Final Environmental Assessment
For
High Altitude Mobile Pointing Platform Tests

Air Force Research Laboratory
Directed Energy Directorate
Kirtland AFB

Report Documentation Page

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FINAL ENVIRONMENTAL ASSESSMENT
High Altitude Mobile Pointing Platform
New Mexico, Arizona and Texas

LEAD AGENCY:

U.S. Air Force
Air Force Research Laboratory, Directed Energy Directorate
Kirtland Air Force Base (KAFB), New Mexico

PROPOSED ACTION:

The Air Force Research Laboratory Directed Energy Directorate (AFRL/DE) located at Kirtland AFB in Albuquerque, New Mexico proposes a series of high altitude balloon borne tests in support of research to advance technology for laser beam propagation through the atmosphere. Propagation testing at the Starfire Optical Range (SOR) has historically used space objects (e.g., stars, orbiting satellites) or horizontal path tests with lab instrumentation at both ends. In order to meet its current mission and technical goals in a timely and cost-effective manner, AFRL proposes to develop and fly a high altitude, near-space platform containing a small, tracking telescope and low-power laser with appropriate sensors for acquiring and tracking a telescope on the ground at the SOR.

AFRL/DE is developing a program called High Altitude Mobile Pointing Platform (HAMPP) to facilitate laser propagation testing. AFRL/DE is teaming with personnel from the AFRL Space Vehicles (AFRL/VS) Balloon Program to provide integration, facilities, and launch demonstrations of this technology. The HAMPP Program would demonstrate tracking and very low power laser propagation with facilities at Kirtland AFB via an optical telescope at an altitude of approximately 100,000ft (30km) and a maximum range of 1,148,350ft (350km). The HAMPP telescope would also be used in horizontal ground tests between the SOR ground site and the SOR's two-mile remote site.

The HAMPP flight program would take place from approximately December 2005 to December 2007. Approximately thirty test launches per year are proposed at various locations across New Mexico, Arizona and Texas, including Portales, Socorro, Grants, Gallup, Quemado, Belen, Los Lunas, Estancia, Roswell, Carizozo, Logan, Clovis, Ft. Sumner, Cannon AFB, Farwell, Tucumcari, Santa Rosa, Moriarty, and Willard in New Mexico; Window Rock, Springerville, and Holbrook in Arizona; and Amarillo and Lubbock in Texas. Launch and recovery of the balloon would be determined on normal weather patterns and those related to the seasonal winds called the "turnaround" – in summer, launches would occur in the east and recover in the west; in winter, launches would occur in the west and recover in the east. The AFRL/VS Balloon Program team would launch the high altitude balloon configured with the instrumented HAMPP package from a location providing the best flight path. During periods of the "turnaround," about two weeks in May and September, launches could take place continuously over a span of four to eight days, depending on the support capabilities of the AFRL/VS Balloon Program.

These flights would collect health and status data from payload components, basic gimbal pointing information, and infrared (IR) and visible camera images of platform components and the SOR site on KAFB. Flights would be instrumented with thermal sensors and accelerometers. For all flights, very low power, eye-safe, invisible lasers would be propagated from the HAMPP to the SOR site and from the SOR site to the HAMPP. Communication with the ground station located at KAFB would be accomplished through radio frequency (RF) using a high-bandwidth Ethernet link module provided by AFRL/VS.

INQUIRIES ON THIS DOCUMENT SHOULD BE DIRECTED TO:

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3550 Aberdeen Ave. SE
Kirtland AFB, NM 87117-5776

FINAL FINDING OF NO SIGNIFICANT IMPACT

High Altitude Mobile Pointing Platform
New Mexico, Arizona and Texas

Pursuant to the National Environmental Policy Act (NEPA), the Council on Environmental Quality (CEQ) regulations implementing NEPA, U.S. Department of Defense (DoD) Instruction 4715.9, *Environmental Planning and Analysis*, Air Force Instruction (AFI) 32-7061, Code of Federal Regulations 32 CFR 989 and other applicable Federal and local regulations, the USAF has conducted an assessment of the potential environmental consequences of the proposed atmospheric data collection flight tests in various remote locations in New Mexico, Arizona and Texas.

