

Traffic Counts

Table 164 shows traffic counts conducted for State Route 83 in 2008, by time of day, on weekdays and weekends, during peak (October) and nonpeak (August and September) seasons, and by traffic type (Tetra Tech 2009e). Types 1 and 2 refer to motorcycles and light-duty cars and trucks. Type 3 refers to buses and large vans. Type 4 refers to medium trucks (2-axle, 6 tires), and Type 5 refers to heavy trucks (3 or more axles).

Table 164. Baseline traffic counts for State Route 83

Analysis Period	Base Traffic Volume Vehicle Types 1 and 2	Base Traffic Volume Vehicle Types 3 to 5
Nonpeak Season		
Weekday a.m.	160	16
Weekday p.m.	212	12
Weekend a.m.	222	10
Weekend p.m.	250	16

Analysis Period	Base Traffic Volume Vehicle Types 1 and 2	Base Traffic Volume Vehicle Types 3 to 5
Peak Season		
Weekday a.m.	194	36
Weekday p.m.	290	20
Weekend a.m.	212	16
Weekend p.m.	290	22

Source: Tetra Tech (Tetra Tech 2009e).

Environmental Consequences

Direct and Indirect Effects of Each Alternative

No Action Alternative

Under the no action alternative, the project area would remain in its present condition with respect to public health and safety.

Impacts Common to All Action Alternatives

The proposed action and all other action alternatives are identical with respect to geological hazards, use and transportation of hazardous materials, and recreation hazards. The traffic and noise analysis differs slightly from alternative to alternative, but the differences were determined to not be significant to the assessment.

Traffic Safety

Traffic safety is a concern primarily along State Route 83, which would be the main transportation route for personnel, materials, and exported product from the mine. Impacts to traffic safety are assessed in terms of traffic type and volume based on traffic modeling on State Route 83 and extrapolation of those modeling results to accidents and fatalities; qualitative assessments of traffic conflicts were conducted using modeled level of service ratings. For a detailed analysis of the impacts to level of service on State Route 83 between Interstate 10 and State Route 82, see the "Transportation/Access" section.

Effects on Traffic Volume

Traffic volume would vary during construction and operation of the mine, increasing over current baseline conditions. The results shown in table 165 are based on the condition that partial carpooling will occur at the mine for the construction phase year 1 (75 percent of workers carpool in 5-person vans) and no carpooling will occur at the mine for the operations phase year 5 and year 20.
The projections include both mine related traffic (worker commutes and commercial trucks) and growth in baseline traffic owing to projected population growth. The projected population growth is based on the annual population growth rate of Pima County from 1990 to 2006.

Table 165. Effects on projected traffic volume

Analysis Period	Base Traffic Volume Vehicle Types 1 and 2	Base Traffic Volume Vehicle Types 3 to 5	Construction Year Vehicle Types 1 and 2	Construction Year Vehicle Types 3 to 5	Year 5 Vehicle Types 1 and 2	Year 5 Vehicle Types 3 to 5	Year 20 Vehicle Types 1 and 2	Year 20 Vehicle Types 3 to 5
Nonpeak Season								
Weekday a.m.	160	16	214	117	651	37	755	48
Weekday p.m.	212	12	271	112	714	33	852	40
Weekend a.m.	222	10	244	11	583	30	763	37
Weekend p.m.	250	16	275	18	617	37	816	48
Peak Season								
Weekday a.m.	194	36	251	139	692	62	819	85
Weekday p.m.	290	20	357	121	808	42	998	55
Weekend a.m.	212	16	233	18	571	37	744	48
Weekend p.m.	290	22	319	24	665	45	890	59

Sources: Tetra Tech (Tetra Tech 2009e) for construction year data; Park (Park 2010) for year 5 and year 20 data.

Mine operations would have a direct effect on traffic volume. The total traffic during year 1 of the construction phase is projected to increase from 10 to 88 percent, assuming a partial carpool scenario for mine worker commutes (75 percent of the commuters carpool in 5-person vans). Mine related traffic during year 1 of the construction phase would account for 28.7 to 41.4 percent of the total traffic on State Route 83. The total traffic during year 5 of the operations phase is projected to increase by 128 to 290 percent with a no carpool scenario. Mine related traffic during year 5 of the operations phase would account for 46.8 to 69.0 percent of the total traffic on State Route 83. The total traffic during year 20 of the operations phase is projected to increase by 204 to 356 percent with a no carpool scenario. Mine related traffic during year 20 of the operations phase would account for 38.6 to 59.0 percent of the total traffic on State Route 83.

Potential Accidents and Fatalities

Based on data collected between 2002 and 2008, under current traffic conditions, roughly 30 accidents per year occur on State Route 83, with a fatality occurring approximately once every 3 years. Total traffic is projected to increase from 10 to 88 percent during construction, from 128 to 290 percent during year 5, and from 204 to 356 percent during year 20 (Tetra Tech 2009b). Assuming the same accident rates, based on projected increases in traffic (population growth as well as mine-related), in year 20 (the year with the highest increase in traffic volume) approximately 61 to 107 accidents per year could occur on State Route 83, with fatalities occurring between one and two times per year.

Use and Transportation of Hazardous Materials

All hazardous materials and petroleum products would be transported to and from the project area by commercial trucks in accordance with 49 Code of Federal Regulations and 28 Arizona Revised Statutes. The main transportation route for these hazardous materials into and out of the project area would be along Interstate 10 and State Route 83. No rail access is proposed for moving hazardous materials to the project area. Impacts to public health and safety from transportation of hazardous materials are assessed based on the daily trip count for all hazardous materials.

All hazardous materials are stored and used within the mine. The majority of these hazardous materials, even in the event of an accident, represent no threat to public health and safety beyond the mine. Impacts to public health and safety are assessed qualitatively for three hazardous materials: ammonium nitrate, petroleum products (gasoline, diesel fuel kerosene), and sulfuric acid. For the purposes of this analysis, "worst-case" scenarios are qualitatively considered, based on similar case studies.

Effects of Onsite Storage of Ammonium Nitrate

Ammonium nitrate is a strong oxidizer, hence its use as an explosive in ammonium nitrate and fuel oil mixtures, but it is stable when stored under proper conditions. The primary risk from onsite storage of ammonium nitrate is the risk of explosion under certain temperature and pressure conditions or contact with combustible materials. Ammonium nitrate will be stored onsite in three 75-ton storage silos.

There are numerous case studies of ammonium nitrate explosions; worldwide, at least eight ammonium nitrate explosions have been widely reported in the past decade. In general, it is quite difficult to make pure-form ammonium nitrate explode, even when it is exposed to fire. Many incidents involved transportation of small amounts of ammonium nitrate (<25 tons) by ship, truck, or train; these explosions were mainly caused by unrelated accidents and the resulting fire. Fewer incidents involved storage or handling of ammonium nitrate. In 2001, an explosion in the AZF fertilizer factory in Toulouse, France, involved 200 to 300 tons of ammonium nitrate, approximately the same amount to be stored at the Rosemont Copper Mine. In addition to deaths and injuries in the immediate vicinity, property damage occurred up to 2 miles away.

The decomposition of ammonium nitrate during a fire or explosion also results in the release of toxic gases, namely, ammonia and NO_x. Release of these gases during a fire at the storage silos would most likely result in plume movement to the east, with prevailing winds, although winds are variable in the project area. A similar event occurred in 2009 in Bryan, Texas, forcing the downwind evacuation of 80,000 people.

Under proper storage conditions, there are unlikely to be direct effects on public health and safety associated with onsite storage of ammonium nitrate. Proper storage conditions are required under Arizona state regulations (Arizona Administrative Code R11-1 Article 2), as well as under federal regulations (30 Code of Federal Regulations 77.1304). Ensuring proper storage conditions is the responsibility of the mine operator. The Arizona State mine inspector has the charge of inspecting mines for violations and enforcing state law with respect to explosive storage, as does the Federal Mine Safety and Health Administration. Consideration of incidents of fire or explosion associated with stored ammonium nitrate suggests that an incident involving the ammonium nitrate storage silos could cause significant damage even up to 2 miles away and produce large plumes of toxic gases of ammonia and NO_x.

Effects of Onsite Storage of Petroleum Products

Storage of petroleum products onsite represents a potential risk of fire and explosion. Onsite storage would include one 12,000-gallon tank for kerosene, four storage tanks for diesel ranging from 10,000 to 100,000 gallons, and one 10,000-gallon tank for gasoline. While present, hazards from explosion or fire are unlikely to immediately impact anything outside the boundaries of the mine.

The use and storage of petroleum products are so ubiquitous that incidents of fire or explosion involving storage of petroleum products are highly variable. In general, blast impacts from gasoline/diesel/kerosene tank explosions likely would not extend beyond the boundaries of the mine; however, the airborne smoke plume would extend beyond the mine. The plume would extend generally to the east, with prevailing winds, although winds are variable in the project area. Airborne byproducts include CO, CO_2, and uncombusted hydrocarbons.

Direct effects on public health and safety associated with onsite storage of petroleum products are unlikely. However, in the event of a fire or explosion, the smoke cloud would likely affect public health and safety.

Effects of Onsite Storage of Sulfuric Acid

Storage of sulfuric acid onsite represents potential adverse health effects if released. Onsite storage includes two 1,200-ton tanks. While representing a hazard through immediate exposure on skin or eyes, a release of sulfuric acid is unlikely to result in exposure by the general public except if airborne. Sulfuric acid is a stable liquid at temperatures below 536 °F; however, at high temperatures, it does decompose into toxic gases. Although it is not combustible or flammable, sulfuric acid is reactive and can create high heat when reacting with combustible materials.

A simple accident, such as rupture of a storage tank, is unlikely to result in direct effects on public health and safety outside the boundaries of the mine. However, an accident involving exposure of sulfuric acid to fire, or reactive materials, could produce an airborne plume of gas (SO_2 and sulfur trioxide) that would represent a direct, adverse effect on public health and safety.

Effects of Transportation of Hazardous Materials

When stored and used under controlled conditions and in accordance with mine plans and regulatory guidance, hazardous materials do not represent a major threat to public health and safety. Transportation of hazardous materials to the project area generates the most risk because of the potential for a traffic accident to cause an accidental release of a hazardous material. The risk can be minimized through adherence to transportation and hazardous material regulations, but it cannot be completely mitigated. The potential will always exist for accidents to occur; in the event of an accidental release, there is the potential for direct, adverse effects on public health and safety.

Hazardous materials would be shipped in a wide variety of forms and quantities and would total an estimated 24 trips per day. Table 166 summarizes methods of shipment, amounts, and potential risks.

Every traffic accident is different, but the potential impacts from a traffic accident involving these compounds can be estimated by examining the emergency response guidelines (Wheat Scharf Associates and ADOT/FHWA/BLM/USFS Steering Committee 2008). Emergency response guidelines include distance guidelines for first responders to first isolate the spill and then protect the public from the spill. These guidelines represent the likely radius of impact in the event of a traffic accident, as follows:

- Sulfuric acid. For a spill, isolate up to 150 feet away. In the event of a fire, isolate and order evacuations up to 0.5 mile away.
- Diesel fuel, gasoline, kerosene. For a spill, isolate up to 150 feet away. In the event of a fire, isolate and order evacuations up to 0.5 mile away.
- Ammonium nitrate. For a spill, isolate up to 150 feet away. In the event of a fire, isolate and order evacuations up to 0.5 mile away.
- Explosives. For a spill, isolate up to 0.3 mile away, or up to 0.5 mile away for a large spill. In the event of a fire, isolate and order evacuations up to 1 mile away.

Table 166. Estimated frequency of shipments of hazardous materials

Material	Quantity per Year	Trips per Day	Shipment Method	Potential Risks
Sulfuric acid (tons)	73,190	9	Liquid by tanker truck	Immediate contact; toxic gases released at high temperatures
Pebble lime (tons)	37,200	5	Bulk dry by truck	Minimal
Diesel fuel (gallons)	9,000,000	4	Liquid by tanker truck	Explosion and fire
Ammonium nitrate (tons)	20,075	4	Bulk dry by truck	Explosion and fire
Miscellaneous reagents (tons)	3,750	1	Various by truck	Minimal
Wear parts and explosives (tons)	3,250	1	Various by truck	Explosion and fire
Fuels and oils (gallons)	105,000	<1	Liquid by tanker truck	Explosion and fire

Source: WestLand Resources Inc. (2007a).

Recreation Hazards

Impacts to public health and safety from recreation hazards result from exposure of the recreating public to mine operations or unsafe terrain or conditions and are qualitatively assessed based on the types and locations of hazards. According to the preliminary MPO (Tetra Tech 2007a), a perimeter fence would be erected to minimize and discourage any access by the recreating public to the operational areas of the mine itself and would prevent any interaction with mine equipment, unsafe terrain, or unsafe conditions. Restricted access would be indicated by signage along the fence and enforced by security patrols. This would minimize and discourage any contact of the recreating public with mine related hazards. Direct effects on public health and safety associated with recreation in the project area are unlikely.

Geological Hazards

Effect of Subsidence

Subsidence risk is solely related to the withdrawal of groundwater in Green Valley for the mine water supply. Hydrologic modeling shows that groundwater declines of up to 80 feet are expected to occur, based on pumping estimates for the mine water supply. This pumping has the potential to increase or exacerbate ongoing subsidence in the area.

Land subsidence caused by groundwater withdrawal is rarely catastrophic but rather is an extended ongoing process, although existing fissures have been known to open rapidly or grow during heavy rains. As such, fissures generally are more of a risk to property than to public health and safety. There may be direct effects on public health and safety associated with land subsidence as a result of an increase in groundwater pumping, depending on the location and magnitude of the fissures.

Noise

Impacts to public health and safety from noise could arise from traffic noise, blasting noise, or construction or operational noise and are only associated with acute exposure where immediate hearing damage or loss might occur. Impacts are assessed by comparing modeled noise levels with regulatory limits. Modeled noise levels were obtained from a series of technical reports (Sculley 2010a, 2010b, 2010c, 2010d, 2010e; Tetra Tech 2009d). Noise impacts are discussed in detail in the "Noise" section.

Noise exposure as regulated under the Mine Safety and Health Administration or Occupational Safety and Health Administration is typically based on the average exposure over a period of time. The Occupational Safety and Health Administration regulatory limit over 8 hours is 80 A-weighted decibels; while not necessarily applicable to the general public, this threshold has been used to conservatively assess the potential for impacts to public health and safety resulting from noise.

Effects of Traffic Noise

Modeling indicates that any noise in excess of 55 A-weighted decibels from traffic is unlikely to exist beyond the immediate vicinity of the transportation routes. Direct effects on public health and safety associated with traffic noise are unlikely.

Effects of Blasting Noise

Noise from blasting attenuates with distance. Members of the general public could be present on Forest Service land near the mine and be exposed to blasting noise. Noise levels exceeding the threshold of 80 A-weighted decibels would occur in the project area within 1 mile of the blasting event; however, more than 1 mile away from the blasting event, noise levels would not exceed the threshold of 80 A-weighted decibels. Modeling indicates that at 1.5 miles from the blasting event, noise levels are unlikely to exceed the maximum ambient noise levels observed in the project area. Direct effects on public health and safety associated with blasting noise are unlikely.

Effects of Construction and Operational Noise

Modeling indicates that any noise in excess of 60 A-weighted decibels from construction and operation is unlikely to exist outside the project boundaries. Direct effects on public health and safety associated with construction and operational noise are unlikely.

Air Quality

Impacts to public health and safety from air quality consist of both acute (immediate danger to life) and chronic exposure and are assessed by comparing modeled air quality with numeric regulatory levels for criteria pollutants and hazardous air pollutants.

Air quality modeling was conducted for conditions during the construction and operational phases of the project, both in the project area and at Saguaro National Park East (the nearest Class I area). Full details of the modeling are included in the "Air Quality and Climate Change" section.

Criteria pollutants (CO, NO_x, SO_2, and PM) are measured against National Ambient Air Quality Standards. The air quality modeling indicates that, with the exception of NO_x, these standards would not be exceeded at either location during either the construction or operation phases of the project.

Four different scenarios were modeled for NO_x emissions throughout the mine life, each scenario modeling a different ratio of NO_2 to NO. National Ambient Air Quality Standards for NO_x include an

hourly standard as well as an annual standard, measured in micrograms of NO_x per cubic meter. Two of the four modeling scenarios indicate that the hourly National Ambient Air Quality Standard of 188.7 micrograms per cubic meter would be exceeded; the scenarios exceeding the standard ranged from 208.3 to 727.8 micrograms per cubic meter.

Hazardous air pollutants regulations are only applicable when certain thresholds of emission are reached, specifically 10 tons per year of any individual hazardous air pollutant, or 25 tons per year of all hazardous air pollutants. Modeling indicates that 3 to 4 tons per year of hazardous air pollutants would be released by mine activities.

Comparison with numeric regulatory levels indicates that, with the exception of NO_x, there would be no direct, adverse effects on public health and safety as a result of changes to air quality. Several adverse health effects are associated with NO_x (U.S. Environmental Protection Agency 2011). NO_x contributes to the creation of both ground-level O_3 and fine particulates. O_3 can contribute to reduction in lung function and increased respiratory symptoms, leading to respiratory related emergency visits, hospital admissions, and possible premature deaths. Fine particulates can penetrate deeply into the lungs and can cause or worsen respiratory diseases like emphysema and bronchitis and can aggravate existing heart disease, leading to increased hospital admissions and possibly premature death.

Proposed Action and Action Alternatives

There are no impacts specific solely to a particular action alternative.

Cumulative Effects

The Council on Environmental Quality defines a cumulative impact as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency (federal or nonfederal) or person undertakes such other actions” (40 Code of Federal Regulations 1508.7). As outlined in the chapter 3 introduction, cumulative impacts of past and present actions are identified and analyzed in the “Affected Environment” part of each resource section, including for “Public Health and Safety.” This cumulative effects discussion addresses the cumulative impacts of the action alternatives and any applicable reasonably foreseeable actions as identified on the Coronado ID team’s list of reasonably foreseeable future actions, provided in the chapter 3 introduction. The following reasonably foreseeable actions from that list were determined to contribute to a cumulative impact to public health and safety:

- Anticipated 100 percent increase in demand for groundwater in the Sahuarita area by 2030
- Community Water Company of Green Valley recharge
- Farmers Investment Company extension of Central Arizona Project water recharge to currently farmed pecan fields and activation of groundwater storage facility
- Stakaer Parsons concrete plant

First, groundwater use in the Sahuarita area is expected to double by the end of the mine life, which could increase the potential for subsidence because of groundwater pumping by the mine. By the same token, the second and third reasonably foreseeable activities are two projects that could deliver and recharge Central Arizona Project water (Community Water Company of Green Valley and Farmers Investment Company), which would tend to offset the effects of groundwater pumping.

When changes were reasonably foreseeable, the groundwater modeling used to assess impacts caused by pumping incorporated future changes in groundwater use and recharge; thus, potential effects from these activities have already been incorporated into the analysis.

The fourth reasonably foreseeable activity is the operation of the Stakaer Parsons concrete batch plant and crushed aggregate plant, located in Sahuarita, which could increase impacts on air quality. This operation has air quality controls in place to prevent dust emissions from facilities and trucks. Cumulative effects owing to this plant on air quality are possible; it is not known whether these impacts would exceed any numeric air quality standards.

Mitigation Effectiveness

Several mitigation measures apply to public health and safety concerns.

In order to mitigate the potential impacts to local emergency service providers, Rosemont Copper will work with these organizations to maintain or increase the appropriate level of service.

Rosemont Copper will comply with Arizona Department of Transportation Encroachment Permit requirements to address State Route 83 improvement issues related to mine operations, such as intersection improvements and development of turn lanes. To reduce mine related traffic, Rosemont Copper will employ a partial carpool system during the operation phase that would require 75 percent of worker commutes carpool in 5-person vans.

Rosemont Copper will implement regional groundwater mitigation measures within the Tucson Active Management Area by using available Central Arizona Project water as a source to conduct recharge within Tucson Active Management Area (Lower Santa Cruz). Recharge will occur as close as possible within the Tucson Active Management Area to the Rosemont Copper supply well field in the area of the cone of depression caused by Rosemont Copper water withdrawal.

In order to reduce potential human health and environmental risks, hazardous materials and substances will be managed and contained within facilities that are designed, constructed, and maintained to meet applicable laws and regulations. These facilities will include leak containment and recovery systems as required and adequate stormwater management and drainage systems to prevent contamination outside containment areas.

Mine Safety and Health Administration regulations require Rosemont Copper to maintain material safety data sheets and keep them available to workers. Material safety data sheets will be provided to appropriate emergency response departments and hospitals and will be available for employees and visitors entering the mine.

The following elements were developed primarily to reduce potential impacts on air quality from dust, vehicle emissions, and volatile chemicals related to mine activities.

- Dust control will be maintained on access, haul, service, and maintenance roads during construction, operation, and closure phases. Dust control methods will be used on the unpaved section of Santa Rita Road, dedicated Bureau of Land Management roads used for access, and Forest Service roads used for project activities on the west side of the Santa Rita Mountains. Methods of dust control could include applying gravel surfacing, applying water to road surfaces, treating road surfaces with dust control agents, and employing other methods specified in the air quality permit. This permit will specify that speed limits within

project area will be set at a level that will reduce dust production. Rosemont Copper will also use dust control methods at material transfer points and other point sources at crushing, conveyor, and bulk material handling facilities. These methods include water sprays, physical covers, wind barriers, mechanical controls (such as dust collectors), and other measures that are deemed appropriate and effective and are approved by the Forest Service. Final details will be specified in a dust control plan and in the air quality permit.

- Rosemont Copper will follow specified procedures contained in material safety data sheets to reduce impacts of chemical releases into the atmosphere. Materials include chemical or physical dust control agents, organics, inorganic binders, and/or stabilizing polymers.
- Rosemont Copper will use low-sulfur diesel fuel onsite for all stationary equipment. Refer to the preliminary MPO (WestLand Resources Inc. 2007a) for further details.
- Rosemont Copper will ensure that construction equipment is properly maintained at all times, does not unnecessarily idle, and is tuned to manufacturer's specifications.
- Construction of electric lines will be expedited in order to reduce the need for onsite electrical generation and associated emissions.
- Rosemont Copper will demonstrate the potential to reduce emissions from the generation of electrical power used by mining and related operations by using alternative methods of power generation, such as solar and wind, to power mine administration buildings. The project administration building will be designed to showcase use of leadership in energy and environmental design and sustainable energy concepts.
- To avoid aerosol losses to the wind, emitters (similar to drip irrigation) will be used to apply acid leaching solution to the heap.

Mitigation to reduce traffic impacts on State Route 83 include commuter carpooling during the operations phase (commuter carpooling during the construction phase was included as a factor to determine traffic levels in the environmental consequences section). A partial carpool scenario for the operations phase is based on 75 percent of the commuters carpooling in 5-person vans. The remaining 25 percent of the commuters would be expected to make a single vehicle trip. When commuter carpooling is combined with the anticipated increase in traffic owing to population growth, total traffic on State Route 83 would increase from 67 to 135 percent for year 5 of the operation phase and from 137 to 201 percent during year 20 of the operations phase (Tetra Tech 2009b). Mine related traffic for year 5 of operations would account for 27 to 49 percent of the total traffic. Mine related traffic for year 20 of operations would account for 21 to 38 percent of total traffic. Direct impacts to public health and safety associated with traffic would remain after mitigation.

Direct impacts to public health and safety are associated with accidental release. Proper storage of hazardous materials and coordination with local emergency service providers would not affect the potential for accidental release. Direct impacts to public health and safety associated with hazardous materials would remain after mitigation.

Groundwater management in the Upper Santa Cruz Sub-Basin may help alleviate the possibility of subsidence and the associated impact to public health and safety.

Air quality mitigation would be effective at reducing emissions. However, air quality was not found to have an impact on public health and safety.

Irretrievable and Irreversible Commitment of Resources

Irreversible changes with respect to public health and safety are not expected. All potential hazards discussed are limited solely to the construction and operation phases of the mine and are not expected to remain after closure of the mine.

Cultural Resources

Introduction

The project is proposed for an area that has been inhabited by people from a variety of cultures over the past 7,000+ years. Each culture has lived off the resources of the land and imbued this landscape with significance grounded in each culture's world view and belief system.

Although there is no direct evidence of occupation during the Paleoindian period (9500 to 8000 B.C.), mammoth-kill sites are reported from the San Pedro River Valley ca. 40 miles to the east. Archaic or Preceramic period (8000 B.C. to A.D. 200) hunters and gatherers left ephemeral traces of their use of the area in the form of resource procurement and processing sites and campsites. The densest Native American occupation of the area occurred during the Ceramic period (A.D. 200 to 1450), when archaeological cultures known as the Hohokam and the Mogollon established villages along the canyons. One site has been identified as a possible Mogollon occupation based on the ceramics; all of the others have been identified as Hohokam villages dating to the Colonial-Sedentary transition (A.D. 850 to 1050). Villagers resided on the ridge tops along the canyons and grew their crops of corn, beans, and squash in the drainage floodplains. Abundant natural resources were hunted and gathered in the area, especially acorn, agave, deer, and rabbit. Exposed clay beds were likely mined to make pottery. Numerous bedrock outcrops and cobbles provided the raw materials for flaked and ground stone tools and personal ornaments. Plant resources were used to craft baskets and other household tools.

The Protohistoric period (A.D. 1450 to 1700) is represented sparsely at a few sites in the Rosemont area, and these campsites appear to have been occupied briefly. During the Historic period (A.D. 1750 to 1950) the upper elevations of the eastern slope of the Santa Rita Mountains provided Native Americans with refuge from the Spanish colonists, who were encroaching into the area in the 17th century. Some of these later sites may have been occupied by the descendents of the Hohokam, the Sobaípuri, a group of O'odham people. Apache bands also used the area as a north-south transportation corridor between the San Pedro and Santa Cruz Rivers, a place to gather resources as they passed through, and also as a refuge from pursuing armies.

Spanish miners sporadically prospected for gold and silver in the Santa Rita Mountains in the 18th century, followed by Mexican and then American immigrants. Limited gold placering occurred in the 1870s. By the late 19th and early 20th centuries, subterranean mining focused on rich copper deposits, and smelters were established at Old Rosemont and Helvetia. At the same time, ranchers took advantage of springs, watered canyons, and grassy ridge tops to raise cattle in this area. Hispanic families also found work among the mines and on the ranches. Hispanic, O'odham, and Apache families continued to visit the area seasonally to gather resources.

At the turn of the 20th century, the Federal Government recognized the unique nature of the landscape and created the Santa Rita Forest Reserve to preserve and manage the resources for the public at large. Although commercial mining in the Rosemont area diminished in the early 20th century and ceased by 1955, ranching has continued on private lands and on Forest Service allotments to the

present day. The landscape continues to attract people to the cooler climes and upland woodland resources, both for sustenance and for recreation.

The Coronado is required under a host of Federal laws, regulations, and policies (see the "Relevant Laws, Regulations, Policies, and Plans" part of this section below) to identify historic properties within the area of potential effects, evaluate those historic properties for their eligibility for listing in the National Register of Historic Places, and consult with culturally affiliated tribes, cooperating agencies, and interested parties to determine whether these historic properties would be adversely affected directly or indirectly by any of the alternatives for the proposed project.

Issues, Cause and Effect Relationships of Concern

All of the action alternatives, including the proposed action, will have direct and indirect effects on National Register of Historic Places eligible historic properties, as well as on traditional uses of the land, and all will result in the disruption of the cultural landscape as perceived by the many communities who have used and continue to use this area.

All the action alternatives and utility corridors are within lands adjudicated and recompensed to the Tohono O'odham by the Indian Lands Claims Commission in 1976. The Hopi, Zuni, and Apache also claim the area as part of their ancestral homelands. The culturally affiliated tribes consulted by the Coronado for this project perceive disruption of the physical world as causing spiritual harm to the earth and to the people present now and in the future. Ancestral villages, human remains, sacred sites, and traditional resource collecting areas are known to exist within all the action alternatives. Tribes also identified additional issues relating to water, air, wildlife, vegetation, scenery, and other resources they consider integral to their heritage. Because of the EIS format, these issues are considered in separate resource sections in this chapter.

Ranching and mining communities also have attachments to the area that began in the late 19th century and continue through the present. Comments submitted during public scoping identified impacts to the historic rural landscape as an issue, as well as impacts to traditional resource collecting areas and recreation venues. Historic human burials may yet be found in areas not excavated during previous archaeological investigations. Based on public input, tribal and cooperating agency consultations, and review of the data on hand (see the "Existing Conditions" part of this section below), the Coronado identified Issue 6: Impact on Cultural Resources. The issue group consists of four subsets of issues: Historic Properties, Disturbance of Human Remains, Sacred Sites, and Traditional Resource Collecting Areas.

Issue 6: Impact on Cultural Resources

Issue 6A: Historic Properties

Mine construction, operation with concurrent reclamation, and closure would bury, remove, or damage historic properties, including traditional cultural properties, sacred sites, traditional use areas, archaeological sites, historical structures, districts, and landscapes. Vibrations from blasting and drilling may damage historical structures in the immediate and adjacent areas. This may also result in the loss of or reduction in the future research and public interpretation potential of known and yet-to-be-discovered sites, along with the permanent alteration of cultural landscapes important to the ongoing cultural practices of Native American tribes and other communities with cultural or historic ties to the project area.

Issue 6A Factors for Alternative Comparison

- National Register of Historic Places eligible historic properties, including traditional cultural properties, sacred sites and other landscape-scale properties, buried, destroyed, or damaged (number)
- Potential for vibrations to damage historic structures in adjacent areas (number of structures)

Issue 6B: Disturbance of Human Remains

Human remains have been discovered in previous archaeological excavations of prehistoric and historical sites in the Rosemont area. Additional burials are present in previously excavated and unexcavated historic properties and may be present in as-yet undetected historic properties. Native American remains fall under the jurisdiction of the Native American Graves Protection and Repatriation Act; nonnative remains fall under the Advisory Council's Policy on Burial Sites, Human Remains and Funerary Objects on Federal Lands (February 23, 2007). Arizona burial laws (Arizona Revised Statutes 41-844 and 41-865) protect human remains on State and private lands.

Issue 6B Factors for Alternative Comparison

- Prehistoric sites known/likely to have human remains (number)
- Historic period sites likely to have human remains (number)

Issue 6C: Sacred Sites

Several Federal laws direct Federal land management agencies, to the extent permitted by law and not clearly inconsistent with essential agency functions, to accommodate access to and use of Native American sacred sites, to avoid affecting the physical integrity of such sites wherever possible, and to temporarily close National Forest System land for traditional and cultural purposes. Tribal consultation has identified springs, high vision points, and many natural resources in the project area as having sacred ceremonial functions. Mine construction, operation with concurrent reclamation, and closure may preclude access to or destroy or degrade these types of resources.

Issue 6C Factors for Alternative Comparison

- Sacred springs impacted (number)
- Qualitative assessment of the impacts on Native Americans of desecration of land, springs, burials, and sacred sites
- Qualitative assessment of the impacts on other communities of the region regarding impacts on resources, such as historical townsites, cemeteries, mines, ranches, and homesteads

Issue 6D: Traditional Resource Collecting Areas

Native Americans and the ranching, mining, and Mexican American communities use the Rosemont area to collect and process natural resources for food, medicines, firewood, and traditional crafts. Mine construction, operation with concurrent reclamation, and closure may preclude access to or destroy or degrade these types of resources.

Issue 6D Factor for Alternative Comparison

- Traditional resource collection areas impacted (acres)

Analysis Methodology, Assumptions, Uncertain and Unknown Information

For the purposes of comparing the alternatives, the analysis area for direct and indirect effects on cultural resources is the perimeter fence for each alternative; these are 750 feet beyond the mine footprint, with the perimeter road included, and are assumed to include all ground-disturbing activities associated with the mine. The analysis area for the utility alternatives is the utility corridors as surveyed for cultural resources. For the 138-kilovolt investigation, the corridor was generally 500 feet wide in portions proposed to contain both a water pipeline and the utilities, and was 150 feet wide in areas with the pipeline only (Sheehan et al. 2010). For the 46-kilovolt investigations, the corridor ranged between 500 and 1,000 feet wide (Swanson et al. 2010). The perimeters and corridors are depicted in figure 95.

For comparison of cumulative effects on the cultural resources, two zones have been identified. Zone 1 consists of the upland areas bordered by the crest of the Santa Rita and Patagonia Mountains on the west and the Whetstone and Huachuca Mountains on the east. This area contains similar environmental zone likely to contain similar types of prehistoric and historical cultural resources. Zone 2 is the U-shaped zone of urban development outside Zone 1 and within the San Pedro River valley, Santa Cruz River valley, and Tucson Basin in Cochise, Santa Cruz, and Pima Counties. This area was cited as the location of economic impacts immediately beyond the mine locality (L. William Seidman Research Institute et al. 2009), and the resulting population growth and associated increase in roads, housing and commercial development, utility lines, and wireless telecommunication towers would likely have adverse effects on the cultural resources in this zone. The northern boundary for Zone 2 follows the Pima County line; the eastern and western boundaries are the eastern and western boundaries of the San Pedro and Santa Cruz River valleys, respectively. The southern boundary is the international border (figure 96).

To identify the historic properties, resources, and interests that would be adversely affected by the identified alternatives, the Coronado designed a four-pronged approach to gather the requisite information to comply with the regulatory environment, as follows:

- Conduct public scoping to identify issues of concern to the public and other interested parties,
- Consult with culturally affiliated tribes and cooperating agencies to identify issues of concern,
- Conduct archival and oral history investigations to document Native American use of the area through time, and
- Evaluate archaeological records and conduct field inventories of all action and utility alternatives to identify historic properties eligible for listing in the National Register of Historic Places.

