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Department of
Agriculture

Forest
Service

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DRAFT Environmental Assessment

Lowell Observatory's Discovery Channel Telescope

**Mogollon Rim Ranger District, Coconino National Forest
Coconino County, Arizona**

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CHAPTER 1. PURPOSE AND NEED

Document Structure

This Environmental Assessment (EA) has been prepared in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations. This EA discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action. The document is organized into six parts:

- **Purpose and Need:** This section includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- **Comparison of Alternatives:** This section provides a more detailed description of the agency's proposed action and discusses possible mitigation measures. A summary table of the environmental consequences associated with each alternative is presented in this section as well.
- **Affected Environment and Environmental Consequences:** This section describes the environmental effects of implementing the proposed action. This analysis is organized by resource area. Under each resource, the affected environment is described first, followed by the effects of the No Action Alternative that provides a baseline for evaluation and comparison of the following Action Alternative.
- **Consultation and Coordination:** This section provides a list of preparers and agencies consulted during the development of the environmental assessment.
- **Literature and Cited References**
- **Appendices:** The appendices provide more detailed information to support the analyses presented in the environmental assessment.

Documents included in the Lowell Observatory's Discovery Channel Telescope project record are identified by a document number and are referenced in this assessment by [PR #].

Background

Lowell Observatory, a privately owned astronomical research institution in Flagstaff, Arizona, was founded in 1894 by Boston mathematician Percival Lowell. For over a century, the observatory has been known worldwide as a leading astronomical research facility. Significant achievements made at Lowell include the discovery of Pluto, the first evidence of the expansion of the universe, and the rings of Uranus.

In September 2003, Lowell Observatory, in collaboration with Discovery Communications, Inc., submitted an application for a Special-Use Permit to the Mogollon Rim Ranger District of the Coconino National Forest build an operate a new observatory and 4-meter-class telescope. The proposed site of Lowell Observatory's Discovery Channel Telescope (DCT) is located on 35 acres of a partially mined cinder cone 0.5 mile northwest of the Happy Jack Ranger Station along Forest Highway 3 (FH3). Lowell Observatory has been conducting suitability tests on four different sites on national forest lands for more than two years. The test results proved the

Happy Jack site to be the most favorable, providing the optimal conditions for astronomical observation, nearby existing infrastructure, and use of previously disturbed land. The site has demonstrated astronomical performance at a level warranting the roughly \$30 million investment needed to complete the telescope.

Project Location

The proposed observatory project site is located approximately 40 miles southsoutheast of Flagstaff, Arizona in T16N, R9E, Section 29 of the Gila and Salt River Meridian. The project area is approximately 40 acres in size and is shown in Figures 1 and 2 at the end of Chapter 1.

Purpose and Need for Action

The purpose and need of this initiative is consistent with Lowell Observatory's stated mission:

- The need to pursue the study of astronomy, especially the study of our solar system and its evolution;
- The need to conduct research in astronomical phenomena; and
- The need to bring the results of astronomical research to the general public through education and outreach programs at the Lowell Visitor Center in Flagstaff.

When completed, Lowell Observatory's DCT project will facilitate dark sky astronomical research by constructing and operating a large state-of-the-art telescope and ancillary facilities at a favorable location. Some areas of discovery anticipated for the DCT are near-earth asteroids, extra-solar planets orbiting distant stars, and solar system exploration, including the Kuiper Belt.

Very few sites within the continental United States possess the characteristics that would justify the cost of building and operating a modern telescope. This site has demonstrated an extraordinary combination of astronomically related qualities, access to nearby existing infrastructure, and the ability to use previously disturbed land. The astronomical qualities include exceptionally clean unpolluted air, stable atmospheric conditions thousands of feet above the site, dark skies, and numerous clear nights. In addition, the proximity of a paved road, electrical power, and the opportunity to share facilities at the Happy Jack Ranger Station reduces the cost of development and disturbance of new land. This observatory has a wide ranging benefit to the public at large, both nationally and globally. Results of the research will expand the public's awareness and understanding of the universe in which they live and may have an affect on quality of life in ways we could not imagine. Because of the potential benefits nationally and globally, this project is considered an important use of federal lands.

Proposed Action

The action proposed by Coconino National Forest to meet the purpose and need consists of:

- Construction of an observatory that would house a 4-meter-class telescope.
- One 15,000-gallon water storage tank.

- One half mile of road reconstruction. Graveling the surface with native materials is initially planned.
- Approximately 500 feet of new road construction. Graveling the surface with native materials is initially planned.
- Approximately 1.0 mile of underground trenching for a powerline. A fiber optic link may be an additional possibility to facilitate communicating data to the Lowell Observatory in Flagstaff. If decided upon, it would be placed within the same trench as the powerline.
- Security fence installation around the observatory facilities. The fence would likely be 6 to 8-foot-high chainlink with a gate where you enter the facility.
- Removal of existing workshop, cook house, wash house, and barracks at the Happy Jack Ranger Station.
- The above buildings would be replaced with new construction of a shop (approximately 1500 square feet) and dormitory (approximately 2000 square feet), providing sleeping quarters for four, a kitchen, and a living area at the Happy Jack Ranger Station.

Implementation is expected to begin in late 2004 or early 2005 and be completed by November 2008.

Decision Framework

The Forest Supervisor of the Coconino National Forest is the deciding official for this project. The deciding official can choose the No Action Alternative or the Action Alternative and include any mitigation measures necessary.

Given the purpose and need, the deciding official reviews the proposed action and the other alternatives in order to make the following decisions:

- Select the No Action Alternative *or*
- Select the Action Alternative

Public Involvement

The proposal was first listed in the Schedule of Proposed Actions in April 2004 [PR 42]. The proposal was provided to the public and other agencies in a scoping letter requesting comment from January 22, 2004 to February 20, 2004 [PR 32]. The scoping letter was sent to approximately 969 individuals and organizations on the project mailing list, which is available at the Mogollon Rim Ranger District in the Lowell Observatory's DCT project record [PR 33]. Comments generated through scoping are also available in the project record in summary form [PR 39] and as original responses [PR 40]. Of the 108 comments received, there were 31 no comments, 53 positive comments, 23 neutral comments, and one negative comment. Of the individuals that did comment most were requesting clarification of various aspects of the project which have been addressed in this EA.

Issues

Significant issues are defined as those directly or indirectly caused by implementing the proposed action and typically result in the creation of additional alternatives. Non-significant

issues were identified as those: (1) outside the scope of the proposed action; (2) already decided by law, regulation, Forest Plan, or other higher level decision not to be significant; (3) irrelevant to the decision to be made; or (4) conjectural and not supported by scientific or factual evidence. The Council for Environmental Quality (CEQ) NEPA regulations requires this delineation in Sec. 1501.7, "...identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)..." A list of non-significant issues and reasons regarding their categorization as non-significant may be found at the Mogollon Rim Ranger District in the Lowell Observatory's DCT project record [PR 41].

No significant issues were raised during the public comment period that would generate additional alternatives.

Applicable Laws and Executive Orders

Shown below is a partial list of federal laws and executive orders pertaining to project-specific planning and environmental analysis on federal lands. Disclosures and findings required by these laws and orders are contained in Chapter 3 of this analysis.

Multiple-Use Sustained-Yield Act of 1960
National Historic Preservation Act of 1966 (as amended)
Wild and Scenic Rivers Act of 1968, amended 1986
National Environmental Policy Act (NEPA) of 1969 (as amended)
Clean Air Act of 1970 (as amended)
Endangered Species Act (ESA) of 1973 (as amended)
Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974 (as amended)
National Forest Management Act (NFMA) of 1976 (as amended)
Clean Water Act of 1977 (as amended)
American Indian Religious Freedom Act of 1978
Archeological Resource Protection Act of 1980
Executive Order 11593 (cultural resources)
Executive Order 11988 (floodplains)
Executive Order 11990 (wetlands)
Executive Order 12898 (environmental justice)
Executive Order 12962 (aquatic systems and recreational fisheries)
Executive Order 13186 Jan. 11, 2001 (Migratory Bird Treaty Act)

Forest Plan Consistency

This action responds to the goals and objectives outlined in the Coconino National Forest Land and Resource Management Plan (Forest Plan), as amended, and helps move the project area towards desired conditions described in that plan (Coconino National Forest Plan 1987) [PR 7].

The Forest Plan establishes goals and objectives for multiple-use and sustained-yield management of renewable resources without impairment of the productivity of the land. The Forest Plan contains Forest-wide Standards and Guidelines for special-use management, which applies to authorizations such as the proposed action. A Special-Use Permit would be required to implement the proposed action. Forest-wide Standards and Guidelines are used in directing

management activities for the project area, as well as Management Area Standards and Guidelines. A Management Area (MA) is defined as “an area that has common direction throughout and that differs from neighboring areas” (Coconino National Forest Plan 1987).

The project area lies within MA 3. The Forest Plan defines MA 3 as ponderosa pine and mixed coniferous forest on slopes less than 40%. Management emphasis for MA 3, as outlined in the Forest Plan, focuses on dispersed and developed recreation, visual quality, wildlife habitat including travel corridors, off-road driving restrictions, fuel treatment, and watershed condition (Coconino National Forest Plan 1987). Consistency with the management directives for MA 3 would be required for issuance of the Special-Use Permit and subsequent implementation of the proposed action. Current analysis indicates that management guidelines defined in the Forest Plan for MA 3 can be easily met in all areas with exception of visual quality [PR 8]. Therefore a site-specific variance from the Forest Plan would need to be part of the decision if the Action Alternative is chosen.

Applicable Legal and Regulatory Requirements and Coordination _____

Legal Requirements

No further NEPA analysis is needed. Further environmental reports are necessary, including a Biological Assessment (BA) for the Mexican Spotted Owl, Biological Assessment and Evaluation (BA&E), and Cultural Resources Inventory Report. These documents must be completed before any decision is made.

Coordination Requirements

Stipulations for coordination of implementation activities will be specified in the BA, BA&E, Cultural Resources Inventory Report, and Best Management Practices for soil and water conservation.

Project Record Availability _____

Additional documentation is in the project record located at the Mogollon Rim Ranger District office. These records are available for public review pursuant to any limitations in the Freedom of Information Act (5 U.S.C. 552). Copies of the EA are available at the Mogollon Rim Ranger District and on the Internet at the following addresses:

Mogollon Rim Ranger District
HC 31 Box 300
Happy Jack, AZ 86024
(928) 477-2255

www.fs.fed.us/r3/coconino/nepa/index.shtml

For information, contact Carol J. Holland at the above address or by email at cjholland@fs.fed.us.