Description of Proposed Action and Alternatives

The Air Force Research Laboratory (AFRL) is performing research on laser propagation in the atmosphere at the Starfire Optical Range (SOR) located on Kirtland AFB. To meet the goals of this program AFRL proposes a series of approximately thirty flight tests per year in New Mexico, Arizona and Texas to develop, integrate, and test technology for a laser tracking experiment utilizing a balloon-borne payload. The High Altitude Mobile Pointing Platform (HAMPP) Program is required to facilitate development of this technology, and would be part of the balloon assembly. AFRL Directed Energy (AFRL/DE) and Space Vehicles (AFRL/VS) Directorates plan to provide technology integration and test demonstrations starting approximately in January of 2006 and ending approximately in December of 2007. The HAMPP Program would demonstrate tracking with the SOR via an optical telescope and control system at an altitude of approximately 100,000ft (30km) and a maximum range of 1,148,350ft (220miles, or 350km). The HAMPP telescope would also be used in horizontal ground tests between the SOR ground site and the SOR's two-mile remote site.

Flights would include a laser beacon from the aperture on the payload. This beacon would be a Class I eye-safe and invisible laser. HAMPP flights would also include a ground beacon from the SOR's 1.5m telescope. All lasers would be eye-safe at the aperture.

Alternatives to the Proposed Action were considered, including the No Action Alternative, performing flight tests at other locations, and using other flight platforms. Under the No Action Alternative, no research or technological advancement would be made. The No Action Alternative would result in no impact on the environment. Performing flights in locations other than those proposed proved to be more costly and challenging to meet schedule deadlines. Using launch locations in New Mexico, Arizona, and Texas would result in a negligible impact, but not significant impact to the environment. Using other flight platforms such as an aircraft was an alternative considered but eliminated from further analysis. Aircraft are not feasible since they are unable to reach a similar altitude required for the research as the proposed balloon platform. No other alternatives were viable in achieving the objectives of the HAMPP Program.

Summary of Anticipated Environmental Effects

The attached environmental assessment identifies the potential environmental impacts of the proposed action. A description of the findings for each potentially impacted environment is given below.

Environmental Attribute	High Altitude Mobile Pointing Platform Flight Test
Land Use/Zoning	No impacts to land use or zoning ordinances are expected.
Air Quality	No impact. Launching a high altitude balloon with the HAMPP does not produce emissions.
Water Resources	No impact, All launch activities would be performed on previously disturbed property. All balloon assets would be recovered upon landing.
Safety and Health	Negligible impact. The balloon payload is structurally configured with proven equipment, components and mounting hardware to prevent falling objects. The laser tracking system is very low power, is propagated at eye safe levels and would not harm personnel, wildlife or threatened and endangered species. All activities would be performed IAW safety standards, OSHA and AF requirements.
Hazardous Materials / Waste	Negligible impact. The platform equipment requires the use of silver-zinc batteries and lithium ion batteries. No other hazardous materials would be used, and no hazardous waste would be generated from the flights.
Biological Resources	Negligible impact. There is a very low probability that the HAMPP balloon would harm wetlands, wildlife and/or threatened or endangered species.
Cultural Resources	Minimal impact. The balloon launch activity would be restricted to previously disturbed areas and the landing of the balloon assets would be controlled as much as possible. No construction or digging would occur.
Geology and Soils Resources	Minimal impact. Test activities would be performed in the air at approximately 100,000 ft altitude. Launch activities would be performed at existing facilities on previously disturbed soil, and recovery activities would incorporate controls to perform recovery with minimal disturbance as possible
Socioeconomic	The proposed action would favorably impact socioeconomics, however the magnitude of the impact is negligible
Cumulative	The incremental impact of approximately thirty balloon flights per year in the areas of New Mexico, Arizona, and Texas combined with existing similar research activities (e.g. 30 scientific balloon flights per year in NM of which approximately 19 are launched from Ft Sumner) and the aggregate of commercial and government aerial activity in the proposed areas indicates the action would have negligible incremental impact on the human environment.