The Coronado tasked SWCA Environmental Consultants with gathering the data from public scoping, providing logistical assistance for tribal consultation, and gathering the archival, oral history, and archaeological survey data for the action alternatives and the utility and road corridors in the proposed action (Barr et al. 2010; Ezzo et al. 2011). Rosemont Copper tasked Environmental Planning Group with the Class III archaeological surveys of the utility corridors for the other action alternatives (Sheehan et al. 2010; Swanson 2011; Swanson et al. 2010). Figure 97 depicts the areas surveyed by the two firms hired by Rosemont Copper to ensure complete field investigation of all potential areas of impact. Surveys were conducted in 15-meter transects in accordance with the

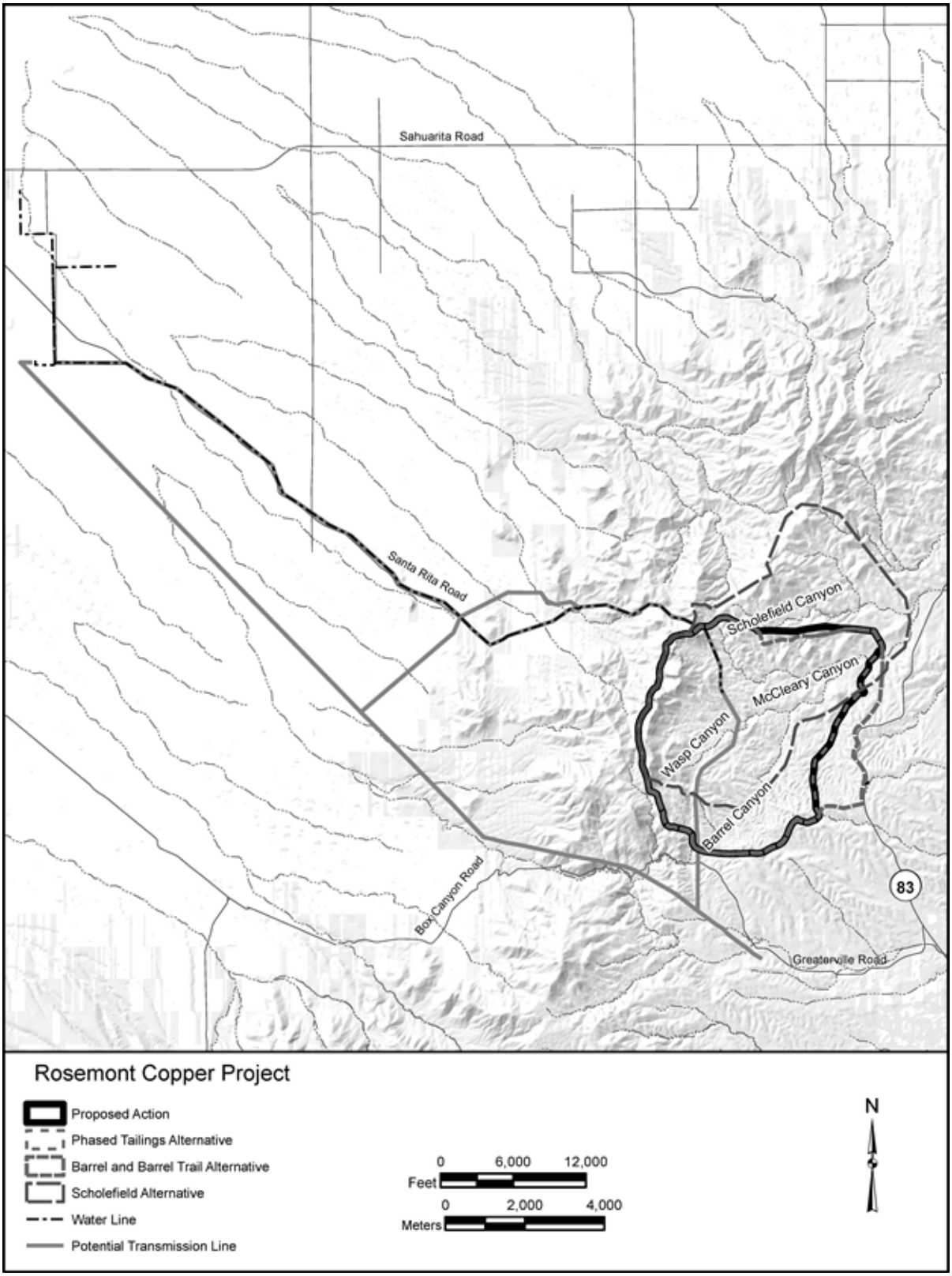


Figure 95. Analysis area for action alternatives, water supply corridor, and utility alternatives

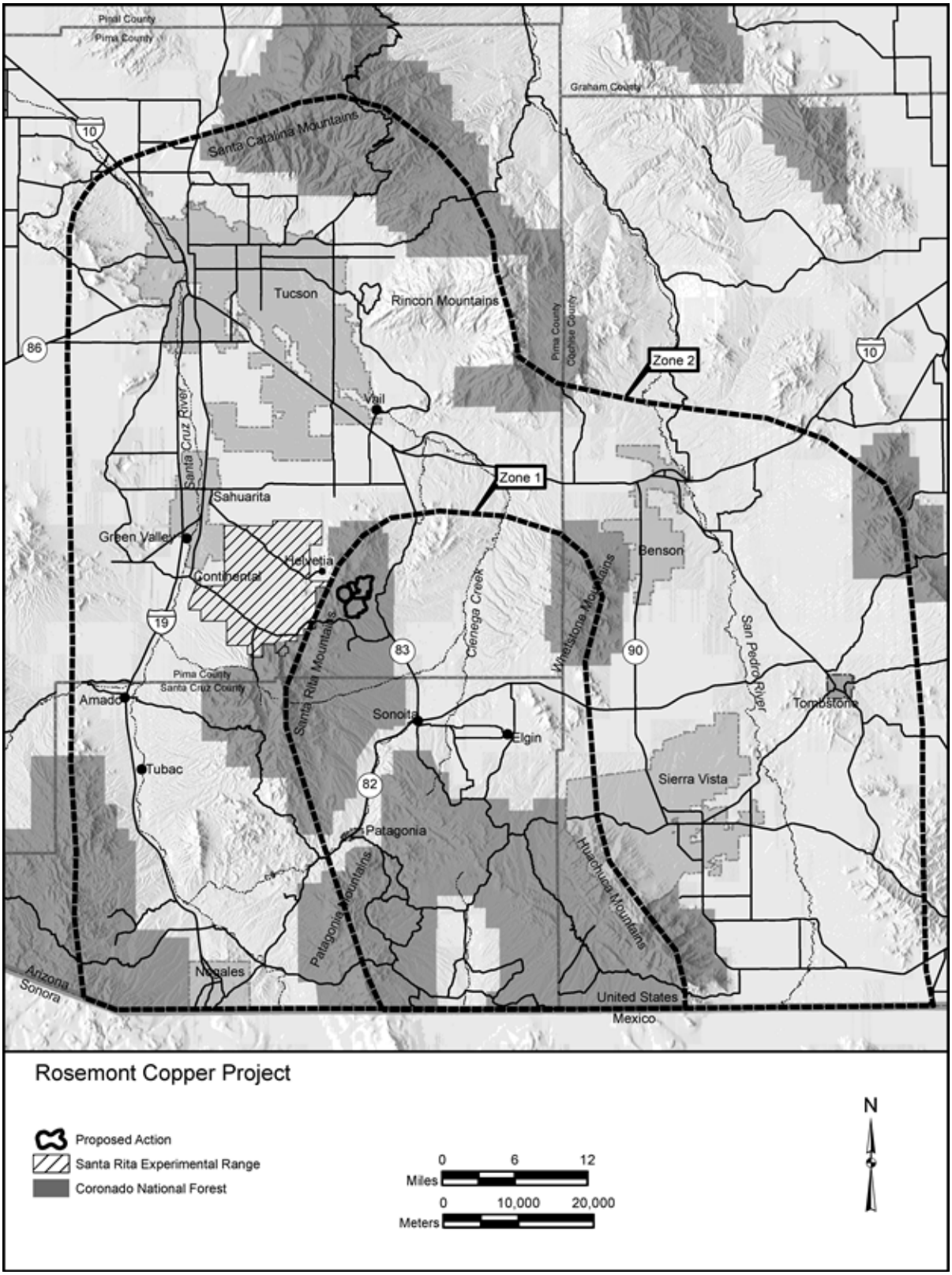


Figure 96. Bounds of analysis for cumulative effects on cultural resources

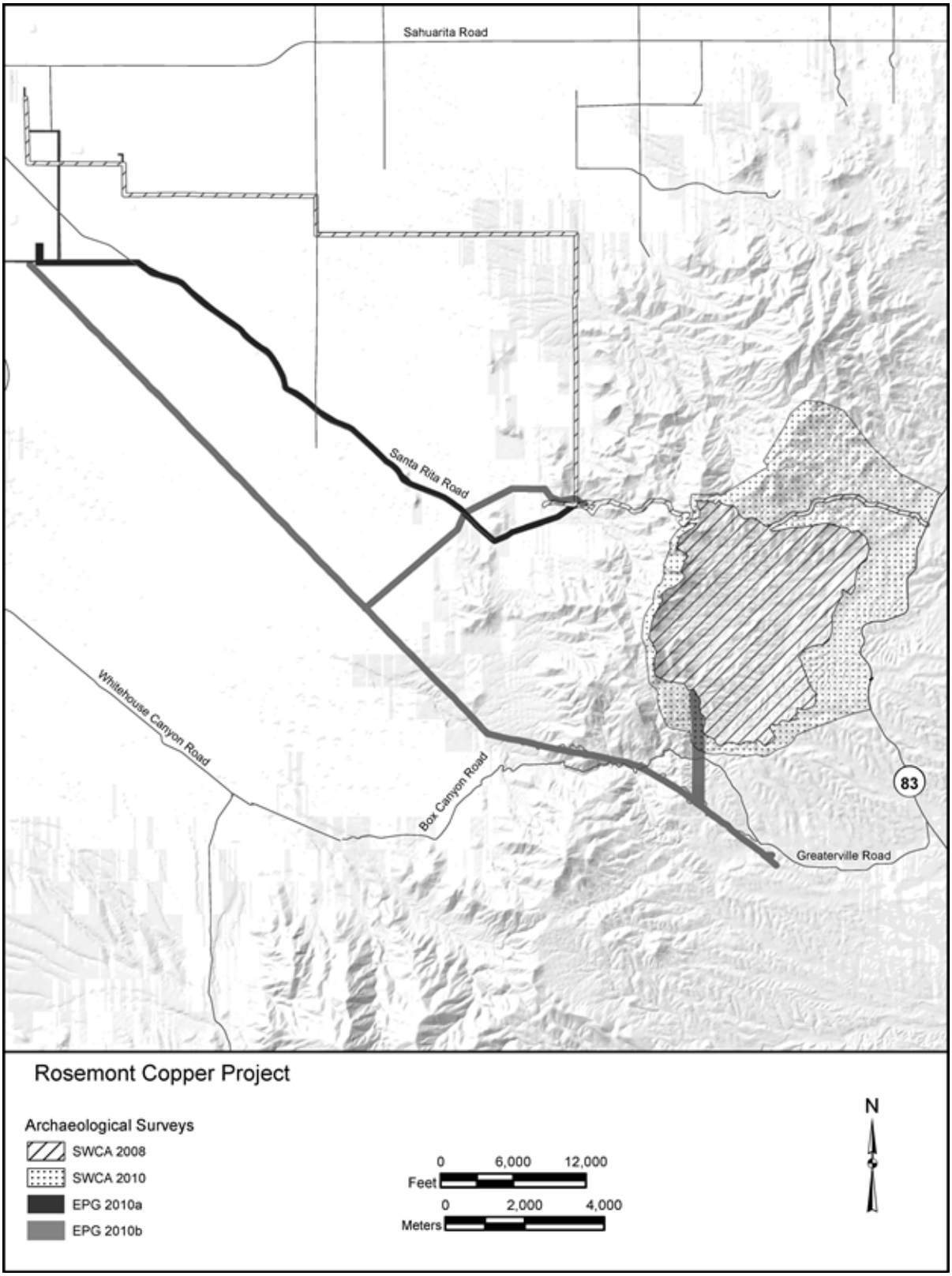


Figure 97. Areas surveyed for cultural resources

standards established by the Arizona State Historic Preservation Office, and sites and isolated artifacts were recorded in accordance with the Arizona State Museum standards. In many cases, the surveyed areas extend beyond the final alternative boundaries for both the mine operations and the utility and water corridors (see the "Methodology" sections in each of the reports cited above).

Uncertain and Unknown Data

Tribal consultation is ongoing; additional field trips to the project area have been requested by several of the consulting tribes at different times of the year to enable a complete assessment of the plant resources available in each of the alternatives. No comprehensive plant inventory has been undertaken for any of the alternatives—only random sampling of special interest species, e.g., agave because of its importance as a food source for long-nosed bats (WestLand Resources Inc. 2009d).

Summary of Effects by Issue Measures by Alternative

Table 167 summarizes the impacts from each alternative and its access corridors. It also includes the water corridor, which is common to all action alternatives. The cultural resources for the water corridor are repeated in the TEP Preferred Alternative in table 168, as they follow the same route between Helvetia West and the Santa Rita South Substation. No cultural resources were found in the portion of the water corridor that is north of the substation (figure 98).

Table 167. Cultural resources within the action alternatives perimeter fences, primary and secondary access roads, and water corridor

Issue Category	Water Corridor	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
6A: Prehistoric sites (number)	5	62	60	77	77	64
6A: Historic sites (number)	5	32	32	33	33	32
6A: Traditional Cultural Properties (number)		1	1	1	1	1
6A: Multicomponent (prehistoric/historic) sites (number)		2	1	1	1	2
6A: Qualitative assessment of mitigation* required		–	–	–	–	–
6B: Prehistoric sites known or likely to have human remains (number)	2	28	25	29	29	20
6B: Historic sites known or likely to have human remains (number)	1	1	1	1	1	1
6C: Springs/seeps impacted (number)						
Major impacts within alternative		12	12	12	12	19
Major and possible impacts external to alternative	1	51	51	51	51	48
Total	1	63	63	63	63	67
6C: Qualitative assessment of impact to Native Americans*		–	–	–	–	–
6C: Qualitative assessment of impact to other communities*		–	–	–	–	–
6D: Traditional resource collection areas (acres)	574†	6,419.4	6,330.0	7,037	7,037.4	7,359.6

* See the "Direct and Indirect Effects of Each Alternative" part of this section below.

† Acreage reflects the 100-meter corridor surveyed for the water alignment; acreage for collection areas would be less if the roadway is subtracted from this acreage.

Table 168. Cultural resources within the utility alignment alternatives (excludes areas within action alternatives and access corridors – see figure 98)

Issue Measure	No Action	TEP Preferred (also Water Corridor)	TEP Alternative 1	TEP Alternative 2	TEP Alternative 3	TEP Alternative 4
6A: Prehistoric sites (number)	–	5	3	9	7	10†
6A: Historic sites (number)	–	5	4	5	4	2
6A: Traditional Cultural Properties (number)		1	1	1	1	1
6A: Qualitative assessment of mitigation* required	–	–	–	–	–	–
6B: Prehistoric sites known or likely to have human remains (number)	–	2	–	4	2	5†
6B: Historic sites known or likely to have human remains (number)	–	1	–	1	–	–
6C: Springs impacted by utilities (number)	–	1	1	1	1	1
6C: Qualitative assessment of impact to Native Americans*	–	–	–	–	–	–
6C: Qualitative assessment of impact to other communities*	–	–	–	–	–	–
6D: Traditional resource collection areas (acres)	–	157	155	183	181	236

* See the "Direct and Indirect Effects of Each Alternative" part of this section below.

† Includes one multicomponent site.

Affected Environment

Relevant Laws, Regulations, Policies, and Plans

Cultural resources on federally owned, leased, or administered lands are regulated by a body of laws, regulations, and policies as outlined in the Forest Service Manual 2300, Chapter 2360 (U.S. Forest Service 2008a, 2010a), the Forest Service Handbook Heritage Program(U.S. Forest Service 2007b), the Forest Service "Tribal Relations Strategic Plan (Fiscal Years 2010–2013)," the "Coronado National Forest Land and Resource Management Plan," as amended (U.S. Forest Service 1986), and the Cultural Heritage Cooperation Authority (Public Law 110-234, Farm Bill 2008, Forestry Title VIII, Subtitle B, 8101–8107).

The laws governing the management of cultural resources include the Organic Act of 1897 (16 United States Code 473–478, 479–482, 551); Antiquities Act of 1906 (16 United States Code 431); Historic Sites Act of 1935 (16 United States Code 461); National Historic Preservation Act of 1966, as amended through 2006 (16 United States Code 470 et seq.); National Environmental Policy Act of 1969, as amended (42 United States Code 4321 and 4331–4335); Archaeological and Historic Preservation Act of 1974 (16 United States Code 469); Federal Land Policy and Management Act of 1976 (43 United States Code 1701); National Forest Management Act of 1976 (16 United States Code 1600); American Indian Religious Freedom Act of 1978 (42 United States Code 1996–1996a); Religious Freedom Restoration Act (42 United States Code 2000bb–2000bb-4); Archeological Resources Protection Act of 1979 (16 United States Code 470aa–470mm); Native American Graves Protection and Repatriation Act of 1990 (23 United States Code 3001 et seq.); Federal Lands

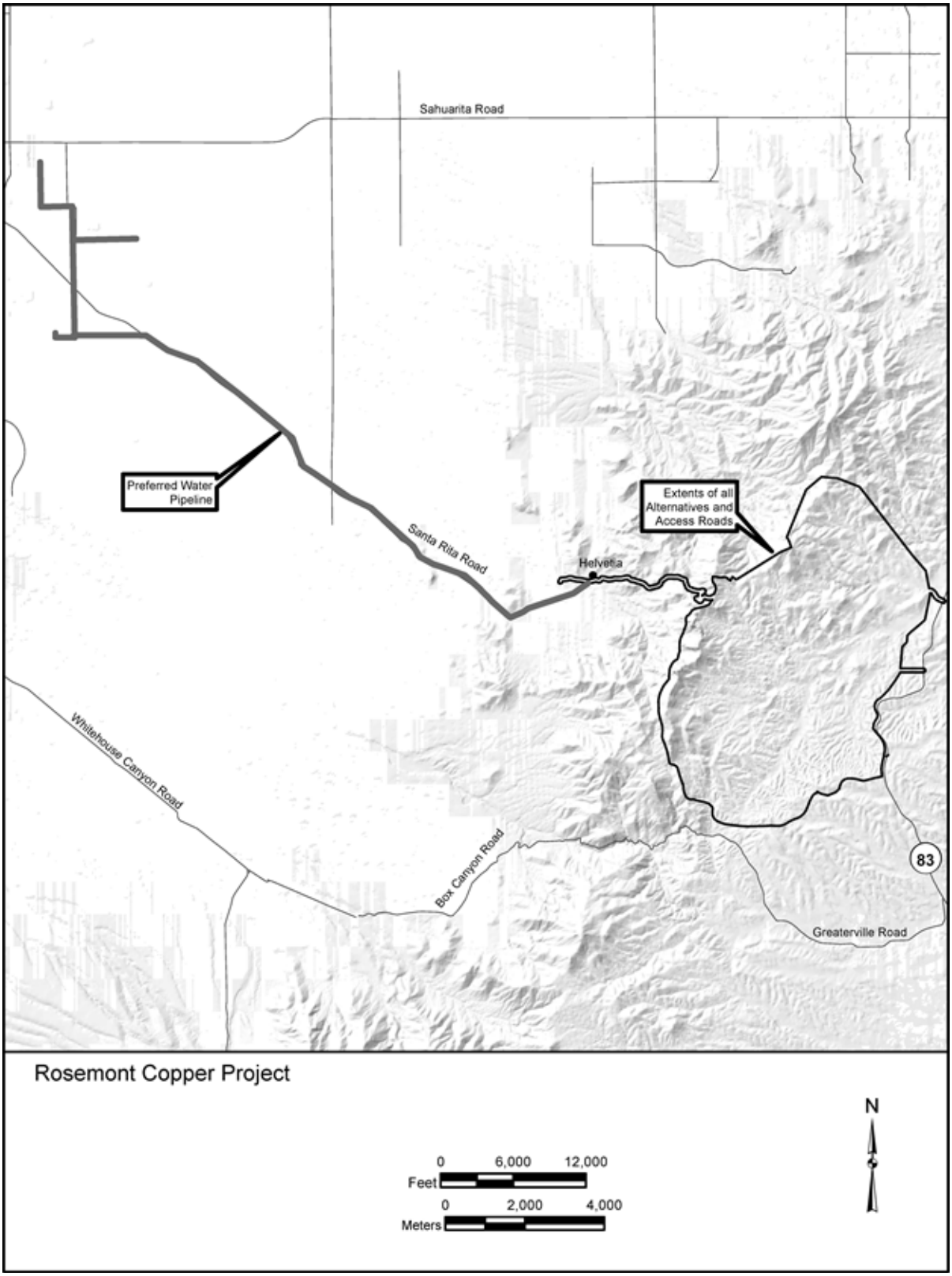


Figure 98. Preferred water supply corridor

Recreation Enhancement Act of December 8, 2004 (16 United States Code 6801–6814); and Title VIII, Cultural and Heritage Cooperation Authority, Farm Bill 2008 (Public Law 110-234).

Executive orders include Executive Order 11593, Protection and Enhancement of Cultural Environment (May 13, 1971); Executive Order 13007, Indian Sacred Sites (May 24, 1996); Executive Order 13175, Consultation with Indian Tribal Governments (November 6, 2000); Executive Order 13287, Preserve America (March 3, 2003); and Executive Order 13327, Federal Real Property Asset Management (February 4, 2004).

Pertinent Federal regulations and guidelines applicable to cultural resources management are Protection of Historic Properties (36 Code of Federal Regulations 800, as amended August 5, 2004); National Register of Historic Places (36 Code of Federal Regulations 60); Protection of Archaeological Resources Uniform Regulations (36 Code of Federal Regulations 296); Native American Graves Protection and Repatriation Act Regulations (43 Code of Federal Regulations 10, Subpart B, Human Remains, Funerary Objects, Sacred Objects, or Objects of Cultural Patrimony from Federal or Tribal Lands); Curation of Federally-Owned and Administered Archeological Collections (36 Code of Federal Regulations 79); Planning (36 Code of Federal Regulations 219); Heritage Assets and Stewardship Land, Statement of Federal Financial Accounting Standards 29 (July 7, 2005); Federal Management Regulation, Historic Preservation (41 Code of Federal Regulations 102–178); and Advisory Council on Historic Preservation Policy Statement Regarding Treatment of Burial Sites, Human Remains and Funerary Objects (February 23, 2007).

National Historic Preservation Act Section 106 requires that Federal agencies “prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register.” Additionally, the National Historic Preservation Act requires Federal agencies to consult with tribes to determine whether there are traditional religious and cultural properties that may be adversely affected by a proposed undertaking (16 United States Code 470a(d)(6)). The Forest Service Southwest Region’s Programmatic Agreement with State Historic Preservation Offices in the region and the Advisory Council that describes procedures national forests follow in complying with Section 106 of the National Historic Preservation Act (First Amended Programmatic Agreement Regarding Historic Property Protection and Responsibilities among the New Mexico, Arizona, Texas, and Oklahoma SHPOs, the Advisory Council on Historic Preservation, and Southwestern Region of the Forest Service).

This regulatory environment guided the Coronado’s investigations to identify and evaluate the significance of the cultural resources within the analysis area; to assess the potential adverse effects on historic properties and resources identified through tribal consultation, archaeological investigations, cooperating agency consultation, and public scoping; and to develop potential mitigations for these adverse effects.

For the purposes of this discussion, heritage or cultural resources can include historical structures and ruins, archaeological sites, sacred sites, traditional cultural properties, cultural landscapes, and natural resources of traditional importance. Historic properties as defined by the National Historic Preservation Act are cultural resources that meet criteria for listing in the National Register of Historic Places, as defined by regulations (36 Code of Federal Regulations 60.4).

Criteria for Identifying and Evaluating Historic Properties and Cultural Resources issues

The criteria for identifying and evaluating historic properties are provided by guidelines established by 36 Code of Federal Regulations 60.4. Generally, a historic property must be more than 50 years old and must possess both historic significance and integrity.

Significance can be established if the property meets at least one of four criteria:

> (A) it is associated with events that have made a significant contribution to the broad patterns of history;
>
> (B) it is associated with the lives of persons significant in our past;
>
> (C) it embodies the distinctive characteristics of a time, period, or method of construction, or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components may lack individual distinction; or
>
> (D) it has yielded, or is likely to yield, information important in prehistory or history.

Integrity relates to location, design, setting, materials, workmanship, feeling, and association (National Park Service 1999); a property must retain integrity of those aspects that are essential to conveying its significance. For example, integrity of association with an event or person is critical for sites that are significant under Criteria A and B; integrity of feeling is more important for a property that is nominated under Criterion C because of its artistic value; integrity of materials and workmanship is important for a property nominated under Criterion C for its architecture; and integrity of location, materials, and workmanship would be important for an artifact scatter nominated under Criterion D for its research value in understanding technology and site function.

Traditional Cultural Properties

A unique category of historic property, a traditional cultural property, is associated with cultural practices or beliefs of a living community that (1) are rooted in that community's history; and (2) are important in maintaining the continuing cultural identity of the community (Parker and King 1998). A traditional cultural property may be a building, site, district, object, or landscape. The significance must stretch beyond the past 50 years yet retain ongoing significance. Although the same aspects of integrity are relevant (e.g., integrity of location, design, setting, materials, workmanship, feeling, and association), National Register Bulletin 38 notes that the concept of integrity is applied somewhat differently for traditional cultural properties than it is for historic buildings or archaeological sites:

> In the case of a traditional cultural property, there are two fundamental questions to ask about integrity. First, does the property have an integral relationship to traditional cultural practices or beliefs; and second, is the condition of the property such that the relevant relationships survive? (Parker and King 1998)

The property must be bounded and its significance documented and evaluated in accordance with National Register of Historic Places Criteria A through D (36 Code of Federal Regulations 60.4).

Existing Conditions

Description of the Historic Context

Human occupation of southern Arizona spans at least 12,000 years, from the time of Pleistocene big-game hunters to the present. Occupation was neither continuous nor homogeneous; periods of social conflict and environmental challenges caused population shifts and episodic abandonment of settled areas. At all times, peoples of diverse ethnic and social identities resided in southern Arizona.

The project area lies within what has been described as the Empire Valley/Cienega Creek sub-region of southern Arizona, located between the two north-trending river valleys of the Santa Cruz River to the west and the San Pedro River to the east. These well-watered valleys have long been the locations of major settlements and routes by which cultural influences spread from the north and south and from there into the uplands. Influences from both of these valleys and the regions beyond them are reflected in the archaeology of the eastern slope of the Santa Rita Mountains. Archaeological evidence from the project area derives from the 1970s to 1980s investigations conducted for the proposed ANAMAX copper mine, which documented occupation of the same area as early as 7,000 years ago and likely earlier.

The culture history of southern Arizona can be roughly divided into six periods: Paleoindian (9500 to 8000 B.C.), Preceramic (8000 B.C. to A.D. 200), Early Ceramic (A.D. 200 to 650), Ceramic (A.D. 650 to 1450), Protohistoric (A.D. 1450 to 1700), and Historic (A.D. 1700 to 1960).

The Paleoindian period is characterized by large bifaces and a mobile pattern of hunting now-extinct megafauna. Much of the evidence for Paleoindian occupation of southern Arizona is from sites in the San Pedro River valley and is surprisingly lacking in the Tucson Basin. No evidence has yet been detected in the project area, although Pleistocene faunal remains are reported from the adjacent Davidson Canyon area to the east of the project area (Haynes 1980; Huckell 1980).

The Preceramic (also known as the Archaic period) is characterized by a greater reliance on plant resources and small game. It is traditionally divided into Early, Middle, and Late sub-periods based on changes in material culture assemblages, primarily biface styles. With recent evidence that corn was grown and plainware ceramics were used in southeastern Arizona much earlier than previously thought, the Late sub-period is now referred to as the Early Ceramic (or Early Agricultural) period in recognition of these major changes in lifestyle. Within the project area, Late Preceramic to Archaic sites have been identified based on projectile point styles and dated as ranging between 1400 B.C. and A.D. 350 (Huckell 1984a).

The Early Ceramic is transitional between the Archaic cultural pattern and the broad regional agricultural cultures (Hohokam, Mogollon, Salado, Chihuahuan, and Trincheras) that developed in the Ceramic period. Undecorated pottery characterizes Early Ceramic sites, with the addition of red ware pottery toward the end of the period. No Early Ceramic sites have yet been identified within the project area, although previous investigations may have been too limited to reveal evidence of occupation during this period (Ferg et al. 1984a).

The Ceramic period is marked by the advent of painted pottery around A.D. 650 and the beginning of the archaeological complex known as the Hohokam culture in the Tucson Basin. Large population centers along the major drainages include residential compounds, ceremonial structures, and extensive irrigation systems. Investigations conducted for the proposed ANAMAX copper mine in a similar footprint as the current project area documented for the first time evidence of Ceramic period habitation sites in upland areas. Small villages were located on ridges adjacent to drainages. One of

these, AZ EE:2:105(ASM), included a ballcourt, the first one to be identified in an upland environment. Ceramic assemblages at these sites suggest influences from all of the broad-scale agricultural cultures: the Hohokam in the Tucson Basin/Santa Cruz River valley to the north and west, respectively; the Mogollon to the east; and the Trincheras to the south.

Circa A.D. 1400 to 1450, the Hohokam archaeological culture changes dramatically in southern Arizona. The large river valley settlements were abandoned, and a greatly reduced population settled once again in small villages or moved away from the area. The cause or causes of this depopulation are unknown; speculation ranges from environmental degradation, major floods that destroyed the complex irrigation systems, and/or nutritional stress as the impetus.

The Protohistoric period (A.D. 1450 to 1700) was a time of flux in southern Arizona. Small O'odham villages and agricultural fields were located along the major river drainages, and forays were made to upland areas for localized resources. Ephemeral house sites are found atop older Hohokam villages in the Rosemont area, as mobile hunters and gatherers left sparse evidence of their activities (Huckell 1984b). Apache bands moved into the area from the north and east; Spanish soldiers, missionaries, prospectors, and ranchers made repeated visits from the south as they also sought to occupy the area.

The Historic period (A.D. 1700 to 1960) consists of three sub-periods (Spanish, Mexican, and American), named for each foreign power that assumed control of the area that would become southern Arizona. In the project area, individual prospectors sought minerals in the Santa Rita Mountains from the mid-17th century through the early 20th century, usually by placer or small prospect pits. Native peoples continued to harvest the resources of the area and travel through the area to other destinations. Neither of these activities left distinguishable archaeological footprints.

It was not until the late 1880s, after the Apache had been forcibly removed from southern Arizona by the U.S. Army, that miners and ranchers moved into the eastern slopes in numbers and established mining camps centered on hardrock copper mining (Rosemont, Helvetia, Greaterville). Ranches were also established in areas with suitable grazing lands and local markets (V.R., Scholefield/Hidden Springs, López, and Martínez) during the beginning of the American sub-period.

The Santa Rita Forest Reserve was created in 1902. A Ranger Station was established at Old Rosemont in 1904 and was occupied until 1932. The V.R. and Scholefield cattle ranches have persisted to the present day under various owners. The end date for the Historic period is arbitrarily set by the National Historic Preservation Act definition of "historic" as being greater than 50 years old.

Contemporary Uses of the Area

In addition to grazing permits managed by the Coronado, the primary contemporary use of the *Ce:wi Duag* area is for hunting, camping, picnicking, hiking, and using off-road vehicles. The Arizona Game and Fish Department issues permits to hunt large (black bear, javelina, and deer) and small (cottontail rabbit, mourning dove, and quail) game and fish on the Coronado National Forest. Traditional resources such as basketry materials, medicinal plants, and acorns continue to be collected through Heritage programs developed by the Coronado and tribal governments, via permits issued for collection of forest products by businesses, or by individuals and families visiting the area. The Tohono O'odham and San Carlos Apache cultural departments are aware of visits to the area by elders, traditional healers, and families, and by individuals on vision quests.

Previous Archaeological Research in the Area

More than 45 archaeological surveys have been conducted within a 1-mile radius of the analysis area of the action alternatives. Most surveys were relatively small and related to construction of roads and utilities, development of water supplies and quarries, or the Coronado's projects (see summaries in Petersen (2007); Petersen and Griset (2010); Sheehan et al. (2010); Swanson (2011); and Swanson et al. (2010)).

The most extensive surveys were conducted between the mid-1970s and mid-1980s in anticipation of the construction of the proposed ANAMAX copper mine, which was centered on the ore deposit near Rosemont. The proposed ANAMAX project would have exchanged a large block of Forest Service administered public land in the Rosemont area for parcels of private land scattered throughout Arizona. Investigations were conducted by archaeologists from the Arizona State Museum between 1974 and 1982. All of the National Forest System land proposed for the land exchange, private lands owned by ANAMAX, and additional areas proposed as the project progressed were surveyed for archaeological sites (Debowski 1980; Ferg et al. 1984a; Huckell 1981).

The archaeological research design sought to identify geographic and biotic factors that could be used to develop a predictive model for site locations in this area. Although 621 "loci" were identified during the combined ANAMAX surveys, fewer than 25 percent were assigned official Arizona State Museum site numbers and tested for significance; fewer than 10 percent underwent data recovery excavations. Most of the loci do not meet current standards for defining an archaeological site and would be classified as isolated occurrences of artifacts or features in a modern reconnaissance.

Prehistoric and protohistoric Native American sites from the ANAMAX project are reported in Ferg et al. (1984b), Huckell (1980; Huckell 1984a, 1984b), and Tagg et al. (1984). The Arizona State Museum subcontracted Centuries Research to evaluate the Historic period properties (Baker 1980). Baker recommended 26 sites eligible for nomination to the National Register of Historic Places. Ayres (1984) conducted archival research and testing and data recovery excavations as warranted at those 26 sites plus another four sites. Interviews of former Rosemont area residents were also conducted by the Arizona State Museum (Schaefer 1979) and Ayres (1984).

The ANAMAX investigations documented human use of the project area from ca. 7,000 years ago to the modern era. Although loci and sites were not individually evaluated for their eligibility for listing in the National Register of Historic Places, Huckell (1980) recommended that a Barrel Canyon Archaeological District be nominated to the National Register of Historic Places; no formal nomination was prepared. The ANAMAX mining project did not go forward, and the excavated archaeological sites were never backfilled. The archaeological collections have been curated at the Arizona State Museum; the human remains and associated funerary objects were repatriated to the Tohono O'odham Nation in 2009.

Archaeological Investigations Related to the Rosemont Copper Project

In the 30 years since the ANAMAX investigations, global positioning system technology has greatly improved the accuracy of recording site locations, and modern standards have been established by the Arizona State Historic Preservation Office for surveying methods and by the Arizona State Museum for defining and recording sites or isolated occurrences of artifacts or features. The Arizona State Historic Preservation Office recommends resurvey of any areas not surveyed within the previous 10 years using these newer methodologies. Consequently, all of the land that would be affected by the action alternatives has been resurveyed as the action alternatives have evolved.

Geotechnical Boring Locations Survey

In 2007, SWCA Environmental Consultants conducted a Class I archival records search for the proposed action in anticipation of surveying 23 locations, each measuring approximately 10,000 square feet that were proposed by Augusta Resource as geotechnical data collection loci on the Coronado National Forest (Petersen 2007). All data contained in the AZSITE online database, on ANAMAX field maps filed in the Arizona State Museum Archives, in the Coronado's Heritage Resources files, in the files maintained by the Arizona State Historic Preservation Office, and in the General Land Office documents were reviewed to identify previous archaeological surveys, recorded sites, and potential historical resources. In many cases, individual sites had been given multiple agency designations. Every attempt was made to coordinate these separate data sets to compile a list of previously recorded sites in and within a 1-mile radius of the proposed action.

The field survey of the proposed geotechnical locations identified two previously recorded ANAMAX sites, one additional site, and three isolated occurrences of artifacts or features. All three sites were recommended eligible for listing in the National Register of Historic Places, and all were avoided by the geotechnical testing. None of the isolated occurrences were recommended eligible for the National Register of Historic Places.

Survey of the Mine Plan of Operations Area of Potential Effects

Based on the data from the geotechnical project, SWCA Environmental Consultants developed a research design for the Class III survey of the areas that would be potentially affected by the preliminary MPO. The survey area was defined by the watershed boundaries around the locations of the proposed mine, plant facilities, tailings and waste rock storage, primary and secondary access roads, and the originally proposed water corridor (see figure 97).

A cultural landscape approach was adopted (Ezzo et al. 2011), with the following themes to be investigated diachronically: (1) the environment, (2) the people, and (3) interactions between people and the environment regarding (a) subsistence and economy, (b) settlement patterns and demography, (c) social organization, and (d) exchange. This framework provides data that can also address the Coronado National Forest Cultural Resources Study Evaluation Units developed in the forest plan for the Santa Rita Mountains geographic region (U.S. Forest Service 1986). These units are Mining Ventures, Routes across the Mountains, Historic Document Verification, Protohistoric/Historic Native American Use, Historic Exploration and Settlement, Archaic Use of the Forest, Prehistoric Agriculture, Adaptations to Upland Areas, Forest Administration History, Historic Recreation and Tourism, and Regional Cultural Interactions.

The field survey was conducted in 2008 and identified 93 sites and 315 isolated occurrences of artifacts or features. Fifty-two sites are prehistoric, one is protohistoric, 36 are historical, and four are multicomponent with both prehistoric and historical occupations of the same locales. In nine cases, previously recorded sites found in proximity were combined under a single site number (usually the lowest of the site numbers involved). Five previously recorded Arizona State Museum sites (all lithic scatters) were not relocated, and 37 sites were newly recorded.