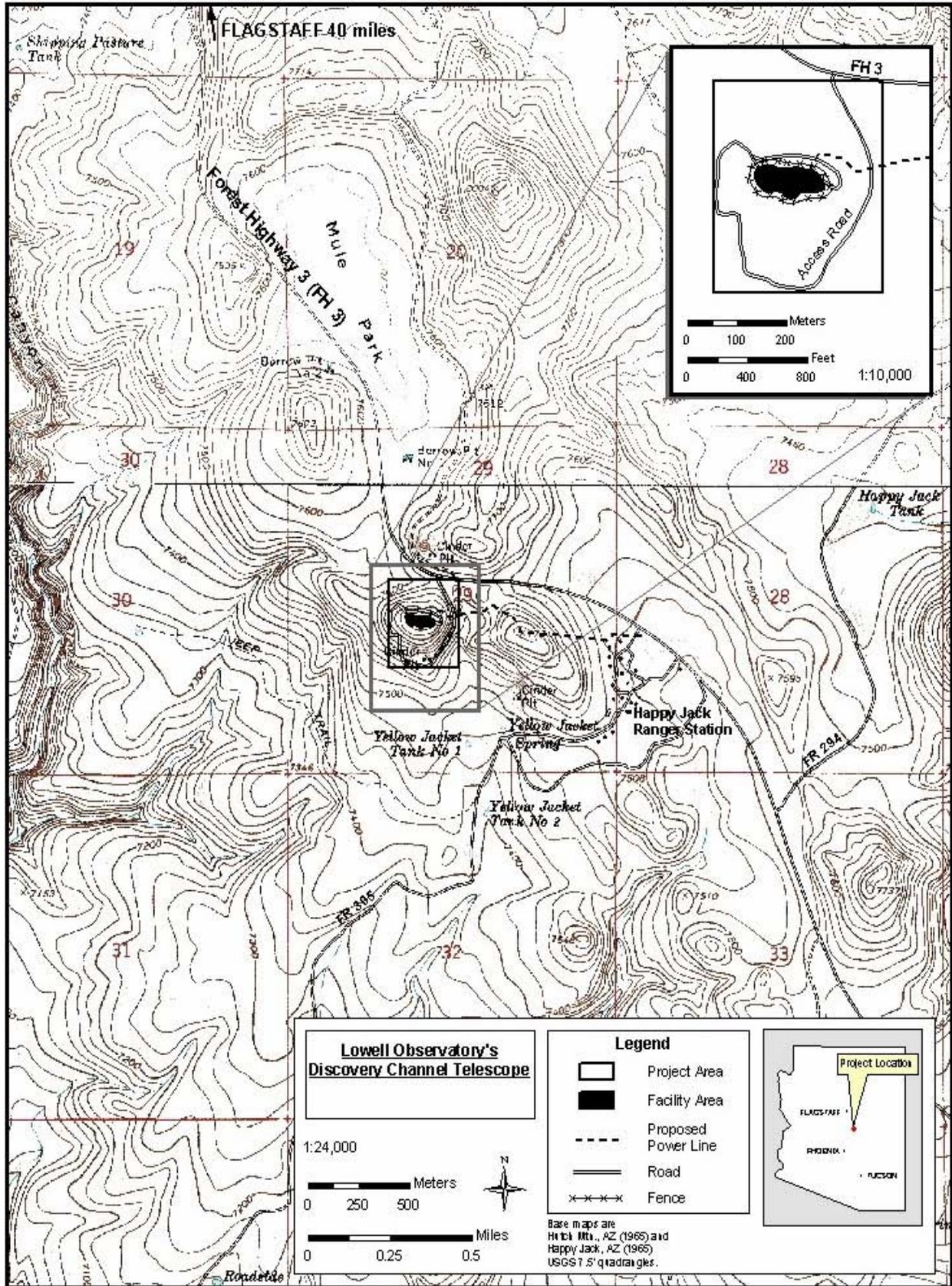


Figure 1. Project Plan and Proposed Associated Features

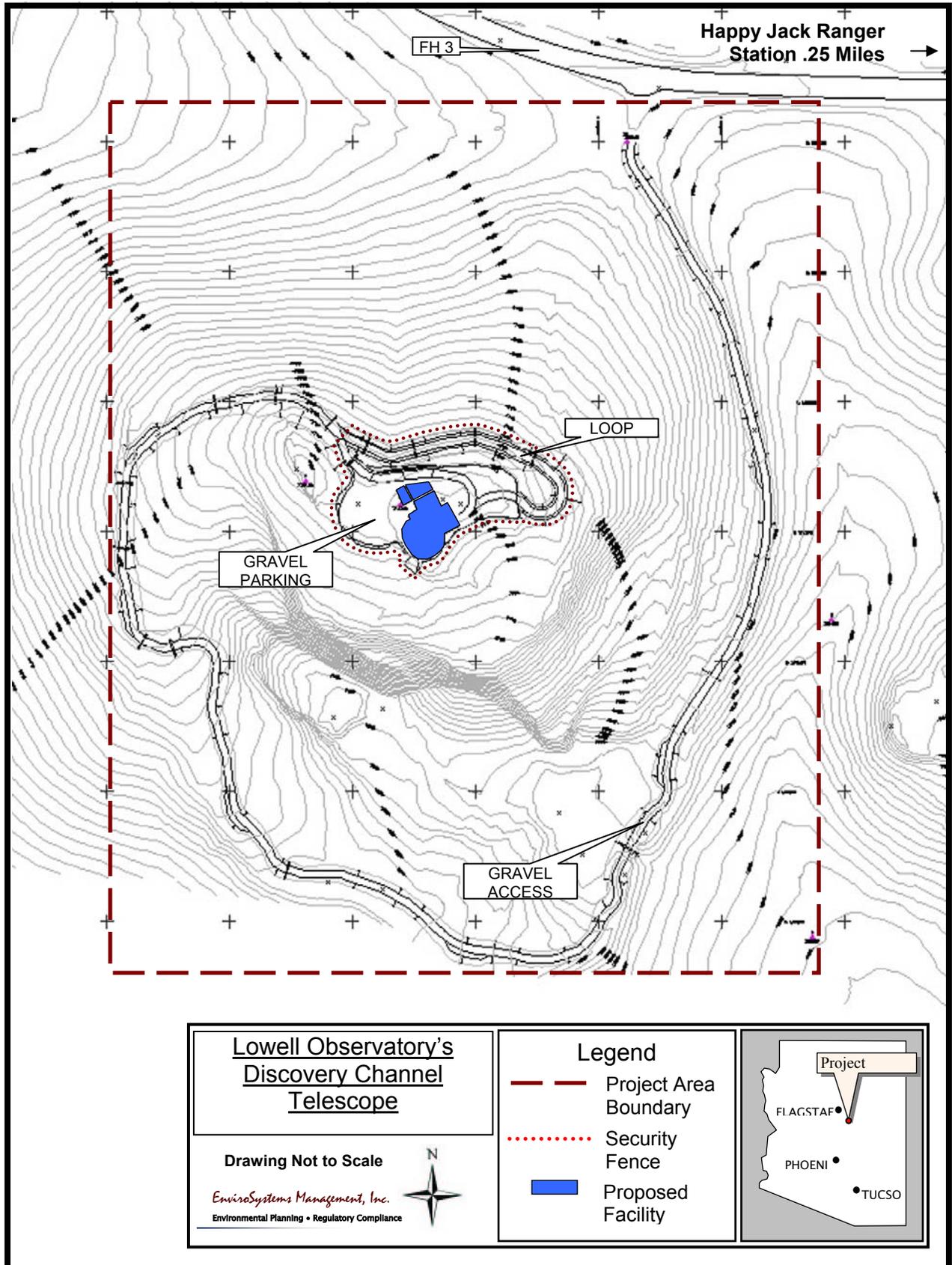


Figure 2. Site Plan

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CHAPTER 2. COMPARISON OF ALTERNATIVES

This chapter describes and compares the alternatives considered for the Lowell Observatory's DCT project. It includes a description of each alternative considered. This section also presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public.

Alternatives

Alternative 1: No Action

The No Action alternative is required by the National Environmental Policy Act (NEPA) and provides a baseline with which to compare any proposed activities. Under the no action alternative the proposal would be withdrawn and the observatory would not be built.

Alternative 2: The Proposed Action

The Proposed Action alternative consists of the following:

- Construction of an observatory that would house a 4-meter-class telescope.
- One 15,000-gallon water storage tank.
- One half mile of road reconstruction. Graveling the surface with native materials is initially planned.
- Approximately 500 feet of new road construction. Graveling the surface with native materials is initially planned.
- Approximately 1.0 mile of underground trenching for a powerline. A fiber optic link may be an additional possibility to facilitate communicating data to the Lowell Observatory in Flagstaff. If decided upon, it would be placed within the same trench as the powerline.
- Security fence installation around the observatory facilities. The fence would likely be 6 to 8-foot-high chainlink with a gate where you enter the facility.
- Removal of existing workshop, cook house, wash house, and barracks at the Happy Jack Ranger Station.
- The above buildings would be replaced with new construction of a shop (approximately 1500 square feet) and dormitory (approximately 2000 square feet), providing sleeping quarters for four, a kitchen, and a living area at the Happy Jack Ranger Station.

Access Road

The proposed access road circumnavigates the site to the south around the existing cinder pit. This road does not currently provide access to the summit where the proposed facility would be located. Approximately 500 feet of clearing would be required to complete access to the facility site. The grade of this existing access road is approximately 10% and therefore requires only a small amount of earth-moving to produce an acceptable use grade. The width of the road would be approximately 12 feet with 6 pull-offs planned to aid large equipment in negotiating turns.

The southern exposure of this road offers fairly rapid snowmelt. The road is approximately 0.5 mile in length from the entrance gate at FH3. A loop road is provided at the telescope facility, which allows trucks delivering components and materials to depart the facility without turning around. The perimeter defined by this loop road and the top of the quarry pit edge where the cinders were mined away would be protected by a fence which would provide both security for the facility and prevent access to the cinder pit by observatory personnel or the public.

Powerline

The proposed powerline route extends from the existing poles at the Happy Jack Ranger Station, up to a Forest Service radio tower site, then along a two-track road to the telescope site. The powerline would be buried for most of its length except where it ascends the cinder cone. Approximately three to four poles would be placed up the slope from the existing access road to the facility site.

Replacement of Facilities at the Happy Jack Ranger Station

Existing workshop, cook house, wash house, and barracks at the Happy Jack Ranger Station would be removed. These older facilities would be replaced with new construction of a shop (approximately 1500 square feet) and dormitory (approximately 2000 square feet), providing sleeping quarters for four, a kitchen, and a living area.

Alternatives Considered but Eliminated from Detailed Study _____

During development of the proposed action, there were other alternatives considered that were not carried forward. Alternative selections were considered for the site location, access road, and powerline route.

Site Location Alternatives

The search for potential sites for Lowell Observatory's DCT began about 10 years ago. The objective was to find a site location farther away from the growing city of Flagstaff and at a higher elevation than Lowell Observatory's current site on Anderson Mesa 15 miles east southeast of Flagstaff. Sites throughout the entire Colorado Plateau were considered based on both topography and location. Actual testing of sites was performed on a number of sites north and east of the San Francisco Mountain, as well as high points southeast of Flagstaff. Potential sites were studied from the standpoint of feasibility of access and perceived long-term vulnerability to light pollution. No private site was identified which would make a suitable site for an astronomical observatory within a reasonable distance of Flagstaff. For this reason, Forest Service lands were considered the only viable option.

In the summer of 2001, image quality measurements were made at three of the more promising sites—Saddle Mountain (northwest of the San Francisco Mountain), Hutch Mountain (southeast of Mormon Lake), and the proposed Happy Jack site. Simultaneous measurements were made with identical equipment at the current Anderson Mesa site. These measurements showed that the Happy Jack site provided the best image quality of the potential three sites and was consistently superior to the Anderson Mesa site in this regard. The attractiveness of this location

was further enhanced by the presence of a paved highway and commercial power adjacent to the site. Because of this, the Saddle Mountain and Hutch Mountain sites were eliminated from further analysis.

Access Road Alternative

The alternate access road considered would have used an existing access road [PR 28]. This existing road makes a nearly direct ascent from the access gate at FH3 and ascends the northeast face of the hill. The current road is too steep for heavy equipment access (in excess of 15 degrees) and therefore the route would have to be modified by traversing the hill to reduce the maximum grade to 10%. This would result in the use of retaining walls and cutbanks to provide a level road surface. The advantage of this road is that it is much shorter and could be paved within the budget for the observatory. However, it does have northern exposure, and there was concern that it could be adversely affected by snow and ice accumulation. In addition, as it traversed the face of the hill toward FH3, it would be more visible from FH3 than the chosen longer road. Because of these reasons this alternate access route was eliminated from further analysis.

Powerline Route Alternatives

Two alternate powerline routes were considered in consultation with Arizona Public Service (APS) [PR 28]. Both routes would have come from the north to link up with an existing APS line crossing FH3. One of these routes would have followed FH3 for approximately 200 yards, turned southwest on an existing skid road, then headed southeast on an existing numbered Forest Road, and proceeded approximately 0.3 mile heading straight up the side of the telescope cinder cone to the summit. The second northern powerline route considered would have paralleled FH3 for most of its length before cutting up to the telescope site. These two alternate powerline routes were longer in length, would cause greater disturbance, and were subsequently more expensive than the proposed route. Because of this, these alternative routes were eliminated from further analysis.

Comparison of Alternatives

A comparison of the ability of each alternative to address the purpose and need of the project is presented in Table 1.

Table 1. Objective Accomplishments by Alternative for the Lowell Observatory's Discovery Channel Telescope Project

Objective	Alternative 1: No Action	Alternative 2: Proposed Action
To pursue the study of astronomy, especially the study of our solar system and its evolution	Use of existing facilities available to Lowell researchers would continue and may limit the ability to collect data to achieve this objective	Objective would be more fully realized through implementation
To conduct research in astronomical phenomena	Same as above	Same as above
To bring the results of astronomical research to the general public through education and outreach programs at the Lowell Visitor Center in Flagstaff	Same as above	Same as above

Mitigation Measures

Mitigation measures were developed to reduce, avoid, and/or compensate for the potential impacts the proposed activities may cause. The mitigation measures are applied to the action alternative and are displayed in Table 2.

In addition to specific mitigation measures prescribed for the action alternative, all management activities implemented are required to follow Forest Plan Standards and Guidelines, Best Management Practices (BMPs) and any other Forest Service Policies.

In Table 2, the **Effectiveness** column is included to give the reader an idea of how well these mitigation measures work based on past experiences and/or research. The numbers correspond to the following results:

1. Almost always reduces impacts significantly. Almost always done in this situation.
2. Usually reduces significant impacts. Often done in this situation.
3. Effectiveness monitoring will be conducted during project implementation & other appropriate times.

Table 2. Mitigation Measures Required for Action Alternative

#	Why	Mitigation	Effectiveness
Heritage Resources			
HR1	Minimize impacts to existing archeological sites	If previously undocumented prehistoric or historic archaeological sites are encountered during the course of the project, these sites will be avoided and reported to the District or Forest Archaeologist.	1
Invasive Plants			
IP1	Minimize weed spread or introduction of invasive plants	Use only certified weed free seed and weed free mulch to re-vegetate and rehabilitate areas.	2
IP2	Minimize weed spread	Vehicles and equipment that are driven through or parked in a weed infested area must be sprayed each time that vehicle leaves the area. Map wash sites within the project area for future monitoring of weed infestations.	2
IP3	Minimize weed spread	All construction vehicles and equipment must be sprayed before coming onto NFS lands. A high-pressure hose will be used to clear the undercarriage, tire treads, grill, radiator, and beds of any mud, dirt, and plant parts that may potentially spread the seeds or viable parts of noxious plants.	2
IP4	Minimize weed spread	Parking and staging must occur within the cinder pit proper where the area has already been disturbed.	2
IP5	Minimize weed spread	The use of off-site fill materials in the project area is discouraged. Utilize excavated substrate from on-site whenever fill substrate is needed. If on-site substrate is used, and if it contains weed seed, this soil should not be part of the top three inches of soil. Instead, weed-free soil will be used in the top three inches. Fill material cannot come from a source infested with noxious weeds.	2

#	Why	Mitigation	Effectiveness
IP6	Minimize weed spread	Water used for dust abatement and other construction activities should be obtained from a source free of noxious plant seeds.	2
Soil and Water			
SW1	Reduce concentration of water runoff, thus minimizing soil detachment & sediment transport	Install silt fences on the downhill side of construction site to trap sediments created on-site.	1
SW2	Reduce concentration of water runoff, thus minimizing soil detachment & sediment transport	Install drainage structures in roads to reduce concentration of water runoff. Road drainages shall direct flow into stable areas of vegetation or rock rip rap.	1
SW3	Minimize sediment delivery into drainage	If needed, gravel and/or install erosion structures on roads, where activities cross drainages. (24.25, 41.14, 41.15, 41.2, 41.26) ¹	1
SW4	Minimize soil erosion	Seed slopes and mulch where necessary. Seed and mulch slopes near drainages. (41.12, 25.18, FP Travel-4)	1
SW5	Avoid soil movement	Revegetate slopes within the project area less than 3:1 slope with certified weed free native seed. Recommended seed mix is Arizona fescue, western wheat grass, and squirrel tail (5lbs to the acre) (41.16,41.27,41.28,25.18,41.5).	1
SW6	Minimize soil detachment, and sediment transport	Install rock rip-rap energy dissipaters on drainage outlets of roads	2
SW7	Minimize soil compaction, soil detachment & sediment transport. To maintain long-term soil productivity.	Schedule operations, construction and ditch/road maintenance activities during periods when probabilities for rain and runoff are low. Equipment shall not be operated when ground conditions are such that unacceptable soil compaction or displacement results.	
SW8	Comply with state and Federal water quality standards by minimizing soil erosion through the stabilizing influence of vegetation ground cover	Storm water Pollution Protection Plans will be required of all contractors prior to beginning construction on any portion of the project that will disturb existing native soils and/or vegetation.	2

¹ Number of BMP from FSH 2509.22

#	Why	Mitigation	Effectiveness
Visual Quality			
VQ1	Minimize visual quality impacts	Paint sides of outbuildings at the observatory site with non-reflective neutral paint, as feasible.	3
VQ2	Minimize visual quality impacts	Retain native vegetation in the form of shrubs and/or trees along perimeter of outbuildings and parking lot to screen viewing of structures from FH3.	3

CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This section summarizes the physical, biological, social and economic environments of the affected project area and the potential changes to those environments due to implementation of the alternatives. It also presents the scientific and analytical basis for the comparison of alternatives presented in Chapter 2.