Conclusion

Based on a review of the preceding discussion and the attached Environmental Assessment, I have concluded that the Proposed Action would not have a significant impact on the quality of the human environment. Therefore, no environmental impact statement will be prepared. This analysis fulfills the requirements of the National Environmental Policy Act, the President's Council on Environmental Quality regulations, Department of Defense Directive 6050.1 and Air Force Instruction 32-7061.

Accepted By: _____ Date: 20 JAN 2006
CYNTHIA L. GOOCH, GS-12
Chief, Environmental Quality
Environmental Planning Function
Environmental Management Division

Approved By: _____ Date: 22 JAN 2006
D. BRENT WILSON, PE
Base Civil Engineer

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ACRONYMS AND ABBREVIATIONS

AF	Air Force
AFB	Air Force Base
AFI	Air Force Instruction
AFRL	Air Force Research Laboratory
AGL	Above Ground Level
AMSL	Above Mean Sea Level
ANSI	American National Standards Institute
AZ	Arizona
BLM	Bureau of Land Management
CAA	Clean Air Act of 1970
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
DE	Directed Energy Directorate
DEIS	Draft Environmental Impact Statement
DEOS	Safety, Security and Facilities Branch
DoD	Department of Defense
EA	Environmental Assessment
e.g.	Exempli Gratia
ER	Environmental Restoration
ESA	Endangered Species Act
° F	Degrees Fahrenheit
FAA	Federal Aviation Administration
ft	Foot/Feet
FY	Fiscal Year
GPS	Global Positioning System
HAMPP	High Altitude Mobile Pointing Platform
hp	Horse power
Hz	Hertz
IR	Infrared
IRP	Installation Restoration Program
KAFB	Kirtland Air Force Base
kg	Kilogram
km	kilometer
Laser	Light Amplification Stimulated by Emission by Radiation
lbs	Pounds
m	Meters

mi	Miles
micron	Micrometer
mm	Millimeter
mph	Mile(s) Per Hour
MSL	Mean Sea Level
° N	Degrees North
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
nm	Nanometer
NM	New Mexico
NOAA	National Oceanic & Atmospheric Administration
NORAD	North American Aerospace Defense Command
NRHP	National Register of Historic Places
OSHA	Occupational Safety and Health Act
RF	Radio Frequency
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SOR	Starfire Optical Range
UHF	
US	United States
USAF	United States Air Force
° W	Degrees West

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1.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

The National Environmental Policy Act (NEPA), the Council on Environmental Quality Regulations implementing NEPA (40 CFR §§1500-1508), and Department of Defense (DoD) Directive 6050.1 direct that DoD officials take into account environmental consequences when authorizing or approving major Federal actions. This Environmental Assessment (EA) presents an analysis of the environmental consequences of conducting activities in support of development of High Altitude Mobile Pointing Platform technology.

1.1 Purpose of and Need for Action

The purpose of HAMPP is to investigate technology that would provide optical tracking with a near space platform. To meet these requirements, AFRL Directed Energy (AFRL/DE) would design a High Altitude Mobile Pointing Platform (HAMPP) Program to demonstrate tracking and laser propagation with the ground via an optical telescope beam director at an altitude of approximately 100,000ft (30km) and a maximum range of 350km. The beam director would also be used in horizontal ground tests between the SOR ground site and the SOR two-mile remote site. Thirty flights would be performed per year to collect health and status data from payload components, basic gimbal pointing information, and infrared (IR) and visible camera images of the platform components, the system and the site at SOR on Kirtland Air Force Base (KAFB).

Testing of a near-space high-altitude platform is needed to demonstrate a small tracking telescope and low power laser with appropriate sensors can acquire and track a telescope on the ground at the SOR. Historically, SOR has used space objects (e.g., stars, orbiting satellites) or horizontal path tests with lab instrumentation at both ends. These flights would collect health and status data from payload components, basic gimbal pointing information, and infrared (IR) and visible camera images. Flights would be instrumented with thermal sensors and accelerometers. For all flights, eye-safe and invisible lasers would be propagated from the HAMPP to the ground and from the ground to the HAMPP. Communication with the ground site would be accomplished through radio frequency (RF) using a high-bandwidth Ethernet link module provided by AFRL/VS.