Seventy of the 93 sites were recommended eligible for the National Register of Historic Places, five were recommended ineligible, and the eligibility of 18 sites and three loci within multicomponent sites could not be determined from survey results alone. SWCA Environmental Consultants also evaluated each site for potential adverse effects from the proposed action and made recommendations for additional archival or archaeological work if ground-disturbing activities cannot be avoided. The draft report was submitted to the Coronado. The agency distributed the draft to the consulting

tribes and the cooperating agencies for comment, and SWCA Environmental Consultants finalized the report in 2010.

Archival Records Search of Potential Alternatives

During the process of formulating alternatives to the proposed action, the Coronado requested that SWCA Environmental Consultants prepare a Class I archival records search for four proposed alternatives under consideration in fall 2009: Phased Tailings, Scholefield-McCleary, Barrel-Sycamore, and Barrel Only (Petersen and Griset 2010). The records search compared the difference between the Class I data for the proposed action (Petersen 2007) with the results of the Class III field survey (a 27 percent increase in the number of sites) and applied that difference to the Class I data for each of these alternatives to project the number and types of sites likely to be found in a modern survey of each alternative.

Survey of the Action Alternatives

In May 2010, the Coronado selected four action alternatives for inclusion in the EIS—proposed action, Phased Tailings, Scholefield-McCleary, and Barrel Only—and established perimeter boundaries for each. SWCA Environmental Consultants performed a Class III field survey of all land in the four action alternatives that had not been previously surveyed (for a total of 5,054.2 acres) (Barr et al. 2010) for the proposed action (Ezzo et al. 2011). The survey reported 66 sites and 258 isolated occurrences of artifacts or features. One site was recommended ineligible for listing in the National Register of Historic Places, and the rest were recommended eligible. The draft report was submitted to the Coronado for review.

Fifth Action Alternative

In October 2010, the Coronado added a fifth action alternative, the Barrel Alternative, and Barrel Only was renamed Barrel Trail. The new alternative lies within the combined survey boundaries, and data from those surveys (Barr et al. 2010; Ezzo et al. 2011) were used to evaluate the adverse effects on cultural resources for this fifth action alternative.

Survey of the Utility Alternatives and Preferred Water Corridor

Environmental Planning Group conducted surveys of the alternate utility lines proposed by TEP for the Rosemont Copper Project—the 46-kilovolt (Sheehan et al. 2010) and the 138-kilovolt lines (Swanson et al. 2010). The Sheehan et al. (2010) survey also included an alternate route for the portion of the water corridor that extends north of the TEP Preferred Alternative (see figure 98). During the Environmental Planning Group surveys, 19 National Register of Historic Places eligible sites and six ineligible sites were documented.

Historic Properties within the Action Alternatives

Together, these reports (Barr et al. 2010; Ezzo et al. 2011; Sheehan et al. 2010; Swanson 2011; Swanson et al. 2010) provide full coverage of the areas that may be affected by any of the action or utility alternatives. All surveys reported newly recorded sites, which included sites that had been assigned an ANAMAX locus number but were never formally recorded or sites that were previously undetected. The newly recorded sites are distributed roughly evenly between prehistoric and historic cultural resources.

All cultural resources were evaluated for their eligibility for the National Register of Historic Places. Draft reports of the SWCA Environmental Consultants surveys were submitted to the consulting tribes and cooperating agencies for review and comment. Changes were incorporated, and the reports

were submitted to the Arizona State Historic Preservation Office for review and eligibility determinations. The Arizona State Historic Preservation Office concurred with the eligibility recommendations for the action alternatives on April 28, 2011. TEP is coordinating the tribal consultation and Arizona State Historic Preservation Office review for the Environmental Planning Group utility surveys.

National Register of Historic Places ineligible sites are not included in any of the discussions below.

Ethnohistorical Investigations for the Rosemont Copper Project

Ethnohistorical investigations were initiated to obtain information about past uses of the area by Native American groups and to provide data on potential sacred sites or traditional cultural properties. The Coronado sent a letter on June 13, 2008, inviting the 12 tribes with which it engages in consultation (see the "Consultation with Tribal Governments" part of this section below) to participate in the creation of an ethnohistorical report on the area by SWCA Environmental Consultants. The Hopi Tribe requested to review the draft report. The Pueblo of Zuni suggested that much of the data pertinent to Zuni presence in southern Arizona are located in its U.S. Land Claims Cases and are not available to the public (Dongoske 2009). Subsequently, Kenny Bowekaty, Zuni Supervisory Archaeologist, met with SWCA Environmental Consultants on November 4, 2009, and provided a summary of some of these data. Peter Steere, Tribal Historic Preservation Officer for the Tohono O'odham Nation, met with SWCA Environmental Consultants to provide oral testimony on information conveyed to him by several residents of the San Xavier District. Michael Darrow of the Fort Sill Apache Tribe also provided information during an interview conducted on October 17, 2008. Additional discussions with tribal cultural staff and elders during onsite tours of the project area, and by Coronado Heritage Resources staff during previous consultations, augmented the literature review (Griset 2011).

Although the proposed mine is located in part of the lands that were officially adjudicated and recompensed to the Papago (Tohono O'odham) by the U.S. Land Claims Commission in 1976, the Chiricahua Apache, San Carlos Apache, Hopi, and Zuni claim the area as part of their ancestral lands. The O'odham claim the area as descendants of the prehistoric Hohokam archaeological pattern, which was present in the area until circa A.D. 1450, and of the Protohistoric to Historic period Sobaípuri O'odham, who lived there until the A.D. 1760s. The O'odham continued to use the area as a resource procurement area up to the present day. Western and Chiricahua Apache used the area to collect resources and as a corridor for travel to the Santa Cruz River valley and northern Sonora in the 18th and 19th centuries. Families from San Carlos continue to visit the area to procure plant resources. Specific Hopi and Zuni clans claim the area as places in which they resided during their migrations to Hopi and Zuni.

Consultation with Tribal Governments

Through the U.S. Constitution, negotiated treaties, and the establishment of reservations, the U.S. Government has a trust obligation to Native American tribes while recognizing their special status as sovereign nations within the United States. The laws and regulations cited above (see the "Relevant Laws, Regulations, Policies, and Plans" part of this section) require federal agencies to consult Federally recognized tribes that are culturally affiliated with the lands administered by the agencies before undertaking actions that would have an adverse effect on historic properties or resources of interest to the tribes. The following sections outline the process of consultation undertaken by the Coronado for the proposed action and the issues identified by the tribes. Specific

locales are discussed in the "Environmental Consequences" part of this section under the relevant alternative(s).

Consultation Process

The Coronado routinely consults with 12 Native American tribes regarding management of Forest Service administered public land: Ak-Chin Indian Community, Fort Sill Apache Tribe, Gila River Indian Community, Hopi Tribe, Mescalero Apache Tribe, Pascua Yaqui Tribe, Salt River Pima Maricopa Indian Community, San Carlos Apache Tribe, Tohono O'odham Nation, White Mountain Apache Tribe, Yavapai Apache Tribe, and Pueblo of Zuni.

The Coronado initiated consultation on the proposed action via a letter dated September 26, 2006, from Jeanine Derby, Forest Supervisor, to the tribal chairpersons informing them of the proposed Rosemont Copper Project, with a description of the proposed action in CD format. A second letter was sent on March 14, 2008, informing the tribes that the Rosemont Copper Project Notice of Intent would be published in the Federal Register; the Coronado provided a copy of the Notice of Intent and the updated proposed action. This was followed on June 13, 2008, by a letter inviting the tribes to participate in the ethnohistory research by SWCA Environmental Consultants. The draft report of the archaeological survey of the proposed action was sent to tribal chairpersons and cultural staff on June 22, 2009, with a request for official comment on the proposed action. All communications were sent via certified mail, return receipt.

The Coronado offered to meet with tribes to discuss the project in greater detail, if so requested. The Coronado staff made presentations that outlined the environmental analysis process, reviewed the scope of the proposed action, and requested tribal input into the ethnohistorical project and tribal comment on the proposed action. Presentations and/or discussions occurred with the Hopi Cultural Preservation staff (February 21, 2007), the Tohono O'odham and Ak-Chin cultural staff (April 25, 2008), the Tohono O'odham Legislative Cultural Resources and Natural Resources committees (June 17, 2008, and August 25, 2009), the Four Southern Tribes Cultural Resources Working Group (June 24, 2008, and August 15, 2008), the Tohono O'odham Legislature (September 12, 2008), the San Xavier District Cultural Committee (November 6, 2008), and the Tohono O'odham District Chairpersons Committee (December 9, 2008). The Coronado and SWCA Environmental Consultants staff met (June 17, 2008) with the Director of the Tohono O'odham Cultural Center and Museum, seeking input into the ethnohistory report.

Tribes were invited to tour the proposed action area. Five tours were conducted between fall 2008 and spring 2009 and were attended by representatives of the Ak-Chin, Fort Sill, Gila River, Mescalero, Salt River, San Carlos, Tohono O'odham, and White Mountain Cultural Resources Departments. Tohono O'odham legislators and district representatives also attended tours. The Hopi and Yavapai Apache declined to tour at this time; no response was received from the Pascua Yaqui. The acting director of the Pueblo of Zuni Heritage and Historic Preservation Office did not receive the first invitations and letters, so those were re-sent; Pueblo of Zuni representatives will likely request tours at a later point in the EIS process.

Most of the tours began with a presentation by Rosemont Copper staff that provided the history of the project; the type and location of the ore deposits; the methods proposed to extract, process, and transport the ore; and the measures proposed to minimize adverse effects. Each tour group was provided an opportunity to ask questions of the Rosemont Copper staff. This was followed by a tour of the proposed action, led by the Coronado and SWCA Environmental Consultants cultural staff. Tribal representatives visited several archaeological sites from which human remains had been

removed during the ANAMAX archaeological excavations, as well as other site types, and were given a general overview of the project area and its natural resources.

Several tribes requested additional tours at different times of the year to evaluate the natural resources. Mescalero elders visited the area in spring 2009 and were particularly interested in inventorying plants of cultural interest; they expressed a desire to visit again during the summer.

Draft reports of the survey of the action alternatives and utilities, and the ethnohistory were sent to the tribes by the Coronado on April 1, 2011. Recommendations were incorporated into the final reports.

Details of tribal consultation efforts are included as Appendix F.

Results of Consultation

Tribal consultation identified the Tohono O'odham Nation as the lead tribe speaking for the O'odham people. The San Carlos Apache Tribe is the lead tribe for the Western Apache, the Chiricahua Apache are represented by the Fort Sill and Mescalero tribes, and the Hopi Tribe and Pueblo of Zuni represent the descendants of ancestral Puebloans.

The foremost concern expressed by all tribes is the potential disturbance of ancestors buried at the prehistoric and protohistoric habitation sites that would be disturbed by construction and operation of the processing facilities, the placement of waste rock, and some of the proposed access road and utility corridor construction for all action alternatives. The previously proposed ANAMAX mine archaeological investigations uncovered the remains of 193 Native American individuals, which were excavated in the mid-1980s and curated at the Arizona State Museum. The Rosemont Copper Project reminded the Coronado, the museum, and the tribes that these remains had not been repatriated. At the request of the tribes and the Coronado, the museum conducted a detailed inventory of the remains and associated funerary objects in fall 2008. The O'odham and Hopi requested repatriation of these remains and objects under the implementing regulations of the Native American Graves Protection and Repatriation Act, and they were repatriated to the Tohono O'odham in fall 2009. One nonnative burial was also exhumed during the ANAMAX investigations; however, it was reburied outside the project area.

Any ground-disturbing activities on Federal lands that are likely to encounter human remains are regulated by the Native American Graves Protection and Repatriation Act under Sections 3(c), "Intentional Excavation," and 3(d), "Inadvertent Discovery." All of the consulted tribes are greatly concerned that additional remains will be disturbed by the project.

Additional concerns expressed by tribes during the meetings and tours were summarized by the Coronado Heritage Resources staff (Farrell 2009), as follows:

- Desecration of sacred springs
- Destruction of ancestral villages and campsites
- Loss of plant collecting areas
- Damage to clay- and pigment-collecting areas
- Alterations to the natural landscape
- Potential water table depletion
- Potential water and air contamination

Many of the tribal concerns overlap with scoping issues identified by the Coronado and the public and will be addressed in the analyses of those issues, e.g., effects on groundwater availability and potential air and water contamination. However, the tribes consulted to date have emphasized the interconnectedness between natural and cultural resources: disruption of the physical world can cause spiritual harm to the earth and to the people living on it. Joseph Joaquin, Tohono O'odham Native American Graves Protection and Repatriation Act Coordinator, during the onsite tour of the area of potential effects on September 16, 2008, explained these concerns as follows:

> To them [Rosemont Copper Project], maybe what are our concerns is just a little thing. But to us, it's a big thing. Because again, the land has always been us, and we have always been a part of this land. We are a part of this land. And that goes way back in our creation story of how we got here and how these lands are supposed to be taken care of; how this stewardship was awarded to the people living in these lands, to manage these lands the way they see fit.
>
> This is our ancestral land. We need to be involved, and we need to be part of some of these decision making things and we need to be at the table.

The consulted tribes consider all cultural loci, as well as the landscape as a whole, their ancestral heritage. They recommend that no subsurface archaeological testing be conducted at any archaeological site to determine eligibility for the National Register of Historic Places; they recommend that the Coronado treat all sites as eligible. They also recommend that no ground disturbance occur at any site until the final decision of record has been made on the proposed action, the adverse effects have been clearly identified, and the final area of potential effects has been determined.

Traditional Cultural Properties

The Tohono O'odham Nation Tribal Resolution No. 09-569 (Tohono O'odham Legislative Branch 2009) opposes the Rosemont Copper Project. The resolution states, "The Nation considers the entire *Ce:wi Duag* (Santa Rita Mountains) eligible for listing as a Traditional Cultural Place/Property under the National Historic Preservation Act, 16 U.S.C. Sec 470a(d)(6)(A) as the area was traditionally used by Tohono O'odham people for hunting and gathering." (See the "Laws, Regulations, Policies, and Plans" part of this section above for the definition of and criteria for designating a traditional cultural property.) The boundary proposed by the Nation in a letter from Tribal Historic Preservation Officer Peter Steere to the Coronado Supervisor dated February 3, 2010 (Steere 2010), would follow the Coronado National Forest boundary to include the entire Santa Rita Mountains from Mount Fagan on the north to the Patagonia-Sonoita Creek Preserve on the south, and from Elephant Head on the west to Fort Crittenden on the east (the latter was located circa 4 miles west of Sonoita). Based on the information provided by tribal representatives and by the ethnohistorical research (Griset 2011), the Coronado has documented the *Ce:wi Duag* Traditional Cultural Property proposed by the Tohono O'odham Nation. This entails applying the National Register of Historic Places criteria of eligibility, integrity, and significance and requesting a determination of eligibility from the Arizona State Historic Preservation Office. Private inholdings within the proposed boundary will be excluded from the traditional cultural property boundary. If determined eligible, the *Ce:wi Duag* Traditional Cultural Property will be a historic property that will be included within the Coronado forest plan's guidance for heritage resources.

Public Scoping

Public scoping identified the following concerns regarding cultural resources:

- The archaeological investigations of the 1970s and early 1980s are not up to modern standards, are known to have under-represented the historic mining features, and may have missed other cultural resources; a modern survey should be completed for the proposed action and all action alternatives to identify cultural resources that would be impacted by the action.
- An ethnographic study should be completed documenting the Native American presence in the area, and a second study should be completed for the "cowboy culture."
- Several comments invoked the provisions of various federal laws to preserve and protect these resources on federal land, e.g., National Environmental Policy Act, National Historic Preservation Act, and Native American Graves Protection and Repatriation Act.
- Many commented on the importance of preserving the area's cultural history, including prehistoric Native American sites, historic Native American and Spanish use of the area, early historic ranches (Vail Ranch was the most often mentioned), and the locations of early western television shows and other movies.
- Concerns were expressed about defiling Native sacred sites; concern was also expressed about effects on adjacent areas such as the Empire Ranch and the cemeteries at Greaterville and Helvetia.
- One individual was concerned that the water table would be drawn down to the point where it would affect the environment of caves in the general area and cause damage to the caves' natural resources and any cached cultural items.

Environmental Consequences

Construction and operation of the proposed mine and attendant services will necessarily involve ground disturbances, ranging from minimal to extensive, all of which will have direct adverse effects on cultural resources within the impact zone (historic properties, natural resources, access to sacred sites, and alteration of cultural landscapes), as well as indirect effects on the communities who have used the project area for hundreds if not thousands of years. These are discussed below by alternative and by the factors for alternative comparison that were identified for cultural resources issues.

Direct and Indirect Effects of Each Alternative

No Action Alternative

Under the no action alternative, the Coronado has an ongoing responsibility and plan for managing cultural resources on Forest Service lands and for regular consultation with tribes (U.S. Forest Service 1986, 2009f, 2010a). The Coronado would continue to preserve and interpret cultural resources in consultation with tribes and other interested parties for any ongoing undertakings to address potential adverse effects under the requirements of Section 106 of the National Historic Preservation Act.
The data from the field surveys for the Rosemont Copper Project resulted in the recording of newly discovered archaeological sites and clarified and updated the status of previously identified cultural resources. These data have been incorporated into the Coronado National Forest Heritage Resources database and into the State of Arizona's records at the Arizona State Museum. The data will assist the Forest Service in future planning, preservation, and interpretation activities.

Direct Impacts Common to All Action Alternatives and the Water Corridor

The scope of impacts with direct, adverse effects is evident in the number of National Register of Historic Places eligible historic properties present in each action alternative and the water corridor

(table 169). The table includes all eligible properties on or within the boundaries of the perimeter fence, primary/secondary road footprints for each action alternative, and the final proposed water corridor. The project design may be able to avoid some of these historic properties, but the majority of the properties will be affected by any of the action alternatives. No properties that were recommended ineligible are included in the table or the discussions.

Table 169. Number of National Register of Historic Places eligible historic properties recorded within the five action alternatives, primary and secondary access corridors, and water corridor

Site Types by Time Period	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary	Water Corridor
Preceramic Habitation	1	1	2	2	1	–
Ceramic Habitation	28	27	29	29	20	2
Protohistoric Habitation	1	1	2	2	2	1
Resource Procurement and Processing[1]	26	25	37	37	33	2
Multicomponent Prehistoric Habitation (Preceramic, Ceramic, and/or Protohistoric)	6	6	7	7	7	–
Prehistoric Unknown	–	–	–	–	1	–
Subtotal Prehistoric	*62 (65%)*	*60 (65%)*	*77 (69%)*	*77 (69%)*	*64 (65%)*	*5 (50%)*
Historic Mining	20	20	20	20	18	4
Historic Ranching	3	3	3	3	3	–
Multicomponent Ranching/Mining	1	1	1	1	1	–
Historic Other (habitation, government facility, water control, roads)	8	8	9	9	10	1
Subtotal Historic	*32 (33%)*	*32 (34%)*	*33 (30%)*	*33 (30%)*	*32 (33%)*	*5 (50%)*
Multicomponent Prehistoric/Historic	2	1	1	1	2	–
Subtotal Multicomponent	*2 (2%)*	*1 (1%)*	*1 (1%)*	*1 (1%)*	*2 (2%)*	–

Site Types by Time Period	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary	Water Corridor
Proposed *Ce:wi Duag* Traditional Cultural Property	**1**	**1**	**1**	**1**	**1**	**1**
Total	**97 (100%)**	**94 (100%)**	**112 (100%)**	**112 (100%)**	**99 (100%)**	**11 (100%)**
Total Acreage	**6,419**	**6,300**	**7,037**	**7,037**	**7,359**	**574**

[1]Includes Archaic resource procurement and processing sites (1 in Scholefield-McCleary; 2 in proposed action and Phased Tailings Alternative; and 4 in Barrel and Barrel Trail Alternatives).

Impacts common to all alternatives are discussed below, followed by a discussion of the differences in impacts within the individual action alternatives.

Destruction of Historic Properties and Their Potential to Contribute to Future Scientific Knowledge

Portions of some sites are outside the primary mine activities (mine pit, facilities, processing areas, and tailings), and some may be avoided by realigning utilities, roads, and fences; however, most of the National Register of Historic Places eligible historic properties (prehistoric and historical habitations, towns, ranches, mines, and water and transportation systems) are within the direct impact areas. Previous investigations sampled the resources; however, even sites that were previously subjected to data recovery have significant unexcavated portions and newly discovered loci, and some will likely contain additional burials.

Prehistoric resources constitute the majority of all the historic properties in each alternative and range from 65 to 69 percent of the resources. Although the number of historic sites is similar for all action alternatives, the sites vary, depending on the alternative boundaries. With a few exceptions, such as the Scholefield Ranch, most of the historic sites are located from Barrel Canyon westward and are within the proposed pit and operations areas, as might be expected, given that more than one-half of the historic sites are related to previous mining activities in the area. The largest sites spatially are the locations of the former mining towns of Old and New Rosemont and another unnamed mining area that has been designated as the Gunsight Pass mining complex.

One significant historic site lies within the rights-of-way for the proposed secondary access road and water corridor for all of the action alternatives. It runs west through López Pass, down into the historic mining town of Helvetia. Only a few structures remain at this location; however, Helvetia has been identified as a Priority Historic Site in the Pima County Sonoran Desert Conservation Plan.

The Ballcourt prehistoric site was identified as another significant site; ANAMAX excavations identified it as the first upland Colonial-Sedentary Hohokam site (A.D. 850 to 1000) to include a ballcourt. It is within and adjacent to the perimeter boundary for the proposed action and Phased Tailings Alternative; for these and the Barrel Alternative, the site is east of the dry-stack tailings and waste rock storage area. It is within the designated waste rock storage area for the Barrel Trail Alternative. The Scholefield-McCleary Alternative primary access road was designed specifically to avoid this and several other Hohokam habitation sites.

All five action alternatives contain the single, previously excavated Preceramic (Archaic) habitation site, AZ EE:2:62(ASM), within the proposed mine pit. They also include within their perimeter fence

the only site identified as Mogollon during the ANAMAX excavations, AZ EE:2:79(ASM) (Ferg et al. 1984b; Huckell 1984a).

Protohistoric sites are ephemeral by their very nature. Seven Protohistoric deposits (five of the seven are parts of multicomponent sites) have been recorded in the areas of potential effects for the action alternatives: two sites are single component, four are situated atop Hohokam sites, and one site is reported to contain a Preceramic component, as well. All alternatives contain the four Ceramic/Protohistoric sites; all but Scholefield-McCleary contain the Preceramic/Protohistoric site; all contain the single-component Protohistoric habitation site; and Barrel, Barrel Trail, and Scholefield-McCleary also contain the second Protohistoric habitation site.

Mining related sites constitute more than one-half of the historical sites in all action alternatives. The Historic Other category includes the location of the original Forest Service facilities, historic habitations with no specific function determined, water control features such as Civilian Conservation Corps dams, and historic roads.

Historic sites of note include the locations of the Old (1894 to 1905) and New (1915 to 1921) Rosemont mining camps; the V.R. (Vail Ranch, 1883 to present; also known as the Gayler or Rosemont Ranch), López Ranch (1894 to 1960), and Martínez Ranch (1900 to 1910); the Rosemont Ranger Station (1904 to 1932); and the Rosemont School site (1895 to 1911). Old Rosemont and the Rosemont Ranch have been designated Priority Archaeological Sites in the Pima County Sonoran Desert Conservation Plan. All of these historical sites are within all of the action alternatives. The Scholefield/Hidden Valley Ranch is within the primary access corridor of the proposed action and adjacent to the tailings conveyor in the Scholefield-McCleary Alternative.

Disturbance of Human Remains

The ANAMAX investigations demonstrated that Ceramic period habitation sites in this area, no matter the size, are likely to contain human remains. Human remains were not found at Preceramic and Protohistoric habitation sites. The Scholefield-McCleary Alternative has the fewest Ceramic period habitation sites, at 20; followed by Phased Tailings, at 27; proposed action, at 28; and Barrel and Barrel Trail Alternatives, both at 29. A Historic period burial was transferred from the Martínez Ranch during the ANAMAX investigations; additional burials may be present, particularly around the unnamed mining sites discovered during the recent surveys. Treatment of Native American human remains will be addressed by the Native American Graves Protection and Repatriation Act; nonnative burials will be subject to the Arizona Burial Law.

Destruction of Sacred Sites

Springs and seeps are considered sacred sites by all of the tribes consulted by the Coronado for the proposed action. Springs/seeps are power-laden loci. They may also contain mineral deposits used for ceremonial purposes, such as those identified by tribal representatives during the onsite tours of the proposed project area (Griset 2011).

Springs and seeps would be impacted either directly within the alternatives boundaries (as shown in figure 99) or through projected changes in the water table beyond the alternatives boundaries (see table 50 in “Groundwater Quantity” section) that would likely desiccate the springs/seeps. Within the action alternatives boundaries, four alternatives (proposed action, Phased Tailings, Barrel, and Barrel Trail) would directly affect 12 springs; and the largest number of springs, 19, would be affected within Scholefield-McCleary. Outside the action alternatives, major and possible impacts have been identified for 51 additional springs for all alternatives except Scholefield-McCleary, which would

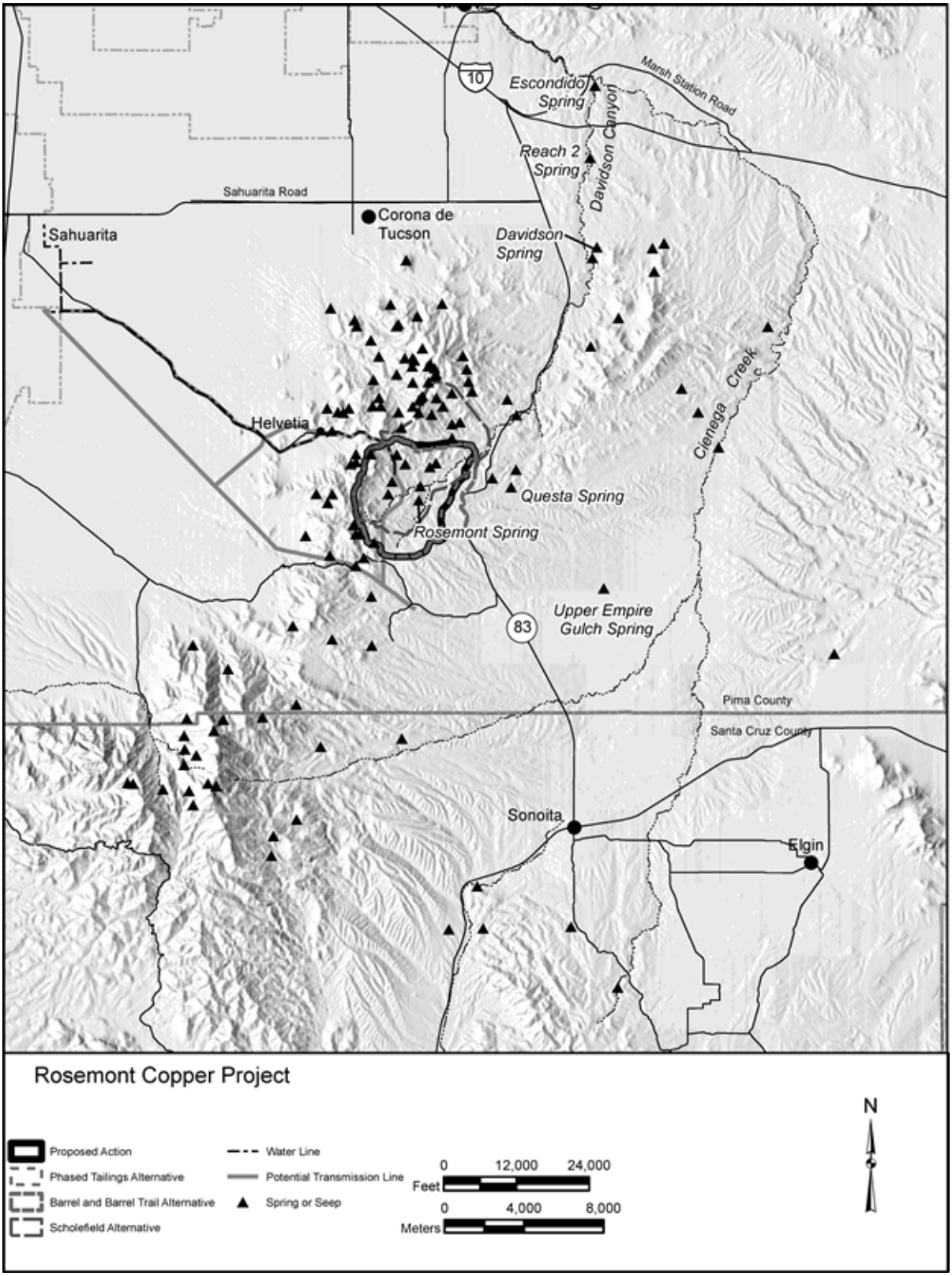


Figure 99. Springs and seeps in the action and utility alternatives and environs

affect 48 additional springs. All of these springs are located within the proposed *Ce:wi Duag* Traditional Cultural Property.

Another class of sacred site, high-elevation vantage points known to have been used by O'odham for personal vision quests, may be indirectly impacted. Restricted access, elevated mechanical noise levels, and the lack of privacy are indirect impacts that preclude the use of these sites as religious retreats while the mine is in operation.

Destruction of Natural Resources

Resource-collecting areas are found at all elevations, from the canyon floors to the hillside slopes, including rock and clay outcrops. Ethnohistorical testimony confirms that O'odham and Apache families continue to visit the area for specific resources such as acorn, tepary beans, coral beans, and plants and minerals to make ceremonial regalia and basketry, as well as medicinal plants (Griset 2011). Hispanic families were also reported to collect acorn and other resources in the Rosemont area (Ayres 1984). Game animals regulated by the Arizona Game and Fish Department are addressed in the "Biological Resources" section.

The two primary biotic zones in the project area are semidesert grassland and Madrean evergreen woodland (figure 100). Critical foods and materials in semidesert grassland are several species of agave and cholla, prickly pear, mesquites, desert hackberry, grasses, sotols, white tail deer, jackrabbits, and bighorn. Amaranth, chenopodium, Palmer agave, oak acorns, sumac, tepary beans, grape, pinyon nuts, walnuts, cottonwood, junipers, mountain mahogany, beargrass, sotols, and coral beans are found in Madrean evergreen woodland. Mule deer and cottontail rabbits are found in both areas and have been a source of food for human from the first occupation up to the present time (Griset 2011).

Direct impacts will destroy the existing natural resources; attempts to replicate a small portion of the biotic communities during the reclamation process or to transplant some species prior to project implementation cannot compensate for the loss of plants and animals, nor can it replicate the spiritual power that is specific to this locale.

Destruction of Cultural Landscapes

Cultural landscapes reflect the interaction of a group of people with a shared culture, a shared environment, and the interactions between the two over time. Each culture imbues a specific landscape with its own set of meanings for individual locations, geological formations, resources, viewsheds, or the landscape as a whole, and those places become the physical manifestation of the origins, history, and worldview of that culture. The Santa Rita Mountains constitute such a cultural landscape. The range is known as *ce:wi duag* (long mountain) to the Tohono O'odham and *dzil enzho* (beautiful mountain) to the Western Apache (Griset 2011:78).

The Tohono O'odham have declared *ce:wi duag*, the entire Santa Rita Mountain range, to be a traditional cultural property that incorporates the landscape, spiritual locations d such as sacred springs and vision quest locales, as well as the remains of their ancestral villages and cemeteries, and traditional resource collecting areas. Native people do not itemize these as distinct resources or locations; they are an integral unit of their heritage.

The east side of the Santa Rita Mountains is also a rural landscape that is important to the resident ranching population. It evokes not only family histories and connections to specific locations on the land, it also embodies the essence of the western ranching ethic and way of life, which has been

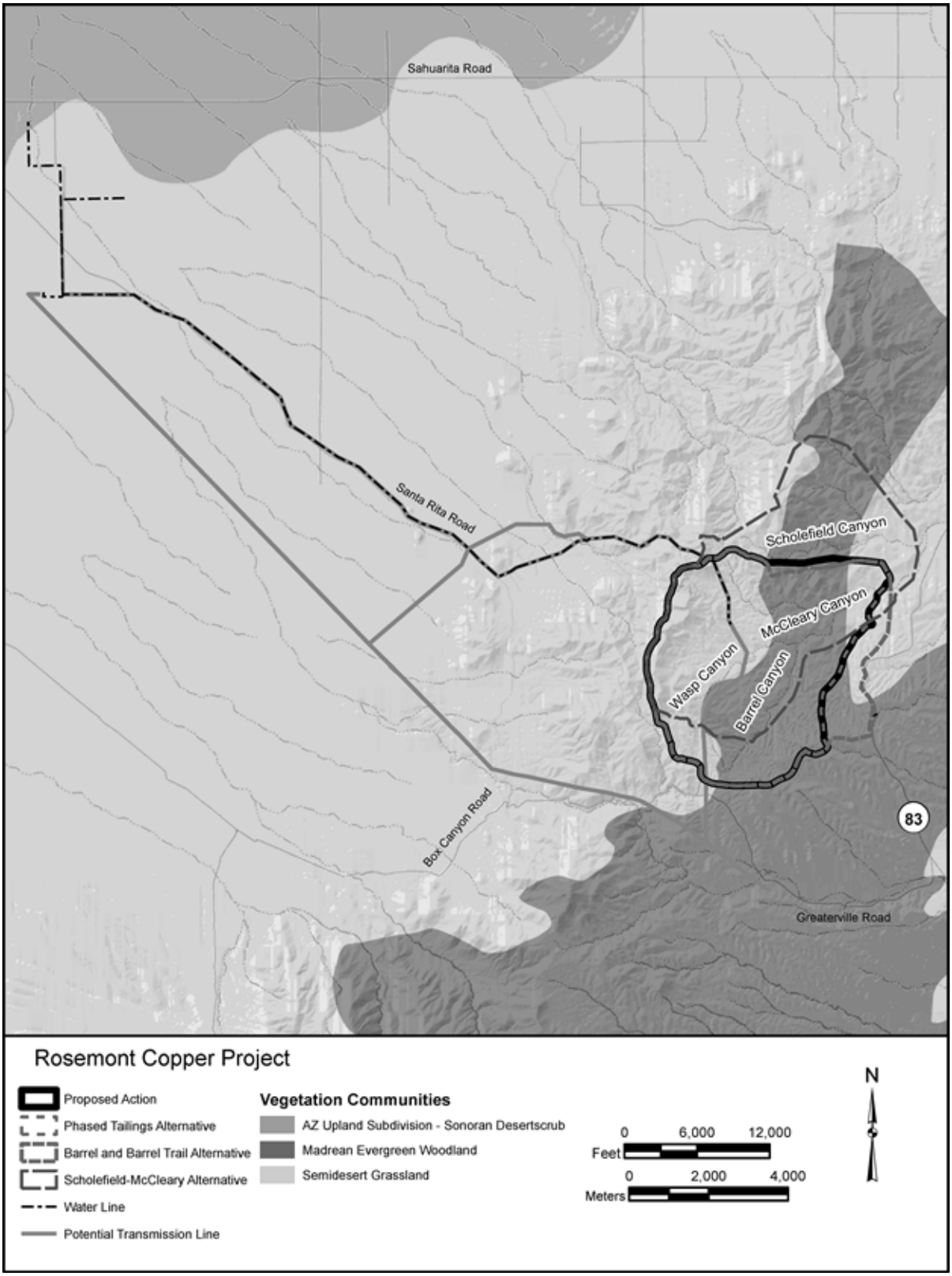


Figure 100. Biotic communities in the action and utility alternatives (Brown 1994)

validated further by its selection by Hollywood as a setting for western movies. The access to Federal grazing permits is intrinsic to maintaining this lifeway.