Past, Present, and Reasonably Foreseeable Future Activities_____

Depending on the resource, activities considered in analysis may vary. Tables 3 and 4 display a general list of past, present, and reasonably foreseeable future activities within the project area.

Table 3. List of Past and Present Actions in the Lowell Observatory's Discovery Channel Telescope Project Area and Vicinity

Project Name or Action	Type of Activity
Development of cinder pit materials	Mining of cinders for Forest Service road surfacing. Three cinder pits involved. The existing cinder pit at the proposed site, cinder pit behind the Happy Jack Ranger Station, and the cinder pit just east of FH3 across from the proposed observatory site.
Happy Jack Timber Sale	1995—Harvesting of timber
Hutch-Boondock Timber Sale	1997—Harvesting of timber
Happy Jack Timber Salvage	2003—Harvesting of dead and dying timber adjacent to the Happy Jack Ranger Station.
Telephone and Fiber Optic Lines	1996—The trenching and laying of telephone and fiber optics for the ranger station.
Yavapai County Special-Use Permit	1996—Early detection flood control device for precipitation monitoring.
NRCS Special-Use Permit	2000—Precipitation monitoring devices. Snow Course.
Happy Jack Wildland Urban Interface EA	2000—Thinning and prescribed burning around the Happy Jack Ranger Station to reduce hazardous fuels.
Rural Development	On-going. The development of the Mule Park area with homes, wildlife tanks, and other outbuildings.
Mule Park Land Exchange	2000—The exchange of approximately 270 acres of private land in three parcels within the Mogollon Rim Ranger District of the Coconino National Forest for approximately 198 acres of Federal lands on the same district.

Table 4. List of Reasonably Foreseeable Future Actions Expected in the Lowell Observatory's Discovery Channel Telescope Project Area

Project Name or Action	Type of Activity
Rural Development	On-going. The development of the Mule Park area with homes, wildlife tanks, and other out buildings.
Commercial Development	Possible development of small-scale commercial enterprise(s).

Air Quality

Affected Environment

The project area occurs within the Little Colorado Airshed as defined by the Arizona Department of Environmental Quality (ADEQ). The ADEQ classifies the project area and vicinity as a Class II airshed currently attaining air quality compliance. There are no Class I or non-attainment areas within 15 miles of the project site. Lands designated as Class I areas are afforded the highest level of protection from air pollutants and consist of national wildernesses, parks, and wildlife refuges. A non-attainment area has recorded violations of the federal health standards for ambient air quality.

Environmental Consequences

Alternative 1: No Action

Under the no action alternative, no construction would occur at the project site and no impacts to air quality would result from any of the ground disturbing activities in the proposed action.

Alternative 2: Proposed Action

Impacts to air quality under the proposed action would consist of short-term construction-related impacts from road reconstruction; clearing of the site for the observatory, water tank and other associated structures; powerline trenching; and security fence installation. The impacts to air quality from fugitive dust would be confined to a relatively small area and could easily be mitigated through regular watering of the site during construction particularly during earthmoving activities.

Removal of the structures at the Happy Jack Ranger Station would likely result in only minor local and temporary impacts to air quality. Most of this site is developed and little new earthmoving activities would be required for removal. Construction of the new shop and dormitory at Happy Jack will likely not result in any impacts to local air quality.

Impacts to air quality from implementation of Alternative 2 would not occur on a regional basis and would not cause the project area to violate ambient air quality standards as enforced by ADEQ. Implementation of Alternative 2 would result in no long-term impacts to air quality.

Cumulative Effects

Alternative 1: No Action

Implementation of Alternative 1, along with past, present and reasonably foreseeable actions, would have no cumulative effects on air quality.

Alternative 2: Proposed Action

Since the impacts to air quality will be short-term and can be mitigated, implementation of Alternative 2, along with past, present and reasonably foreseeable actions, would have no cumulative effects on air quality.

Environmental Justice

Affected Environment

During the scoping process, the Forest Service considered whether the proposed action in this geographic area would potentially affect any low income, minority populations or Indian tribes. A scoping letter was sent out to potentially affected Native American tribes asking for input. Social, economic, and environmental impacts of the project were considered and it was determined that none of the alternatives considered in this analysis would have a disproportionate impact on any minority population in the immediate area, within the surrounding counties, or in the Northern Arizona region at large.

Heritage Resources

Affected Environment

As no prehistoric materials were observed within the project area, this brief overview deals only with Euroamerican settlement of the Happy Jack area. In the early 1900's, the Forest Service established the Long Valley Ranger District. In the mid 1940's and early 1950's the timber industry began playing a major role in the local economy. In 1947, Southwest Forest Industries established a permanent logging camp across from the ranger station; the camp became known as Happy Jack and the Ranger station became known as the Happy Jack Ranger Station. Today, the Happy Jack area relies more on tourism and recreation than timber.

A site file search of Coconino National Forest records at the Flagstaff Supervisor's Office on November 7, 2003 revealed that the project area had been previously surveyed in part in 1990 by Coconino National Forest personnel for the existing materials pit (Gratz 1980, Pilles 1985 and Boston 1997) [PR 2, 6 and 18]. No historic properties were found during the 1990 survey. Several linear surveys were also shown to have cut across the proposed powerline route. The closest site to the project area is the Happy Jack Ranger Station complex. The facilities at the Happy Jack Ranger Station to be removed as part of the proposed action, specifically the workshop, cook house, wash house, and barracks, have been evaluated as to their National Register of Historic Places (NRHP) eligibility. These facilities are being recommended by the Coconino National Forest as ineligible for inclusion on the NRHP, and the forest is currently seeking State Historic Preservation Office concurrence regarding the buildings (Martine 2004) [PR 53]. The determination of ineligibility for these structures is primarily due to their lack of historic integrity. The facilities have either been moved from their original locations and/or heavily modified and modernized.

On November 29, 2003, and February 16, 2004, a cultural resources survey of 39.8 acres of the proposed telescope site and powerline was conducted. Survey revealed one isolated historic feature and no historic properties (Lane and Neal 2004) [PR 52].

The isolated feature consists of two large, rectilinear rock piles. Both rock piles measure 5 m NE-SW by 2 m NW-SE. The piles are 5.5 m apart and lie in a NW-SE line. The northernmost rock pile is 0.8 m high and contains two burned pieces of saw-cut (possibly chain saw-cut) milled lumber in direct association with the pile. One of the lumber fragments is a 4" × 4" post; the other fragment is a wooden plank. A church key-opened Coors flat-top can (likely dating to the 1950s, according to Goodman [1998]) is located just 1.5 m southeast of the northeast end of the pile. The southernmost pile is deflated, has a maximum height of 0.45 m, and is associated with a rotten milled post and wooden plank fragments. A cut section of twisted cable (possibly guy wire), and a five-gallon pail with no lid and an intact handle (likely dating to the 1950s) that contains a smashed older coffee pot with a soldered handle seam and pour spout (likely dating to the 1910s-1920s) were located near the southern rock pile. The surface around the rock piles is covered with duff and leaves; however, the depth of the features is expected to be limited due to the age and generally shallow soil depth in the immediate area. The site likely dates to the 1950s, and may have served as a log-piling site where logging crews stored cut timber on the rock platforms before transport (Kristen Martine, District Archaeologist, personal communication, February 10, 2004) [PR 49].

Environmental Consequences

Alternative 1: No Action

There are no NRHP-eligible historic properties within the project area; therefore, no impacts to cultural resources will result from implementation of Alternative 1. The ineligible isolated feature will likewise not be impacted by the no action alternative.

Alternative 2: Proposed Action

Since the workshop, cook house, wash house, and barracks at the Happy Jack Ranger Station are likely to be ineligible for inclusion on the National Register, removal of these facilities will not result in impacts to historic properties. Likewise, the isolated feature is not considered eligible to the National Register, and additionally, it occurs outside the area of impact and will not be affected by the proposed action. Construction-related activities associated with development of the observatory site, road reconstruction and construction, powerline trenching, and fence installation will not result in impacts to cultural resources. There are no eligible cultural resources within the project area; therefore, no impacts to cultural resources will result from implementation of Alternative 2. However, if previously undocumented prehistoric or historic archaeological sites are encountered during the course of the project, these sites will be avoided and reported to the District or Forest Archaeologist.

Cumulative Effects

Alternative 1: No Action

Implementation of Alternative 1, along with past, present and reasonably foreseeable actions, would have no cumulative effects on heritage resources.

Alternative 2: Proposed Action

Implementation of Alternative 2, along with past, present and reasonably foreseeable actions, would have no cumulative effects on heritage resources.

Range

Affected Environment

The project lies in the extreme northeast corner of the Beaver Creek Allotment on the Mogollon Rim Ranger District. The Beaver Creek Allotment covers approximately 63,263 acres and lies in a west-to-east configuration across the District. The allotment covers a diverse ecological area from the low desertscrub country near Verde Valley up to the ponderosa pine habitat on the Colorado Plateau. Because of this, the Bar D Cattle Company, LLC has been allowed to graze their cattle on a year-long basis, wintering cattle in the lower elevations and grazing in the higher elevations come spring and summer. Cattle have access to and graze outside the cinder pit where there is adequate feed; however, it is unclear how much cattle utilize the very top of the cinder cone (although there is not currently evidence of their presence). Because of the adverse grade to the top, it is unlikely that cattle make the effort to climb the hill to feed when they can stay on lower slopes where there is better forage.

Environmental Consequences

Alternative 1: No Action

Under the no action alternative none of the actions items will occur. Status quo will be maintained. Grazing capacity and permitted numbers of cattle will not be affected. Cattle would continue to have access to the project area and specifically the cinder knoll for grazing.

Alternative 2: Proposed Action

Under the proposed action the observatory and telescope, 15,000-gallon water storage tank, and road construction from FH3 to the top of the cinder cone would occur. The top of the knoll will have a security fence surrounding the facilities. By virtue of the fence, approximately 4 acres of land would be eliminated from the grazing allotment permit. These four acres are not considered to be in prime grazing land and are therefore considered to be insignificant when compared to the total allotment acreage of 63,263 acres.

Under the proposed action there would be approximately 1.0 mile of underground trenching for the powerline. Cattle are curious by nature and it is conceivable that construction noise and

activity may attract some cattle to the area. Normally, during the trenching process, the trench is open only for a short period of time and is quickly backfilled. It is noteworthy that cattle could fall into the trench if they are in the vicinity. The trenching crew will be made aware of the proximity of cattle in the area when the trenching is being planned, and appropriate safety and protection measures will be taken.

Under Alternative 2, there would be removal of the existing workshop, cookhouse, washhouse, and barracks and the subsequent replacement of those same buildings within the fenced compound known as the Happy Jack Ranger Station. Cattle have always been and will continue to be excluded from grazing within the Administrative Site. The status quo would be maintained.

Cumulative Effects

Alternative 1: No Action

Implementation of Alternative 1, along with past, present and reasonably foreseeable actions, would have no cumulative effects relative to range lands and any permitted activity.

Alternative 2: Proposed Action

Implementation of Alternative 2, along with past, present and reasonably foreseeable actions, would have no cumulative effects relative to range lands and any permitted activity.

Recreation

Affected Environment

The Coconino National Forest offers a wide range of dispersed recreation opportunities. FH3 provides a great deal of access to forest resources for camping, hiking, horseback riding, bicycling, hunting, and off highway vehicle (OHV) use. FH3 and other forest roads in the area receive heavy use particularly during summer months. Most of the private lands in the project vicinity have been developed by individuals for second/seasonal homes. No developed forest trails occur in the area. The project site does not provide any other recreational opportunities than may be found in abundance in other areas in the immediate vicinity. In fact, the previous use of the site for quarry materials has resulted in making the site less desirable for recreational use and may pose issues to public safety due to the steep and unstable exposed side of the abandoned quarry operation. The existing access roads do not connect with other forest roads in the area other than the two-track road leading to the Forest Service radio tower adjacent to the site that continues east to the Happy Jack Ranger Station. The Apache Maid Lookout Tower occurs on top of Apache Maid Mountain to the west. The Apache Maid Mountain area is accessible and does receive dispersed recreational use.