1.2 Program Overview

Balloons have historically played an important role in high-altitude data collection. Since the 1950s, scientific experimentation using balloons has contributed substantially to our understanding of the near-Earth and space environments. In the mid-1980s, the Livermore Observables Program at Lawrence Livermore National Laboratory in California performed high-resolution, high-altitude data collection for target discrimination and aimpoint selection. The concept of a balloon-borne platform launched from ground level was identified as a means of providing the desired high-altitude data gathering capability less prone to atmospheric distortions of data and altitude limitations of aircraft.

Testing of optical technology at SOR has historically used space objects (e.g., stars, orbiting satellites) or horizontal path tests with lab instrumentation at both ends. AFRL/DE has been developing lasers, communication links and imaging since the early 1970's. For this activity, AFRL DE has teamed with AFRL/VS, who has launched and flown in excess of 3,000 balloon platforms since 1947. AFRL/VS has well-established procedures for ground tests, pre-flight checks, launch, tracking, and recovery.

1.3 Scope of Environmental Resources

The scope of the environmental analysis in this document has been limited to the environmental issues relevant to implementing the proposed action or its alternatives. The following environmental parameters

are appropriate and relevant for discussion on the "affected environment" and "environmental consequences" sections: land use/airspace, air quality, safety and occupational health, hazardous materials/waste, biological resources, cultural resources, geology and soils, and cumulative impacts.

Evaluation of the proposed action and alternatives reveals that several parameters/resources are not affected and do not generate relevant consideration. Parameters which have been considered but rejected from further study include surface and ground water resources, domestic and industrial waste treatment, stormwater, petroleum/oils/lubricants, herbicides and pesticides, and underground storage tanks.

Launches of the HAMPP balloon are proposed at only two locations in Texas, Lubbock and Amarillo, which are similar to proposed launch locations in eastern New Mexico. Specifically, performance and operational protocols require the HAMPP to be launched from level surfaces, preferably paved, that are previously disturbed. This analysis assumes previously disturbed launch surfaces in Texas are similar to previously disturbed launch surfaces in New Mexico. No landings are expected in Texas locations. As a result, this analysis primarily focuses on the New Mexico and Arizona environment.

1.4 Other Environmental Assessments

This EA closely follows a previous EA and Finding of No Significant Impact prepared for the Ballistic Missile Defense Organization (BMDO) Balloon Program, dated June 1993.
Summary of the BMDO Balloon Program Environmental analysis is as follows:
The U.S. Department of Defense BMDO proposed to an action to develop, launch, operate and test the High Altitude Balloon Experiment (HABE) and the Kestrel Balloon Experiment and to conduct a data collection program. Objectives of the program were to demonstrate the capability to acquire, track and point at targets having various trajectories at varying altitudes; measure the target and background radiometric observables of rocket motors in their boost phase; and collect data on the phenomenology of rocket booster signatures. These objectives would be accomplished using passive and active electro-optical laser sensors and other instrumentation that would be launched on large volume, high altitude balloons to observe target-of-opportunity missile launches from several locations. Launches were proposed at Vandenberg AFB, California; Cape Canaveral AFS, Florida; and White Sands Missile Range, New Mexico. Findings from the environmental analysis focused on the recovery of the balloons and payload which could be on land or water for either the HABE system or the Kestrel system. The descent of the payload and the balloon could be controlled with reasonable accuracy, and would not be initiated until a projected clear area was available for landing. No significant impacts were expected to result from the launch, flight, operation, or recovery of the HABE or Kestrel systems.

1.5 Decision to be Made

The decision to be made by the AF is to proceed with flight tests in remote locations in New Mexico, Arizona and Texas to demonstrate tracking with the ground via an optical telescope, or to take no action.