The cultural landscape would be irrevocably altered by any of the action alternatives. The massive movement of rock and soil and transformation of the topography would significantly alter the landscape and adversely affect the integrity of the cultural landscape as well. For the Native American tribes and the local ranching community, the adverse effects of the alteration of this cultural landscape have social and cultural impacts that cannot be mitigated.

Disturbance of Traditional Cultural Properties

The Tohono O'odham Nation has requested that the Coronado nominate the Santa Rita Mountains as the *Ce:wi Duag* Traditional Cultural Property, with a proposed boundary that follows the Coronado National Forest boundary and includes the entire Santa Rita Mountains from Mount Fagan on the north to the Patagonia-Sonoita Creek Preserve on the south, and from Elephant Head on the west to the site of former Fort Crittenden on the east. The Coronado is preparing a nomination of this traditional cultural property for the National Register of Historic Places.

Disturbance of the *Ce:wi Duag* Traditional Cultural Property would occur under all action alternatives. The disturbance of the *Ce:wi Duag* Traditional Cultural Property would include impacts to individual resources such as springs, plants, and animals, as described in the specific resource sections of this document. The disturbance of the *Ce:wi Duag* Traditional Cultural Property would also include the overall impacts to the cultural landscape, as well as impacts to contemporary uses of the area, as described earlier in this section.

Direct Impacts Specific to the Proposed Action and Phased Tailings Alternatives

The proposed action and Phased Tailings Alternative are discussed jointly, as they have similar footprints with regard to cultural resources (figures 101 and 102). The single difference lies in the location of the primary access road for each and accounts for three fewer cultural sites in Phased Tailings Alternative, making it the alternative with the fewest historic properties (93) subject to adverse impacts; the proposed action has the second fewest historic properties at 96. An additional 10 historic properties may be affected by the construction of the water supply.

These alternatives, along with the Barrel Alternative, have 32 habitation sites with the potential for human remains; this is the middle range amount. Barrel Trail has the highest number, at 38, and Scholefield-McCleary has the lowest, at 29.

The perimeter fences for the proposed action and Phased Tailings Alternative are immediately adjacent to the Ballcourt site, AZ EE:2:105(ASM).

Direct Impacts Specific to the Barrel and Barrel Trail Alternatives

The Barrel and Barrel Trail Alternatives have the same perimeters and include additional acreage to the east and southeast of the proposed action to accommodate the reduction in the northern perimeter. Both sides of Barrel Canyon are included within the area of direct impact; direct impacts to McCleary Canyon are avoided (figure 103). The major difference between these two alternatives is the additional use of the northern portion of Trail (South) Canyon and the ridge between it and Barrel Canyon for waste rock storage; the Ballcourt site would be covered in the Barrel Trail Alternative.

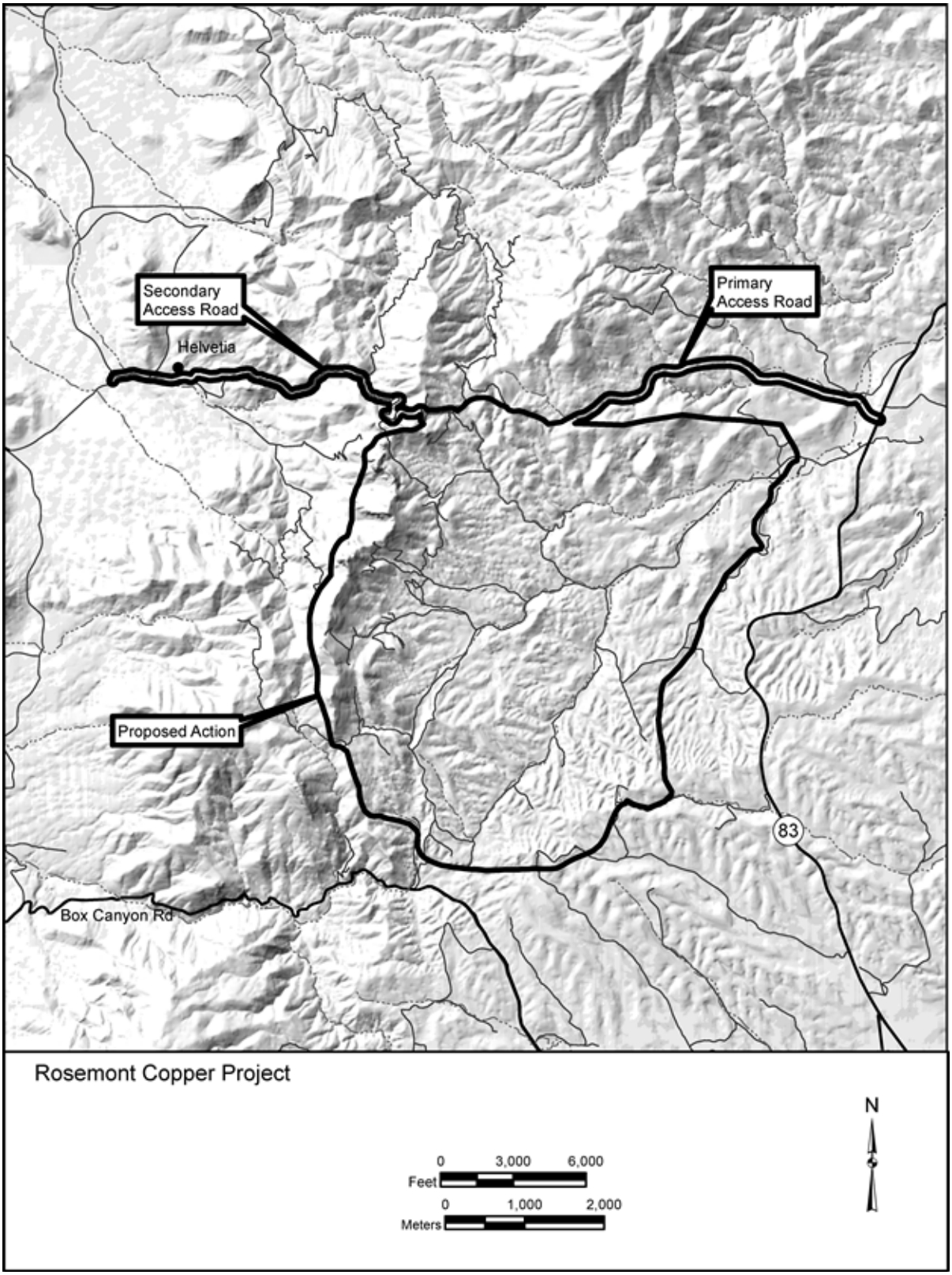


Figure 101. Footprint of the proposed action alternative

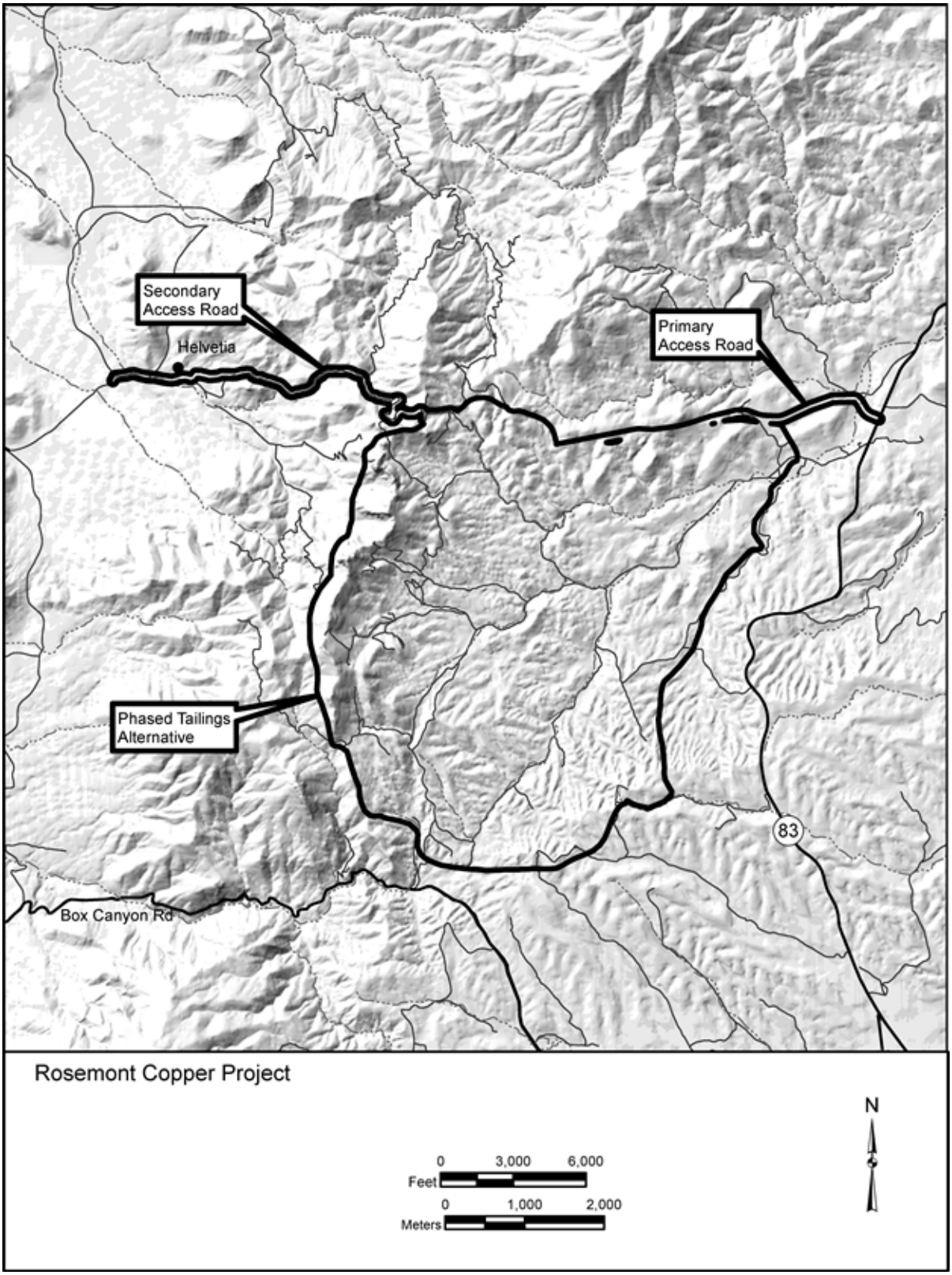


Figure 102. Footprint of the Phased Tailings Alternative

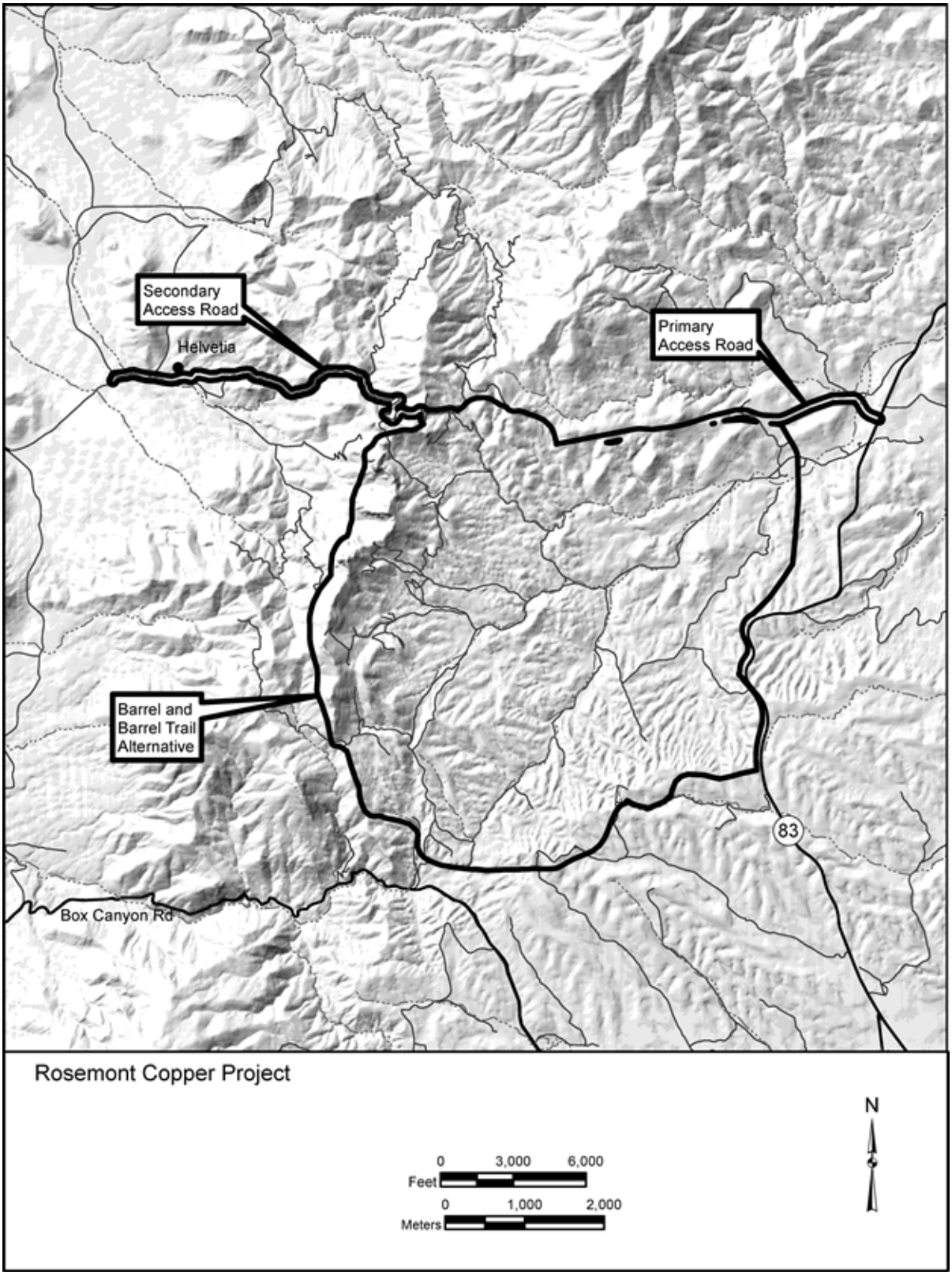


Figure 103. Barrel and Barrel Trail Alternatives

Both of these alternatives have 111 National Register of Historic Places eligible historic properties—the highest total of all alternatives. An additional 10 historic properties may be affected by the construction of the water supply.

Direct Impacts Specific to the Scholefield-McCleary Alternative

The Scholefield-McCleary Alternative has a sizable amount of acreage north of the proposed action footprint, leaving free the southern portion of Trail (South) Canyon. This alternative also has a unique primary access road that has been designed to avoid the Ballcourt site, AZ EE:2:105(ASM), as well as sites AZ EE:2:92(ASM) and AZ EE:2:121(ASM) (figure 104). This alternative has the potential to impact 98 historic properties, with two sites more than the proposed action and five sites more than Phased Tailings. An additional 10 historic properties may be affected by the construction of the water supply.

Indirect Impacts Common to the Action Alternatives

Any of the action alternatives would have indirect impacts on cultural resources beyond the project area. The economic study commissioned by Rosemont Copper concludes that an average net population migration into the Cochise/Pima/Santa Cruz Counties area of 150 persons per year would occur over the 20-year production period of the project, or a total population increase of 4,000 (L. William Seidman Research Institute et al. 2009). Workers and their families would require additional housing, facilities, infrastructure, and services. It is likely that providing these would result in adverse effects on the types of cultural resources and historic properties enumerated above in areas of the three counties beyond the area of potential effects.

Another possible indirect impact raised during public scoping is the possibility that adjacent historic properties would be destroyed or damaged as a result of vibrations from mine construction and operations such as blasting and crushing rock. A noise study by Tetra Tech (Tetra Tech 2009d) projected that construction activities should not be noticeable at distances more than 1.5 miles away from the construction site. Airborne vibrations may be capable of rattling loose objects or windows at 0.5 mile from the blast site but fall off rapidly 5 miles away from the site. Based on modeled ground vibrations, Tetra Tech (Tetra Tech 2009d) concluded that the vibrations would “be well below the threshold for any kind of cosmetic building damage and would generally be below the threshold of human perception at almost all residential locations.” Historic properties that lie within the 1.5-mile radius from the mine operations areas may be affected by airborne or subsurface ground vibrations from the blasting and crushing activities.

Direct Impacts Common to the Utility Alignments

Table 170 summarizes the National Register of Historic Places eligible historic properties that may be adversely affected by utility construction and maintenance (see figure 95). The data discussed below are drawn from recent archaeological surveys of the utility corridors (Sheehan et al. 2010; Swanson 2011; Swanson et al. 2010), supplemented by data from the archaeological surveys of the action alternatives (Barr et al. 2010; Ezzo et al. 2011). The portions of each utility alternative that lie within an action alternative for the mine are not included in this table; only sites beyond the action footprints are included here. All National Register of Historic Properties eligible properties within the surveyed corridor are included in the table; some of these properties may be avoidable by project design. No properties that were recommended ineligible are included in the table. As mentioned previously, the historic properties listed under the TEP Preferred Alternative are the same resources described in

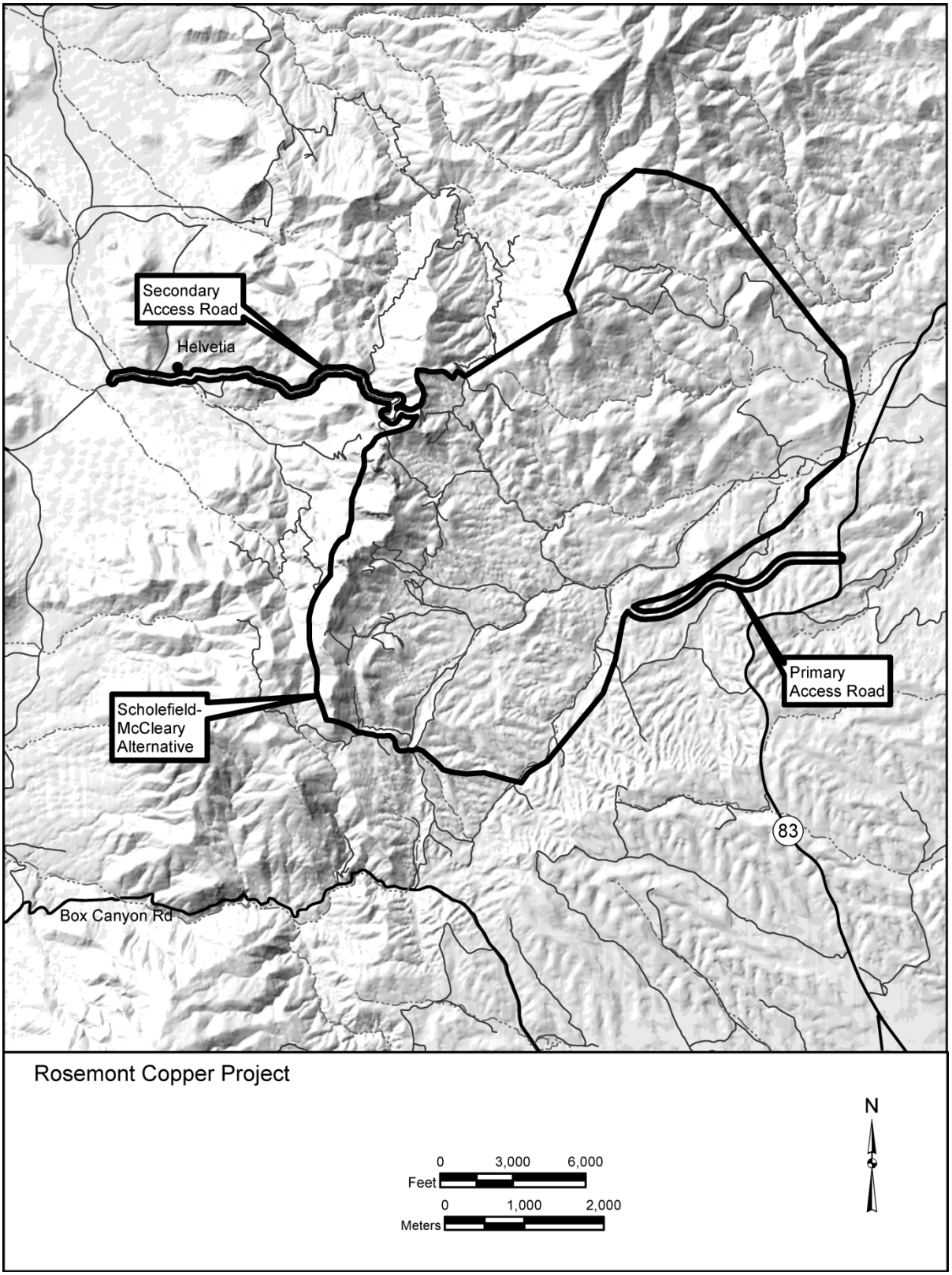


Figure 104. Scholefield-McCleary Alternative

table 169 for the water corridor. If any of the other utility alternatives is selected, the historic properties listed for that alternative would be additional to the properties of the selected action alternative.

Table 170. National Register of Historic Places eligible historic properties in the utility alternatives external to the action alternatives boundaries*

Site Types by Time Period	TEP Preferred	TEP Alternative 1	TEP Alternative 2	TEP Alternative 3	TEP Alternative 4
Preceramic Habitation	0	0	0	0	0
Ceramic Habitation	2	0	4	2	3
Protohistoric Habitation	0	0	0	0	0
Resource Procurement and Processing	3	3	5	5	6
Multicomponent Prehistoric Habitation (Preceramic/Ceramic and/or Protohistoric)	0	0	0	0	0
Prehistoric Unknown	0	0	0	0	0
Subtotal Prehistoric	*5 (50%)*	*3 (43%)*	*9 (64%)*	*7 (64%)*	*9 (75%)*
Historic Mining	4	4	4	4	1
Historic Ranching	0	0	0	0	0
Multicomponent Ranching/Mining	0	0	0	0	0
Historic Other (habitation, government facility, water control, roads)	1	0	1	0	1
Subtotal Historic	*5 (50%)*	*4 (57%)*	*5 (36%)*	*4 (36%)*	*2 (17%)*
Multicomponent Prehistoric/Historic†	0	0	0	0	1
Subtotal Multicomponent	*0*	*0*	*0*	*0*	*1 (8%)*
Proposed *Ce:wi Duag* Traditional Cultural Property	**1**	**1**	**1**	**1**	**1**
Total†	**11 (100%)**	**8 (100%)**	**15 (100%)**	**12 (100%)**	**13 (100%)**

* Data compiled from Ezzo et al. (2011), Sheehan et al. (2010), Swanson (2011), and Swanson et al. (2010).

† Totals do not equal totals in table 168 because multicomponent sites were recorded individually as prehistoric and historic sites in that table.

Destruction of Historic Properties and Their Potential to Contribute to Future Scientific Knowledge

The placement of poles for electrical transmission lines can often be adjusted to avoid historic properties; however, water and service roads may be less flexible. The smallest number of National Register of Historic Places eligible historic properties affected by the utilities, 7, is within TEP Alternative 1; the largest number, 14, is within the TEP Preferred Alternative and TEP Alternative 1 and is nearly evenly split between prehistoric and Historic period sites; TEP Alternatives 2, 3, and 4

have more prehistoric sites than Historic period sites. TEP Alternative 2 has the most Ceramic period habitation sites, which are more likely to contain human remains, based on the results of the ANAMAX excavations in the Rosemont area. Two corridors, the TEP Preferred Alternative and TEP Alternative 2, pass by the Helvetia Cemetery.

Portions of the former mining town of Helvetia (1879 to 1923, with peak population 1898 to 1911) are within four of the utility routes, the exception being TEP Alternative 4. As mentioned previously, this site is designated a Priority Historic Site in the Pima County Sonoran Desert Conservation Plan. All of the Historic period sites are related to mining, save one: Box Canyon Road in TEP Alternative 4, retains historical features constructed by the Civilian Conservation Corps in the 1930s.

Disturbance of Human Remains

Ceramic period habitation sites likely to contain human remains range from a low of two in the TEP Preferred Alternative and TEP Alternative 3, to a high of four in TEP Alternative 2. The TEP Preferred Alternative and TEP Alternative 2 pass by the Helvetia Cemetery. The exact locations of burials in the cemetery are not known, despite recent volunteer efforts to outline the locations.

Destruction of Sacred Sites

No springs are within the surveyed utility corridors; however, several springs are less than 250 feet from the corridors. The unnamed spring near the former town of Helvetia was recorded as 240 feet from the corridors of the TEP Preferred Alternative and Alternatives 1, 2, and 3. Proctor Box Spring was recorded as being 140 feet from Alternative 4. Recent attempts by WestLand Resources (WestLand Resources Inc. 2011c)
to relocate these springs met with mixed success. Springs are the traditional loci for ceremonial activities, and visual or auditory disturbances may affect the sanctity of these loci. Both of these springs are within the proposed *Ce:wi Duag* Traditional Cultural Property.

Utility corridors and roads cross the upper elevations at López Pass and the unnamed pass to the Greaterville Substation. Increased traffic and noise would affect these areas and preclude use of vantage points for religious activities.

Destruction of Natural Resources

More than three-fourths of the lengths of all utility corridors are west of the Santa Rita Mountains ridge line; less than one-fourth is east of the ridge line. The corridors extend from the east side of the Santa Cruz River, stretch across river terraces, bajadas, and the steep slopes on either side of the ridgeline, and eventually connect with the Greaterville Substation south of the proposed project. Similarly, three-fourths of this area is semidesert grassland; one-fourth is Madrean evergreen woodland (see figure 100). The same critical resources enumerated above pertain to these areas, as well.

Destruction of Cultural Landscapes

Portions of the utility corridors are within the proposed *Ce:wi Duag* Traditional Cultural Property. Power transmission lines will affect the visual landscape of this area and their construction may have specific impacts on pole or access road locations. No springs are within the transmission corridors

Cumulative Effects

Cumulative effects result from spatial and temporal crowding of environmental perturbations from the proposed action and from other actions in the past, present, and foreseeable future. The direct effects of the action and utility alternatives on cultural resources within approximately 6,000 acres have been described above, as well as the indirect impacts that would extend beyond the area of potential effects into urban areas in Pima, Cochise, and Santa Cruz Counties. The analysis area for cumulative effects has been divided into two zones (see figure 96): Zone 1 incorporates a similar upland environmental zone known or likely to contain similar types of historic properties; and Zone 2 incorporates the urban areas in Cochise, Pima, and Santa Cruz Counties that would be affected by the projected 4,000-person net increase in population that would result from the project (L. William Seidman Research Institute et al. 2009).

Zone 1: The action alternatives are located at elevations between 4,390 to 6,300 feet above mean sea level. Prior to the archaeological investigations conducted in the Rosemont area for the proposed ANAMAX mine, the prevalent thinking was that upland zones were used solely for collecting resources and were likely occupied only temporarily. ANAMAX demonstrated that prehistoric Hohokam villages were centered along the Barrel Canyon drainage and included at least one site with a ceremonial ballcourt. Similar habitats and possibly similar prehistoric and historic occupations of upland areas exist all along both sides of the Santa Rita Mountains, southward to Canelo Hills and the Patagonia Mountains, and eastward to the Huachuca Mountains, north along the Whetstone Mountains, and up the Las Cienegas drainage. However, only small portions of these areas have been surveyed for cultural resources, and none have been studied systematically in a manner comparable to the ANAMAX investigations at Rosemont. Fewer than 25 percent of the large tracts of public land in Zone 1 managed by the Coronado, Bureau of Land Management, and Arizona State Land Department have been surveyed for cultural resources, which makes comparisons difficult. However, in the Bureau of Land Management's Las Cienegas National Conservation Area east of Rosemont, a recent survey of 10,000 acres resulted in 70 sites, or an average of 4.5 sites per square mile, whereas the approximately 10,000 acres of land surveyed recently for the action alternatives resulted in 159 sites, or 10.2 sites per square mile.

Past impacts on cultural resources in Zone 1 included mining that ranged from individual prospectors and small-scale mining operations, beginning with the Spanish, Mexican, and American miners through the 1860s, followed by larger operations beginning in the 1880s after the Apache were removed from the area. These developments included the construction of roads and railroads, water systems, and individual house sites, as well as mining camps and towns. Ranchers also developed these lands using many of the same facilities and site locations. Cattle grazing affected the distribution of plant species and contributed to the erosion of cultural site surfaces as noted in the archaeological survey reports mentioned throughout this section. When the Coronado assumed management of much of Zone 1 at the turn of the 20th century, additional impacts were introduced by new road systems and increased recreational use of the area.

Present impacts include the ongoing ranching and forest activities, including increasing use of off-road recreational vehicles, development of the Arizona National Scenic Trail, realignment of State Route 83, and the wildcat roads and trash created by border crossers and the U.S. Border Patrol's pursuit efforts. Zone 1 contains significant mineral deposits on private and public lands, including existing and expanding limestone quarries, small-scale exploration and placering on the Coronado National Forest, and a recently proposed mine in the Patagonia Mountains. Federal land is currently

leased for research projects by the Whipple Observatory on Mount Hopkins, and state land is leased by the University of Arizona's Santa Rita Experimental Range.

Foreseeable future impacts within Zone 1 include additional mineral exploration and development, widening of transportation corridors in response to increased traffic, expansion of residential development in the Sonoita and Patagonia areas and intensified recreational use of public lands with similar environment as a result of population increases and the removal of approximately 5,000 acres of available recreation lands if the project proceeds.

Zone 2: The area outside the area of potential effects and within the three counties consists of the Santa Cruz and San Pedro River valleys and the Tucson Basin. These are the loci of much of the urban development in southern Arizona over the past 300 years. They, too, contain areas of intensive mineral exploration.

Past impacts from urban development, particularly within the past 20 years, have caused extensive land disturbance and consequent destruction of prehistoric and Historic period cultural resources. Pima County's population increased by 15 percent between 2000 and 2006, when it exceeded 1,000,000 residents. A construction boom began circa 2005 and was curtailed by the recession of 2008, as evidenced by the 12,509 residential building permits issued in 2005 versus the 3,394 permits issued in 2008 (Pima Association of Governments 2011). Over the past 20 years, however, thousands of new archaeological sites have been recorded as part of environmental compliance required prior to land development on non-reservation land, generally the east half of Pima County (the Tohono O'odham Reservation occupies much of the west half of the county). The total number of archaeological sites and historical structures in Pima County exceeds 8,500 (Karl 2011) within an area measuring 9,200 square miles. Neither of the other two counties has similar requirements to identify cultural resources prior to land disturbance, and many historic properties have undoubtedly been damaged or destroyed without documentation.

Present impacts include slowed but continued population growth and attendant land disturbance for residential and commercial development and infrastructure. The Sierrita and Mission copper mines in Green Valley continue to expand their exploration and waste rock areas. Arizona Portland Cement is in the process of developing a haul road to reopen a limestone quarry in Davidson Canyon, and Regional Transit Authority road projects are continuing to improve existing roadways or develop new roadways.

Foreseeable impacts include the Regional Transit Authority projects slated for the next 15 years. The Town of Sahuarita is seeking to annex 16 sections of Arizona State Land Department land and expand light industry development and infrastructure. Arizona Portland Cement is planning a haul road for its limestone quarry in Davidson Canyon, and Farmers Investment Company is seeking to obtain an extension of the Central Arizona Project water to its groundwater storage south of Sahuarita. Other proposed projects include possible land acquisition for the Pima County Sonoran Desert Conservation Plan, construction of the PNM power line, and designation of the Tumacácori Wilderness.

Additionally, recreational or grazing activities currently ongoing in Zone 1 may be relocated elsewhere, where they may have adverse effects on the cultural resources in the new locations.

The overall forecast is one of continued degradation and loss of cultural resources from land disturbance. Where Pima County averages 0.0001 recorded archaeological or historic site per acre and the Las Cienegas National Conservation Area averages 0.007, the combined action alternatives

averaged 0.014 in the recent resurveys. The project area is rich in a diverse array of cultural resources and has the additional cultural significance of the open spaces, heights, and natural resources of the Santa Rita Mountains.

Mitigation Effectiveness

Tribal consultation resulted in a unanimous recommendation that adverse effects on Native American sites be avoided, thereby precluding any need for mitigation. Several representatives stated that they could not be part of the destruction of their ancestral heritage and did not recognize any mitigation as successful if it resulted in the destruction of the historic property.

Mitigation of adverse effects on archaeological sites has traditionally involved data recovery excavations that sample or completely excavate a site to document the information contained therein and to identify human remains and arrange for their repatriation to culturally affiliated individuals or tribes. Excavation, however, destroys the site and is constrained by the analytical technology available at the time of the excavation. Any future information potential of the site is destroyed as well.

Alternate methods of mitigating adverse effects on archaeological sites have included analysis of extant collections from the same or similar sites; creation of public outreach products such as exhibits and brochures; conducting oral history interviews to produce an area history; developing curriculum packets geared toward elementary and secondary education; purchasing land in a similar biotic zone with similar cultural resources for preservation in perpetuity, etc. These mitigations do not preclude the destruction of historic properties if the mine goes forward.

Rosemont Copper has discussed potential mitigation measures such as creating a public Mining Museum and Interpretive Center at the Scholefield Ranch. They have expanded the types of plants being investigated for transplanting as part of the reclamation plan and have stated that they would encourage transplanting resources important to Native and local communities before ground disturbance begins. Tribal representatives consulted by the Coronado have stated repeatedly that plants take on the specific characteristics of the locales in which they grow naturally; hence, Native people travel to specific locations to pick specific plants. Plants associated with high elevations and springs are especially powerful.

In addition to historic properties, the Tohono O'odham Nation (Steere 2010) requested that the Santa Rita Mountains be designated the *Ce:wi Duag* Traditional Cultural Property, a cultural landscape that includes the archaeological sites, natural resources, landforms, and vistas considered to be part of Tohono O'odham traditional cultural inheritance. Disruption of any part affects not only the individual part but the effectiveness of the landscape as a part of the Tohono O'odham cosmos. The Nation has issued a tribal resolution stating that the disruption to the landscape resulting from the construction, operation, and reclamation of the mine is a permanent effect that cannot be mitigated.

The objective of the Coronado's consultation with tribes, cooperating agencies, and the Arizona State Historic Preservation Office is to formulate a memorandum of agreement with these parties and the Advisory Council on Historic Preservation, and this process is ongoing. The memorandum of agreement will include a historic properties treatment plan that will describe the measures to mitigate adverse effects on National Register of Historic Places eligible historic properties and the disposition of collected materials. It will also include a plan of action for the treatment of human remains discovered during intentional excavations or inadvertent discoveries, as required by the Native

American Graves Protection and Repatriation Act. The plan of action will also specify the procedures to be followed in the event that previously undetected cultural resources or human remains are uncovered during ground-disturbing activities during operation and reclamation of the project area.

Irretrievable and Irreversible Commitment of Resources

An intact archaeological site preserves cultural deposits in their original deposition, with the earliest at the bottom and the most recent at the top. Any ground disturbance, including archaeological excavation, compromises or destroys that depositional integrity, and it cannot be restored.
The preferred treatment for historic properties facing potential adverse impacts is to design around the property and preserve it intact, in the hope that new techniques will provide new ways to conduct scientific investigations without destruction, e.g., as ground-penetrating radar can do in a limited way presently. The mid-1980s ANAMAX excavations of sites within this area demonstrated the rich research potential of this area: the results of those excavations transformed our understanding of Hohokam occupancy and culture. The recent resurveys of the area have illustrated the limitations of the previous sample: many new resources were recorded, and many previously tested sites have been demonstrated to include much larger contents that would have been lost if the previous project had gone forward. These properties retain great potential to further elucidate prehistory as our methodology and techniques improve, provided that the resources are preserved. For the Native communities for whom these historic properties contain ancestral remains, any disturbance is viewed as yet another indignity perpetuated by others controlling ancestral lands.