Environmental Consequences

Alternative 1: No Action

No impacts to recreational use of the area will result through implementation of the no action alternative. Under this alternative, the observatory would not be constructed and the recreational resources of the area would remain unchanged.

Alternative 2: Proposed Action

No impacts to recreational opportunities will result from construction of the observatory or through improvements to the Happy Jack Ranger Station. The observatory will not be open to the public; however, information obtained from research conducted at the observatory will be made available to the public through education programs offered at Lowell Observatory in Flagstaff. This may result in a greater beneficial educational experience for visitors to Lowell Observatory. There will be no negative impacts to recreational opportunities from implementation of Alternative 2.

Cumulative Effects

Alternative 1: No Action

Implementation of Alternative 1, along with past, present and reasonably foreseeable actions, would have no cumulative effects relative to recreation.

Alternative 2: Proposed Action

Implementation of Alternative 2, along with past, present and reasonably foreseeable actions, would have no cumulative effects relative to recreation.

Socioeconomic

Affected Environment

The socioeconomic environment of the project area and vicinity includes Forest Service personnel working at the Happy Jack Ranger Station and private individuals with seasonal homes in the area. Private land ownership in the vicinity is low and there is no commercial development for several miles. There are residential developments such as Mule Park 0.5 mile to the north and Double Cabin approximately 4 miles to the north. These residential developments are mostly summer homes and are not occupied year round. The closest year-round residences are approximately 15 miles away at the village of Mormon Lake.

Concern was raised regarding lighting restrictions that may be imposed around observatory facilities and the potential to restrict commercial and residential development. Coconino County Zoning Ordinance *Section 17: Lighting* addresses lighting guidelines in relation to observatories. Three Lighting Zones are defined within this ordinance from most restrictive to least and are described as follows:

- Zone I: all area within Coconino County located within 2.5 miles of the following locations:
 - a. The Hall telescope at Lowell Observatory on Anderson Mesa

- b. The Kaj Strand telescope at the U.S. Naval Observatory
 - c. Roden Crater
- Zone II: all areas within Coconino County more than 2.5 miles yet less than 7 miles from the locations listed above.
 - Zone III: all other areas within Coconino County.

Environmental Consequences

Alternative 1: No Action

Under the no action alternative there would be no change to the current socioeconomic environment of the project area and vicinity.

Alternative 2: Proposed Action

Under the proposed action alternative, increased employment opportunities will be made available during construction of the observatory facilities, road improvements, fencing and removal and construction of buildings at the Happy Jack Ranger Station. The cost of implementing the proposed action is estimated at \$30 million. It is anticipated that some dollars would be going into the local economy of Flagstaff and surrounding communities in northern Arizona for construction and related services and materials; however, the amount of dollars going in to the local economy is unknown at this time. Long-term employment opportunities will be available to observatory research staff. Additionally, the Happy Jack Ranger Station will receive new shop facilities to be equally shared with the Forest Service. Therefore, impacts to socioeconomics as a result of implementation of Alternative 2 are generally positive.

At this time, Lowell Observatory would have to submit an application to invoke the Zone I lighting restrictions around the new observatory facility. Lighting associated with current development in the area would be "grandfathered" and would not be affected if Lowell did apply for and was granted the Zone I lighting restrictions. Zone I imposes restrictions that are attainable for typical residential development yet, may be too restrictive for commercial development. Zone II is much less restrictive and includes the City of Flagstaff. Zone III is the least restrictive. Currently there is no private, commercially-zoned property within the 2.5-mile buffer around the proposed observatory site and therefore no restriction to potential commercial development is anticipated, even in the event that Lowell Observatory applied for and was granted the Zone I lighting restrictions.

Cumulative Effects

Alternative 1: No Action

Implementation of Alternative 1, along with past, present and reasonably foreseeable actions, would have no cumulative effects relative to the socioeconomic environment.

Alternative 2: Proposed Action

There are no other developments of this size and scope currently planned in the project vicinity in the foreseeable future. Impacts to the socioeconomics of the area will not be cumulatively affected by implementation of the proposed project in relation to any other planned action. Therefore, implementation of Alternative 2, along with past, present and reasonably foreseeable actions, would have no cumulative effects relative to the socioeconomic environment.

Soils and Water

Affected Environment

The project site consists of a cinder cone overlaying basalt bedrock. Soils in the project area are described by the Terrestrial Ecosystem Survey (TES) for the Coconino National Forest (Miller 1995) [PR16] and the bulk of the project area lies within TES Unit 565. The erosion hazard for this map unit has been rated as severe since these soils are subject to damage (compaction, puddling and displacement) when wet. These problems can be mitigated or avoided by restricting ground-disturbing activities to periods when the soils are dry. The natural regeneration potential for the project area soils is high.

Principal soil series are the Anthony, Broliar, Siesta, Sponseller, and Springerville series. The most abundant series occurring in the project area is the Springerville series. This series consists of moderately deep, well-drained soils on the Coconino Plateau. The slope ranges from level to steep, and the topography from smooth and undulating to rough. These soils derived from the weathering of basalt and cinders (Hendricks 1985) [PR 5].

The project site lies within the Beaver Creek Watershed. The center of the watershed is about 80 km (50 miles) south of Flagstaff, Arizona, in Coconino and Yavapai counties and encompasses 275,000 acres on the Coconino National Forest. It is located upstream from the junction of Beaver Creek and the Verde River in north-central Arizona. General drainage of the watershed is towards the southwest, and Dry Beaver Creek and Wet Beaver Creek are the two major streams draining the basin (<http://ag.arizona.edu/OALS/watershed/beaver/>) [PR 44]. No developed drainages occur on site, and storm water runoff is minimal.

Environmental Consequences

Alternative 1: No Action

Under the no action alternative, the current soil and water conditions associated with the project site would remain unchanged. The steep slopes of the abandoned quarry operation will continue to be subject to erosion as evidenced by rills and gullies on site.

Alternative 2: Proposed Action

Under the proposed action, negative effects to soil and water quality from storm water runoff will increase as a result of the earthmoving activities associated with land clearing for the observatory site, road reconstruction and construction, trenching for the underground powerline

and installation of the security fence. In addition, the removal and rebuildidnign of structures at the Happy Jack Ranger Station will also have some minor impacts to soil and water resources. The effects of all the proposed activities are all localized and will be mitigated through the implementation of site-specific Best Management Practices (BMPs).

During construction activities, effects will be minimized be employing erosion control and energy dissipation devices which will stabilize the site during construction. Site specific BMPs are listed below and can be found in the mitigation measures section in Chapter 2 and in Appendix A. With the implementation of these site specific BMPs, it is expected that there will be no negative effects to soil and water resources will result from implementation of Alternative 2.

- Install silt fences on the downhill side of construction site to trap sediments created on-site.
- Install drainage structures in roads to reduce concentration of water runoff. Road drainages shall direct flow into stable areas of vegetation or rock rip rap.
- If needed, gravel and/or install erosion control structures on roads, where activities cross drainages.
- Seed and mulch where necessary. Seed and mulch slopes near drainages.
- Install rock rip-rap energy dissipaters on drainage outlets of roads.
- Revegetate slopes within the project area less than 3:1 slope with certified weed free native seed. Recommended seed mix is Arizona fescue, western wheat grass, and squirrel tail (5lbs to the acre).
- Schedule operations, construction and ditch/road maintenance activities during periods when probabilities for rain and runoff are low. Equipment shall not be operated when ground conditions are such that unacceptable soil compaction or displacement results.
- Storm Water Pollution Protection Plans will be required of all contractors prior to beginning construction on any portion of the project that will disturb existing native soils and vegetation.

Cumulative Effects

Alternative 1: No Action

Implementation of Alternative 1, along with past, present and reasonably foreseeable actions, would have no cumulative effects relative to soils and water.

Alternative 2: Proposed Action

There are no other earthmoving-related developments being planned in the project vicinity in the foreseeable future that would result in significant cumulative effects to soil and water. In addition, implementation of BMPs and other construction planning activities will effectively reduce the potential negative effects from construction of the proposed action to pre-construction levels. Therefore, implementation of Alternative 2, along with past, present and reasonably foreseeable actions, would have no cumulative effects relative to soils and water.

Transportation

Affected Environment

FH3 (Lake Mary Road) provides the only paved access to the project site. FH3 is a Forest Service road maintained by the Coconino County Public Works Department. The highway is classified as a major collector road by the County, which is designed to accommodate from 500 to 10,000 annual average daily trips. Coconino County conducted traffic counts on FH3 in 2000. The following information presents the annual average daily trip counts at specific locations along FH3 obtained by the County (Dale Wegner, County Engineer, Coconino County, personal communication, May 3, 2004) [PR 49]:

Flagstaff City Limits: 2265
South of Lower Lake Mary: 1494
Happy Jack Ranger Station: 677
Clints Well: 866

There are four unnumbered dirt roads that take off from FH3 towards the cinder knoll. These roads are unimproved two-track roads. The first road turns abruptly to the west after leaving FH3 and follows the base of the cinder cone and dead ends. A second road climbs the cinder cone on the northern aspect perpendicular to the slope. This road is gated prohibiting access to the top of the knoll. The third road follows the base of the cinder cone on its east aspect and dead ends in the cinder pit. There was a time when this road continued to climb around the knoll on the south and west aspect, dead-ending on the west side. This portion of the road is closed due to advanced ponderosa pine regeneration now occupying the site. A fourth road immediately turns east and leads to the Forest Service radio tower on the adjacent hill.

A Roads Analysis Report is required on all projects that have road construction/reconstruction, road decommissioning, change in maintenance levels or if road access is changed as a result of a proposed action. The Roads Analysis Report can be found in the project record [PR 47].

Environmental Consequences

Alternative 1: No Action

The no action alternative will not result in increases to traffic volume on FH3 and there will be no change to the existing road system within the project area

Alternative 2: Proposed Action

The proposed action will result in increases of approximately 10 trips per day by construction vehicles and equipment during the height of construction activities, which will be concentrated during the construction season of April through October for four construction seasons. Operation of the observatory facility will require two to four trips per day for researchers and observatory maintenance staff (Marianna de Kock, Facilities Engineer, Lowell Observatory, personal communication, May 16, 2004) [PR 49].

The increase in traffic posed by construction and operation of the facility is minor and well below the design criteria threshold for the major collector road classification. During construction, signage will be placed on FH3 notifying travelers of heavy equipment entering and leaving the area. No changes in traffic patterns are anticipated.

Under the proposed action, approximately 0.5 mile of the old road that is currently closed due to advanced ponderosa pine regeneration will be reconstructed and surfaced with native gravel. Approximately 500 feet of new road construction will be completed on this same road extending the road up to the top of the cinder cone. This new construction will also be surfaced with native gravel.

Cumulative Effects

Alternative 1: No Action

Implementation of Alternative 1, along with past, present and reasonably foreseeable actions, would have no cumulative effects relative to transportation.

Alternative 2: Proposed Action

There are no construction projects utilizing heavy equipment currently planned or expected in the near future in the project vicinity. No other development in the region is planned that would result in significantly higher numbers of travelers than would result from implementation of the proposed action. Implementation of Alternative 2, along with past, present and reasonably foreseeable actions, would have no cumulative effects relative to transportation.

Vegetation

Affected Environment

Elevation of the project area ranges from 7,500 to 7,750 feet at the summit of the cinder cone and is within the Petran Montane Conifer Forest vegetation community (Brown 1994) [PR 15]. The project area lies within MA 3. The Forest Plan defines MA 3 as ponderosa pine and mixed coniferous forest on slopes less than 40% (Coconino National Forest Plan 1987) [PR 8]. The project area is characterized as a ponderosa pine (*Pinus ponderosa*) forest. Vegetation on the top of the cinder cone and the southern portion of the cone was disturbed during quarry activities. The most heavily disturbed areas of the quarry are nearly void of vegetation. The ponderosa pine on the disturbed slopes leading to the top and at the top of the cone are typically <12 inches diameter-at-breast-height (dbh), although a few mature trees still remain. The undisturbed sides of the cinder hill consist of a mature ponderosa pine forest with some Gambel oak (*Quercus gambelii*) understory. Overstory canopy cover in undisturbed areas is about 30%. The slopes of the cinder cone show evidence of a mostly low intensity burn, resulting from a prescribed fire carried out in the fall of 2002 (Debra McGuinn, District Biologist, personal communication, April 5, 2004) [PR 49].

Common understory plants are *Lupinus argenteus*, *Lathyrus* sp., *Vicia* sp., *Carex geophila*, *Thalictrum fendleri*, *Chenopodium graveolens*, and *Erigeron flagellaris*. The face of the pit and

other disturbed portions of the site are dominated by *Pericome caudate* and *Vicia pulchella*, with a smattering of weedy species at the bottom of the pit, including *Cirsium vulgare*, *Convolvulus arvensis*, *Verbascum thapsus*, and *Sisymbrium altissimum*. The east portion of the proposed powerline crosses a meadow dominated by grasses and sedges, with some ponderosa pine and stands of Gambel oak. Other plants in the meadow include *Potentilla hippiana*, *Iris missouriensis*, *Achillea millefolium*, *Rosa woodsii*, and *Eriogonum racemosum*. No perennial streams, wetlands, or riparian areas exist in the project area.

The vegetation along the existing powerline corridor from the Happy Jack Ranger Station to the Forest Service radio tower is occupied by a few ponderosa pine saplings and Gambel oak clumps. The two-track road leading from the Forest Service tower to the project site is not vegetated. The Happy Jack Ranger Station is an open park area surrounded by mature ponderosa pine.