Similarly, cultural landscapes are dependent upon the existing topography and the meaning attributed to it by each community. Massive movement of rock and soil will irrevocably alter those landscapes as it destroys the culturally imbued topography. That same process will also eradicate or greatly reduce the natural resources found within these uplands, which are critical for day-to-day needs and for ceremonies that perpetuate traditional cultures. Access to these resources has already been drastically reduced in areas immediately adjacent to the reservations of the tribes consulted. They have relied on the access facilitated by the Coronado for lands under its management and made the long journeys to be able to collect these resources. Reservation lands are in different environmental zones, and transplanting these resources is probably not a feasible solution to their potential loss.

Socioeconomics and Environmental Justice

Introduction

The analysis for social and economic concerns includes a discussion of current social and economic data relevant to the proposed project, including population, housing, economic and social conditions, financial resources, facilities and services, and quality of life; these elements are considered to help analyze potential impacts from the proposed project to social and/or economic conditions.

Information in this section was obtained from various sources, including the U.S. Census Bureau, the State of Arizona, Regional Economic Models, Impact Analysis for Planning (IMPLAN), and the Sonoran Institute Economic Profile System database, which uses different sources of information, such as Bureau of Economic Analysis, Bureau of Labor Statistics, and State of Arizona data.

The economic effects of the proposed project, both beneficial and adverse, have been the subject of several reports produced at different times by different parties for different purposes. All of these reports were considered and used for this analysis in order to provide a range of economic viewpoints. Three of the primary reports made available are as follows:

- "Economic Impacts of the Rosemont Copper Project on Pima County, Arizona" (Applied Economics 2011). This report was commissioned by Tucson Regional Economic Opportunities for the purpose of performing an economic impact analysis of the construction and operations. Specifically evaluated were the economic impacts that the mine would create through its direct operations, local supplier purchases, and employee spending. The potential impacts of the mine on the value of public lands, the tourism industry, air and water quality, wildlife habitat, astronomical observation conditions, and recreational and cultural resources were not addressed in this report.
- "Analysis of Economic Costs of the Proposed Rosemont Copper Project" (Power 2010). This report was commissioned by the Mountain Empire Action Alliance for the purpose of conducting an independent, objective study of the economic impacts, specifically addressing the adverse economic impacts the proposed mine would pose to local businesses, the regional economy, and quality of life.
- "Mining's Potential Economic Impacts in the Santa Rita and Patagonia Mountains Region of Southeastern Arizona" (Marlow 2007). This report was commissioned by Save the Scenic Santa Ritas. This report focuses solely on the direct economic impacts associated with the project; the indirect impacts were considered to have too high a level of uncertainty.

Issues, Cause and Effect Relationships of Concern

Two significant issues were identified during public scoping concerning socioeconomic resources.

Issue 11A: Regional Socioeconomics

The mine facilities and operation may result in changes over time to local employment, property values, tax base, tourism revenue, and demand and cost for road maintenance and emergency services. There may be costs to the alternative elements and mitigation measures that influence the present net value of the mine operations and, thus, its economic profile.

Issue 11A Factors for Alternative Comparison

- Change in employment over time
- Change in property values over time
- Change in tax base per year over time
- Change in demand and cost for road maintenance over time
- Change in demand and cost for emergency services over time
- Qualitative assessment of change in tourism revenue over time

Issue 11B: Rural Landscapes

The mine operation may not conform to the quality of life expectations as expressed by the forest plan and Federal, State, and local regulations and ordinances. Concerns have been expressed about modification of rural historic landscapes and local ranching traditions, which are important to local residents.

Issue 11B Factor for Alternative Comparison

- Qualitative assessment of the ability of alternatives to meet rural landscape expectations as expressed by Federal, State, and local regulations and ordinances

Other Effects Considered

While not raised as a major concern during scoping, the following issue has also been analyzed in order to provide a complete analysis of socioeconomic impacts:

- Environmental Justice: impacts to populations protected by Title VI of the Civil Rights Act

Following are the measures that will be used to evaluate the issue factors.

Employment

- **Issue Factor:** Changes in employment over time.
- **Measure:** Use of Regional Economic Models, Inc., IMPLAN modeling to determine direct, indirect, and induced effects of mine employment (Applied Economics 2011).

Property Value

- **Issue Factor:** Change in property value over time.
- **Measure:** Based on previous research regarding property value impacts, determine the number of residential properties within a 2-mile buffer and estimate change in value.

Taxes and Revenues

- **Issue Factor:** Change in tax base per year, over time revenues gained through extraction, and revenues lost as a result of inaccessibility of recreational lands.
- **Measure:** Use of Regional Economic Models, Inc., IMPLAN modeling to detail multiyear forecasts and tax revenue impacts (Applied Economics 2011). Qualitative and quantitative analysis of losses to recreation.

Road Maintenance Costs

- **Issue Factor:** Change in demand and cost for road maintenance of State Route 83, over time.
- **Measure:** Expected change in Arizona Department of Transportation maintenance funding needs.

Emergency Services Costs

- **Issue Factor:** Change in demand and cost for emergency services over time.
- **Measure:** Use of Regional Economic Models, Inc., modeling to detail multiyear forecasts and demographic impacts, based on estimated changes in population to determine demand for emergency services. Qualitative assessment of potential costs.

Tourism

- **Issue Factor:** Qualitative assessment of change in tourism revenue over time
- **Measure:** Qualitative and quantitative assessment of potential changes in tourism revenue in the analysis area. Assessment of nonmarket goods where available.

Quality of Life

- **Issue Factor:** Changes in physical settings, rural landscape expectations and ranching traditions, and quality of life for analysis area residents and visitors.
- **Measure:** Qualitative assessment of changes in the landscape from the forest plan; changes in local, State, and Federal guidelines; and public perception about how quality of life will change as the area setting changes.

Environmental Justice

Public scoping did not identify environmental justice as an issue; however, impact analysis of populations protected by Title VI of the Civil Rights Act is required by Executive Order 12898.

- **Issue Factor:** Disproportionately high and adverse environmental or human health impacts to an identified minority or low-income population that appreciably exceed those to the general population around the analysis area.
- **Measure:** Presence of minority or low-income populations within the analysis area.

Analysis Methodology, Assumptions, Uncertain and Unknown Information

The analysis for socioeconomics evaluates the social and economic effects, both positive and negative, of the construction, operation, and reclamation phases of the project.

The analysis area for socioeconomics includes the communities most likely to be affected by the proposed project. The geographic boundaries that form the area for socioeconomic analysis have been identified as a 50-mile radius around the proposed mine (figure 105). This buffer was selected based on various factors that may influence the location and magnitude of potential socioeconomic impacts, including the following:

- Communities that may experience direct and/or indirect economic impacts as a result of the proposed mine, either as a result of construction, operation, or closures (e.g., from employment, wages and taxes, changes in tourism spending, etc.)
- Anticipated changes in population as a result of in- and out-migration resulting from mine operation and/or employment
- The availability and location of existing housing and potential housing and the capacity and condition of existing local services and facilities
- Changes in quality of life for area residents and visitors, including changes in recreation opportunities

The 50-mile buffer extends into five counties (Santa Cruz, Pima, Cochise, Pinal, and Graham). However, only 1 percent of the 50-mile buffer extends into Graham County, and 0.5 percent extends into Pinal County. Additionally, no major towns or places are located within the portions of these two counties that extend into the 50-mile buffer analysis area. Therefore, Graham and Pinal Counties are not included in this analysis. Political jurisdictions include Pima, Santa Cruz, and Cochise Counties and the communities within those counties.

This discussion describes the social and economic conditions of these three counties in southern Arizona and, when appropriate data are available, communities near the project area that may be impacted by the project.

The temporal bounds of analysis for analyzing socioeconomics will be guided in part by available data, an assessment of current conditions (without the proposed mine or associated activity), and the phases of activity associated with the proposed mine, including construction, operation, reclamation, and closure.

Residents in the region have expressed concern that development of an open-pit copper mine could impact property values, impact economic activity related to local tourism industry, and change area quality of life and the sense of place currently derived from the Coronado National Forest and

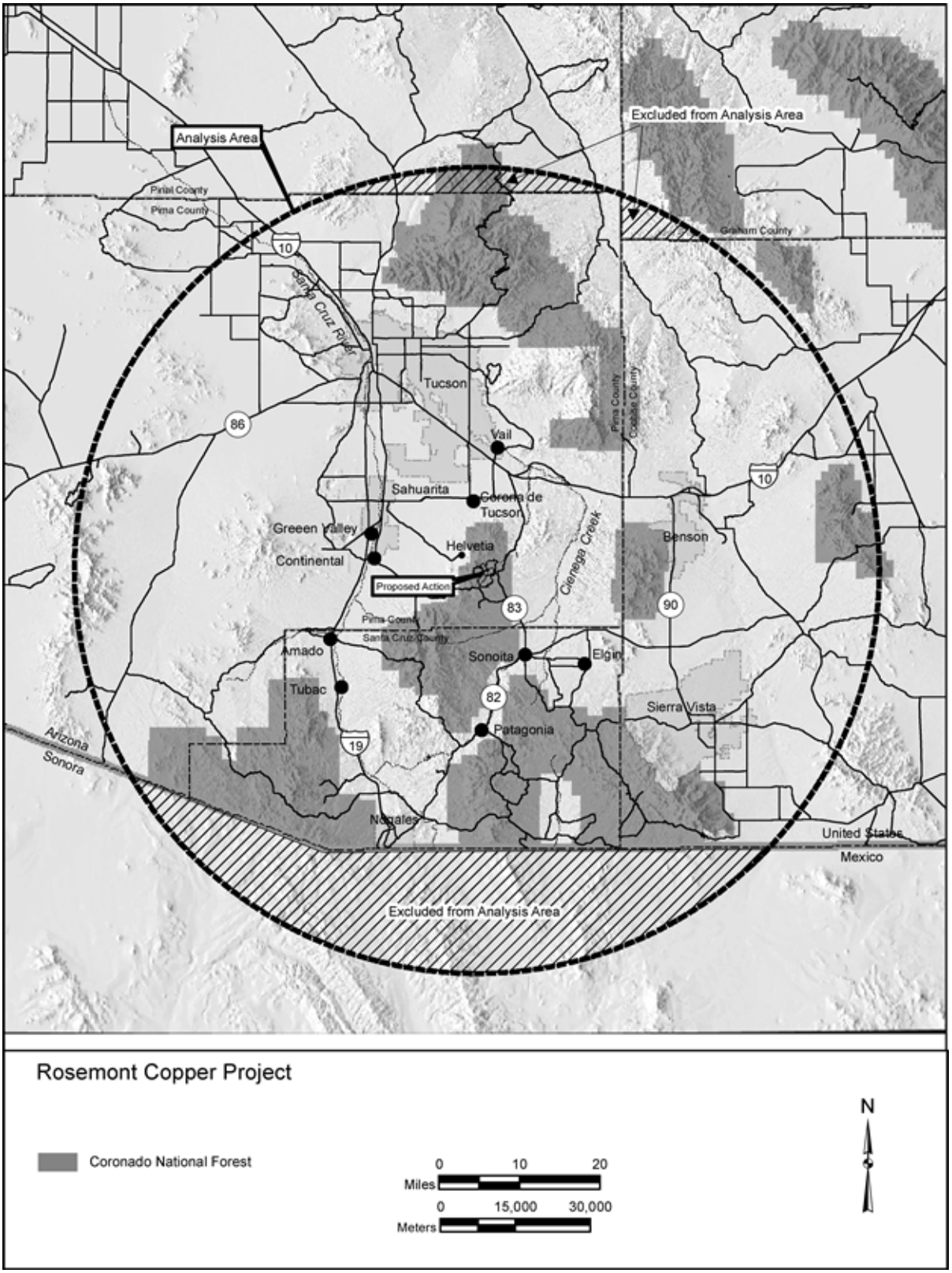


Figure 105. Analysis area for socioeconomics and environmental justice

recreation opportunities on area public lands. Other concerns expressed include adequacy of the local housing supply for a potential influx of mine and construction workers and financial pressure on local jurisdictions as a result of changes in infrastructure needs (e.g., roads, schools, fire, police) related to mining employment in-migration. The social and economic impacts are quantified where possible. However, where quantification of impacts is not possible, the analysis includes a qualitative discussion of possible effects.

The following analysis focuses on the potential effects on socioeconomics. Impacts to social and economic conditions could result from the implementation of any of the action alternatives.

Assumptions for this analysis include the following:

- All dollar figures in this analysis are stated in terms of 2008 dollars unless otherwise noted
- Engineering and construction would occur over an approximately 3- to 4-year period; of this, 18 months would be spent on construction
- Mine operation, reclamation, and closure would last for an estimated 21 years
- Employment and output projections will not fluctuate over the life of the project

Impacts to socioeconomic resources from implementation of alternatives would be considered significant if one or more of the following occurs:

- Substantial gains or losses in population and employment, or general economic stability
- Activities or operations that substantially alter the quality of life of individuals using or living near the forest. Note that quality of life impacts are discussed here qualitatively; however, impacts such as noise, air quality, recreation, and visual resources are quantitatively assessed in their respective sections of the document.

Summary of Effects by Issue Measures by Alternative

The following table summarizes effects by the eight issue factors (described below) and by alternative (table 171). A full discussion of the effects summarized below can be found in the "Environmental Consequences" part of this section. In terms of impacts to socioeconomics, changes (if any) to employment, property value, taxes and revenues, road maintenance costs and emergency services costs, tourism, quality of life, and environmental justice, as summarized here, are expected to be the same for all action alternatives.

Table 171. Summary of socioeconomic effects by issue factor by alternative

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
11A: Change in employment over time	No change (therefore no effect)	Small regional increase; 2,400 direct jobs for construction (3 to 4 years), 350 to 480 annual jobs for mining operations and closure.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
11A: Change in property values over time	No change (therefore no effect)	Potential decrease in area property value of up to 15% within 2 miles of the project area, with the potential for a rebound in values once operations begin. Rebounding property values unlikely in areas where domestic wells are adversely impacted.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
11A: Change in tax base per year over time	No change (therefore no effect)	Small regional increase. Generates $11 million in construction sales tax during construction. Total direct revenues over the life of the mine are estimated at $136.7 million.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
11A: Change in demand and cost for road maintenance over time	No change (therefore no effect)	Increase in funding needs during operation phase of mine.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
11A: Change in demand and costs for emergency services over time	No change (therefore no effect)	Potential change in population not expected to result in dramatic demands on public services and emergency services costs.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
11A: Qualitative assessment in change of tourism revenue over time	No change (therefore no effect)	Negligible changes in regional tourist spending. Adverse impacts on dark skies could result in an impairment of observatories near the project area, which could result in a decrease in State revenues generated from astronomy, space, and planetary research and tourism.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action
11B: Qualitative assessment of the ability of alternatives to meet rural landscape expectations as expressed by Federal, State, and local regulations and ordinances	No change (therefore no effect)	Potential degradation of area quality of life in terms of community values	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action

Issue Measure	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
Other Effects Considered						
Environmental justice	No change (therefore no effect)	Possible disproportionate effects on Tohono O'odham Nation, as well as the other consulting tribes, with regard to disturbance to cultural resources.	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action

Affected Environment

Relevant Laws, Regulations, Policies, and Plans

Major legislation, mandates, and guidance directing the evaluation of social and economic impacts as a result of projects on public lands includes Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations" (1994). See the "General Management Direction for Environmental Justice on the Coronado National Forest" part of this section for a full discussion of this executive order.

General Management Direction for Socioeconomics on the Coronado National Forest

One of the purposes of the forest plan is to be responsive "to changing conditions of land and other resources and to changing social and economic demands of the American people" (U.S. Forest Service 1986). Forest Service guidelines for socioeconomic analyses are outlined in the Forest Service "Economic and Social Analysis Handbook" (U.S. Forest Service n.d. (1985)). The handbook provides guidelines to be used to evaluate socioeconomic impacts that may result from policy, program, plan, or project decisions on Forest Service lands. Forest Service Manual 1970.1 directs how economic and social analyses be conducted to aid Forest Service decisionmaking.

General Management Direction for Environmental Justice on the Coronado National Forest

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations," was signed by President Clinton in 1994. The executive order requires agencies to advance environmental justice by pursuing fair treatment and meaningful involvement of minority and low-income populations. Fair treatment means that such groups should not bear a disproportionately high share of negative environmental consequences from Federal programs, policies, decisions, or operations. Meaningful involvement means that Federal officials actively promote opportunities for public participation and that Federal decisions can be materially affected by participating groups and individuals.

Existing Conditions

Analysis Area

The project area is in southern Pima County, Arizona. Pima County covers approximately 9,184 square miles and includes Federal, State, private, and tribal lands. The San Xavier Pascua Yaqui and Tohono O'odham Reservations account for 42.1 percent of the county lands, State of Arizona lands account for 14.9 percent, Forest Service and Bureau of Land Management lands combined account for 12.1 percent, other public lands account for 17.1 percent, and the remaining 13.8 percent of lands are private, or corporate, property (Arizona Department of Commerce 2009a; 2009b; 2009c).

U.S. Census 2010 is available for select demographic information, and where available, U.S. Census 2010 has been incorporated. Where it is not available, U.S. Census 2000 or other U.S. Census reports have been used. The most current data for estimating (modeling) impacts to employment, employment compensation, and economic output are from 2008.

The three phases of activity associated with the mine for which socioeconomic impacts can actually be measured will be the 25-year period encompassing preproduction, operation, and closure. Impacts to the region "postclosure" will not be estimated, as estimating social and economic impacts beyond a 25-year period to which no specific activity is associated is too speculative. Thus, as data are available, the temporal bounds of analysis will extend from 1990 to the year of closure of the mine (roughly 2035 (based on when construction starts and closure ends)).

Population and Demographics

The following section includes a summary of the total population count, population density, ethnicity and race, migration statistics, gender distribution, and age distribution within the analysis area.

Arizona

The State of Arizona has experienced rapid growth over the past 15 years. Between 1990 and 2000, the population increased by almost 40 percent; and between 2000 and 2010, it increased by an additional 24.6 percent. Arizona is projected to grow by another 50 percent by 2025. Arizona has an average population density of 27.2 persons per square mile (U.S. Census Bureau 2000e). Table 172 presents historical, current, and projected population for jurisdictions within the analysis area. In 2000, approximately 98.3 percent of the State's residents worked in-state; of those residents, 96.9 percent worked inside the county of residence, and 49.7 percent worked in the city/town of residence (U.S. Census Bureau 2000d). The majority of residents working in the State had an average commute time of less than 30 minutes (U.S. Census Bureau 2000a).

Cochise County

The population of Cochise County was 117,755 in 2000, up from 97,624 (20.6 percent) in 1990 (U.S. Census Bureau 1990, 2000 #23524). According to State of Arizona estimates, the population of Cochise County continued to increase between 2000 and 2010 (an 11.5 percent increase). Cochise County is expected to have a population of 179,317 by 2025, a 36.5 percent increase from 2010, according to the Arizona Department of Commerce (2009a). In 2007, Cochise County had a population density of 68 persons per square mile and a median age of 36.9 years, compared with a median age of 34.2 years for the State (U.S. Census Bureau 2000b).

Sierra Vista was the largest city in the county in 2007, with a population of 46,184. No cities in Cochise County are within 20 miles of the proposed project. There are, however, scattered homesites and unincorporated areas that have been developed closer to the proposed project. The city of Sierra Vista has a median age of 32 years, which is somewhat lower than the state median age of 34.2 years (U.S. Census Bureau 2000b, 2000g). Other selected age characteristics of the communities within the analysis area are summarized in table 173.

In 2000, approximately 95 percent of the county's residents worked in the county, with an average commute time of less than 30 minutes (U.S. Census Bureau 2000a). In Sierra Vista, approximately 98.1 percent of the city's residents worked in Cochise County, with only 44.2 percent of them working in the city itself. The average commute was less than 30 minutes (U.S. Census Bureau 2000a).

Pima County

The population of Pima County was 843,746 in 2000, up from 666,880 (26.5 percent) in 1990 (U.S. Census Bureau 1990; 2000g). According to State of Arizona estimates, the population of Pima County continued to increase between 2000 and 2010 to 136,517 (a 16.2 percent increase) (U.S. Census Bureau 2010a). Pima County is expected to have a population of 1,070,723 by 2025, a 38.8 percent increase from 2010, according to the Arizona Department of Commerce (2009b). In 2007, Pima County had a population density of 276 persons per square mile and a median age of 35.7 years, compared with a median age of 34.2 years for the State (U.S. Census Bureau 2000e).

The fastest growing cities from 2000 to 2010 for which data are available in Pima County were Sahuarita (a 679.1 percent increase) and Marana (a 157.9 percent increase). The largest city in 2010 was Tucson/South Tucson, with a population of 520,116. Sahuarita is within approximately 15 miles of the proposed mine. Green Valley is also close to the proposed mine (about 15 miles west); and has a population of 21,391 in 2010. The city of Sahuarita had a median age of 37.9 years, while Tucson/South Tucson had a median age of 31.8 years, compared with the State median age of 34.2 years (U.S. Census Bureau 1990; 2000g). Other selected age characteristics of the communities within the analysis area are summarized in table 173.

In 2000, approximately 98.1 percent of Pima County's residents worked in the county, with average commute times of less than 30 minutes. In Sahuarita, 86 percent of the residents worked in Pima County, although only 13.8 percent worked in Sahuarita itself. Average commute time for Sahuarita residents in 2000 was 30 to 44 minutes. In the city of South Tucson, 97.2 percent of the residents worked in Pima County, while only 11.2 percent worked in the city. The average commute time for South Tucson residents was less than 30 minutes. Approximately 98.8 percent of residents living in Tucson in 2000 worked in Pima County, with 79.8 percent of the residents working in Tucson. Average commute time was less than 30 minutes (U.S. Census Bureau 2000a).

Santa Cruz County

The population of Santa Cruz County was 38,381 in 2000, up from 29,676 (29.3 percent) in 1990 (U.S. Census Bureau 2000g). According to State of Arizona estimates, the population of Santa Cruz County continued to increase between 2000 and 2010 (a 23.5 percent increase). Santa Cruz County is expected to have a population of 66,627 by 2025, a 40.5 percent increase from 2007, according to the Arizona Department of Commerce (2009c). In 2007, Santa Cruz County had a population density of

Table 172. Comparative historical and projected populations for the analysis area and the United States

Location	1990 Population*	2000 Population*	2010† Population*	1990 to 2000 Percent Change	2000 to 2010 Percent Change	2015 Projected Population	2020 Projected Population	2025 Projected Population	2010 to 2025 Percent Change
United States*	**248,709,873**	**281,421,906**	**308,745,538**	**13.2**	**9.7**	**322,365,000**	**341,387,000**	**357,452,000**	**15.7**
Arizona	**3,665,228**	**5,130,632**	**6,392,017**	**40.0**	**24.6**	**7,915,629**	**8,779,567**	**9,588,745**	**50.0**
Counties									
Cochise	97,624	117,755	131,346	20.6	11.5	158,650	169,717	179,317	36.5
Pima	666,880	843,746	980,263	26.5	16.2	1,175,967	1,271,912	1,360,157	38.8
Santa Cruz	29,676	38,381	47,420	29.3	23.5	56,144	61,658	66,627	40.5
Communities									
Benson	3,824	4,711	5,104	23.2	8.3	4,795	4,818	4,838	−5.2
Casas Adobes	NA	54,011	66,795	NA	19.1	NA	NA	NA	NA
Catalina	4,864	7,025	7,569	44.4	7.7	NA	NA	NA	NA
Catalina Foothills	NA	53,794	50,796	NA	−5.6	NA	NA	NA	NA
Corona de Tucson	NA	813	5,675	NA	598	NA	NA	NA	NA
Drexel Heights	NA	23,849	27,749	NA	16.4	NA	NA	NA	NA
Elgin	NA	309	161	NA	47.8	558	636	705	337.8
Green Valley	13,231	17,283	21,391	30.6	23.7	NA	NA	NA	NA
Huachuca	1,782	1,751	1,853	1.7	5.8	1,981	2,043	2,098	13.2
Marana	2,187	13,556	34,961	519.8	157.9	60,809	72,915	82,252	135.2
Nogales	19,489	20,878	20,837	7.1	7.1	23,858	24,783	25,617	22.9
Oro Valley	6,670	29,700	41,011	345.3	38.1	50,222	54,134	57,493	40.1
Pascua Yaqui Reservation	2,412	3,315	NA	4.4	NA	NA	NA	NA	NA
Patagonia	888	881	913	4.3	3.6	1,003	1,041	1,075	17.7
Rio Rico	NA	10,413	18,962	NA	82.1	23,301	27,303	30,908	62.9
Sahuarita	NA	3,242	25,259	NA	679.1	57,367	71,479	78,754	211.7
Sierra Vista	32,983	37,775	43,888	14.5	16.2	55,010	59,674	63,720	45.1
Sonoita	NA	826	818	NA	−0.09	1,314	1,465	1,601	95.7
St. David	1,468	1,744	1,882	18.8	NA	2,028	2,104	2,171	15.4
Three Points	NA	5,273	5,581	NA	5.8	NA	NA	NA	NA

Location	1990 Population*	2000 Population*	2010† Population*	1990 to 2000 Percent Change	2000 to 2010 Percent Change	2015 Projected Population	2020 Projected Population	2025 Projected Population	2010 to 2025 Percent Change
Tohono O'odham Reservation	NA	10,787	NA	NA	NA	NA	NA	NA	NA
Tubac	NA	949	1,191	NA	25.5	1,301	1,411	1,509	26.7
Tucson/South Tucson	410,483	492,189	520,116	19.9	5.7	602,329	630,414	654,539	26.2
Tucson Estates	2,662	9,755	12,192	265.2	24.9	NA	NA	NA	NA
Vail	NA	2,484	10,208	NA	31.1	NA	NA	NA	NA
Whetstone	1,289	2,354	2,617	5.0	11.1	3,449	3,746	4,003	52.9

Note:
NA: Data not available.
* Source: Arizona Department of Commerce (2009a; 2009b; 2009c).
† Source: U.S. Census Bureau (2000g; 2010b).

Table 173. Selected age, household, and housing characteristics, 2000

	Median Age	Age 65 Years and over	Percent Female	Percent Male	Number of Households	Average Household Size	Number of Housing Units	Number of Vacant Housing Units	Housing: Vacancy Rate	Urban Counts	Rural Counts	Percent Units Urban/ Rural	Median Home Value
Arizona	34.2	13.0	50.1	49.9	1,901,327	2.64	2,189,189	287682	13.1	1,898,320	290,869	87/13	$109,400
Pima County	35.7	14.2	51.1	48.9	332,350	2.47	366,737	34,387	9.4	337,779	28,958	92/8	$102,600
Santa Cruz County	31.8	10.7	52.2	48.9	11,809	3.23	13,036	1,227	9.4	8,064	4,972	61/39	$92,800
Cochise County	36.9	13.9	49.6	50.4	43,893	2.55	51,126	7,233	14.1	33,059	18,067	64/36	$80,200
Sahuarita	37.9	15.4	50.8	49.2	1,155	2.78	1,247	92	7.4	965	282	77/23	$136,500
Sierra Vista	32.0	12.1	49.8	50.2	14,196	2.48	15,685	1,489	9.5	15,415	270	98/2	$100,000
Tucson	32.1	11.9	51.0	49.0	192,891	2.42	209,609	16,718	8	207,872	1,737	99/1	$91,200
South Tucson	30.9	10.0	47.0	53.0	1,810	2.94	2,059	249	12.1	2,059	0	100/0	$47,100
Rio Rico	27.8	5.2	51.0	49.0	2,938	3.61	3,117	86	7.8	1,573	1,544	47/53	$91,850
Tubac	58.5	35.2	51.9	48.1	481	1.97	569	88	15.5	0	569	0/100	$180,500
Elgin	43.1	12.6	46.3	53.7	123	2.51	153	30	19.6	0	153	0/100	$203,100
Sonoita	50.1	20.2	52.0	48.0	358	2.31	401	43	10.7	0	401	0/100	$193,600

Sources: Economic Profile System (2007a; 2007b; 2007c).

38 persons per square mile and a median age of 31.8 years, compared with a State median age of 34.2 years (U.S. Census Bureau 2000b). The fastest growing cities from 2000 to 2010 for which data are available in Santa Cruz County were Rio Rico (82.1 percent), Elgin (47.8 percent), and Tubac (25.5 percent).

The largest city in 2010 was Nogales, with a population of 20,837. Sonoita and Elgin are the two communities in the county that are closest to the proposed project (approximately 10 miles). There are, however, scattered homesites and unincorporated areas that have been developed closer to the proposed project. In 2000, the city of Tubac had a median age of 58.5 years, while Rio Rico had a median age of 27.8 years, compared with the State median age of 34.2 years (U.S. Census Bureau 2000g). Other selected age characteristics of the communities within the analysis area are summarized in Table 173.

In 2000, approximately 90.4 percent of Santa Cruz County residents worked in the county, with an average commute time of less than 30 minutes. Approximately 37.4 percent of Elgin's residents worked in Santa Cruz County, with only 10.4 percent working in Elgin. Residents in Elgin had an average commute time of 60 minutes or more. In Rio Rico, 89.4 percent of the population worked in Santa Cruz County, with a mere 5.7 percent working in the town. Average commute time for Rio Rico residents was less than 30 minutes. In Sonoita, 64.8 percent of the residents worked in the county, and 36.6 percent worked in the town itself. The average commute time for Sonoita residents was 60 minutes or more. In Tubac, approximately 81.3 percent of residents worked in the county, with 32.9 percent working in Tubac. Average commute time was less than 30 minutes (U.S. Census Bureau 2000a).

Housing

Characterization of the existing housing situation is dynamic because housing availability and price change are not static, and there are gaps in the availability of recent data. The following sections characterize the existing condition of housing in the analysis area based on U.S. Census Bureau data.

Cochise County

In 2000, Cochise County had 51,126 housing units, of which 33,059 units (64 percent) were in an urban area. Of the 51,126 units, 14.1 percent were vacant. The median home value in 2000 was $80,200 (Economic Profile System 2007a). Estimates for the 2006 to 2008 period indicate that vacancy increased to 16.10 percent, leaving 9,175 units vacant in the county (U.S. Census Bureau 2008).

As of 2000, the city of Sierra Vista had a total of 15,685 housing units, with 15,415 units (98 percent) being in an urban area and 9.5 percent vacant. The median home value in 2000 was $100,000, which was well above the county median value (Economic Profile System 2007a).

Pima County

In 2000 Pima County had 366,737 housing units, of which 337,779 units (92 percent) were in an "urban" area as defined by the U.S. Census Bureau. Of the 337,779 units, 9.4 percent were vacant. The median home value in 2000 was $102,600 (Economic Profile System 2007b). Estimates for the 2006 to 2008 period indicate that vacancy rates increased to 11.8 percent, leaving 49,716 units vacant in the county (U.S. Census Bureau 2008).

As of 2000, the city of Tucson had a total of 209,606 housing units, with 207,872 units (99 percent) being in an urban area and 8 percent vacant. These rates are similar to the State numbers. The median home value in 2000 was $91,200, which was well below the county median value. South Tucson's median home value was less than one-half of the county's, at $47,100 (Economic Profile System 2007b).

Sahuarita had 1,247 total housing units in 2000; of these, 965 (77 percent) were considered to be in an urban area and 7.4 percent were vacant. The median home price in 2000 was $136,500, well above the county median value (Economic Profile System 2007b).

Santa Cruz County

In 2000, Santa Cruz County had 13,036 housing units, with 8,064 units (61 percent) in an urban area and 9.4 percent vacant .The median home value in 2000 was $92,800 (Economic Profile System 2007c). Estimates for the 2006 to 2008 period indicate that vacancy rates increased to 37.30 percent, leaving 6,293 units vacant in the county (U.S. Census Bureau 2008).

As of 2000, Rio Rico had 3,117 housing units, with 1,573 (47 percent) being in an urban area and 7.8 percent vacant. The median home value in 2000 was $91,850, which was close to the county median value. The communities of Tubac, Elgin, and Sonoita had a combined total of 1,123 housing units; all were considered to be in a "rural" area, as defined by the U.S. Census Bureau, with vacancy rates of 15.5, 19.6, and 10.7 percent, respectively. These communities also had a combined median home value of $192,400, more than double the median home value for the county (Economic Profile System 2007c).

Employment

Both labor force and employment increased throughout the analysis area between 2000 and 2009 (table 174). Labor force statistics reflect employment by residence, unlike employment by sector statistics, which reflect employment by work location. Arizona's labor force increased by 26 percent between 2000 and 2009, while Pima County's labor force increased by 19.9 percent, Cochise County's by 31.1 percent, and Santa Cruz County's by 27.1 percent in the same period.

Table 174. Labor force summary, 2000 and 2009

Location	2000 Labor Force	2009 Labor Force	2000 Employed	2009 Employed	2000 Unemployed	2009 Unemployed	2000 Unemployment Rate (Percent	2008 Unemployment Rate (Percent)
Arizona	2,505,306	3,156,563	2,404,916	2,851,063	100,390	305,500	4.0	9.7
Pima County	408,961	490,395	393,716	474,094	15,245	43,301	3.7	8.8
Santa Cruz County	14,738	18,727	13,508	15,841	1,230	2,886	8.3	15.4
Cochise County	48,549	63,662	46,353	58,715	2,196	4,947	4.5	7.8

Source: Arizona Workforce Informer (2011).

The unemployment rate for Pima and Cochise Counties was very similar to the rate for the state as a whole, but Santa Cruz County had a much higher unemployment rate than the state for both years identified.

Table 175 summarizes major employers in the analysis area by county. Government provides the greatest share of employment in Pima County, with 6 of the 12 largest employers. Raytheon and Wal Mart represent the largest private sector employers in the county. Cochise and Santa Cruz Counties also have a large number of government employers, including Homeland Security/U.S. Border Patrol, military (Fort Huachuca), and school districts.

Table 175. Major employers by county, 2008

Employer	Sector
Cochise County	
Fort Huachuca	Government
Sierra Vista School District	Education
Cochise County	Government
Sierra Vista Regional Health Center	Health Services
Arizona Department of Corrections, Douglas	Government
Aegis, Sierra Vista	Customer Support Center
Douglas Unified School District	Education
Douglas Border Patrol Station	Government
City of Sierra Vista	Government
Walmart, Douglas/Sierra Vista	Trade
Pima County	
Raytheon Missile Systems	Technology
University of Arizona	Education
State of Arizona	Government
Davis Monthan Air Force Base	Government
Tucson Unified School District	Education
Wal Mart Stores	Trade
Pima County	Government
Freeport-McMoRan Copper and Gold	Mining
City of Tucson	Government
Carondolet Health Network	Health Services
Tohono O'odham Nation	Government
Santa Cruz County	
Canchola Foods Company	Retail
Carondolet Holy Cross Hospital	Health Services
Immigration and Naturalization Service, Nogales	Government
City of Nogales	Government
District 35 Public Schools, Tubac	Education
Nogales Unified School District	Education
Santa Cruz County	Government
Walmart, Nogales	Trade
United Musical Instruments, Nogales	Manufacturing
U.S. Customs Service, Nogales	Government

Sources: Arizona Daily Star (2010); Arizona Department of Commerce (2009a; 2009b; 2009c).

Cochise County

Government as a whole is the largest employment sector in Cochise County, at 28.8 percent, as evidenced by the levels of employment shown in table 174. Military is at 9.2 percent, which reflects the presence of Fort Huachuca. Retail trade (at 12.3 percent) and State and local government (at 11.8 percent) are the other sectors with employment greater than 10 percent of the total for the county. Cochise County is the only one of the three counties in the analysis area that had an increase in farm employment from 2000 to 2007. It was also a significant increase, at 19.6 percent, compared with losses in the other two counties and the State as a whole. Educational services increased by 114.4 percent over the period, along with mining, by 76.3 percent; professional, scientific, and technical services, by 69.7 percent; management of companies and enterprises, by 49.2 percent; and arts, entertainment, and recreation, by 34.8 percent.

Pima County

State and local government are the primary industries in Pima County, at 12.7 percent, as evidenced by the levels of employment shown in table 174. Retail trade accounted for 11.1 percent of total employment in the county, with health care and social assistance at 11.3 percent. The fastest growing employment sectors between 2000 and 2007 were real estate, at 106.9 percent; educational services, at 67.7 percent; construction, at 37.7 percent; and professional/technical services, at 33.1 percent. These figures do not reflect the recent downturn in housing activity in Arizona, as well as in the country, so it would be expected that real estate and construction figures, in particular, have been impacted.

Santa Cruz County

In terms of employment by industry in 2007, retail trade accounted for 18.3 percent of county employment, while State and local government represented 11.7 percent; these two sectors provide the greatest share of employment in Santa Cruz County. Government as a whole represents 19.3 percent of all employment in the county. Table 176 summarizes major employers in the analysis area.

The fastest growing employment sectors between 2000 and 2007 were finance and insurance (52.4 percent increase), manufacturing (42.7 percent increase), real estate (39 percent increase), Federal civilian government (28.7 percent increase), retail trade (38.3 percent increase), construction (37.7 percent increase), and accommodation and food services (29.1 percent increase).

Mine Related Employment

In terms of employment by industry in 2007, mining accounted for 15,513 jobs in Arizona, 2,616 in Pima County, and 134 in Cochise County. Between 2000 and 2007, mining related employment increased by 19.7 percent for Arizona, 4.4 percent for Pima County, and 76.3 percent for Cochise County. Mining accounts for less than 1 percent of total employment for the three counties analyzed.

Recreation Related Employment

The Travel Management Economic Contribution Application data estimate the local and regional economic contribution of expenditures associated with current levels of recreation activity on national forest roads and trails. The National Visitor Use Monitoring survey generates use and expenditure data by recreation activity; this information allows for the estimation of the local economic contribution of different types of recreation activities, based on whether the recreationists stayed for one day or overnight. The Travel Management Economic Contribution Application organizes and analyzes information from the National Visitor Use Monitoring survey, as well as from Minnesota IMPLAN Group.

Table 176. Employment by industry, 2001 and 2007

Total Employment by Industry	2000 (Arizona)	2007 (Arizona)	Percent Change (Arizona)	Percent of 2007 Total (Arizona)	2000 (Pima County)	2007 (Pima County)	Percent Change (Pima County)	Percent of 2007 Total (Pima County)	2000 (Santa Cruz County)	2007 (Santa Cruz County)	Percent Change (Santa Cruz County)	Percent of 2007 Total (Santa Cruz County)	2000 (Cochise County)	2007 (Cochise County)	Percent Change (Cochise County)	Percent of 2007 Total (Cochise County)
Total employment	2,856,941	3,520,657	23.2	–	444,468	528,850	19.0	–	15,955	19,054	19.4	–	51,832	61,578	18.8	–
Farm employment	22,552	23,968	6.3	>1.0	1,173	1,135	−3.3	>1.0	277	262	−5.4	1.4	2,016	2,411	19.6	3.9
Nonfarm employment	2,834,389	3,496,689	23.4	99.3	443,295	527,715	19.0	99.8	15,678	18,792	19.9	98.6	49,816	59,167	18.8	96.1
Private employment	2,435,948	3,048,122	25.1	86.5	362,326	441,908	21.9	83.6	12,355	15,109	22.2	79.2	32,951	41,469	25.9	67.3
Forestry, fishing	23,918	19,431	−23.1	>1.0	499	373	−25.2	>1.0	(D)	(D)	>1.0	>1.0	(D)	384	NA	>1.0
Mining	12,960	15,513	19.7	>1.0	2,505	2,616	4.4	>1.0	(D)	(D)	>1.0	>1.0	76	134	76.3	>1.0
Utilities	11,289	13,142	16.4	>1.0	1,575	2,169	37.7	>1.0	60	17	−71.7	>1.0	505	550	8.9	>1.0
Construction	214,599	284,383	32.5	8.1	28,990	34,897	20.4	6.6	694	832	19.9	4.4	2,994	3,673	22.7	6.0
Manufacturing	211,289	194,130	−8.8	5.5	34,862	29,522	−15.3	5.6	982	563	42.7	3.0	1,161	1,043	−10.2	1.7
Wholesale trade	105,811	122,891	16.1	3.5	8,692	11,925	37.2	2.3	1,701	2,038	19.8	10.7	621	719	15.8	1.2
Retail trade	328,290	410,925	25.2	11.7	48,768	58,474	19.9	11.1	2,523	3,489	38.3	18.3	6,172	7,558	22.5	12.3
Transportation and warehousing	81,212	96,248	18.5	2.7	8,916	10,039	12.6	1.9	1,331	1,360	2.2	7.1	848	875	3.3	1.4
Information	61,481	52,542	17.0	1.5	9,119	7,757	−14.9	1.5	102	85	−15.9	>1.0	610	655	7.4	1.1
Finance and insurance	150,491	182,212	21.1	5.2	14,252	18,337	28.7	3.5	248	378	52.4	2.0	963	1,226	27.3	2.0
Real estate and rental and leasing	134,332	248,094	84.7	7.0	21,100	43,655	106.9	8.3	677	941	39.0	4.9	(D)	3,657	NA	5.9
Professional, scientific, and technical services	170,065	217,318	27.8	6.2	27,010	35,939	33.1	6.8	496	(D)	NA	NA	2,607	4,424	69.7	7.2
Management of companies and enterprises	22,628	30,310	33.9	>1.0	2,801	3,365	20.1	>1.0	(D)	(D)	NA	NA	118	176	49.2	>1.0
Administrative and waste services	232,810	296,790	27.5	8.4	31,605	38,099	20.5	7.2	(D)	1,067		5.6	2,297	2,774	20.8	4.5
Educational services	32,328	58,357	80.5	1.7	4,789	8,032	67.7	1.5	94	109	16.0	>1.0	298	639	114.4	1.0
Health care and social assistance	233,941	312,951	33.8	8.9	46,576	59,542	27.8	11.3	668	765	14.5	4.0	4,182	4,816	15.2	7.8
Arts, entertainment, and recreation	54,848	70,616	28.7	2.0	10,762	11,730	9.0	2.2	251	245	−2.4	1.3	758	1,022	34.8	1.7
Accommodation and food services	213,670	254,147	18.9	7.2	34,953	37,400	7.0	7.1	1,165	1,504	29.1	7.9	3,932	4,098	1.7	6.7
Other services, except public administration	139,986	168,122	20.1	4.8	24,552	28,037	14.2	5.3	743	751	1.1	3.9	2,869	3,046	6.2	4.9
Government and government enterprises	398,441	448,567	12.6	12.7	80,969	85,807	6.0	16.2	3,323	3,683	10.8	19.3	16,865	17,698	4.9	28.8
Federal civilian	47,017	52,371	11.4	1.5	8,820	10,505	19.1	2.0	1,068	1,375	28.7	7.2	4,236	4,749	12.1	7.7
Military	33,546	33,797	0.7	1.0	7,951	8,060	1.4	1.5	88	88	0	>1.0	5,738	5,689	−0.9	9.2
State and local	317,878	362,399	14.0	10.3	64,198	67,242	4.7	12.7	2,167	2,220	2.4	11.7	6,891	7,260	5.4	11.8

Source: Bureau of Economic Analysis (2011).

Notes:

(D) = Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.

NA = Data not available.

According to the Travel Management Economic Contribution Application (U.S. Forest Service 2009e), area employment totals 538,376; in terms of recreation contributions to the area economy, approximately 0.15 percent (or 799 jobs) of area employment (employment in Cochise, Pima, and Santa Cruz Counties) is directly related to the Coronado National Forest. Table 177 shows the contribution to the local economy, by industry, from the Coronado National Forest.

Of these industries, "arts, entertainment and recreation, and accommodation" and "food services" can likely be attributed to recreation activities. Forest Service related employment in these two industries totals 440 jobs (see table 177), or 0.81 percent of analysis area employment. Although recreation activities specific to the Coronado National Forest contribute to the local economy in terms of employment, they do not account for substantial employment numbers in the three-county analysis area.

Table 177. Current role of the Coronado National Forest's recreation related contributions to the area economy (employment and labor income)

Industry	Area Totals* Employment (jobs)	Forest Service Related Employment (jobs)	Area Totals Labor Income (millions of dollars)	Forest Service Related Labor Income (millions of dollars)
Agriculture	2,936	7	$67	$0.180
Mining	2,359	1	$294	$0.086
Utilities	2,659	1	$262	$0.130
Construction	34,100	4	$1,598	$0.194
Manufacturing	25,256	20	$2,114	$0.948
Wholesale trade	13,010	48	$737	$2.726
Transportation and warehousing	61,385	22	$1,821	$0.855
Retail trade	11,350	67	$530	$1.914
Information	10,172	7	$504	$0.278
Finance and insurance	19,913	8	$859	$0.401
Real estate and rental and leasing	19,450	12	$569	$0.354
Professional, scientific, and tech services	36,942	17	$2,385	$0.972
Management of companies	3,145	4	$159	$0.204
Administration, waste management, and remedial services	35,705	44	$1,014	$1.956
Educational services	6,186	8	$169	$0.242
Health care and social assistance	61,628	35	$2,776	$1.597
Arts, entertainment, and recreation	9,554	196	$183	$4.004
Accommodation and food services	40,215	244	$785	$4.899
Other services	31,053	30	$733	$0.849
Government	111,356	23	$7,133	$1.304
Total	**538,376**	**799**	**$24,691**	**$24.092**
Forest Service as Percentage of Total	**–**	**0.15%**		**0.10%**

* These numbers differ slightly from total county employment described in table 174. The Travel Management Economic Contribution Application uses Minnesota IMPLAN Group data to calculate employment, which is based on Covered Employment and Wages (formerly known as ES202) data, Regional Economic Information System, and County Business Patterns; no one data set provides enough information to create a complete Minnesota IMPLAN Group database.

Income Characteristics

Cochise County

Per capita income for Cochise County was $15,988 in 2000. As shown in table 178, the median household income for Cochise County of $32,105 in 2000 was 20.8 percent lower than the State's median household income of $40,558. Sierra Vista was somewhat higher than the county median household income.

Total labor income in Cochise County in 2000 was $1.8 billion, while nonlabor income contributed an additional 22.15 percent to the county total for personal income. Personal income in Cochise County was $3.06 billion in 2000. In Sierra Vista, personal income totaled $611 million, 25.09 percent of which was derived from nonlabor income (table 179). The allocation of personal income in Cochise County, between labor and nonlabor income, is generally consistent with State totals (see table 179). Labor income is directly related to wages and employment; nonlabor income is derived from sources such as stock dividends, capital gains, inheritances, etc.

Table 178. Personal and household income characteristics, 2000

Location	Per Capita Personal Income	Median Household Income	Median Family Income
Arizona	$20,275	$40,558	$46,723
Pima County	$19,785	$35,758	$44,446
Santa Cruz County	$13,278	$29,710	$32,057
Cochise County	$15,988	$32,105	$38,005
Sahuarita	$22,075	$53,194	$55,338
Sierra Vista	$18,436	$38,427	$44,077
Tucson	$16,322	$30,981	$37,344
South Tucson	$8,920	$14,587	$17,614
Rio Rico	$12,315	$37,740	$38,085
Tubac	$46,643	$39,444	$59,375
Elgin	$27,909	$64,167	$66,250
Sonoita	$27,312	$51,310	$58,571

Source: U.S. Census Bureau (2000d).

Table 179. Labor and nonlabor income totals, 2000

Location	Labor Income	Labor Income Percent of Total	Nonlabor Income	Nonlabor Income Percent of Total	Total Personal Income
Arizona	73,527,811,700	77.8%	20,925,637,900	22.2%	94,453,449,600
Pima County	15,398,000,000	62.3%	9,299,000,000	37.7%	24,697,000,000
Santa Cruz County	553,000,000	62.9%	326,000,000	37.1%	879,000,000
Cochise County	1,873,000,000	61.1%	1,191,000,000	38.9%	3,064,000,000
Sahuarita	50,290,200	77.3%	14,755,500	22.7%	65,045,700
Sierra Vista	458,432,000	74.9%	153,555,400	25.1%	611,987,400
Tucson	5,580,236,100	77.0%	1,665,370,900	23.0%	7,245,607,000
South Tucson	32,733,700	74.0%	11,493,700	26.0%	44,227,400
Rio Rico	99,318,500	79.6%	25,510,200	20.4%	124,828,700
Tubac	18,172,000	64.3%	10,072,700	35.7%	28,244,700
Green Valley	71,750,500	19.7%	292,053,500	80.3%	363,804,000

Location	Labor Income	Labor Income Percent of Total	Nonlabor Income	Nonlabor Income Percent of Total	Total Personal Income
Elgin	4,894,800	70.9%	2,005,300	29.1%	6,900,100
Sonoita	11,988,700	63.7%	6,834,700	36.3%	18,823,400

Source: U.S. Census Bureau (2000d).

As shown in table 178, the median household income for Pima County of $35,758 was 11.8 percent lower than the State's median household income of $40,558 in 2000. Tucson and South Tucson were below the median household income of the county, and Sahuarita was well above the county figure.

Total personal income in Pima County in 2000 was $24.7 billion; 62.35 percent of this total was labor income. In Tucson and South Tucson, personal income totaled $7.2 billion and $44.2 million, respectively, while in Sahuarita, personal income totaled $65 million. In each of these three places, nonlabor income contributed 22.98, 25.99, and 22.65 percent, respectively (see table 179). Green Valley personal income totaled $363 million in 2000; of this, 80.28 percent can be attributed to nonlabor income. Green Valley, more than any other place evaluated in this analysis, relies heavily on nonlabor income.

Santa Cruz County

Per capita income for Santa Cruz County was $13,278 in 2000. As shown in table 178, the median household income for Santa Cruz County of $29,710 was 26.7 percent lower than the State's median household income of $40,558.

Tubac, Rio Rico, Elgin, and Sonoita were well above the median household income of the county in 2000. This would indicate that households scattered outside those urban areas would have relatively lower median household incomes.

Total labor income in Santa Cruz County in 2000 was $553 million, while nonlabor income contributed an additional 37.65 percent to the county total for personal income. Personal income in Santa Cruz County was $879 million for the same period. In Rio Rico, Elgin, and Sonoita, nonlabor income contributed 20.44, 29.06, and 36.31 percent, respectively, to total personal income (see table 179).

Recreation Related Labor Income

According to the Travel Management Economic Contribution Application, area labor income totals $24.7 billion. In terms of recreation contributions to the area economy, approximately 0.10 percent (or $24.1 million) of area employment is Forest Service related. In other words, $24.1 million of labor income in Cochise, Pima, and Santa Cruz Counties is directly attributable to recreation activities on the Coronado National Forest (see table 177) (U.S. Forest Service 2009e). In terms of Coronado National Forest related recreation, labor income contributions to area employment are not substantial at the county level.

Economic Activity

Economic Output by Industry

The following profile uses data compiled by Minnesota IMPLAN Group (Version 3.0), from sources such as the Bureau of Economic Analysis, U.S. Census Bureau, and Bureau of Labor Statistics. Although the Regional Economic Models, Inc., model, not the Minnesota IMPLAN Group model, is used for environmental consequences analysis, Minnesota IMPLAN Group data are still used here as they represent a robust compilation of necessary data.

Industry output for the analysis area is characterized by the value of industry production. These are annual production estimates for the year of the dataset and are in producer prices. For manufacturers, this would be sales ± change in inventory; for service sectors, production equals sales; and for retail and wholesale trade, output equals gross margin and not gross sales. Economic output is presented in constant 2008 dollar terms, rounded to the nearest thousand.

Table 180 presents a summary of the top 20 industry sectors (shaded in gray) that contribute to the economic output of each county. In 2008, output in Cochise County was dominated by electric power generation (3.82 percent of the county total) and computer programming services (2.76 percent). Output in Pima County was dominated by missile and space vehicle manufacturing (6.76 percent of the county total) and real estate establishments such as brokers, agents, realtors, etc. (4.63 percent). Finally, output in Santa Cruz County was dominated by wholesale trade businesses (17.29 percent of the county total) and real estate establishments (3.73 percent). Only Pima County included mining (copper, nickel, lead, and/or zinc) in the top 20 industries for the county.

Table 180. Industry output in 2008 for the analysis area—top 20 industries in each county

Industry	Cochise	Pima	Santa Cruz	Three-County Total
Mining copper, nickel, lead, and zinc	$39,855,400	$1,291,225,856	$0	$1,331,081,256
Electric power generation, transmission, and distribution	$241,067,584	$774,964,416	$2,371,847	$1,018,403,847
Construction of new nonresidential commercial and health care structures	$124,294,048	$1,281,559,424	$25,809,554	$1,431,663,026
Construction of other new nonresidential structures	$71,018,832	$730,151,488	$14,592,972	$815,763,292
Construction of new residential permanent site single- and multi-family structures	$72,777,112	$765,629,312	$15,515,803	$853,922,227
Fertilizer manufacturing	$84,356,872	$0	$0	$84,356,872
Ready-mix concrete manufacturing	$66,738,512	$144,748,976	$2,526,719	$214,014,207
Semiconductor and related device manufacturing	$0	$704,470,336	$0	$704,470,336
Aircraft manufacturing	$68,792,664	$391,535,936	$0	$460,328,600
Guided missile and space vehicle manufacturing	$0	$3,865,522,432	$0	$3,865,522,432
Wholesale trade businesses	$67,041,144	$1,619,845,632	$332,643,424	$2,019,530,200
Retail stores – motor vehicle and parts	$48,456,172	$552,308,864	$18,479,166	$619,244,202
Retail stores – building material and garden supply	$35,646,040	$257,752,928	$20,489,232	$313,888,200
Retail stores – food and beverage	$73,895,824	$676,453,056	$36,846,116	$787,194,996
Retail stores – gasoline stations	$84,540,152	$198,992,272	$24,463,052	$307,995,476

Industry	Cochise	Pima	Santa Cruz	Three-County Total
Retail stores – clothing and clothing accessories	$19,827,068	$207,584,592	$25,941,616	$253,353,276
Retail stores – general merchandise	$83,115,408	$453,992,544	$55,298,328	$592,406,280
Transport by truck	$32,262,158	$334,022,464	$36,788,632	$403,073,254
Scenic and sightseeing transportation and support activities for transportation	$14,534,603	$118,395,064	$25,286,994	$158,216,661
Warehousing and storage	$2,397,550	$15,616,372	$19,148,372	$37,162,294
Software publishers	$9,345,167	$628,325,312	$0	$637,670,479
Cable and other subscription programming	$0	$64,255,768	$34,576,588	$98,832,356
Telecommunications	$168,252,448	$458,066,688	$13,838,104	$640,157,240
Monetary authorities and depository credit intermediation activities	$42,145,816	$750,676,032	$20,862,966	$813,684,814
Securities, commodity contracts, investments, and related activities	$5,270,192	$1,116,370,176	$6,434,259	$1,128,074,627
Real estate establishments	$93,269,072	$2,650,526,464	$71,774,256	$2,815,569,792
Automotive equipment rental and leasing	$26,579,032	$179,215,344	$33,981,548	$239,775,924
Architectural, engineering, and related services	$52,595,744	$944,738,752	$4,019,868	$1,001,354,364
Custom computer programming services	$173,880,112	$280,961,952	$3,890,366	$458,732,430
Management, scientific, and technical consulting services	$103,786,960	$411,560,288	$21,309,406	$536,656,654
Business support services	$81,038,664	$566,655,552	$18,060,294	$665,754,510
Offices of physicians, dentists, and other health practitioners	$112,478,760	$1,852,135,680	$25,776,444	$1,990,390,884
Medical and diagnostic labs and outpatient and other ambulatory care services	$61,983,684	$712,055,104	$6,200,458	$780,239,246
Private hospitals	$142,838,608	$1,599,200,384	$0	$1,742,038,992
Hotels and motels, including casino hotels	$27,729,842	$414,977,920	$21,128,012	$463,835,774
Food services and drinking places	$162,979,296	$1,662,258,560	$44,028,292	$1,869,266,148
Other state and local government enterprises	$78,090,008	$451,660,896	$82,035,888	$611,786,792
County Total	**$6,309,434,130**	**$57,198,691,255**	**$1,924,342,608**	**$65,432,467,993**

Source: Minnesota IMPLAN Group (2008).

Note: Shaded sectors rank in the top 20 for the county.

Taxes and Revenues

Arizona ranks 25th in the Business Tax Climate Index in the context of corporate taxes, individual income taxes, sales taxes, unemployment insurance taxes, and taxes on residential and commercial property (The Tax Foundation 2010). In comparison, California ranks 47th, Nevada 3rd, New Mexico 23rd, Utah 17th, and Colorado 13th. Arizona has a tax climate that neither encourages nor discourages new business expansion or startups. The State does have luxury, estate, personal, and corporate income taxes. Only those revenues that are clearly and concisely reported by the State or Federal government (i.e., property taxes, sales tax, payment in lieu of taxes, etc.) were considered for the analysis. Revenue information was gathered for the county level.

Real Estate/Property Tax

State property tax in Arizona, collected by county treasurers, is based on property value (ad valorem). Property tax is calculated from two different bases: the primary, or limited, value (i.e., statutorily controlled value) and the secondary, or full cash, value (market value). In most cases, property tax is collected on the primary property value. The total annual tax bill is calculated by adding the secondary taxes to the primary taxes and is deposited in the State's general fund. Property is also classified according to its value (i.e., residential, commercial, agricultural, etc.) (Arizona Department of Revenue 2007).

In general, revenue from primary property tax collections helps fund State and local government budgets in terms of local government operating budgets and school and fire districts. Counties can use their allocation of property taxes to fund superior court systems, sheriff's departments, transportation projects, and emergency services.

In Arizona, the ratio of assessed valuation (percentage of market value) is 10 percent on residential properties and 20 percent on commercial properties (Arizona Capital Times and Arizona Tax Research Association 2010); by comparison, the ratio of assessed valuation on residential properties is 35 percent in Nevada and 100 percent in California. The average State primary property tax in 2007 was $6.75 per $100 and decreased to $6.24 per $100 in 2008; the average state secondary property tax in 2007 was $3.29 per $100 and decreased to $2.99 per $100 in 2008 (Arizona Department of Revenue 2007).

In 2008, statewide primary and secondary property tax levies generated almost $6.8 billion of revenue; of the $6.8 billion, Cochise County collected $101.6 million, Pima County $1.11 billion, and Santa Cruz County $43.1 million. Primary and secondary tax levies for 2008 are summarized in table 181 (Arizona Department of Revenue 2008).

Table 181. Primary and secondary property tax levies in 2008

Jurisdiction	Net Assessed Valuation	Primary Tax Levy	Secondary Tax Levy	Primary Rate	Secondary Rate
Arizona	$153,609,461,886	$4,211,313,863	$2,576,525,762	6.24	2.99
Cochise County	$1,922,262,041	$76,237,336	$25,415,234	8.44	2.49
Pima County	$17,825,828,053	$728,823,693	$385,109,480	8.85	4.01
Santa Cruz County	$757,051,894	$27,552,434	$15,567,215	7.81	3.85

Source: Arizona Department of Revenue (2008).

Payment in Lieu of Taxes

In 1976, Congress directed Federal land management agencies to allocate income to states and counties with Federal lands, to provide a payment in lieu of taxes program to help offset lost tax revenues. Because the Bureau of Land Management is the largest Federal landowner and land manager, the Bureau of Land Management was chosen by the Secretary of the Interior to administer the Payment in Lieu of Taxes program.

Federal lands are not subject to the property taxes that support county governments and education, although local communities play an important role in supporting the management of Federal lands. Congress appropriates payments in lieu of taxes each year. The formula used to compute the

payments is contained in the Payment in Lieu of Taxes Act and is based on population, receipt sharing payments, and the amount of Federal land within an affected county (U.S. Department of the Interior 2011b).

Table 182 provides a breakdown of annual payments in lieu of taxes received by each county and the State during the same period. Since 2005, payments in lieu of taxes received by the three counties and the State have increased in the general range of 60 to 65 percent. Pima County has consistently been the largest recipient of payments in lieu of taxes, as it has the largest acreage of Federal land of the three counties.

Table 182. Total payments in lieu of taxes and total acreage

Location	2005	2006	2007	2008	2009	Percent Increase 2005 to 2009
Arizona Payment	$19,233,714	$19,023,415	$19,098,223	$30,674,473	$31,662,123	64.6
Acres	27,885,022	27,869,615	27,872,586	NA	27,932,596	
Cochise County Payment	$1,251,218	$1,242,640	$1,236,526	$2,044,105	$2,062,085	64.8
Acres	899,429	900,746	900,747	NA	900,752	
Pima County Payment	$1,930,009	$1,925,348	$1,902,625	$3,003,013	$3,073,106	59.2
Acres	1,599,452	1,600,332	1,600,331	NA	1,600,331	
Santa Cruz County Payment	$614,189	$574,210	$570,905	$931,234	$1,006,572	63.9
Acres	432,810	432,961	432,586	NA	432,595	

Source: U.S. Department of the Interior (2011a).

Note: NA = Data not available.

Transaction Privilege and Severance Taxes

Sales taxes apply to the retail sale of personal property or services within the State. Arizona levies a 5.6 percent general sales (transaction privilege) tax on consumers, which is just above the national average of 5.4 percent. Cochise County imposes an additional 0.5 percent general sales tax, and Santa Cruz County has an additional 1 percent general sales tax. Individual cities or communities within each county can also levy an additional sales tax. It is important to note that Arizona does not charge sales tax on food purchased at retail outlets for home consumption, such as food purchased at grocery stores. As discussed in the “Lodging Tax” part of this section below, some communities assess a bed or lodging tax in addition to the sales taxes.

In Arizona, a severance tax is imposed in lieu of a transaction privilege tax on mining metalliferous minerals (2.5 percent). The severance rates are 2.5 percent on mining metalliferous minerals.

All three counties in the analysis area, as well as the State itself, have seen an overall increase in sales and severance tax revenue between Fiscal Year 2003 to 2004 and Fiscal Year 2007 to 2008. Santa Cruz County had the highest increase in distributed tax revenue (29.7 percent), while Pima and Cochise Counties increased at a lower rate, somewhat below the State rate of 29.5 percent for the same period. The three counties and the State actually received less sales and severance tax revenue in Fiscal Year 2007 to 2008 than they did in the previous fiscal year. State sales and severance tax distribution is summarized in table 183.

Table 183. Transaction privilege and severance tax distribution to counties

Location	Fiscal Year (FY) 2003 to 2004	FY 2004 to 2005	FY 2005 to 2006	FY 2006 to 2007	FY 2007 to 2008	Percent Change FY 2003 to 2004 to FY 2007 to 2008
Cochise County	$10,135,220	$10,852,890	$12,250,317	$13,078,428	$12,547,126	23.8%
Pima County	$82,562,254	$90,284,731	$102,619,310	$106,931,317	$104,069,379	27.2%
Santa Cruz County	$3,627,497	$3,949,677	$4,604,423	$4,919,731	$4,703,843	29.7%
State Total	**$551,804,281**	**$609,615,497**	**$705,794,789**	**$748,692,595**	**$724,417,089**	**29.5%**

Source: Arizona Department of Revenue (2008).

Lodging Tax

The Arizona state tax for lodging is 5.5 percent. Communities, by voter approval, may impose an additional lodging excise tax on sleeping accommodations for guests staying fewer than 31 days. This tax extends to mobile accommodations, such as tents, trailers, and campers. The revenue from these taxes goes to various recipients; some communities report that the lodging taxes feed back into the General Fund, while others report that revenue is directed to a community's Chamber of Commerce or other specific tourism promotion or economic development activities (Arizona Hospitality Research and Resource Center School of Management 2005).

Table 184 summarizes the lodging and sales taxes for the analysis area. In Pima County, Sahuarita, Marana, and Oro Valley impose a lodging, or bed, tax. Tucson has a hotel/motel tax and room rented surcharge ($1 per room rented). In Santa Cruz County, Patagonia also imposes a hotel/motel tax. Benson and Bisbee (Cochise County) have an additional hotel/motel tax, and Tombstone has an additional bed tax.

Table 184. Bed and sales taxes in the analysis area

State Tax for Lodging	**5.5%**
Cochise County	
Benson	2.50%
Bisbee	2.50%
Tombstone	3.00%
Pima County	
Sahuarita	2.0%
Marana	3.0%
Oro Valley	3.0%
Tucson	4%
Santa Cruz County	
Patagonia	3.0%

Sources: Arizona Department of Commerce (2009a; 2009b; 2009c).

Federal and Mineral Lease Royalties

A mineral royalty is the amount of money the owner of the mineral resource receives as a payment or royalty from the mineral producer. Fifty percent of Federal mineral royalties are returned to the State,

and a portion of that is then distributed to counties and cities. Arizona received $266,834 as its share of lease payments made on Federal lands in the State for fiscal year 2008, making Arizona twenty-sixth among the 35 states that received royalties and leases. The leading state was Wyoming, with $1.27 billion. States receiving larger payments have significant oil and gas production or coal production on Federal lands. Arizona's oil and coal are produced largely from Native American reservations, so the only revenues the State receives currently are largely from the leasing of Federal lands.

Hardrock mining does not pay royalties on Federal lands, in accordance with the Mining Act of 1872. Unlike severance taxes, royalties are based on the value of production and by-products. Federal royalties are distributed by the State of Arizona and are used to fund roads, public education, higher education, and other public services.

Property Values

Based on 2000 and 2006 U.S. Census Bureau (U.S. Census Bureau 2000c) data, the average median property value of owner-occupied units in the three-county analysis area was $99,167 in 2000 and $167,967 in 2006; there was an increase of 69 percent over the 6-year period. In 2000 and 2006, the median property value of owner-occupied units was below the state and national averages. Pima County experienced the most significant increase (82.4 percent) in the median property value of owner-occupied housing.

In terms of owner-occupied units, there was a 46 percent increase in the number of units in the three-county area between 2000 and 2006, compared with a 49 percent increase in Arizona and a 36.5 percent national increase. Housing growth during this period was substantial and on track with overall growth in the state. Cochise County experienced the most significant change (an increase of 73.3 percent) in the number of owner-occupied housing. Table 185 summarizes the number of owner-occupied housing units and median property values in the analysis area for the years 2000 and 2006.

Table 185. Number of owned-occupied housing units and median property values for the analysis area

Location	2000 No. of Owner-Occupied Housing Units	2000 Median Value	2006 No. of Owner-Occupied Housing Units	2006 Median Value	2000 to 2006 No. of Units Percent Change	2000 to 2006 Value Percent Change
Cochise	19,237	$88,200	33,335	$155,200	73.3%	76.0%
Pima	169,297	$114,600	244,519	$209,000	44.4%	82.4%
Santa Cruz	6,420	$94,700	7,719	$139,700	20.2%	47.5%
Arizona	1,032,103	$121,300	1,537,334	$234,600	49.0%	93.4%
United States	55,212,108	$119,600	75,363,085	$192,400	36.5%	60.9%

Sources: U.S. Census Bureau (2000c; 2006).

Note: No. = Number.

The average full-cash value is used to identify property values for all parcels within buffers of 0.5, 1, 2, 5, and 10 miles of the footprint of the project area. The average value of the 115 parcels in the 0.5-mile buffer is $199,663; the average value for 163 parcels within 1 mile is $232,645; the average value for 333 parcels within 2 miles is $205,476, and the average value for 1,048 parcels within 5 miles is $212,730. The number of parcels owned by the Federal Government, Rosemont Copper, the State of Arizona, and other private entities is summarized in table 170. Within 0.5 and 1 mile, 99.13 and 91.41 percent, respectively, of the parcels are owned by Rosemont Copper or the Federal

Government (the Coronado). However, within 10 miles, less than 5 percent of properties are owned by Rosemont Copper or the Federal Government (table 186).

Table 186. Summary of property values within 10 miles of the project area

Distance from Project Area	No. of Parcels	Average Value*	No. of Parcels Owned by Rosemont Copper	No. of Parcels Owned by Federal Government	No. of Parcels Owned by the State of Arizona	No. of Parcels Privately Owned (other than Rosemont Copper)
0.5	115	$199,663	81	33	0	1
1	163	$232,645	98	51	1	13
2	333	$205,476	159	99	10	65
5	1,046	$212,730	183	226	60	579
10	10,593	$178,112	183	296	226	9,888

Note: No. = Number.

* Value based on assessor data provided on February 8, 2010.

Property Value and Forest Resources

As discussed later in the "Social Benefits of Amenities on the Coronado National Forest" part of this section, environmental amenities associated with the Coronado National Forest contribute to the region's identity, as well as area quality of life. Specific to this discussion, these same amenity characteristics, along with a variety of other characteristics (location, area land and housing prices, area wages, number of bedrooms, bathrooms, etc.), can also influence where people live (migration) and property values (Hand et al. 2008b).

Research by Hand et al. (2008b) indicates that "people make regional housing and labor market decisions based in part on the availability of forest resources, as well as other environmental measures." That is, population movement and migration into environmentally desirable areas, like the analysis area, can be explained by the presence of, and density of, forest resources and associated environmental amenities. Additionally, in the Southwest, housing prices are higher based on overall proximity and access to forest resources: "forest area in a household's own geographic area is associated with higher housing prices" (Hand et al. 2008b).

Although research indicates that proximity to forest resources, and the density of those resources, can influence where people chose to live and how much people are willing to pay for housing, the specific characteristics of the forest amenities that are influential is unknown. As Hand et al. (2008a) ask, "is it open space, recreation opportunities, or wildlife habitat that is attractive to people, of which forest area may simply be a proxy? Or is it the higher altitudes and varied topography associated with many forest areas in the Southwest that are important?"

Whatever the specific characteristics are, analysis of property values in the environmental consequences discussion later in this section assumes that people value proximity to the forest and its resources and that the existence of an open-pit copper mine could result in negative impacts on values to neighboring properties.

Economic Diversity (Shannon-Weaver Diversity Index)

The Shannon-Weaver Diversity Index can measure the economic diversity of the analysis area. The Shannon-Weaver Diversity Index evaluates the extent to which the economic activity of a region is distributed between a number of industries in the region. In general, more diverse economies will

have larger multipliers because more inputs will be provided locally. The Shannon-Weaver Diversity Index is determined by Minnesota IMPLAN Group by calculating the number of industries in the region against how well distributed employment is throughout all of regional industries.
The Shannon-Weaver Diversity Index ranges from 0 to 1. An index of 1 would be "perfect" diversity, whereas, as output and employment become concentrated in fewer industries, the index would be closer to 0. The higher the diversity index, the more stable the economy is assumed to be. The index for each county is presented in table 187.

Table 187. Shannon-Weaver Diversity Index for each county in the analysis area

County	Index
Cochise	0.64168
Pima	0.70068
Santa Cruz	0.60946

Source: Minnesota IMPLAN Group (2008).

Pima County has the highest diversity index (0.70), while Santa Cruz County has the lowest index at 0.61. It is important to note that all counties in the analysis area have a Shannon-Weaver Diversity Index greater than 0.50, which indicates that the regional economies are relatively diverse.
The greater the diversity in the region, the more resilient the economy is in the face of change because the economy is more stable.