Invasive plant species in the project area were also evaluated. The Coconino National Forest ranks invasive plants as Class A, B, and C. Class A plants receive the highest priority and management emphasis is complete eradication. Class B species receive second highest priority. Management emphasis is to contain the spread, decrease population size, and eventually eliminate the infestation. Class C species receive the lowest priority; management emphasis is to contain spread to present population size or to decrease the population (Phillips et al. 1998) [PR 20]. Results of the invasive weed survey of the project area and powerline corridor are presented below.

Table 5. Invasive Weed Species Observed During Surveys in Project Area

Class	Scientific Name	Common Name	Objective	Relative Abundance in Project Area
A	<i>Chrysanthemum leucanthemum</i>	Oxeye daisy	Eradicate	One plant on north side of cinder cone – pulled up and removed by surveyor
B	<i>Cirsium vulgare</i>	Bull thistle	Contain/control	One plant in pit
B	<i>Linaria dalmatica</i>	Dalmatian toadflax	Contain/control	Small population near FH3
C	<i>Bromus tectorum</i>	Cheatgrass	Contain	Throughout the project area
C	<i>Bromus rubens</i>	Red brome	Contain	Small population near cinder pit entrance
C	<i>Verbascum thapsus</i>	Common mullein	Contain	Small amount in pit

Environmental Consequences

Alternative 1: No Action

Under the no action alternative, the vegetation communities associated with the project site would remain unchanged.

Alternative 2: Proposed Action

Under Alternative 2, vegetation of the construction site will be modified. Development of the top of the cinder cone for the observatory facilities will result in removal of some ponderosa pine. Large ponderosa pine (>12 inches dbh) and Gambel oak will be avoided whenever possible. The reconstruction (widening) and construction of the road for the final ascent to the observatory

facility site will result in the removal of several small (<12 inches dbh) and sapling ponderosa trees. Trenching for the powerline installation will result in removal of small ponderosa pine and some clumps of Gambel oak. Much of the construction activities will be confined to areas that have been previously disturbed; therefore, the effects to vegetation are minimal. No significant impacts to vegetation will occur as a result of implementation of Alternative 2.

Spreading of invasive plant species may increase from implementation of Alternative 2. The increased transport of noxious weed seed may increase from the soil-disturbing nature of the proposed construction, fence and powerline installation activities and the increased concentration of equipment entering and leaving the project area. The one plant of *Chrysanthemum leucanthemum* has been removed from the project area. The *Cirsium vulgare* plant and small population of *Linaria dalmatica* should also be removed to reduce the chance of spreading. Any other individuals of these species occurring in the project area in the future should also be removed, if possible. Otherwise, the following standard mitigation measures will be implemented to limit the potential spread of invasive species.

- Use only certified weed free seed and weed free mulch to re-vegetate and rehabilitate areas.
- Vehicles and equipment that are driven through or parked in a weed infested area must be sprayed each time that vehicle leaves the area. Map wash sites within the project area for future monitoring of weed infestations.
- All construction vehicles and equipment must be sprayed before coming onto NFS lands. A high-pressure hose will be used to clear the undercarriage, tire treads, grill, radiator, and beds of any mud, dirt, and plant parts that may potentially spread the seeds or viable parts of noxious plants.
- Parking and staging must occur within the cinder pit proper where the area has already been disturbed.
- The use of off-site fill materials in the project area is discouraged. Utilize excavated substrate from on-site whenever fill substrate is needed. If on-site substrate is used, and if it contains weed seed, this soil should not be part of the top three inches of soil. Instead, weed-free soil will be used in the top three inches. Fill material cannot come from a source infested with noxious weeds.
- Water used for dust abatement and other construction activities should be obtained from a source free of noxious plant seeds.

Cumulative Effects

Alternative 1: No Action

Implementation of Alternative 1, along with past, present and reasonably foreseeable actions, would have no cumulative effects relative to vegetation. There are no cumulative effects associated with the no action alternative relative to vegetation and invasive plants.

Alternative 2: Proposed Action

There are no other vegetation clearing-related developments being planned in the project vicinity in the foreseeable future that would result in significant cumulative effects to the area's

vegetation community. No other similar projects in the project vicinity are planned that would cumulatively effect the spread of invasive plants. Therefore, implementation of Alternative 2, along with past, present and reasonably foreseeable actions, would have no cumulative effects relative to vegetation and invasive plants.

Visual Quality

Affected Environment

The project area lies within the *Flagstaff* character type, and is typical of landscapes within the type (USDA Forest Service 1974) [PR 1]. The project site is atop a rocky basalt knob typical of the area, overlooking a portion of the Mogollon Rim to the southwest with a clear view of the San Francisco Mountains 35 miles north. Views to the north and east (as well as the ultimate visibility of the proposed observatory) are screened by the slightly higher elevations of Hutch Mountain and Pine Mountain. The southwest quadrant of the hill below the project site was removed for surfacing material several years ago and ponderosa pine saplings have grown in around the margins of the remaining rock pit. The pit has been partially rehabilitated but the obvious evidence of pit development activities reduces the visual quality of the immediate pit area to *maximum modification*, one level below the minimum allowed for this specific area under the terms of the Coconino National Forest Plan (USDA Forest Service 1974 and Coconino National Forest Plan 1987) [PR 1 and PR 8]. The rock pit is not visible from FH3 and is screened from views to the north and east by topography. The tree canopy surrounding the rock pit shields it from view from the south and west as well, except for portions of the northeast wall of the rock pit that might be barely visible to a careful observer using binoculars from Interstate 17; 12 to 15 miles away.

Environmental Consequences

Alternative 1: No Action

No changes in the current visual quality of the site will immediately result from the no action alternative.

Alternative 2: Proposed Action

The Forest Plan base map for scenic resources shows that the proposed observatory building sits very close to, if not on, the visual quality objective (VQO) boundary between objectives of modification (M) and retention (R), depending on whether the proposed building is within the foreground view of the adjacent FH3 [PR 9]. The definition of foreground is within 0.5 mile of the viewer unless obscured by topography (Forest Service policy is to conduct both seen area inventory and analysis with topography only as though no trees were present, a policy that recognizes the somewhat ephemeral nature of vegetation). Figure 3 shows the area visible from the maximum height of the proposed dome (87.5 ft. above the floor elevation) and conversely shows the surrounding areas from which the dome will be visible or will be screened by topography. Figure 3 indicates that the proposed observatory may be seen by FH3 travelers as they drive south on FH3 through Mule Park and as they approach and pass the observatory site

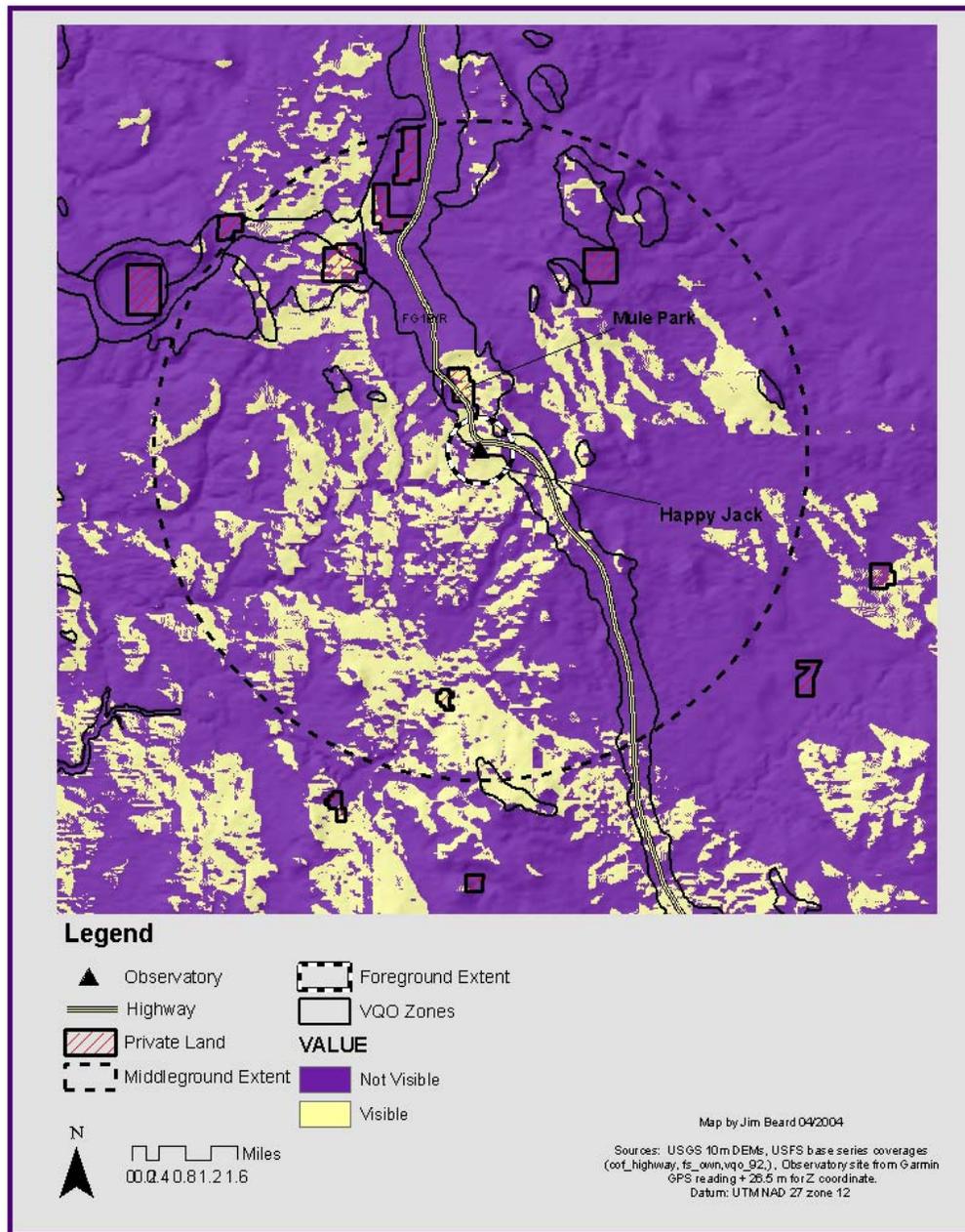


Figure 3. Visual Assessment

from both directions. The observatory would also be visible from private land in Mule Park and Pratt Park.

The proposed building site is well within 0.5 mile of FH3 and even though the rock pit is screened from the highway by topography, the observatory building would not be (again assuming no trees are present) and so would need to meet standards for a R VQO in order to meet the basic requirements of the Forest Plan. An R VQO requires that all aspects of site development be indistinguishable to the casual observer. Without tree cover, the 87.5 foot tall white observatory dome would be clearly visible to travelers along FH3 as well as to others using

the forest near this major travel corridor and would at best meet standards for a maximum modification (MM) VQO if no mitigating features softened the visual features of the facility. The shape, size, and color of the observatory dome are dictated by rigid scientific requirements.

A MM VQO allows facilities to visually dominate the site and surrounding view-shed but still borrow from adjacent natural features for some aspect of scale, line, form, texture or color that serves to soften the contrast between the facility and the adjacent natural appearing landscape. The dome shape, white color, prominent position in the landscape, and proximity to a popular scenic drive combine to lower the rating of this facility against Forest scenic standards. The scale of the proposed building is similar to the ridge top rock forms, and the building height is only slightly higher than adjacent trees making the facility fall within the basic standards of a maximum modification VQO. A MM VQO falls well below the “one level downward” deviation allowed for specific reasons defined in the Forest Plan and is actually three levels below an R VQO. Implementation of Alternative 2 will require a site-specific variance to the VQO standards in order to document deviation from Forest scenic quality standards.

The ponderosa pine forest surrounding the proposed site will partially screen the proposed building from most views; though glimpses of the dome from FH3 will be visible to travelers intermittently through the trees or from open fields from some of the locations shown as “visible” in Figure 3. The adjacent forest canopy, assuming it stays largely intact over time, will greatly reduce the scenic impact of the facility. The relation of the facility to the overall FH3 alignment minimizes the duration of focal views of the facility for motorists.

Figure 4 presents a visual simulation of the site following construction of the observatory. The simulation demonstrates how the proposed observatory will visually dominate the original characteristic landscape, thereby supporting the reclassification of the site to a MM VQO.



Figure 4. Visual Simulation of Lowell Observatory's DCT

Figure 5 depicts Lowell's Anderson Mesa Observatory and the US Naval Observatory when viewed from a distance of 11 and 22 miles, respectively. This photo illustrates the appearance of the observatory viewed from "background" (greater than 5 miles) distances typical of views of the proposed observatory from Interstate 17 (12 to 15 miles away). It demonstrates how resolution by the human eye diminishes considerably with distance.



Figure 5. Lowell's Anderson Mesa Observatory and US Naval Observatory when viewed from a distance of 11 and 22 miles, respectively.

Efforts to reduce visual effects of the proposed project may include:

- Painting the sides of outbuildings at the observatory site with non-reflective neutral paint, as feasible.
- Planting native shrubs and/or trees along perimeter of outbuildings and parking lot to screen viewing of structures from FH3.

Cumulative Effects

Alternative 1: No Action

Implementation of Alternative 1, along with past, present and reasonably foreseeable actions, would have no cumulative effects relative to visual quality. There are no cumulative effects associated with Alternative 1 relative to visual quality.

Alternative 2: Proposed Action

There are no other projects that would have impacts to visual quality planned in the area in the foreseeable future. No other site-specific variances changing visual quality objectives for any area in the project region are currently being considered or are proposed in the near future. Therefore, there are no cumulative effects associated with Alternative 2 relative to visual quality.

Wildlife

Affected Environment

The wildlife of the project area consists of those species typical of a ponderosa pine forest ecosystem. Wildlife species are integral components of the ecosystems that comprise the project area and surrounding environs. Common species of the project region include elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), Abert's squirrel (*Scuirus aberti*), eastern cottontail (*Sylvilagus floridanus holzeri*), Merriam's turkey (*Meleagris gallopavo merriami*), and pygmy nuthatch (*Sitta pygmaea*). The project area provides summer range for elk, deer, and turkey. A few snags and some downed wood are located within the project area. Many species of birds use snags for breeding, nesting, and foraging sites. Downed wood is used by rodents, which serve as a prey base for many wildlife species. Cover includes all forms of vegetation and any physical entities such as brush piles, fallen logs, snags, tree cavities and rock piles/formations. Cover is utilized by animals to shelter their young, avoid detection from predators, and for protection against weather extremes. The quality of cover offered in the project area ranges from low in disturbed areas to moderate in the natural areas. There are no perennial waters or wetlands within the project boundaries. The following discussion focuses on the affected environment for threatened, endangered, Forest Service sensitive species, migratory birds, and management indicator species.

Threatened and Endangered Species

The U.S. Fish and Wildlife Service (USFWS) lists 27 threatened, endangered or candidate species or species with conservation agreements as potentially occurring within Coconino County. Of the 27 species, two threatened species were identified during habitat evaluations of the project area and powerline corridor as having potentially suitable habitat in the project area and vicinity: the Mexican spotted owl (MSO) and the bald eagle (winter habitat only) (see Table 6). Additionally, the USFWS has proposed 13.5 million acres to be designated as critical habitat for the MSO in Arizona, Colorado, New Mexico, and Utah. The final ruling on this designation will be made in August 2004. However, the USFWS is currently managing the proposed critical habitat as designated critical habitat.

The project area, powerline corridor, and Happy Jack Ranger Station lie within proposed Critical Habitat Unit 11 for MSO. However, the top of the cinder cone where observatory construction, road improvements, and fence installation activities would be concentrated has been classified as other forest and woodland types, which is non-restricted habitat for MSO (Debra McGuinn, District Biologist, personal communication, May 26, 2004) [PR 49]. Non-restricted habitat does not meet the target or threshold criteria for conditions suitable for nesting or roosting (USDI Fish and Wildlife Service 1995) [PR 17].

Mexican Spotted Owl and Proposed Critical Habitat. The Arizona Game and Fish Department (AGFD) Heritage Database lists the MSO as occurring within 3 miles of the project area [PR 34]. A historic MSO Protected Activity Center (PAC) is documented within 0.5 mile of the project area. The PAC has been consistently surveyed for MSO from 1991 to 2002. The last

Table 6. Status and Habitat of Threatened (T), Endangered (E), Proposed Endangered (PE), Candidate (C), or Conservation Agreement (CA) Species listed by the US Fish and Wildlife Service for Coconino County, Arizona

SPECIES	SCIENTIFIC NAME	PREFERRED HABITAT DESCRIPTION	HABITAT PRESENT	FEDERAL STATUS
Apache trout	<i>Oncorhynchus apache</i>	Cold mountain streams with many low gradient meadow reaches.	no	Threatened
Arizona bugbane	<i>Cimicifuga arizonica</i>	Moist, loamy soil in the transition between coniferous forests and riparian zones. Seems to require rich, fertile soils high in humus, deep shade, and high humidity.	no	Conservation Agreement
Bald eagle	<i>Haliaeetus leucocephalus</i>	Winter foraging and roosting habitat widespread in northern Arizona. Nesting habitat consists of large trees or cliffs near water (reservoirs, rivers, and streams) with abundant prey.	Wintering only	Threatened
Black-footed ferret	<i>Mustela nigripes</i>	Grassland plains generally found in association with prairie dogs.	no	Endangered
Brady pincushion cactus	<i>Pediocactus bradyi</i>	Benches and terraces in Navajo desert near Marble Gorge. Substrate is Kaibab limestone chips over Moenkopi shale and sandstone soil.	no	Endangered
California brown pelican	<i>Pelecanus occidentalis californicus</i>	Coastal land and islands; uncommon transient in Arizona on many Arizona lakes and rivers.	no	Endangered
California condor	<i>Gymnogyps californianus</i>	High desert canyonlands and plateaus. Interstate 40 is the southern boundary of the experimental/non-essential area in Arizona.	no	Endangered
Chiricahua leopard frog	<i>Rana chiricahuensis</i>	Permanent or nearly permanent water sources. Streams, rivers, backwaters, ponds, and stock tanks that are mostly free from introduced fish, crayfish, and bullfrogs.	no	Threatened
Fickeisen plains cactus	<i>Pediocactus peeblesianus</i> var. <i>fickeiseniae</i>	Exposed layers of Kaibab limestone on canyon margins or hills in Navajo Desert.	no	Candidate
Gila chub	<i>Gila intermedia</i>	Streams, cienegas, pools, streams, marshes.	no	Proposed
Gila trout	<i>Oncorhynchus gilae</i>	Small, headwater streams which are generally narrow and shallow and have little silt accumulation. Cobbles are the predominant substrate.	no	Endangered
Humpback chub	<i>Gila cypha</i>	Large, warm, turbid rivers, especially canyon areas with deep fast water.	no	Endangered
Kanab amber snail	<i>Oxymora hoyden Canadensis</i>	Travertine seeps and springs in Grand Canyon National Park.	no	Endangered
Little Colorado spine dace	<i>Lepidomeda vittata</i>	Moderate to small streams in pools and riffles with water flowing over gravel and silt.	no	Threatened
Loach minnow	<i>Tiaroga cobitis</i>	Bottom dweller in small to large perennial creeks and rivers. Not known to occur in Coconino County.	no	Threatened
Mexican spotted owl	<i>Strix occidentalis lucida</i>	Nests in canyons and dense forests with multi-layered structure of mixed conifer or ponderosa pine/Gambel oak. Sites with cool microclimates appear to be preferred.	yes	Threatened

SPECIES	SCIENTIFIC NAME	PREFERRED HABITAT DESCRIPTION	HABITAT PRESENT	FEDERAL STATUS
Mexican gray wolf	<i>Canis lupus baileyi</i>	Chaparral, woodland, and forested areas. May cross desert areas. Experimental/non-essential population introduced in the Blue Primitive Area approximately 160 miles southeast of project area.	no ²	Endangered
Navajo sedge	<i>Carex specuicola</i>	Silty soils at shady seeps and springs on vertical cliffs of pink-red Navajo sandstone.	no	Threatened
Paradine (Kaibab) plains cactus	<i>Pediocactus paradinei</i>	On Kaibab limestone gravels in pinyon-juniper woodland and in shrub/grassland.	no	Conservation Agreement
Razorback sucker	<i>Xyrauchen texanus</i>	Riverine and lacustrine areas generally not in fast moving water. May use backwaters.	no	Endangered
San Francisco Peaks groundsel	<i>Senecio franciscanus</i>	Alpine tundra on talus slopes.	no	Threatened
Sentry milk vetch	<i>Astragalus cremnophylax</i> var. <i>cremnophylax</i>	Unshaded openings in pinyon-juniper-cliffrose plant community. Kaibab limestone with little soil.	no	Endangered
Siler pincushion cactus	<i>Pediocactus sileri</i>	Gypsiferous clay and sandy soils of Moenkopi Formation. Desertscrub transitional areas of Navajo, sagebrush, and Mohave Desert.	no	Threatened
Southwestern willow flycatcher	<i>Empidonax traillii extimus</i>	Migratory riparian obligate. Native and non-native vegetation communities along rivers and streams.	no	Endangered
Spike dace	<i>Meda fulgida</i>	Shallow riffles with gravel and rubble substrates, moderate to swift currents, and swift pools over sand or gravel substrates in moderate to large perennial streams. Not known to occur in Coconino County.	no	Threatened
Welsh's milkweed	<i>Asclepias welshii</i>	Open stabilized desertscrub dunes and leeside of active dunes.	no	Threatened
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	Large blocks of riparian woodlands with cottonwood, willow, or tamarisk.	no	Candidate

response by MSO occupying this PAC was in 1994 (Debra McGuinn, District Biologist, personal communication, April 5, 2004) [PR 49]. Surveys for the MSO were conducted for the proposed project using the Mexican Spotted Owl Inventory Protocol (USDI Fish and Wildlife Service 2003) [PR 26]. No MSO responded during surveys or within a 0.5-mile radius of the project area and powerline corridor. However, due to the proximity of the proposed project to an established MSO PAC and since the powerline corridor and Happy Jack Ranger Station occur within proposed critical habitat, potential impacts to MSO and critical habitat have been evaluated. As required by Section 7 of the Endangered Species Act (ESA), potential affects to

² Though habitat exists for this species in the project area and since introduction in the Blue Primitive Area, at least one individual has been documented to have roamed into the Coconino National Forest; the project area is however outside the geographic range of the experimental/non-essential population.

MSO or critical habitat were evaluated in a Biological Assessment (BA) (EnviroSystems Management 2004) [PR 29] prepared for threatened and endangered species for this project.

MSO nest and roost primarily in closed-canopy forests or rocky canyons. Forest areas used for roosting and nesting often contain mature or old growth stands with a complex structure. A wide variety of trees may be used for nesting and roosting with Douglas fir as most commonly used. Nest trees are typically large in size (USDI Fish and Wildlife Service 1995) [PR 17]. Owls use a wider variety of forest conditions for foraging than they use for roosting. High-use foraging areas have more big logs, higher canopy closure and greater densities and basal area of both trees and snags than random foraging sites (USDI Fish and Wildlife Service 1995) [PR 17].

Bald Eagle. The project area and vicinity was also identified as winter foraging habitat for bald eagles. Bald eagles are known to migrate through and winter in ponderosa pine forested regions in northern Arizona. Nesting or wintering bald eagles are found in close association with water. Rivers, lakes or reservoirs that provide a reliable food source and isolation from disturbing human activities are preferred. Large trees and snags along shorelines provide feeding and loafing perches and potential nest sites. Larger stands of mature trees that are free from disturbance provide adequate perches, protection from the winter elements and are needed for communal winter roosting.

During the fall and spring migration, when most water areas are ice free and milder weather conditions predominate, bald eagles may be seen along virtually any waterway or impoundment. During the critical wintering period (December to February), eagles are usually forced to concentrate in areas where waters remain free of ice and food is available (<http://azstrip.az.blm.gov/wildlife/Eagle.htm>) [PR 48].

A small resident population nests primarily along the Salt and Verde Rivers (USDI Fish and Wildlife Service 1991) [PR 12]. Nesting requirements are generally described as large trees, snags, or cliffs near water with abundant fish and waterfowl for prey. The nearest water source is Stoneman Lake less than 10 miles to the northwest of the project area. They are known to build large stick nests up to 7 to 8 feet in diameter and 12 feet deep. No critical habitat has been designated for this species. Roosting sites are usually selected in large, open trees on sites with protection from inclement weather, especially wind (Johnsgard 1990, Terres 1980, and USDI Fish and Wildlife Service 1991) [PR 11, PR 3 and PR 12].

The project region does offer winter foraging habitat for bald eagles and bald eagles may occasionally forage in the project area. Bald eagles have been observed along FH3; however, no known winter roosts are located within 1 mile of the project area (Debra McGuinn, District Biologist, personal communication, May 26, 2004) [PR 49].

Forest Service Sensitive Species

Habitat evaluations were conducted for 30 Forest Service sensitive species for the proposed project area. Habitat for seven Forest Service sensitive species was identified as potentially occurring within the project area: five rare plants, the Navajo Mountain Mexican vole, and northern goshawk (see Table 7). The AGFD Heritage Database only identified northern goshawk as occurring within 3 miles of the project area. A northern goshawk Post-Fledgling Family Area (PFA) is documented as occurring 1 mile south of the project area.

A botanical survey for rare plants (five of the seven sensitive species) was conducted within the project area, powerline, and in and around the Happy Jack Ranger Station. No occurrences of rare plants were observed.

Surveys for the Navajo Mountain Mexican vole were conducted by observing the site for the presence of vole runways on the ground. Vole runways were observed off the project site during MSO surveys. However, no runways were observed within the project boundaries.