Recreation and Tourism

Towns and cities throughout southern Arizona profit economically from expenditures made by visitors to the Coronado National Forest. Visitors to the region enjoy thousands of acres of undeveloped land and scenery. Remote and rural areas of these counties are tourist destinations and are ideal for nature based activities that are popular in the region, such as skiing, hiking, camping, mountain biking, wildlife viewing, scenic viewing, amateur astronomy, hunting, fishing, and off-highway vehicle use. The region is a year-round destination for tourists; however, winter tourism is a particularly important component of the regional economy. Many communities benefit from visitors to the region, who book hotel rooms, eat, purchase gas, and shop, among other activities.

Recreation and tourism are important contributors to the economic stability of the area; economic benefits are derived from direct spending on food, gas, lodging, etc., but also from sales tax generated from visitor spending. Local and sales tax revenue is extremely important in rural (or nonurban) areas because tourism often forms a larger proportion of the economic activity in these areas, and special excise taxes on tourists and visitors (i.e., from food, lodging, auto rentals, etc.) are more heavily paid by visitors than residents (Dean Runyan Associates 2008).

In 1998, the National Visitor Use Monitoring project was implemented to respond to the need to better understand the use of, importance of, and satisfaction with National Forest System recreation opportunities. In 2008, the Forest Service compiled the visitor use monitoring results for surveys conducted in 2007 on the Coronado National Forest. The purpose of the survey was to assist Congress, Forest Service leaders, and program managers in making sound decisions that best serve the public and protect valuable natural resources by providing scientific, reliable information about the type, quantity, quality, and location of recreation use on public lands. Approximately 3,572 visitors were surveyed in 2007 by the Forest Service with a 90 percent confidence interval with a 3.2 percent margin of error (U.S. Forest Service 2008e).

Based on the 2007 visitor use survey, an estimated 2.4 million people visited the Coronado National Forest. Of the visitors contacted, 85 percent indicated they were visiting the area primarily for recreation purposes. Relaxing (45.9 percent); viewing natural features (64.8 percent); viewing wildlife, birds, and/or fish (65.9 percent); and hiking or walking (75.6 percent) were listed as the primary reasons participants visited the Coronado National Forest. Driving for pleasure (23.7 percent), visiting a nature center (17.2 percent), and nature study (15.7 percent) are also important tourism and recreation activities that provide employment and revenue to local economies (U.S. Forest Service 2008e).

Off-highway vehicle use and camping (both dispersed and developed), along with hunting and fishing, stimulate the regional economy through direct local expenditures on motorized vehicles, trailers, equipment and accessories, and insurance and maintenance costs (Arizona State Parks 2003). It should be noted that off-highway vehicle purchases are not necessarily directly related to the availability of recreation opportunities on Coronado National Forest. Local spending on food, gas and lodging, and souvenirs also indirectly benefits the region by supporting wages and income in the local economy, as well as contributing local and state tax dollar revenue. Off-highway vehicle users alone spend an estimated $3.1 billion (Silberman n.d. (2003b)) to $4 billion annually (Arizona State Parks 2003) in Arizona. According to Silberman (n.d. (2003b)), off-highway vehicle expenditures in the three-county area in 2002 totaled an estimated $450 million (table 188).

Table 188. Off-highway vehicle expenditures in the analysis area and in Arizona, 2002

Location	Trip	Equipment	Vehicles	Total
Cochise County	$27,670,716	$32,653,623	$38,146,809	**$98,471,148**
Pima County	$71,672,219	$139,449,312	$112,492,355	**$323,613,886**
Santa Cruz County	$20,795,765	$5,567,760	$935,409	**$27,298,934**
Three-County Total	$120,138,700	$177,670,695	$151,574,573	**$449,383,968**
Arizona	$842,316,226	$1,178,148,417	$1,035,243,712	**$3,055,708,355**

Source: Silberman (n.d. (2003b)).

Off-highway vehicle use, hunting, and fishing are interrelated; visitors and recreationists often use off-highway vehicles for big-game retrieval and access to remote areas for fishing. According to a national study on the economic importance of hunting (International Association of Fish and Wildlife Agencies 2002), hunters spend an average of $1,896 annually per hunter. Annual hunting expenditures in Arizona range from an estimated $126 million (Silberman n.d. (2003a)) to $1.3 billion (Congressional Sportsmen Foundation n.d. (2008)). Expenditures include hunting gear, such as guns and ammunition, hunting tags and permits, processing, and taxidermy costs, as well as in the sectors noted above, such as gas, food, and lodging. Silberman (n.d. (2003a)) estimated that 2001 expenditures on fishing and hunting were $84,832,296 and $26,158,896, respectively; total expenditures in the three-county analysis area reached about $111 million (table 189).

Table 189. Hunting and fishing expenditures in the analysis area and in Arizona, 2001

Location	Fishing	Hunting	Total
Cochise County	$6,744,982	$5,883,086	**$12,628,068**
Pima County	$66,941,072	$17,560,929	**$84,502,001**
Santa Cruz County	$11,146,242	$2,714,881	**$13,861,123**
Three-County Total	$84,832,296	$26,158,896	**$110,991,192**
Arizona	$831,493,493	$126,628,825	**$958,122,318**

Source: Silberman (n.d. (2003a)).

In terms of economic output related to tourism and recreation, sectors included in the broader category of tourism for this analysis include hunting and trapping; fishing; food and beverage stores and drinking locales; gasoline stations; clothing, sporting goods, and general merchandise stores; lodging; travel arrangement and reservation services; and transportation (transit/ground passenger and scenic/sightseeing). It is important to note that not all economic activity in tourism related industries can be attributed to tourist spending. Only a portion of sales in hotels, restaurants, and other sectors are actual tourist sales. Using National Tourism Impact ratios (table 190) for each sector, actual tourist spending related industry output for the region is estimated (table 191). These ratios can be applied to industry output. Using these ratios, for example, industry output for the "hunting and trapping" sector was $1.69 million in the three-county analysis area in 2008 (Minnesota IMPLAN Group 2008); using the tourism impact ratio for this sector (20 percent), the portion of industry output attributed to actual tourist spending is $337,508.

Table 190. National tourism impact ratios

Sector	Ratio
Hunting and trapping	20.00%
Transit and ground passenger transportation	23.00%
Scenic and sightseeing transportation	3.00%
Motor vehicle and parts dealers	17.00%
Food and beverage stores	4.00%
Health and personal care stores	3.00%
Gasoline stations	4.00%
Clothing and clothing accessories stores	4.00%
Sporting goods; hobby, book, and music stores	4.00%
General merchandise stores	4.00%
Miscellaneous store retailers	4.00%
Machinery and equipment rental and leasing	11.00%
Services to buildings and dwellings	3.00%
Other amusement; gambling and recreation	20.00%
Hotels and motels, including casino hotels	81.00%
Other accommodations	81.00%
Food services and drinking places	17.00%
Automotive repair and maintenance, except car	3.00%

Source: Stynes (2001).

Table 191. Tourism related sectors for three-county area: industry output using Minnesota IMPLAN Group (2008) and adjusted using tourism impact ratios

Industry	Cochise	Pima	Santa Cruz	Total
Hunting and trapping	$261,300	$0	$76,208	**$337,508**
Fishing	$0	$387,770	$0	**$387,770**
Transit and ground passenger transportation	$1,433,108	$25,597,550	$1,597,535	**$28,628,192**
Scenic and sightseeing transportation	$436,038	$3,551,852	$758,610	**$4,746,500**
Motor vehicle and parts dealers	$8,237,549	$93,892,507	$3,141,458	**$105,271,514**
Food and beverage stores	$2,955,833	$27,058,122	$1,473,845	**$31,487,800**
Health and personal care stores	$382,774	$6,677,009	$269,133	**$7,328,916**
Gasoline stations	$3,381,606	$7,959,691	$978,522	**$12,319,819**
Clothing and clothing accessories stores	$793,083	$8,303,384	$1,037,665	**$10,134,131**
Sporting goods; hobby, book, and music stores	$332,923	$5,145,143	$187,938	**$5,666,004**
General merchandise stores	$3,324,616	$18,159,702	$2,211,933	**$23,696,251**

Industry	Cochise	Pima	Santa Cruz	Total
Miscellaneous store retailers	$774,261	$9,767,416	$461,494	**$11,003,171**
Automotive equipment rental and leasing	$2,923,694	$19,713,688	$3,737,970	**$26,375,352**
Travel arrangement and reservation services	$129,814	$3,878,560	$5,872	**$4,014,245**
Amusement parks, arcades, and gambling industries	$2,851,902	$42,612,774	$1,656,322	**$47,120,999**
Hotels and motels, including casino hotels	$22,461,172	$336,132,115	$17,113,690	**$375,706,977**
Other accommodations	$8,074,706	$19,690,706	$1,508,865	**$29,274,277**
Food services and drinking places	$27,706,480	$282,583,955	$7,484,810	**$317,775,245**
Auto repair and maintenance (except car washes)	$1,245,319	$12,418,165	$426,230	**$14,089,714**

Source: Minnesota IMPLAN Group (2008).

According to Minnesota IMPLAN Group and adjusted using tourism impact ratios, industry output for tourism sectors in the three-county analysis area (in 2008) was $1.05 billion, or 1.61 percent of the region's output. Of the three-county analysis area, tourism sectors in Pima County generated the most output, at $923 million, Cochise County fell in the middle, at $87 million, and Santa Cruz was last, at $44 million. Although total regional output for sectors associated with tourism was less than 2 percent of the total regional output, it is still an important component of the economic stability of the region.

As mentioned above, amateur astronomy is considered a recreation opportunity on the Coronado National Forest. In addition to recreational astronomy, there are numerous observatories throughout the State used for planetary and space science research. Specifically, there are two observatories located within 15 miles of the proposed Rosemont Copper site. The observatories hire professionals, staff, and students and thus have direct impacts on Arizona's local economy. Indirect employment contributions to the economy are also generated via the purchase of equipment, utilities, office supplies, and consumption by both employees of the observatories and those employees in businesses that supply good and services (The Arizona Arts Sciences and Technology Academy 2007).

In Fiscal Year 2006 the total dollar impact (sales or output) in Arizona that was attributed to the State's planetary and science research was estimated to be $252.8 million. The total contribution includes $138.6 million in earnings, and $12 million in tax revenues. During the same year Arizona's observatories and related research organizations spent a total of $135.4 million on operations, including wages and salaries. Capital investment/construction related expenditures totaled $28.2 million. Of the $164.2 million in expenditures for Fiscal Year 2006, $69.3 million was spent in Arizona (The Arizona Arts Sciences and Technology Academy 2007). The observatories and related facilities received 200,805 visitors in Fiscal Year 2006, and 22 percent of the 194,137 public visitors were from outside Arizona. According to the Arizona Arts, Sciences, and Technology Academy (2007), the total cumulative investment of astronomy, space, and planetary sciences equaled $1.199 billion in Fiscal Year 2006.

Quality of Life

The analysis area has a diverse population, economy, housing, land use, and natural features that are supported by an infrastructure of facilities and services.

Public Facilities and Services

County and community profile information was primarily obtained from State and community Web sites, particularly from County and Community Profiles compiled by the Arizona Department of Commerce (2009a; 2009b; 2009c). All three counties in the analysis area provide typical county

government services, including a county assessor, county attorney, county commissioners, treasurer, road department, planning, landfill, emergency services, sheriff, search and rescue, parks and recreation, and libraries. The larger incorporated jurisdictions, such as Tucson and Sahuarita, provide similar municipal services, including administration, public works, police, fire, and parks and recreation services. Each county also has educational and health care facilities.

Transportation and Road Maintenance

As discussed in the "Transportation/Access" section, State Route 83, a designated State Scenic Highway, will provide the primary access route connecting Rosemont Copper Mine with Interstate 10 to Tucson. Access to the project site is proposed to come from a newly developed road that would pass along the northern boundary of the site and connect with State Route 83.

Because State Route 83 is a state highway, the Arizona Department of Transportation oversees maintenance. Funding amounts for road maintenance along State Route 83 have not been consistent since 2001. Over the past 9 years, funding for State Route 83 improvements has ranged from $550,000 in 2005 to $4.7 million in 2004 (table 192). Of the $4.7 million in 2004, $1.4 million was spent on scenic easement acquisition along State Route 83. Additionally, $2.75 million for repaving State Route 83 was funded through Federal economic recovery funds (American Recovery and Reinvestment Act) in 2009, and as of August 2010, project construction was ongoing.

See the "Transportation/Access" section for a full discussion of potential changes in traffic patterns, and see the "Public Health and Safety" section for a full discussion of these resource issues.

Table 192. Arizona Department of Transportation programmed funding for State Route 83 improvements, 2001 to 2010

Fiscal Year	Funding	Percent Change from Previous Year
2001	$1,675,000	–
2003	$1,600,000	−4.48%
2004	$4,692,000	193.25%
2005	$550,000	−88.28%
2010	$9,390,000	1,607.27%

Community Values and Social Trends

The Coronado National Forest has an important link to its neighbors because of the significant amount of forest lands in the region. The social environment of the surrounding communities for many years has been in transition from traditional extractive associations with natural resources (i.e., grazing, ranching, agriculture, and mining) to more tourism and amenity based economies and lifestyles. Although these traditional economic activities have changed, the lifestyles associated with them continue to be important. Values and beliefs associated with recreation also link residents to national forest lands and resources; these same natural amenities attract retirees and others to the area.

The local economy near the proposed mine and in rural areas of Pima, Cochise, and Santa Cruz Counties is typical of the changing economy of the West as people move to these rural areas to live, work, and play. Many people moving into these areas make these choices based on quality of life considerations, along with environmental amenities such as clean air and water and recreation opportunities (Russell and Adams-Russell 2005). Communities in the area, such as Sonoita and Elgin, benefit from proximity to public lands.

Common social trends in the western United States include rapidly growing urban populations, increased concern over loss of open space, increasingly transformed landscapes, continued and increasing loss of biodiversity, increased pressures for uses of all types (in particular, strong trends in recreation uses, such as hiking, biking, off-highway vehicle and sport utility vehicle use, camping, picnicking, etc.), rising pressures for preservation and conservation, and increased feelings of loss associated with public and private lands, including lost access to public lands and recreation.

Although economic conditions are changing in the communities surrounding the Coronado National Forest, forest resources continue to be perceived as being linked to local economic well-being. The scenic resources (including State Route 83), climate, dark skies, and outdoor opportunities in the region often attract retirees and those looking for second homes. Some residents in the surrounding communities perceive forest lands as being critical to their economy by providing hunting, fishing, wildlife, and recreation trails, as well as being a direct link to the local tourism industry.

Increased growth in southern Arizona exerts environmental pressures on surrounding areas as development moves closer to public lands. As growth continues and development increases, the demand for access to and use of open space and recreation areas will also increase. In addition, urban residents from other areas of Arizona may have limited knowledge and connection to the Coronado National Forest and, therefore, have a different valuation of the forest.

In 2005, a report was prepared for the Forest Service titled “Values, Attitudes and Beliefs Toward National Forest System Lands: the Coronado National Forest,” which revealed important information about the relationship between neighbors and users of the forests. The document identifies values, attitudes, and beliefs about forest resources and their management for the Coronado National Forest (Russell and Adams-Russell 2005).

The values, attitudes, and beliefs study revealed that residents near the Coronado National Forest continue to value their proximity and access to the forest. There is also a great deal of local public interest in the Coronado National Forest and its natural resources (Russell and Adams-Russell 2005). The public perception is that the Coronado National Forest is a “recreation forest,” that is, the Coronado National Forest is important to the public because of the recreation opportunities. The public perceives the Coronado National Forest to be vulnerable to the effects of population growth pressures, illegal border crossing and smuggling activity along the United States/Mexico border, and changes to the lifestyle and values associated with ranching and agriculture.

Access to the Coronado National Forest, especially for urban populations, is both a valued asset and desired future. National forests that continue to be accessible without fees or undue restrictions are valued as contributing to recreation opportunities and enhancing the overall quality of life in the region. Some participants in the values, attitudes, and beliefs study expressed a desire for the Forest Service to manage the unique ecological characteristics of the Coronado National Forest, considered “sky islands,” and recognized that communities adjacent to these sky islands have a unique socioeconomic relationship with the Coronado National Forest. Hunting, birding, and off-road riding are identified as important recreation uses of the Coronado National Forest (Russell and Adams-Russell 2005).

In total, 1,999 visitors were contacted on the Coronado National Forest during the sample year. The survey showed that recreation is a priority for users on the Coronado National Forest. Nearly one-half (48 percent) of respondents indicated they lived within 25 miles of their Coronado National Forest destination; 69.5 percent lived within 50 miles. The top five primary activities identified by

respondents were hiking or walking (52.6 percent); viewing natural features/scenery (11.2 percent); driving for pleasure (5.9 percent); relaxing (5.3 percent); and camping in developed sites (3.5 percent) (Russell and Adams-Russell 2005).

Social Benefits of Amenities on the Coronado National Forest

Environmental amenities associated with the Coronado National Forest contribute to the region's identity, as well as area quality of life. As previously discussed, regional population growth has brought on significant changes in the local and regional quality of life over the past 2 decades; extensive population growth has driven changes (increases) in demand on forest resources. The region is shifting from a solely commodity based lifestyle toward a more recreation and tourism based way of life.

Communities adjacent to Coronado National Forest lands have a strong sense of place tied to the forest, specifically to the recreational opportunities of the forest. Environmental amenities that attract tourists are also appealing to area residents. People often live in areas surrounding forest lands specifically to use the forest as their backyard and to enjoy the benefits of reduced noise and light pollution, unobstructed natural views, and easy access to forest lands. Lee and Driver (1999) identified four major types of benefits derived from recreation participation: personal, social and community, economic, and environmental.

As discussed above, people are drawn to the Coronado National Forest because of the unique ecology, scenery, scenic driving, relaxing, and hiking and camping opportunities. Landscape appearance and scenery can be important public land amenities, not just as recreation opportunity settings, but also as elements of the region's identity. Regional economic development is also increasingly dependent on the environmental and ecological amenities associated with the Coronado National Forest specifically, and public lands in general. Factors such as clean air and water quality, scenery and natural landscape, open space, dark skies, and the number of recreation opportunities can be economic assets themselves for local economies.

Environmental Justice

Consideration of environmental justice issues is mandated by Executive Order 12898, which was published on February 11, 1994. This executive order requires that all federal agencies incorporate environmental justice into their mission by "identifying and addressing . . . disproportionately high and adverse human health or environmental effects of [their] programs, policies and activities on minority and low-income populations in the United States."

The goal of the executive order is to ensure the following:

- That all people are treated fairly with respect to the development and enforcement of protective environmental laws, regulations, and policies;
- That potentially affected community residents are meaningfully involved in the decisions that would affect their environment and/or their health.

The U.S. Environmental Protection Agency defines a community with potential environmental justice populations as one that has a greater percentage of minority or low-income populations than an identified reference community. The standard for identifying minority populations is either (1) the minority population of the affected area exceeds 50 percent or (2) the minority population percentage

of the affected area is "meaningfully greater" than the minority population percentage in the general population or other appropriate unit of geographic analysis, such as a reference community (Council on Environmental Quality 1997). The U.S. Environmental Protection Agency has not specified what percentage of the population can be characterized as "meaningfully greater" in order to define an environmental justice population. For the purposes of this analysis, it is assumed that if the affected area's minority and/or poverty status population is 50 percent or greater than the reference community, there is likely an environmental justice population of concern. Because of the large geographic boundaries of the socioeconomic study area (a 50-mile radius around the proposed mine), the reference community is considered the State of Arizona.

There are two components to addressing income as it relates to environmental justice: "low income" and "below poverty level." A low-income population is defined by the U.S. Department of Housing and Urban Development as 80 percent of the median family income for the designated area. The low-income designation is subject to adjustment for areas with unusually high or low incomes or housing costs. Families and persons are classified by the U.S. Census Bureau as "below poverty level" if their total family income or unrelated individual income was less than the poverty threshold specified for the applicable family size, age of householder, and number of related children under 18 that are present. For persons not in families, poverty status is determined by their income in relation to the appropriate poverty threshold. Thus, two unrelated individuals living together may not have the same poverty status. The U.S. Census Bureau defines poverty level thresholds for individuals and a family of four as income levels below $8,501 and $17,029, respectively (U.S. Census Bureau 2000f). A community is considered an environmental justice community if the total number of individuals living below poverty level is 50 percent or more of the community or 50 percent greater than the reference community (State of Arizona) percentage.

Minority and/or Low-Income Populations in the Analysis Area

Minority Populations

Table 193 summarizes relevant data regarding minority populations for the analysis area in 2010. Using the criteria presented above, where a minority population exceeds 50 percent or a minority population is 50 percent greater than the reference community (the State of Arizona), there are three places in the analysis area where the minority population of the affected area exceeds 50 percent, based on 2000 and 2010 U.S. Census Bureau data: Santa Cruz County, the Pascua Yaqui Tribe and the Tohono O'odham Nation (see table 193). The Santa Cruz County Hispanic population totals 82.8 percent of the total population, which exceeds the 50 percent threshold by 32.2 percent. The Pascua Yaqui Tribe and the Tohono O'odham Nation minority populations are more than 50 percent greater than the reference community, with 90.6 and 90.1 percent of the population identifying itself as American Indian, respectively.

Low Income

Table 178 summarizes median family incomes for the analysis area. The 2000 U.S. Census showed Arizona's median family income as being $46,723; therefore, the poverty level threshold for family income would be $37,378 (80 percent of median family income). Santa Cruz County had a median family income of $32,057, which is 68.6 percent of the State's median income. Therefore, Santa Cruz County is classified as a low-income area for the purposes of this study. Tucson was slightly below the threshold, with a median family income of $37,344, while South Tucson was significantly below the poverty line, with median family income at $17,614, or 37.7 percent of the State's median family income.

Table 193. Minority populations in the analysis area, 2010 (2000)

Location	Total Population	Caucasian Alone (Number)	Caucasian Alone (Percent)	Black or African American Alone (Number)	Black or African American Alone (Percent)	American Indian and Alaska Native Alone (Number)	American Indian and Alaska Native Alone (Percent)	Asian Alone (Number)	Asian Alone (Percent)	Native Hawaiian or Pacific Islander (Number)	Native Hawaiian or Pacific Islander (Percent)	Other Race (Number)	Other Race (Percent)	Hispanic or Latino Origin (of any race) (Number)	Hispanic or Latino Origin (of any race) (Percent)
Arizona	6,392,017	4,667,121	57.8	259,008	3.2	296,529	2.1	176,695	2.1	12,648	>1	761,716	9.4	1,895,149	23.4
Cochise County	131,346	103,085	78.5	5,465	4.2	1,589	1.2	2,525	1.9	418	>1	12,989	9.9	42,543	32.4
Pima County	980,263	728,751	74.3	34,674	3.5	32,605	3.3	25,731	2.6	1,624	>1	120,639	12.3	338,802	34.6
Sahuarita Town	25,259	20,280	80.3	742	2.9	334	1.3	499	2.0	31	>1	2,309	10.5	8,077	32.0
Green Valley CDP*	21,391	20,710	96.8	92	>1	66	>1	149	>1	9	>1	218	1.0	1,049	4.9
Santa Cruz County	47,420	34,835	73.5	179	>1.0	328	>1.0	255	>1.0	15	>1	10,855	22.9	39,273	82.87
Sonoita CDP	818	755	92.2	3	>1	10	1.2	9	1.1	0	>1	30	3.9	120	14.7
San Xavier Pascua Yaqui†	3,315	36	1.1	8	0.2	3,002	90.6	1	>0.1	0	0	197	5.9	756	22.8
Tohono O'odham†	10,787	873	8.1	11	0.1	9,718	90.1	17	0.2	10	0.1	54	0.5	761	7.1

Sources: Economic Profile System (2007a; 2007b; 2007c); U.S. Census Bureau (2010c).

* CDP = Census designated place.

† Tribal Census numbers are from U.S. Census 2000. U.S. Census 2010 data not yet available.

Table 194 identifies persons below poverty level by county and provides a comparison of those figures with the State. While there are no counties or Tribal populations in the socioeconomic analysis area that exceed 50 percent, the percentage of families living below the poverty level (21.4 percent) is 50 percent greater than the reference community (9.9 percent). The percentage of both families and individuals in the San Xavier Pascua Yaqui tribe (44 percent of individuals and 40 percent of families) and the Tohono O'odham Nation (46 percent of individuals and 40 percent of families) is
50 percent greater than the reference community (13.9 percent of individuals and 9.9 percent of families). Therefore, Santa Cruz County, the San Xavier Pascua Yaqui Tribe, and the Tohono O'odham Nation meet the low-income and/or poverty criteria for identification as an environmental justice community.

Table 194. Environmental justice statistics for the analysis area, 2000

Location	Persons/Percent Below Poverty Level	Families/Percent Below Poverty Level
Arizona	698,669 / 13.9	128,318 / 9.9
Cochise County	19,772 / 17.7	4,195 / 13.5
Pima County	120,778 / 14.7	22,432 / 10.5
Santa Cruz County	9,356 / 24.4	2,056 / 21.4
San Xavier Pascua Yaqui	1,435 / 44	277 / 40
Tohono O'odham	4,929 / 46	918 / 40

Source: U.S. Census Bureau (2000d).

In summary, communities that meet the criteria for identification as environmental justice community because of minority populations, low income, or living below poverty level include Santa Cruz County, the San Xavier Pascua Yaqui Tribe, and the Tohono O'odham Nation.

Environmental Consequences

Direct and Indirect Effects of Each Alternative

No Action Alternative

Under the no action alternative, the mine would not be developed, and existing socioeconomic conditions would continue, as described in the "Affected Environment" part of this section. There would be no change from current conditions under this alternative.

Because the no action alternative means that no mining activity would take place, there are no mitigation measures identified, and there would be no remaining effects.

Population and Demographics

There would be no change to population as a result of mine construction or operation. Population would continue to grow at a rate consistent with historic trends.

Housing

There would be no change to demands on housing needs, and housing conditions would remain unchanged.

Employment

There would be no change to employment as a result of mine construction or operation; employment would continue to change at a rate consistent with historic trends. Jobs would not be created by construction, operation, or reclamation activities.

Income Characteristics

There would be no change to income characteristics as a result of mine construction or operation; area income characteristics would continue to change at a rate consistent with historic trends.

Economic Activity

There would be no change (increase) to economic activity and output, and in general, the balance of economic activity would remain unchanged.

Taxes and Revenues

There would be no change (increase) in tax or revenue figures, other than changes that are consistent with historic trends.

Property Value

There would be no change to property values, other than fluctuations in value consistent with historic and current trends. Properties within the analysis area surrounding the mine would not experience an additional impact on price fluctuations.

Recreation and Tourism

There would be no displacement of recreation activities or change in recreation opportunities in the project area (mine footprint). Thus, there would be no changes in associated tourism activity, although no measurable impacts are anticipated under any of the action alternatives.

Quality of Life Conditions

In terms of quality of life, specifically “Community Values and Social Trends” and “Social Benefits of Amenities on Coronado National Forest,” there would be no change in the natural amenities and environmental quality that area residents treasure. Environmental amenities that contribute to the region’s identity and area quality of life would remain untouched, and the rural landscape would be preserved. Current quality of life conditions would be unchanged, and there would be no degradation of the analysis area quality of life. Residents who move to the region because of the rural, undeveloped landscape would not experience the negative impacts of the mine.

Environmental Justice

Under the no action alternative, adverse impacts to the potential environmental justice populations would not occur because the current land use would remain unchanged and opportunities for disproportionate adverse impacts would be nonexistent.

Impacts Common to All Action Alternatives

Under all action alternatives, the mine and associated facilities would be constructed. In terms of impacts to socioeconomics, changes (if any) to employment, property value, taxes and revenues, road maintenance and emergency services costs, tourism, quality of life, and environmental justice are expected to be the same for all action alternatives. Differences between these alternatives are not

expected to result in changes in socioeconomic impacts; therefore, potential impacts, as described below, are considered common to all alternatives.

The economic impacts of the preproduction, production, and postproduction phases of the project were estimated by using regional economic modeling, or more specifically, by using IMPLAN (Applied Economics 2011). These types of regional economic modeling are standard approaches to measuring the production and consumption linkages in an economy between households, industries, and institutions (such as government), thus providing an estimate of the ripple effects in an economy associated with a direct stimulus or investment. The multipliers of IMPLAN measure these downstream or ripple impacts.

As previously discussed, Cochise, Pima, and Santa Cruz Counties were selected as the economic impact analysis area. The multipliers of Regional Economic Models, Inc., are defined as the sum of the direct, indirect, and induced effects divided by the direct impact. In the Regional Economic Models, Inc., model, businesses produce goods to sell to other businesses, consumers, governments, and purchasers outside the region. The output is produced using labor, capital, fuel, and intermediate inputs. The demand for labor, capital, and fuel per unit of output depends on their relative costs.

Implementation of the action alternatives and development of the proposed Rosemont Copper Mine facilities could have direct and indirect impacts to the local (county), State, and national economies in terms of employment, government revenues, personal income, business sales, and quality of life. The potential impacts are detailed below.

Population and Demographics

Preproduction: Engineering and Construction

It is anticipated that the vast majority (approximately 90 percent) of the construction workforce would be drawn from the local workforce. These workers are expected to commute to the project area from their residences, rather than relocate. Construction employees typically commute up to 2 hours from their homes (Gilmore et al. 1982).

Project engineering and construction would occur over an approximately 3- to 4-year period, creating estimated total of approximately 4,100 jobs (2,400 direct and 1,800 indirect jobs) (Applied Economics 2011). Annually, the engineering and construction would result in approximately 600 jobs (assuming a 4-year construction phase). Assuming that 10 percent of the construction workforce temporarily relocates to the project area, this would result in a total population increase of 240 during the construction phase.

Thus, direct impacts to population in the analysis area would result from the 10 percent of employees likely to relocate to the region; these employees would need to possess specialty skills and would either relocate to the region temporarily or permanently, including staying in hotels/motels, apartments, or purchasing a home. Thus, population is expected to grow at least temporarily by approximately 240 individuals over the duration of the construction phase. Tucson and Green Valley would likely receive these residents. This immigration represents a 0.046 and 0.024 percent increase in 2010 population levels in Tucson and Pima County, respectively. These immigration figures are summarized in table 195. Further, because of the considerable loss of construction jobs in surrounding communities in recent years as a result of the current economic recession, there is a significant pool of unemployed skilled construction labor in the region. Consequently, workers hired to construct the project would likely be drawn from the existing workforce and not from a migratory workforce from outside the Tucson metropolitan statistical area.

Production and Postproduction

As previously noted, mine operation would occur over an approximately 21-year period, with an annual range of 350 to 480 employees (Applied Economics 2011).

Table 195. Construction and operation population impacts

Population	Tucson	Pima County
Construction		
Population (2010)	520,116	980,263
Relocating construction workforce (2010)	410	410
Percent of relocating construction workforce	0.046	0.024
Operation		
Population (2010)	520,116	980,263
Total annual relocating operation workforce	735 to 1,008	735 to 1,008
Percent of relocated operation population (2010)	0.14 to 0.19	0.076 to 0.10

Sources: Arizona Department of Commerce (2009a; 2009b; 2009c); U.S. Census Bureau (2010a; 2010b).

Note: NA = Data not available.

Thus, direct impacts to population in the analysis area would result from the 10 percent of employees likely to relocate to the region to fill mine operation jobs; these employees would need to possess specialty skills and would likely relocate to the region permanently. Tucson and the larger Pima County area would likely receive these residents. These immigration figures are summarized in table 195. As during the construction phase, workers hired to operate the project would likely be drawn from the existing workforce and not from a migratory workforce from outside the Tucson metropolitan statistical area.

Housing

Preproduction: Engineering and Construction

As previously noted, research indicates that construction workers are willing to commute up to 2 hours one way for a job (an average of 73 miles and maximum of 115 miles one way) (Gilmore et al. 1982). As a result, most of the workers would be coming from the Tucson area and its suburbs, approximately 40 miles north of the project area.

Housing vacancy rates in the analysis area in 2000 averaged approximately 11 percent. Data for each place in the analysis area are not available from the U.S. Census Bureau for the 2006 to 2008 American Community Survey; therefore, those data are not presented here. However, based on information for select cities in the analysis area for which data are available from the 2006 to 2008 American Community Survey, vacancy rates have increased. For instance, the vacancy rate in Pima County increased from 9.4 percent in 2000 to 11.8 percent in 2008; in Santa Cruz County, housing vacancy increased from 9.4 percent in 2000 to 37.3 percent in 2008. In Tucson, housing vacancy rates increased from 8 to 10.9 percent between 2000 and 2008. Considering the significant number of vacant housing units in the analysis area, and with 90 percent of the construction workforce expected to commute to the project area rather than relocate, little or no transient housing would be required in the project area or in the communities closest to the project area. As a result, there would be minimal demands on the local housing supply.

Production and Postproduction

Operation of the project is expected to have very little impact to the availability of housing because the number of workers needed for the operation of the mine and mill (average annual employment is 35 to 48 workers) and the resulting population changes (735 to 1,008 people over the life of the project (approximately 21 years)) would not be more than the number of vacant housing units in Cochise, Pima, and Santa Cruz Counties (more than 40,000 units). Tucson alone had more than 16,000 vacant units (U.S. Census Bureau 2008). As a result, there would be minimal demands on the local housing supply during the operational phase of the mine. In-migration would result in beneficial long-term impacts to the local housing supply; an increase in population would help offset local housing vacancies.

Employment

Preproduction: Engineering and Construction

Project engineering and construction would occur over an approximately 3- to 4-year period, and construction would last approximately 18 months. Preproduction would include up to approximately direct and indirect 4,100 jobs over the construction process (2,400 direct and 1,800 indirect jobs) (Applied Economics 2011). Thus, assuming the engineering and construction phase lasted 4 years, the project would directly employ 600 people annually. During the same time frame, approximately 450 indirect jobs would result from the project. Indirect jobs include local vendors from whom Rosemont Copper would make purchases and local retail stores and establishments where Rosemont Copper employees would shop.

Construction employment is expected to draw from the local workforce in the greater Tucson and Green Valley areas; however, some people may also come from the Sonoita area and other communities to the south. This would result in a direct increase in employment in area communities and would include skilled and unskilled labor. It is expected that approximately 10 percent of the construction jobs would require specialty skills that could not be filled by the local workforce. Thus, an estimated 240 may relocate temporarily or move to the area permanently to fill jobs that require specialty skills.

The construction industry in Arizona, including Pima County and the greater Tucson and Green Valley areas, has been particularly affected by the nation's recent economic downturn and the State's weak housing market. As a result, there is a substantial workforce available in this region to accommodate construction needs of the project. For example, construction employment in the Tucson metropolitan statistical area fell by 21.5 percent between 2008 and 2009, with another projected drop of 2 percent between 2009 and 2010 (Arizona Department of Commerce 2009b). Similarly, the Tucson metropolitan statistical area unemployment rate has risen from 5.8 percent in 2008 to 8.3 percent in 2009; the unemployment rate for the greater Tucson area remained constant, at 8.9 percent, in January 2010, indicating that a considerable workforce is seeking jobs and available in the region to fulfill the estimated 900 annual jobs for the proposed project (Arizona Workforce Informer 2011).

The construction workforce for the project would be expected to be filled by the available labor supply; as such, construction employment resulting from the development of the project would be a beneficial short-term impact to individuals in nearby communities seeking employment because the project would provide new construction jobs to an area that has recently endured high rates of unemployment.

Indirect impacts during the construction phase of the project would result in 1,800 jobs in Pima County. Because of the large number of workers involved in this type of construction, the project would result in significant potential for increasing consumer spending in the county during this phase (Applied Economics 2011). However, the indirect and induced jobs created during the construction and operations phases are often relatively low-wage jobs such as fast food workers or convenience store clerks. Increases in equipment manufacturing and health care jobs would provide wages similar to those in the mining industry (Power 2010). Recreation related employment is not expected to change to a measurable degree; the number of jobs and associated labor income (approximately 800 jobs attributed to recreation on the Coronado National Forest within the three-county analysis area) is not expected to change during mine construction.