Table 7. Coconino National Forest Sensitive Species, Mogollon Rim Ranger District

SPECIES	SCIENTIFIC NAME	PREFERRED HABITAT DESCRIPTION	HABITAT PRESENT
Tiger Beetle	<i>Amblychila picolomini</i>	Very little is known about the life cycle or preferred habitat. Reported only in dry, open rocky country in north-central and northeastern Arizona, as well as a few isolated localities in Colorado and Texas.	No
American peregrine falcon	<i>Falco peregrinus anatum</i>	Rock cliffs for nesting. Peregrines prey mainly on birds found in wetlands, riparian areas, and meadows within a 10 to 20-mile radius from their nest site.	No
Arizona sneezeweed	<i>Helenium arizonicum</i>	Roadsides and in clearings of ponderosa pine forests between 7000-9000 feet generally near drainages, lakes, ponds, or roadsides. Seems to prefer moist soil.	Yes
Aryxna giant skipper	<i>Agathymus aryxna</i>	Found in arid but well-vegetated desert canyons, or in canyons with periodic water and open grassy woodlands. Its host plant is agave.	No
Blue-black silverspot butterfly	<i>Speyeria nokomis nokomis</i>	Wet alpine meadows and seeps or sloughs at lower elevations. It is found where there is enough permanent moisture to support a healthy violet population.	No
California floater	<i>Anodonia californiensis</i>	Known to occur in upper elevations from 7,000 to 8,000 feet in undeveloped reaches of the Black River in eastern Arizona.	No
Cliff fleabane	<i>Erigeron saxatilis</i>	Sheer canyon walls, moist north-facing slopes, steep solid rock and bedrock outcrops from 4400-7000 feet. It is known to occur on dacite but seems to prefer Coconino sandstone. Most known populations occur on inaccessible cliffs.	No
Common black-hawk	<i>Buteogallus anthracinus</i>	Riparian-obligate nesters requiring mature, relatively undisturbed habitat supported by permanently flowing streams.	No
Eared trogon	<i>Euptilotis neoxenus</i>	Neotropical migrant generally in northwestern Mexico, but has been documented in Arizona. In Arizona, it generally inhabits pine and pine-oak forests from 6,000 to 10,000 feet in elevation. It is an infrequent visitor to the US, the majority of sightings occurring in southeastern Arizona.	No
Early elfin	<i>Incisalia fotis</i>	Local and usually uncommon in arid plateau country and desert mountains around 6000-7000 feet. The early elfin favors roadsides with flowers. The caterpillars feed on cliffrose.	No
Eastwood alumroot	<i>Heuchera eastwoodiae</i>	Rocky slopes, cliffs, hillsides and along streams from 4500-7500 feet from chaparral to pine forests. Usually on shady north facing slopes	Yes
Flagstaff beardtongue	<i>Penstemon nudiflorus</i>	Found between 4500-7000 feet on dry slopes in ponderosa pine forest in mountainous or hilly places south of the Colorado River.	Yes

SPECIES	SCIENTIFIC NAME	PREFERRED HABITAT DESCRIPTION	HABITAT PRESENT
Flagstaff pennyroyal	<i>Hedeoma diffusum</i>	Found in the Petran Montane Conifer Forest plant community at elevations between 4500-7000 feet. Restricted to small and scattered limestone and sandstone outcrops of relatively undisturbed habitats.	No
Freeman's agave borer	<i>Agathymus baueri freemani</i>	Requires agaves, especially <i>Agave chrysantha</i> , as host plants.	No
Hairy-necked tiger beetle	<i>Cicindela hirticollis corpuscula</i>	Tidal flats, coastal beaches, and the sandy shores of freshwater rivers or lakes.	No
Little Colorado River sucker	<i>Catostomus sp. nova</i>	Creeks, small to medium rivers, and impoundments. Predominantly found in pools with abundant cover but also in riffles.	No
Maricopa tiger beetle	<i>Cicindela oregona maricopa</i>	Occurs in open sand or mud flats and stone terraces along permanent or intermittent streams and near temporary and permanent ponds, open soil such as dirt roads, and parking lots near water to some distance from water.	No
Mogollon thistle	<i>Cirsium parryi</i> ssp. <i>mogollonicum</i>	Moist to very moist soils in riparian understory of perennial stream with ponderosa pine, Douglas fir, and white fir.	No
Mountain silverspot butterfly	<i>Speyeria nokomis nitocris</i>	Wet alpine meadows and seeps or sloughs at lower elevations. It is found where there is enough permanent moisture to support a healthy violet population.	No
Mt. Dellenbaugh sandwort	<i>Arenaria aberrans</i>	Between 5500-9000 feet in oak and pine forests.	Yes
Narrow-headed garter snake	<i>Thamnophis rufipunctatus</i>	Pinyon-juniper and pine-oak woodland into ponderosa pine forest. Found in or next to clear, cool, permanently flowing rocky streams between 5000-6000 feet. Almost strictly aquatic, rarely seen greater than a meter from water.	No
Navajo Mountain Mexican vole	<i>Microtus mexicanus navaho</i>	Typically occupy dry grassy or dry grass-forb vegetation in association with ponderosa pine or other coniferous forests. Also found in low, dense, shrubby thickets.	Yes
Northern goshawk	<i>Accipiter gentilis</i>	All ponderosa pine and mixed conifer above the Mogollon Rim is considered goshawk habitat.	Yes
Northern leopard frog	<i>Rana pipiens</i>	Usually found in association with permanent waters with rooted aquatic vegetation. Also frequents ponds, canals, marshes, springs, and streams.	No
Obsolete viceroy butterfly	<i>Limenitis archippus obsoleta</i>	Riparian canyons and desert arroyos. The caterpillars feed on willows. It is not found in high mountains or arid lands away from water.	No
Roundtail chub	<i>Gila robusta</i>	Cool to warm water, mid-elevation streams and rivers.	No
Rusby's milkvetch	<i>Astragalus rusbyi</i>	Meadows in ponderosa pine forests or at the edge of thickets and aspen groves. Found in dry or temporarily moist basaltic soils mostly between 7000-8000 feet.	Yes
Southwestern (Arizona) toad	<i>Bufo microscaphus microscaphus</i>	Rocky streams and canyons in the pine-oak belt. Also occurs in upland deserts.	No
Spotted skipperling	<i>Piruna polingii</i>	Moist meadows and streamsides in mountains of Arizona, New Mexico, and Mexico. Adults visit yellow composites for nectar.	No
Tusayan rabbitbrush	<i>Chrysothamnus molestus</i>	Pinyon-juniper woodland or associated grassy/shrubland on calcareous deposits between 5900-6900 feet. The calcareous	No

SPECIES	SCIENTIFIC NAME	PREFERRED HABITAT DESCRIPTION	HABITAT PRESENT
		deposits can originate from soils whose parent material was alluvium derived from Kaibab limestone.	

Northern Goshawk. Formal inventory for northern goshawk were conducted utilizing the USFS 1994 Southwestern Region Goshawk Inventory Protocol (Joy, Reynolds, and Leslie 1992; Kennedy and Stahlecker 1993) [PR 13 and PR 14]. No occurrences of northern goshawks within a 0.5-mile radius of the project area or powerline corridor were documented. Details of survey results are presented in the Biological Assessment and Evaluation (BA&E) prepared for forest service sensitive species for the proposed project (EnviroSystems 2004a) [PR 50].

Northern goshawks use a variety of forest types in various stages of succession and structure. The principal forest types occupied by the goshawk in the Southwest are ponderosa pine, mixed conifer species and spruce-fir. Important components of the goshawks nesting home range are the nest area, the PFA, and the foraging area. The nest area, which often includes more than one nest typically occupying about 30 acres, is usually located on a northerly facing slope in a drainage or canyon, and is often near a stream. Nest areas contain one or more stands of large, old trees with a dense canopy cover and open understories. A goshawk pair occupies its nest area from early March until late September (Reynolds et al. 1992 and Reynolds 2004) [PR 13 and PR 31]. The nest is a platform of sticks.

The PFA surrounds the nest area and is considerably larger (about 600 acres). It usually includes a variety of forest types and conditions. PFAs have patches of dense trees, developed herbaceous and/or shrubby understories, and features such as snags, downed logs, and small openings that are critical for many goshawk prey.

The foraging area surrounds the PFA and is about 5,400 acres in size. Foraging goshawks are apparently opportunistic when it comes to use of available habitats. Choice of foraging habitats may be as closely tied to prey availability as to habitat structure and composition. Important features for goshawk prey include small openings, edges of openings, forest edges, and mid-aged to old forests. Since most goshawk foraging attempts in forests are conducted below the canopy level, forest age classes that include mid-aged, mature, and old forests (forest areas composed of trees with lifted crowns) not only provide habitat for prey but also provide suitable structure for goshawks to search, chase, and capture prey (Reynolds et al. 1992, and Reynolds 2004) [PR 13 and PR 31].

One historical goshawk PFA has been documented approximately 1 mile south of the project area. This PFA was monitored from 1991-2001 but no responses have been elicited from this PFA since about 1993 (Deb McGuinn, District Biologist, personal communication, April 5, 2004) [PR 49]. Though territorial goshawks have high site fidelity to their territories, they do not breed every year. Non-breeding goshawks do not respond to some commonly used survey techniques, such as broadcast calls (Reynolds 2004) [PR 31]. It is possible that this PFA is still occupied but no breeding has occurred since about 1993. It is also possible that the project area serves as a small portion of the foraging area surrounding this PFA.

During formal inventories, no goshawks were seen or heard within a 0.5-mile radius around the project area or powerline corridor. No stick nests were observed during surveys. No stands of

large old trees providing dense canopy cover for nesting goshawks are located in the project area. Very few downed logs or snags, typical in PFAs, were observed in or around the project area. Though suitable vegetative community for northern goshawks exists in the project area, specific features preferred by goshawks for nesting are not present.

Migratory Birds

The Arizona Partners in Flight (PIF) Bird Conservation Plan (Latta et al. 1999) [PR 22] identifies priority species for effective and efficient ecological management by habitat type for the state of Arizona. The ponderosa pine habitat of the project area has the potential to support all of the migratory birds listed in Table 8. Of the migratory birds listed, purple martins were observed during field surveys within in a 0.5-mile radius from the project area and powerline; however, none were observed within the project area. Northern goshawk is also listed as a migratory bird in ponderosa pine habitat and is discussed in the section on Forest Service sensitive species.

Table 8. Migratory Birds Identified by Partners in Flight

SPECIES	SCIENTIFIC NAME	PREFERRED HABITAT DESCRIPTION
Olive-sided Flycatcher	<i>Contopus borealis</i>	Ponderosa pine, Douglas fir. Multi-level, mature forest, fairly open canopy. Live mature pines for nesting. Snags important. Most common in patchy areas of closed and open habitats where tall conifers overlook ridges and canyons. Prefers forest edges and openings. Arrival on breeding ground generally (may be as late as June).
Cordilleran (Western) Flycatcher	<i>Empidonax difficilis</i>	Ponderosa pine, Douglas fir, oak, aspen. Dense canopy closure. Drainages to create a cool microclimate. Snags and downed trees for nesting. Rare cowbird host.
Purple Martin	<i>Progne subis</i>	Ponderosa pine. Open canopy. Open midstory cover. Open understory cover. High snag density. Large snags, cavities. Open space for flying. Snags need to be close to or in open areas. Just above and below the Mogollon Rim. Often prefers habitat near open water. Prefers tall snags adjacent to open areas.

Management Indicator Species

Forest Service Management Indicator Species (MIS) are wildlife species representative of different vegetation communities. Long-term changes in the population of these species serve as a barometer of the overall health of ecosystems. Coconino National Forest has identified eight MIS as potentially occurring in the project area and vicinity (Table 9). MSO and northern goshawk are also listed as MIS but are discussed in elsewhere in this section. During biological field surveys, no MIS were documented as occurring within the project area; however, pygmy nuthatch and turkey were observed within the project vicinity. Elk sign was found throughout the project area and vicinity.

Environmental Consequences

Alternative 1: No Action

Implementation of the no action alternative will result in the project area remaining in its current condition and will result in no impacts to wildlife or wildlife habitat in the area. No federally listed threatened, endangered, Forest Service sensitive species, migratory birds, or MIS will be affected.

Table 9. Management Indicator Species Identified as Potentially Occurring in the Project Area and Vicinity

SPECIES	SCIENTIFIC NAME	PREFERRED HABITAT DESCRIPTION	HABITAT WITHIN THE PROJECT AREA
Elk	<i>Cervus elaphus</i>	Occupy mountain meadows and coniferous forest, pinyon-juniper woodlands, are occasionally seen in the plains grassland, and even desertscrub. They are primarily grazers.	Yes
Red Squirrel	<i>Tamiasciurus hudsonicus mogollonensis</i>	Found in Arizona where spruce, spruce / Douglas fir, or white fir / Douglas fir occur at elevations above 7500 feet. Red squirrel nests are often in tree cavities. Feed on Engelmann spruce, Douglas fir, white fir, fungi, buds, fruits and harvest seeds from cones. Large standing snags and large downed logs are important sites for caches.	No
Abert Squirrel	<i>Sciurus aberti</i>	Favor multi-storied stands with scattered large trees mixed with poles. Nests occur in large ponderosa pines 20 to 110 feet tall, with 12 to 41 inches dbh.	Yes
Wild Turkey	<i>Meleagris gallopavo merriamii</i>	Need a variety of habitats and forage types. Winter habitat includes mixed ponderosa pine and pinyon-juniper. A Gambel oak component is important for mast production and foraging. Winter foraging tends to focus on oak and pinyon mast and grasses. Nesting usually occurs on steep (>30%) slopes with good canopy and horizontal cover.	Yes
Hairy Woodpecker	<i>Picoides villosus</i>	Over-wintering cavity nesters that tend to need larger trees. An indicator species for the snag component of ponderosa pine and mixed-conifer forests. Show strong selection for aspen snags, use live aspen proportional to availability, and select against non-aspen snags.	Yes
Pygmy Nuthatch	<i>Sitta pygmaea</i>	Tree-trunk foragers that occur in ponderosa pine and pinyon-juniper up to elevations of 10,000 feet. Feed on a variety of insects and seeds. Usually secondary cavity nesters, selecting larger trees for nesting and roosting.	Yes

Alternative 2: Proposed Action

Threatened and Endangered Species

Mexican Spotted Owl and Proposed Critical Habitat. Surveys concluded that there are no MSO within 0.5-mile radius of the project area and powerline corridor. Further, the observatory construction site and access road within the project area has been previously disturbed as well as being classified as non-restricted habitat for MSO. Areas within the remaining project area, powerline corridor, and Happy Jack Ranger Station are within proposed critical habitat and but do not contain all of the primary constituent elements as defined by the USFWS for MSO (EnviroSystems Management 2004) [PR 51]. The area of primary impact associated with observatory construction and access road will be confined to non-restricted habitat. Installation of the powerline will likely result in the removal of some small (<12 inches dbh) ponderosa pine, Gambel oak clumps, and shrub species. However, the preferred corridor has been previously disturbed by the existing powerline and by an existing two track road, thereby minimizing potential impacts.

Construction activities related to road building, building construction, fencing, and powerline trenching will generate noise and dust during the MSO breeding season. Negative results from the current MSO survey imply that no direct effects to the species or individuals will result from these activities. Construction activities will likely have a direct negative effect on any prey base using the project area.

Noise generated by heavy equipment and power tools is likely to be much louder than the imitations and tapes of MSO calls used during surveys. The increase in human use of the area during and after construction may also increase noise levels at the project area. However, the sound will diminish with distance and vegetative and topographic buffering offered by the canyon where the PAC is centralized. The nearest MSO nest/roost sites are one mile away from the observatory site, and MSO are not known to currently forage in the project area.

There is little published information documenting the hearing range and sensitivity of birds of prey. Previous studies conducted in New Mexico noted “. . . no spotted owl flushed when noise stimuli were greater than 105 meters away.” Chainsaws were found to be more disturbing to MSOs than helicopters at comparable distances (Delaney et al. 1999) [PR 23]. The decibel levels of helicopters are generally 120 to 160 decibels as compared to 110 decibels for chainsaws (www.atlasaviation.com/medical/hearing_and_noise_in_aviation.htm) [PR 46]. Decibel levels of typical construction equipment to be utilized on the project site ranges from about 70 to 100 decibels (<http://www.ci.salinas.ca.us/CommDev/GenPlan/DraftEIR/Constnoise>) [PR 25]. Furthermore, studies conducted in Canyonlands National Park found that 95% of owls were not flushed when hikers stayed about 80 feet away (Swarthout and Steidl 2003) [PR 27].

Other studies have observed bird responses to noise frequency (measured in kilohertz [kHz]). These studies have documented that birds hear best between about 1 and 5 kHz and are able to hear well between about 0.1 kHz and 8 to 10 kHz. Compared to most mammals, including humans, birds do not hear well at either high or low frequencies. There are no cases in which birds hear at frequencies higher than about 15 kHz. Acoustic deterrents or “scarecrow” devices are not generally effective because birds habituate to them and eventually ignore them completely (Grubb et al. 1998, Dooling 2002) [PR 21 and PR 24]. Logging trucks and other diesel trucks under load have been measured to emit sound energy in the vicinity of 0.08 kHz (Grubb et al. 1998) [PR 21]. Noise at these low frequencies may be insignificant or less noticed by birds than humans.

No impacts to MSO during nighttime foraging are anticipated as construction activities are not planned to occur at night. Nesting and roosting MSO will likely utilize more desirable habitat within the PAC, which would receive reduced construction-related noise as a result of increased distance and topographic buffering.

Removal and construction of facilities at the Happy Jack Ranger Station are not anticipated to increase potential impacts to MSO greater than already existing factors. The Ranger Station undergoes day-to-day human occupation and equipment and vehicles are currently utilized on site.

No impacts to MSO during nighttime foraging are anticipated as construction activities are not planned to occur at night. Nesting and roosting MSO will likely utilize more desirable habitat

within the PAC, which would not receive construction-related noise due to increased distance from the project area and vegetative and topographic buffering.

Since the powerline and the Happy Jack Ranger Station occur in proposed critical habitat and modification of the existing conditions will occur as a result of the proposed project, a determination of may effect, but not likely to adversely affect is concluded. The powerline corridor and Happy Jack Ranger Station do not offer all of the primary constituent elements as defined by the MSO recovery plan, and habitat modification in these areas is expected to be minimal supporting the no adverse affect determination as a result of implementation of Alternative 2.

The BA concluded that there would be no effect of the proposed project to individual MSO. The BA also concluded a determination of not likely to adversely modify MSO proposed critical habitat. These results were obtained largely from the absence of the species within the project area and vicinity, and that impacts to primary constituent elements as defined by the MSO Recovery Plan of proposed critical habitat are minor and insignificant (USDI Fish and Wildlife Service 1995) [PR 17].

Bald Eagle. Winter roosting and foraging habitat occurs throughout ponderosa pine forested areas in the project vicinity. No known winter roosts occur within one mile of the project site. Bald eagles may occur in the project area on a transient basis. Construction-related activities associated with access road improvements, observatory buildings, and powerline and fence installation may result in the bald eagle avoiding the area in response to noise and activity. Activities associated with the building removal and construction at the Happy Jack Ranger Station will have no effects to bald eagles. Since construction activities would be reduced or shut down for winter during the time of year the eagles may most likely be present, no impacts to bald eagles are anticipated as a result of implementation of Alternative 2.

Forest Service Sensitive Species

No rare plants are present on the project site. Thus, no impacts to rare plants will occur through implementation of Alternative 2.

Although no evidence of their presence was noted during surveys, the Navajo Mountain Mexican vole may occur within the project area or vicinity. Construction-related activities such as road building, building construction, fencing, and powerline trenching may result in mortality of individuals if present. However, individuals occurring within the area of impact will likely relocate to adjacent habitat. Planned construction at the Happy Jack Ranger Station will likewise result in species utilizing other habitat in the area. No significant impacts to this species as a group are anticipated to result from the proposed project.

Northern Goshawk. Though suitable forest habitat for northern goshawks occurs in the project area, specific features preferred by goshawks for nesting are not found in the project area. Construction activities related to road building, building construction, fencing, and powerline trenching will generate noise. However, negative results from northern goshawk surveys imply that no direct effects to the species or individuals will result from these activities. Construction activities may have a direct negative effect on the prey base in the project area, however it would

be minimal due to the small number of acres being impacted. There would be a minor impact to localized canopy closure and tree density due to removal of trees, however the overall forest structure of the project area would not measurably change due to project activities. No direct effects and minimal indirect effects to northern goshawks are anticipated as a result of implementing Alternative 2. Alternative 2 is not likely to result in a trend to federal listing or loss of viability for the northern goshawk.

Migratory Birds

Appropriate habitat for migratory bird species does occur in the project vicinity. Purple martins were observed outside of the project area during field surveys and potentially occur within the project area on a transient basis. Large trees and snags will be avoided to the extent possible thereby minimizing impacts to potential habitat. Construction-related activities such as road building, observatory construction, fencing, and powerline trenching will generate noise and dust and will likely result in these species utilizing other habitat in the area. Removal and construction of facilities at the Happy Jack Ranger Station will not significantly affect the occurrence of migratory birds since human occupancy and use of vehicles and equipment are currently ongoing. Following construction, potential for bird collisions with the observatory structure during migration is minimal. The observatory structure is not disproportionately greater in size or elevation than surrounding topography and vegetation and is readily visible due its reflective nature. No impacts to migratory birds are anticipated as a result of implementing of Alternative 2.

Management Indicator Species

It is likely that many of the MIS occur on the project site on an occasional basis. Two MIS, pygmy nuthatch and turkey, were observed in the project vicinity during field surveys. Elk sign was observed within the project area and vicinity. Wildlife habitat in the project area can be found in abundance in the project region, and impacts to MIS species are expected to be minimal. Important habitat components such as snags and downed wood will be avoided during construction. Cover, mostly in the form of small shrubs and tress will be removed in construction areas. In addition, construction-related activities such as road building, observatory construction, fencing and powerline trenching will generate noise and dust. Species occurring within the project area will likely relocate off site and utilize other habitat in the area. Planned construction at the Happy Jack Ranger Station will likewise result in species utilizing other habitat in the area. However, given the current activity levels presently occurring at the Ranger Station, effects to these species will be minimal. MIS populations are stable in the project vicinity and the proposed project will not affect MIS species on a forest-wide basis. Thus, no significant impacts to MIS will result from implementation of Alternative 2.

Cumulative Effects

Alternative 1: No Action

There are no cumulative effects associated with the no action alternative relative to wildlife.

Alternative 2: Proposed Action

There are no other projects that would have significant impacts to wildlife planned in the area in the foreseeable future. Therefore, there are no cumulative effects associated with the proposed action alternative relative to wildlife.

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CHAPTER 4. CONSULTATION AND COORDINATION

The following individuals; federal, state and local agencies; tribes; and non-Forest Service personnel were consulted during the development of the EA.

ID Team Members and Resources Staff

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Dick Fleishman, District Soil and Watershed Staff, Mogollon Rim Ranger District
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Jim Beard, Landscape Architect, Coconino National Forest Supervisor's Office

Federal, State, and Local Agencies

Shaula Hedwall, U.S. Fish and Wildlife Service, Flagstaff Field Office
Arizona Game and Fish Department, Flagstaff
Bill Towler, Coconino County Board of Supervisors, Flagstaff

Tribes

Hopi Tribe
Navajo Nation
Yavapai-Apache Nation
White Mountain Apache Tribe

Non-Forest Service Personnel

Robert Millis, Director, Lowell Observatory
Nathaniel White, Astronomer, Lowell Observatory
Thomas Sebring, DCT Project Manager
Marianna DeKock, DCT Facility Engineer

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APPENDIX A: Mitigation and Monitoring for Lowell Observatory's DCT

All projects require periodic monitoring of resources or activities on a representative sample basis in order to establish long-term trends, assess the impacts of land management activities, determine how well objectives have been met, and check compliance with established standards. Most of the monitoring activities will be ongoing as the project progresses through its various stages.

#	Why	Mitigation	Monitoring
Heritage Resources			
HR1	Minimize impacts to existing archeological sites.	If previously undocumented prehistoric or historic archaeological sites are encountered during the course of the project, these sites will be avoided and reported to the District or Forest Archaeologist.	If District archaeologist is notified of undocumented archaeological sites, the District Archaeologist will then implement monitoring measures.
Invasive Plants			
IP1	Minimize weed spread or introduction of invasive plants.	Use only certified weed free seed and weed free mulch to re-vegetate and rehabilitate areas.	Included in DCT design. FS to review and approve DCT Site Plan and construction design and do contract oversight. District Multi-Resource and/or Wildlife crew will monitor the site during construction and after for any introductions of invasive weeds on an annual basis and will take appropriate measures for removal.
IP2	Minimize weed spread.	Vehicles and equipment that are driven through or parked in a weed infested area must be sprayed each time that vehicle leaves the area. Map wash sites within the project area for future monitoring of weed infestations.	Included in DCT design. FS to review and approve DCT Site Plan and construction design and do contract oversight.
IP3	Minimize weed spread.	All construction vehicles and equipment must be sprayed before coming onto NFS lands. A high-pressure hose will be used to clear the undercarriage, tire treads, grill, radiator, and beds of any mud, dirt, and plant parts that may potentially spread the seeds or viable parts of noxious plants.	Included in DCT design. FS to review and approve DCT Site Plan and construction design and do contract oversight.
IP4	Minimize weed spread.	Parking and staging must occur within the cinder pit proper where the area has already been disturbed.	Included in DCT design. FS to review and approve DCT Site Plan and construction design and do contract oversight.
IP5	Minimize weed spread.	The use of off-site fill materials in the project area is discouraged. Utilize excavated substrate from on-site whenever fill substrate is	Included in DCT design. FS to review and approve DCT Site Plan and construction design and do contract oversight.

#	Why	Mitigation	Monitoring
		needed. If on-site substrate is used, and if it contains weed seed, this soil should not be part of the top three inches of soil. Instead, weed-free soil will be used in the top three inches. Fill material cannot come from a source infested with noxious weeds.	
IP6	Minimize weed spread.	Water used for dust abatement and other construction activities should be obtained from a source free of noxious plant seeds.	Included in DCT design. FS to review and approve DCT Site Plan and construction design and do contract oversight.
Soil and Water			
SW1	Reduce concentration of water runoff, thus minimizing soil detachment & sediment transport	Install silt fences on the downhill side of construction site to trap sediments created on-site.	Included in DCT design. FS to review and approve DCT Site Plan and construction design and do contract oversight.
SW2	Reduce concentration of water runoff, thus minimizing soil detachment & sediment transport	Install drainage structures in roads to reduce concentration of water runoff. Road drainages shall direct flow into stable areas of vegetation or rock rip rap.	Included in DCT design. FS to review and approve DCT Site Plan and construction design and do contract oversight.
SW3	Minimize sediment delivery into drainage	If needed, gravel and/or install erosion structures on roads, where activities cross drainages. (24.25, 41.14, 41.15, 41.2, 41.26) ³	Included in DCT design. FS to review and approve DCT Site Plan and construction design and do contract oversight.
SW4	Minimize soil erosion	Seed slopes and mulch where necessary. Seed and mulch slopes near drainages. (41.12, 25.18, FP Travel-4)	Included in DCT design. FS to review and approve DCT Site Plan and construction design and do contract oversight.
SW5	Avoid soil movement	Revegetate slopes within the project area less than 3:1 slope with certified weed free native seed. Recommended seed mix is Arizona fescue, western wheat grass, and squirrel tail (5lbs to the acre) (41.16,41.27,41.28,25.18,41.5).	Included in DCT design. FS to review and approve DCT Site Plan and construction design and do contract oversight.
SW6	Minimize soil detachment, and sediment transport	Install rock rip-rap energy dissipaters on drainage outlets of roads	Included in DCT design. FS to review and approve DCT Site Plan and construction design and do contract oversight.
SW7	Minimize soil compaction, soil detachment & sediment transport.	Schedule operations, construction and ditch/road maintenance activities during periods when probabilities for rain and runoff are low. Equipment	Included in DCT design. FS to review and approve DCT Site Plan and construction design and do contract oversight.

³ Number of BMP from FSH 2509.22

#	Why	Mitigation	Monitoring
	To maintain long-term soil productivity.	shall not be operated when ground conditions are such that unacceptable soil compaction or displacement results.	
SW8	Comply with state and Federal water quality standards by minimizing soil erosion through the stabilizing influence of vegetation ground cover	Storm water Pollution Protection Plans will be required of all contractors prior to beginning construction on any portion of the project that will disturb existing native soils and/or vegetation.	Included in DCT design. FS to review and approve DCT Site Plan and construction design and do contract oversight.
Visual Quality			
VQ1	Minimize visual quality impacts	Paint sides of outbuildings at the observatory site with non-reflective neutral paint, as feasible.	Included in DCT design. FS to review and approve DCT Site Plan and construction design and do contract oversight.
VQ2	Minimize visual quality impacts	Retain native vegetation in the form of shrubs and/or trees along perimeter of outbuildings and parking lot to screen viewing of structures from FH3.	Included in DCT design. FS to review and approve DCT Site Plan and construction design and do contract oversight.