Production and Postproduction

The total mine operation workforce would consist of an annual range of approximately 350 to 480 workers. The operations of Rosemont Copper Mine would directly and indirectly support an average of 1,600 jobs per year and $75.2 million in annual personal income for Pima County (Applied Economics 2011). Indirect impacts are the result of the multiplier effect calculated through IMPLAN, and they capture "ripple" effects of supplier and consumer businesses and their employees throughout Pima County.

Based on staffing information provided in the preliminary MPO (WestLand Resources Inc. 2007a), 9 percent of employment would be general and administrative positions, 62 percent would be for mine operations, 21 percent would be for mill operations, and 8 percent would be for solvent extraction operations. Additionally, "the vast majority of the skilled mining personnel needed for the Rosemont Project are available in the greater Tucson area" (WestLand Resources Inc. 2007a).

Mine operations would include hourly employees and salaried employees. Salaried employees would include mine engineers, geologists, and shift supervisors. Hourly employees would include shovel operators, haul truck drivers, drill operators, and additional mine operations support such as maintenance. In general, the number of pit operations employees per shift would range from 148 to 181 people. With four rotating crews working 12-hour shifts, mining crews would average about 37 to 45 people for each shift (WestLand Resources Inc. 2007a).

Mill operations would have 17 salaried employees and 79 hourly employees. Salaried employees would include mill administration staff, shift supervisors, and maintenance supervisors.

The operational workforce for the mine would be expected to be filled primarily by the available labor supply in Pima County and the greater Tucson area (WestLand Resources Inc. 2007a). Construction employment resulting from the development of the mine would be a beneficial short-term impact to individuals in nearby communities seeking employment because the project would provide new construction jobs to an area that has recently endured high rates of unemployment.

It should be noted that the total number of direct mining jobs required under the proposed action would be quite modest, compared with the total employment in the counties where the mining employees would most likely reside. A report completed by Power in 2010 indicates that the total direct mining jobs (approximately 400) represent a 1 in 1,500 (0.07 percent) job increase within Pima, Santa Cruz, and Cochise Counties (Power 2010). Further, a study by the Sonoran Institute states that if 90 percent of the Rosemont Copper employees lived in Pima and Santa Cruz Counties they would account for 0.08 percent of the total employment of the counties combined (when using the combined 2005 employment total of 503,563) (Marlow 2007).

The postproduction and mine closure phase of the project is expected to last 3 years. This phase would include an estimated 326 people in the first year, with an annual payroll of $11.5 million. No employees of Rosemont Copper are expected during the final 2 years of mine closure (Singh 2009).

As with preproduction, recreation related employment is not expected to change to a measurable degree during production and postproduction.

Income Characteristics

Preproduction: Engineering and Construction

Over the 3- to 4-year period, expenditures in Pima County are estimated at $355.7 million. This includes actual construction activity, such as labor, materials, and subcontractors, as well as construction equipment rentals, engineering and project management, and commissioning and spare parts, which would all be procured by local vendors. Total construction impacts in Pima County would precipitate a $194 million increase in payroll.

Operational payroll is estimated to range between $19.5 million to $26.2 million, with a total direct payroll over the life of the project of more than $516 million (Applied Economics 2011). A range of wages would be expected among those employed by the mine, from the lower wages of a general laborer to the higher wages of the project management staff and technical advisors. According to Rosemont Copper, the average annual income for a Rosemont Copper employee would be $59,000.

Overall, the average annual payroll of Rosemont Copper employees would add minimally to the total wages and salary in Pima and Santa Cruz Counties (Marlow 2007). When using an average of $20 million in annual payroll, approximately 80 percent is actually “take home” pay, and the other 20 percent goes toward workers’ compensation, health insurance, unemployment, and social security. Thus, approximately $16 million would flow in to the local economies, where employees reside (primarily in the Tucson area, with smaller portions in Santa Cruz and Pima Counties). If 90 percent of the Rosemont Copper employees live in Pima and Santa Cruz Counties, $14.7 million in wages and salaries would flow into the local economies, representing approximately 0.1 percent of the total wages and salaries paid in the two counties combined ($14.03 billion) in 2005 (Marlow 2007).

Economic Activity

Preproduction: Engineering and Construction

Construction of the proposed mine and facilities would create positive, temporary impacts to the local, State, and national economies. Benefits associated with the three to four year construction period would result in a total capital investment of $897.2 million (Applied Economics 2011).

This figure includes $355.7 million in local construction spending, including labor, materials, subcontractors, engineering and project management and equipment rentals, which would create direct economic impacts in Pima County. The total economic impact during the construction period is an estimated $536.6 million, supporting 4,100 direct and indirect jobs and an additional $194 million in personal income (Applied Economics 2011).

Production and Operations Impacts

Employee Spending

The Rosemont Copper Project will employ between 350 and 480 people in Pima County throughout its 21-year life cycle, including mine workers, process workers, and general administrative

employees. Employee purchases in the local economy have an estimated impact of $21.7 million to $29.2 million on the county each year over the 21-year life of the project. This would reflect a total project impact of $576. 3 million for local Pima County businesses (Applied Economics 2011).

Vendor Spending

During the 21-year life cycle, the Rosemont Copper Project is projected to make between $90.4 million and $158.1 million in purchases from local vendors. Local vendors, in turn, support jobs and payrolls in Pima County. Local vendor purchases would generate $127.1 million to $225.2 million annually, or $3.6 billion over the life of the project. This activity would support about 770 to 1,500 jobs over the life of the mine (Applied Economics 2011).

Taxes and Revenues

Direct Revenue Impacts — The Rosemont Copper Project would generate direct tax revenues to State and local governments. Annual property taxes paid by the company are estimated at $3.5 million per year. Rosemont Copper is also subject to severance taxes in Arizona at an average of $2.8 million per year. Because of the shared distribution of severance taxes throughout the State (80 percent to the State general fund and 20 percent to counties and municipalities), the portion of severance taxes paid to Pima and Santa Cruz Counties and municipalities would only equate to a portion of the total severance taxes generated as a result of the mine (Marlow 2007).

They could also generate an estimated $11 million in one-time construction sales tax during the preproduction period. Total direct revenues over the life of the mine are estimated at $136.7 million. Revenue is based on copper being valued at $1.85 per pound (Applied Economics 2011).

Indirect Revenue Impacts — In addition to direct revenues, the direct and indirect employees supported by the project would yield an average of $4.7 million per year over the life of the project. This would be a total of $107.6 million for state and local governments over the life of the mine (Applied Economics 2011).

Property Value

Measuring the social costs of mining is challenging owing to the absence of quantitative values for social conditions. Estimating changes in property values is one approach to measuring social changes, as it reflects changes in structural attributes of homes and neighborhood quality. To date, there has been limited research completed on open-pit mining operations, especially in the southwestern United States. In order to assess potential impacts to property values, other open-pit mining studies and reported impacts from industrial sites, landfills, and large scale feed operations are discussed in the analysis of the Rosemont open-pit copper mine on property values.

Preproduction: Engineering and Construction — In general, construction activities associated with the mine are expected to have effects similar to those of operations. By changing the land use from an undeveloped setting with a recreation focus to an industrial one, changes in property values would likely begin as the changes to the landscape become apparent to local residents and visitors.

Production and Postproduction — As discussed in the “Community Values and Social Trends” part of this section, a shift from a rural, undeveloped landscape to a more industrialized landscape would negatively impact local residents who are seeking a rural residential community and, thus, could impact area property values.

The existence of an open-pit copper mine could result in negative impacts on values to neighboring properties from traffic, noise, degraded air quality, congestion, loss of natural open space, and alteration or obstruction of views (Kim and Harris 1996). In a study of how open-pit copper mines impacted property values in Green Valley, Arizona, Kim and Harris found that both dust pollution and viewshed degradation decreased property values "significantly." More specifically, the impact of dust pollution on property values was determined to be greater than that caused by viewshed degradation. The average property value decrease due to both of these factors was estimated to be $18,000 (in 1992 dollars) (Kim and Harris 1996). This would equate to approximately $27,600 in 2010. Although these values may not be directly applicable to impacts from the Rosemont Copper Project, the study highlights the potential for decreases in property values for homes in the vicinity of the mine that would experience dust pollution and viewshed degradation.

Further research indicates that the effect of industrial site presence on housing prices is only experienced within relatively short distances to the site. Houses within 0.15 mile of an industrial site are predicted to sell at 14.9 percent less than houses located 1.4 miles from an industrial site. Residential properties located greater than 0.6 mile from an industrial site were found to have no discernible change in property values (de Vor and H.L.F. de Groot 2009). Impacts to residential property values vary considerably, depending on the location, amenities, housing markets, and size of the industrial site, etc.

In terms of proximity to large-scale animal feeding operations, studies in Iowa have demonstrated that negative impacts to property values are experienced most acutely between 0 and 2.5 miles (Herriges et al. 2003; Kim et al. 2004; Ready and Abdalla 2003). Research (Kim et al. 2004) indicates that median property value decreases by 8 percent at 1 mile from the feeding operation.

Research on property value fluctuations from an operating landfill in Ohio indicates that properties within 1.25 miles declined significantly while the landfill was in operation, with decreases in value ranging from 5 to 15 percent, depending on distance from the landfill (Reichert 1997); the overall average impact for residential properties within 1 mile was a reduction of 12.5 percent. Similar research on proximity to landfills indicates that property value impacts are most significant at 0 to 2.5 miles from the landfill (Smolen et al. 1992).

Using these studies, 2 miles is the threshold for assessing which residential properties may experience a decrease in property value. Additionally, the largest value decrease noted in these studies was 15 percent in Ohio (Reichert 1997); thus, 15 percent is the threshold used for assessing changes in property value to the identified residential properties.

According to Pima County Assessor data, there are no single-family residences within 0.5 mile of the proposed mine; there is one single-family residence (not owned by Rosemont Copper) within 1 mile of the project area, and there are 13 single-family residences (not owned by Rosemont Copper) within 2 miles. Based on these data, as many as 13 residences could experience a reduction in property value (up to 15 percent) as a result of construction and operation of the mine.

It should be noted that previous research on nonrenewable energy development and property values has shown that declines in property values surrounding oil and gas drilling activities tended to rebound during initial phases of operation. Communities adjacent to oil and gas drilling activities in western Colorado reportedly endured a decline in property values upon announcement of drilling and during the initial stages of extraction. However, property values rebounded, at least partly, once production was underway (U.S. Department of Energy and Bureau of Land Management 2010). It is

uncertain whether decreases in well water were figured into the property value impacts analysis in this previous research. Property values would be less likely to rebound if domestic wells that supply the residential homes were impacts over the long term. Therefore, if any of the residences within the 2-mile radius of the project area experienced drawdown of their wells that would require modifications to wells to ensure water availability, it is unlikely that property values would rebound throughout the life of the mine.

Property values do have the potential to increase under conditions of moderate population growth and housing demand. In studies where expansion of the local employment occurred as a result of a new industrial facility operation, a positive impact on property values was found to be associated with an increase in the demand for local housing (U.S. Department of Energy and Bureau of Land Management 2010). However, the operation of the copper mine would be have little impact on housing demand, based on the existing housing vacancy rates and the small amount of workers anticipated to relocate to the area.

Analysis of the impacts of an open-pit gold mine in New Zealand indicated that that there could be a positive impact to property value from increased area employment opportunities (Gamby and Reid 2005). Additionally, research by Hand et al. (2008a; 2008b) indicates that proximity to forest resources positively influences property value; however, given the community values associated with the project area and vicinity, this seems unlikely.

Recreation and Tourism

Preproduction: Engineering and Construction — Area public lands are seen as important economic assets that support local and regional economic stability. The Coronado National Forest provides key environmental amenities that are important contributors to the recreation and tourism identity of the analysis area. Construction traffic, visual changes, and increased noise and dust may affect recreationists (see the “Recreation and Wilderness” section), and they may choose to stop recreating in the region. However, placing a number on the amount of visitors who would choose not to come to the area as a result of the mine would be speculative.

The extent to which visitor use and associated spending (i.e., off-highway vehicle use (see table 188), hunting and fishing (see table 189), or overall tourism industry output (see table 190)) would be displaced by the open-pit copper mine is difficult to predict and quantify (Marlow 2007). As reflected in the tables noted above, visitor spending contributes a substantial amount of money to the local economy on an annual basis. The total direct economic impacts from the tourism and outdoor recreation in Pima and Santa Cruz Counties totaled $2.95 billion in 2006. As a general comparison, if the proposed project displaced 1 percent of the tourism and outdoor recreation, the economic losses would be greater than the annual payroll of the proposed project during operations (Marlow 2007).

Tourism related output is based on visitor use and trip expenditures by recreationists and other visitors. As discussed in the “Recreation and Wilderness” section, the public would be displaced from 6,175 acres for usage over the life of the mine. Assigning value to this area is vital to an accurate assessment of costs associated with the construction of the project. Without an attempt to value this wilderness area, by default it is would be assigned a value of 0. According to Cordell et al., value for wilderness area can be estimated to be $34.50 per acre. This would put the annual loss for this recreational land at $213,037, or $5,325,937 over the life of the proposed mine.

Production and Postproduction — In the analysis area, particularly in the communities of Sonoita, Elgin, and Patagonia, there are numerous tourist destinations that rely almost exclusively on the

area's natural amenities; these include guest ranches, motels, and numerous wineries and bed-and-breakfast inns. These local destinations boast proximity to open spaces, scenic landscapes, and access to the Coronado National Forest for hiking, biking, etc.

As discussed in the "Recreation and Wilderness" section, area recreationists would be displaced from the project footprint for the life of the project. In addition to a direct loss of recreation opportunities, recreationists could be directly impacted as a result of the diminished recreation setting and loss of scenic landscapes, as well as noise and dust from equipment operation. Recreationists and area users are expected to avoid the mine and areas that are impacted visually or otherwise; however, they are not expected to stop recreating in the area altogether. As indicated in the "Engineering and Construction" part of this section, above, predicting how many recreationists or tourists would be displaced by the proposed action is not possible. But even the slightest decrease (1 percent) in recreation activity in the area would result in annual economic losses greater than the annual operative payroll for the proposed project (Marlow 2007).

Recreationists displaced from the project area could likely visit nearby areas such as Madera Canyon, Mount Wrightson, Las Cienegas National Conservation Area, and the remaining roads and trails within the area. Increased visitation in nearby recreation sites, such as south of Box Canyon Road, could lead to an increase in user conflicts (see the "Recreation and Wilderness" section).

Thus, although area communities rely on proximity to the Coronado National Forest and associated environmental amenities and operation of the mine would result in displaced recreationists at the mine footprint, numerous additional recreation opportunities exist in the region that tourists and recreationists are expected to visit. As a result, overall tourism industry output (see table 191) is not expected to change substantially during the production phase of the mine. Tourism related output is based on visitor use and trip expenditures by recreationists and other visitors. Tourism numbers could be affected negatively by the project, with people who chose to recreate in the area of the mine before and are now not offered that opportunity.

According to the "Dark Skies" analysis, there would be long-term, adverse impacts to dark sky visibility at the Whipple and Jarnac Observatories. Adverse impacts to these world-class astronomy research facilities would likely have long-term, adverse impacts on the economic contributions of the astronomy, planetary, and space sciences. As indicated in the "Recreation and Tourism" part of this section, above, the total economic impact (sales and output) of the research operations totaled $252.8 million dollars in Fiscal Year 2006. The total economic contributions are distributed between 30 observatories and related technology facilities, according to the Arizona Arts, Sciences, and Technology Academy (2007) report. Should the adverse impacts from the proposed mining construction and operation cause impairments or render the Whipple and/or Jarnac Observatories inoperable, the overall economic contributions to the State would decrease accordingly.

Quality of Life Conditions

Public Facilities and Services

Preproduction: Engineering and Construction — As previously discussed, 10 percent of the construction workforce (90 employees annually) are expected to relocate to the analysis area. Because of the number of housing vacancies in the analysis area, there would be adequate housing available for employees who may relocate. Because no new homes are expected, construction of the mine is not expected to result in an increased demand for public services. Current police, fire, medical, and educational facilities should be sufficient to handle mine construction, staffing, and expected population changes.

Production and Postproduction — As with the construction phase of the mine, 10 percent of the mine operation workforce is expected to relocate to the analysis area, resulting in an annual average increase of 45 employees into local communities. Because of the number of housing vacancies in the analysis area and the proximity to the Tucson metropolitan statistical area, there would be adequate housing available for employees who may relocate. Because no new homes are expected, operation of the mine is not expected to result in an increased demand for public services. Current police, fire, medical, and educational facilities should be sufficient to handle mine operation, staffing, and expected population changes.

The long-term operation of the copper mine has the potential to impact domestic wells in the residential neighborhood along Singing Valley Road west of State Route 83 and Hilton Ranch Road east of State Route 83. Groundwater drawdowns of 10 to 100 feet are likely in these areas, and water availability is likely to be impacted, although little is known about the characteristics of the domestic wells in these areas. Further, approximately 500 to 550 domestic or other production wells would be impacted with drawdowns over 10 feet. See the "Groundwater Quantity" section for more details on impacts to water quantity. There would likely be an increase in domestic and agricultural water pumping costs. In addition to increased economic costs of water delivery, local residents may be concerned about contamination of surface water and groundwater, wells drying up, increases in sediment loads in springs, and changes in aquifer recharge (Power 2010). The potential impacts could all produce economic and social costs. From a social perspective, without an adequate water supply local residents may experience uncertainty and discomfort in their current quality of life. From an economic perspective, costs could be "reflected in decrease tourism and outdoor recreation, increased water treatment requirements, increased domestic and agricultural water pumping costs" (Marlow 2007).

Transportation and Road Maintenance

Preproduction: Engineering and Construction — As stated in the "Transportation/Access" section, all action alternatives would increase the heavy-truck traffic, commercial deliveries, and daily commuter trips on State Road 83 during the construction phase. The increase in traffic would result in a lower level of service during construction, which means that commute times would be longer. However, all sections along State Road 83 and the four analyzed intersections would remain at acceptable levels of service. During construction, an average of 2.6 heavy trucks transporting equipment and construction materials would occur each day during the 18-month construction phase. Thus, local residents who use State Road 83 would experience more construction related traffic and longer commute times. Adverse traffic impacts could be mitigated through carpools and busing opportunities, as specified in the mitigation section of the "Transportation/Access" section.

Production and Postproduction — Mine operation is expected to increase traffic along State Route 83, particularly haul traffic. For instance, copper concentrate shipments would form the largest number of routine truck shipments, with approximately 56 round trips per day, 7 days per week. In general, passenger cars are considered to have no measurable impact to the service life of pavement or asphalt. Thus, traffic changes that could impact road maintenance are expected to come from haul traffic from the mine.

Experiments conducted starting in the 1950s by the American Association of State Highway and Transportation Officials have shown that heavily loaded trucks can do much more damage to road surface than a normal passenger car on a paved surface. As indicated in "Transportation/Access," haul trucks would increase along State Route 83 throughout the life of the project. This increase in heavily loaded trucks would likely increase maintenance needs along State Route 83, according to previous

experiments. However, as stated in the "Transportation/Access" section, baseline conditions of State Route 83 are not currently known, and damages resulting from the proposed action would be difficult to quantify because of the lack of baseline data. A mitigation measure, on behalf of Rosemont Copper, that could offset damages to road surfaces would be to conduct a baseline analysis of road conditions along State Route 83, as indicated in the "Transportation/Access" section.

Funding for maintenance costs on the section of State Route 83 from milepost 46 north to Interstate 10 required a total of $106,408.63 from October 2004 through October 2007. With increases in traffic, and specifically heavy-truck traffic, on this section of roadway throughout the life of the proposed project, maintenance costs would likely increase (Marlow 2007).

The Arizona Department of Transportation oversees road maintenance and provides funding for maintenance on all state highways. The Arizona Department of Transportation would be responsible for evaluating when maintenance would be required and determining how that maintenance would be funded. The fuel tax generated in the State of Arizona is disbursed to the Arizona Department of Transportation and funds road maintenance. The Arizona tax on gasoline is $0.18 per gallon for motor vehicle fuel and $0.26 per gallon for heavy trucks, vehicles over 26,000 pounds, and those that have two or more axles (Arizona Department of Transportation 2011c). Over the life of the project, the increases in project related vehicle traffic would result in an increase in fuel purchases. The increase in fuel tax generated as a result of the proposed project would lead to increased tax revenues and funding for road maintenance projects.

Further, as part of the proposed action, the Arizona Department of Transportation would require Rosemont Copper to complete an encroachment permit as they tie their access road into State Route 83. While Rosemont Copper will be legally required to make highway improvements within 1 mile of the tie-in point, further stipulations between the Arizona Department of Transportation and Rosemont Copper regarding road maintenance would be negotiated in the development of the encroachment permit.

In addition to road maintenance costs, other societal costs of motor vehicle transportation could be incurred as a result of the proposed project. While employees comminuting to and from work would generate direct expenses such as fuel, maintenance, insurance, and vehicle registration fees, increases in driving, in general, increase costs to society as a whole. These could include accidents, parking, waste disposal, air pollution (health costs, trees, and crops), increase in CO_2, traffic noise, and barrier effects on pedestrians and bicycles (Marlow 2007). These societal costs, estimated at $0.33 per mile, would amount to approximately $418,000 per year when considering the estimated weekly trips on State Route 83 and 24 yields approximately 1,267,969 vehicle miles traveled (Marlow 2007).

Community Values and Social Trends

Preproduction: Engineering and Construction — As previously discussed, residents and area communities have physical and emotional connections to lands on the Coronado National Forest and other public lands. People value proximity and access to the forest because of the recreation opportunities and natural amenities which enhance overall quality of life. Approximately 63 percent of the lands that surround the Tucson metropolitan area are public lands, and it is these lands that provide a foundation for the area's recreation and visitor economy and shape how local residents identify with the landscape. The public investment in the public lands that define the area is currently valued at $2.3 billon (Power 2010). Changes to the public lands that attract visitors and provide for an attractive quality of life for local residents would have the potential to decrease the public investment

value of the lands as well as the sense of place that these public lands provide to residents and visitors.

Residences closest to the proposed mine would likely notice negative impacts to their current quality of life. Landscape changes, mining related explosions and vibrations, increases in heavy-truck traffic, and nighttime light pollution would likely change the rural ambiance of the area (Power 2010). During the construction phase, traffic would increase along State Route 83 as crews are bused from staging areas along Interstate 10 to the north and Sonoita to the south (see the "Transportation/Access" section), which could result in longer commute times for residents traveling to or from area communities (i.e., Patagonia, Elgin, and Sonoita). Additionally, noise levels are expected to increase at residential receptor locations during the construction phase (see the "Noise" section for detailed information on receptor locations and analysis results), as construction noise is expected to be clearly audible. From a visual perspective, construction activity would increasingly change area landscape characteristics, landforms, and vegetation in the area as construction activities near completion (see the "Visual Resources" section); these changes would contribute to an overall change in the sense of place for members in nearby communities. The changes in the viewshed, from an undeveloped setting to an industrial facilities setting, has the potential to decrease the scenic quality of the area and adversely impact residents and visitors who value the undeveloped setting.

The shift from a rural, undeveloped landscape to a more industrialized landscape would negatively impact local residents who are seeking a rural residential community. Recreation experiences can contribute to a person's overall quality of life and/or shape their identity and self-perceptions. Individuals seeking solitude and a primitive recreation experience would be negatively impacted by the views and noise from construction activities.

Production and Postproduction — As with the preproduction phase, communities closest to the proposed mine would likely notice negative impacts to their current quality of life. Over the life of the mine, traffic would increase along State Route 83 as ore is hauled from the site and supplies are hauled to, and employees travel to, the site (see the "Transportation/Access" section). Similar to impacts during construction, these changes in traffic patterns could result in longer commute times for residents traveling to or from area communities (i.e., Patagonia, Elgin, and Sonoita). Additionally, many area residents and tourists treasure the experience of traveling through the landscape on State Route 83 and have expressed concern that additional mine traffic would impact enjoyment of this scenic route.

Similarly, negative changes to ambient noise levels (see the "Noise" section) and visual resources (see the "Visual Resources" section) are expected during mine operation, as described above for the preproduction phase. However, more so than during the construction phase, these changes in traffic, noise, and visual quality during mine operation could dramatically change community well-being and sense of place, particularly for those communities closest to the mine, such as Sonoita, Elgin, Patagonia, Sahuarita, and Corona de Tucson.

The amount of vehicle traffic would decrease during production and postproduction, compared with the construction phase of the mine. The change to the visual landscape would remain for the life of the project. Operation of the mine would result in a change in an individuals' identification with the area, as the mine would change the existing land use from one they have historically identified with to an industrialized land use. The long-term operation of the mine could lead to a change in the nearby communities' self-perception, from identifying with an area that is rural and moderately developed to identifying with a place shaped by industry and mining.

Residents move to the region because of the rural, undeveloped landscape, and a shift from this landscape expectation to a more industrialized landscape would negatively impact local residents who are seeking a rural residential community. Additionally, individuals seeking solitude and a primitive recreation experience would be negatively impacted by the views and noise from mine operation. People are drawn to the region to live, work, and play because of the region's natural amenities; a real or perceived decline in local environmental quality would likely impact community values and well-being, and could also reduce the demand for living in or visiting the area.

Social Benefits of Amenities on the Coronado National Forest

Preproduction: Engineering and Construction — People are drawn to the region to live, work, and play because of the region's natural amenities; a real or perceived decline in local environmental quality would likely impact community values and well-being. Thus, construction activities, as discussed above in the "Community Values and Social Trends" part of this section, would likely result in a negative impact to the social benefits people derive from the Coronado National Forest's natural amenities.

Production and Postproduction — Similarly, operation of the mine, as discussed above in the "Community Values and Social Trends" part of this section, would likely result in a negative impact to the social benefits people derive from the forest's natural amenities. The industrial nature of the long-term operation may adversely impact those residents of, and visitors to, the area who have previously identified with the area as an undeveloped, rural landscape. Those members of the community who have an adverse reaction to a change in their perceived quality of life may choose to move from the area. People who are seeking to relocate to a rural community, such as Sonoita or Elgin, may not be attracted to the area and could choose to live elsewhere.

Environmental Justice

As described in the "Environmental Justice" part of this section, above, there are three communities who have the potential to be disproportionately impacted by the proposed action or action alternatives. These potential environmental justice communities are Santa Cruz County, the San Xavier Pascua Yaqui Tribe, and the Tohono O'odham Nation. Santa Cruz County lies approximately 8 miles south of the project area, and the San Xavier Pascua Yaqui Tribe is located in Pima County approximately 20 miles northeast of the project area and south of Tucson. The Tohono O'odham Nation is located in Pima, Pinal, and Maricopa Counties and the main reservation is located approximately 45 northwest of the project area.

Under all action alternatives, impacts to environmental justice communities would be largely the same because the physical construction and long-term operation of the copper mine would create an opportunity that could induce disproportionately high and adverse impacts on human health and/or the environmental conditions of minority populations. For detailed differences between alternatives by resource, see the respective resource analyses in the "Environmental Consequences" parts of each resource section.

For many resources, potential adverse impacts resulting from the copper mine would be specific to the project area and would not affect potential environmental justice communities. These resources are geology, livestock grazing, paleontology, soils, dark skies, and vegetation. Resources that may be subject to adverse impacts as a result of the copper mine and that may have subsequent adverse impacts to environmental justice communities are as follows: air, climate, cultural resources, land use, noise, recreation, transportation, visual, and water resources. Consideration regarding whether

the action alternatives would result in a disproportionate impact to environmental justice communities was given to these resources, and a rationale has been provided in table 196.

Table 196. Potential environmental justice impacts common to all action alternatives

Resources	Adverse Impact/ Rationale	Disproportionate Impact—Rationale
Air	Yes	No—The potential effects on air quality due to emissions from the proposed action and Phased Tailings Alternative, in conjunction with nearby source emissions, are expected to result in predicted concentrations in Class I and II areas that are in compliance with the National Ambient Air Quality Standards (NAAQS) limits and would therefore not disproportionately impact environmental justice communities. However, the potential exists for PM_{10} concentrations at the project site to reach 97% of the PM_{10} NAAQS. Under the Barrel, Barrel Trail, and Scholefield-McCleary Alternatives, $PM_{2.5}$, PM_{10}, and NO_2 NAAQS standards would be exceeded at the perimeter fence but would dissipate prior to the Santa Cruz County border. Further, prevailing winds predominantly blow from west to east. Ambient air quality impacts would then be highest at the eastern and western perimeters of the project area.
Climate	Yes	No—Impacts not localized to environmental justice communities but to the region as a whole.
Cultural	Yes	Yes—Potential disturbance of ancestors buried within the project area would adversely impact members of the Tohono O'odham Nation.
Dark Skies	Yes	No—Impacts would not be localized to environmental justice communities but to the region as a whole.
Geology	No—Impacts limited to project area.	–
Hazardous Materials	No—Materials would be managed in accordance with laws and regulations within project area and transported to appropriate disposal sites.	–
Land Use	Yes	No—Impacts would be limited land uses within the project area.
Livestock Grazing	No—Impacts limited to project area.	–
Noise	Yes	No—Impacts from noise would not be experienced by environmental justice communities because the communities identified are not within an audible range of the project area. Noise from traffic along State Road 83 did not exceed unacceptable thresholds at monitoring site in Pima County, and impacts would be expected to be similar in Santa Cruz County.
Paleontology	No—Impacts limited to project area.	–
Recreation	Yes	No—Loss of acres for dispersed recreation would not be limited to environmental justice communities.

Resources	Adverse Impact/ Rationale	Disproportionate Impact—Rationale
Socioeconomics	Yes	No—Increases in tax revenues from the proposed project could result in beneficial economic impacts. The proposed project could result in an increase in direct and indirect employment opportunities for members of environmental justice communities, thus having a beneficial impact on the environmental justice communities. Adverse impacts to quality of life and community values would be experienced by not only by environmental justice communities but by other nonenvironmental justice communities living in close proximity to the project area and perhaps to a larger degree than the environmental justice communities living farther from the project area.
Soils	No—Impacts limited to project area.	–
Transportation	Yes	No—Increases in traffic would be concentrated along State Road 83 but would not reach an unacceptable level in Pima and Santa Cruz Counties. Further, increases in traffic along State Road 83 are not likely to impact tribal communities, who live northwest of the transportation routes.
Vegetation	No—Impacts limited to project area.	–
Visual	Yes	No—Project would not be directly visible from environmental justice communities.
Water Quality	No—Water quality impacts would meet standards.	–
Water Quantity	Yes	No—Wells that would experience drawdowns greater than 10 feet would not be located within environmental justice communities. East side domestic wells that are estimated to experience a drawdown of more than 100 feet would not extend past the Pima County line into Santa Cruz County. West side wells that would likely experience drawdowns of approximately 10 feet would not extend to the environmental justice communities to the northwest.
Wilderness	No—Impacts would be felt by all individuals who visit special designation areas and would not be specific to environmental justice communities.	–
Wildlife	No—Loss of wildlife habitat and movement corridors not directly connected to environmental justice communities because they are not dependent on wildlife.	–

As indicated in table 196, the only resource anticipated to have disproportionate adverse impacts on an environmental justice community is cultural resources. The “Cultural Resources” section indicates that during consultation with Native American Tribes, the Tohono O’odham Nation (an environmental justice community because of low-income and minority percentages) expressed concern over the potential disturbance of ancestors buried at the prehistoric and protohistoric habitation sites that are located in any of the action alternatives. Although the physical boundaries of the Tohono O’odham Nation reservation are not within the Rosemont Copper project area boundaries, disturbance of the sites would result in a disproportionate impact to the Tohono O’odham Nation,

given their historical connection to the land. Compliance with existing laws and regulations, including Section 106 of the National Historic Preservation Act and the Native American Graves Protection and Repatriation Act, may alleviate some of the adverse impacts to the Tohono O'odham Nation, to the point where the impacts would no longer be disproportionate to the community. However, given the known presence of ancestral villages, human remains, sacred sites, and traditional resource collecting areas and the expression that disturbance would cause spiritual harm to the earth and to the people present now and in the future, it is unlikely that compliance and/or mitigation would substantially relieve the disproportionality of the impacts to the Tohono O'odham Nation. These effects would also apply to the other consulting tribes with interests in the project area (see the "Consultation with Tribal Governments" part of the "Cultural Resources" section).

Cumulative Effects

The Council on Environmental Quality defines a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 Code of Federal Regulations 1508.7). As outlined in the chapter 3 introduction, cumulative impacts of past and present actions are identified and analyzed in the "Affected Environment" part of each resource section, including for "Socioeconomics and Environmental Justice." This cumulative effects discussion addresses the cumulative impacts of the action alternatives and any applicable reasonably foreseeable actions as identified on the Coronado ID team's list of reasonably foreseeable future actions, provided in the chapter 3 introduction. The following reasonably foreseeable actions from that list were determined to contribute to a cumulative impact to socioeconomic resources:

- Pima County Conservation Plan activities may include acquisition of archaeological and historical sites and traditional use sites for conservation and heritage education purposes, tours, monitoring, and other uses of sites by County staff and others
- Designation of the Santa Rita Mountains as a traditional cultural place
- Maintenance of Forest Service and private roads to support Rosemont grazing permits
- Sahuarita Road Phase II

In general, these future foreseeable activities that would have cumulative impacts include activities that would influence quality of life, specifically community values. These activities are expected to improve area quality of life by enhancing community values. That is, these activities would enhance the characteristics of communities in the analysis area that residents and visitors treasure. As such, cumulatively, these actions would result in a long-term, beneficial impact to local residents and visitors, and could help to offset the adverse direct and indirect impacts experienced by residents and visitors under the action alternatives (see the "Preproduction, Production, and Postproduction Impacts under the Social Benefits of Amenities on the Coronado National Forest" part of this section).

Mitigation Effectiveness

Mitigation for air quality, plants and animals, reclamation, recreation, transportation, and visual resources, as well as other offsite mitigation, is intended to mitigate the effects of each of these resources, but it also has the indirect effect of minimizing impacts to socioeconomics in terms of quality of life, and to a certain extent, environmental justice. For instance, a water source enhancement and mitigation plan will be prepared to offset the loss of surface water sources for

livestock and wildlife; this type of mitigation is applied to impacts to animals (see the "Biological Resources" section), but it also has the effect of reducing rural landscape impacts in terms of quality of life. See the "Mitigation Measures" section of chapter 2 for a full list of measures designed to reduce or eliminate environmental effects.

Irretrievable and Irreversible Commitment of Resources

There would be irretrievable socioeconomic impacts under all action alternatives because existing land uses, including recreation opportunities, would be precluded within the project area during the life of the copper mine. Adverse impacts from increases in nighttime lighting to dark skies would have irretrievable impacts on the observatories and related research and tourism. Upon termination and reclamation of the site, it is possible that these uses would return.

Mining is usually an irreversible use of land, particularly where extraction is from open-pit rather than underground mines (Crowson 2009). The action alternatives would potentially cause irreversible impacts to the affected area with regard to changes in the local landscape, community values, and quality of life. Disturbance to cultural resources that would disproportionately adversely impact the Tohono O'odham Nation, as an environmental justice community, would be irretrievable.
The Rosemont Copper Reclamation Plan could mitigate some of the potentially irreversible impacts to the project area, which could have impacts on socioeconomics. For example, relocating the Arizona National Scenic Trail may mitigate the adverse impacts to recreationists, but under all action alternatives, between 29 and 33 miles of Forest Service off-highway routes would be lost to recreation use indefinitely. As noted in the "Recreation and Wilderness" section, it would take decades or centuries before the project footprint is no longer apparent. The economic contributions from these users would also be lost for decades or centuries.