1.6 Environmental Permits, Licenses and Entitlements

Coordination with the Federal Aviation Administration (FAA) is required to accomplish the proposed flight tests. The Class 1 laser would be certified by the AF in accordance with the American National Standard Institute's (ANSI) Standard for Safe Use of Lasers (ANSI Z136.1 – 2000). Written permission would be obtained from the airports in each launch location for the placement of vehicles on existing roadways and runways. Coordination with the USFWS and the SHPO for NM and AZ are underway and would be completed prior to implementation of the proposed action. No other agency permits would be required.

2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.1 Description of Proposed Action

AFRL is performing research on laser propagation in the atmosphere at the SOR located on Kirtland AFB. To meet the current mission and technical goals of this program AFRL proposes a series of approximately thirty flight tests per year in New Mexico, Arizona and Texas to develop, integrate, and test technology for a laser tracking experiment utilizing a balloon-borne payload. The HAMPP Program is required to facilitate development of this technology, and would be part of the balloon assembly. AFRL/DE and AFRL/VS Directorates plan to provide technology integration for HAMPP starting in approximately January of 2006 and ending in approximately December of 2007. The HAMPP Program would demonstrate tracking with the SOR via a small beam director optical telescope at an altitude of approximately 100,000ft (30km) and a maximum range of 350km. The HAMPP beam director telescope would also be used in horizontal ground tests between the SOR ground site and the SOR's two-mile remote site.

The HAMPP flight program would begin January 2006 and last approximately 2 years. There would be approximately thirty launches per year at various locations across New Mexico, Arizona, and Texas; including Portales, Socorro, Grants, Gallup, Quemado, Belen, Los Lunas, Estancia, Roswell, Carizozo, Logan, Clovis, Ft. Sumner, Cannon AFB, Farwell, Tucumcari, Santa Rosa, Moriarty, and Willard in New Mexico; Window Rock, Springerville, and Holbrook in Arizona; and Amarillo and Lubbock in Texas (Figure 1). Launch and recovery of the balloon would be determined on normal weather patterns and those related to the seasonal winds called the "turnaround" – in summer, launches would occur in the east and recover in the west; in winter, launches would occur in the west and recover in the east. The AFRL/VS Balloon Program team would launch the high altitude balloon configured with the instrumented HAMPP package from a location providing the best flight path. During periods of the "turnaround," about two weeks in May and September, launches would take place continuously over a span of four to eight days, depending on the support capabilities of the AFRL/VS Balloon Program. Once a launch site is selected, the AFRL/VS Balloon Program team would launch the high altitude balloon configured with the instrumented HAMPP package. All launch sites considered must have the following characteristics: hard packed earth surface or paved airfield with approximately a 400ft x 200ft runway, hangar space to integrate the payload, permission from airfield manager and an FAA approved balloon system.

In the weeks preceding the flight, AFRL/VS can approximate the payload's trajectory given historical climatological data. Three days before the planned flight, AFRL/VS is able to project a more accurate trajectory for the balloon and payload using the data taken from National Oceanic & Atmospheric Administration (NOAA) weather models. These models are continually updated using the latest meteorological data and provide the most timely and accurate data for balloon launch and recovery activities. The models are developed using an extensive database of wind data collected by both NOAA and the USAF Weather Agency over the course of the past 30 years. Once the payload is launched, AFRL/VS would maintain a Global Positioning System (GPS) track on the balloon throughout the mission to constantly evaluate possible landing sites. Tracking the balloon is accomplished by importing real-time GPS coordinates transmitted from the balloon to the ground station. These coordinates are updated once every second and are accurate to within ten meters. The coordinates are transmitted to the ground station via a continuous UHF RF signal and redundant Iridium satellite communication system. The data is then overlaid onto a flight control mapping software program for location reference. In addition to the AFRL/VS flight control and tracking systems, the balloon is equipped with an FAA-approved transponder with altitude encoding to 62,000 ft.

Landing and recovery sites would be planned to avoid wilderness areas, Native lands, populated areas, surface waters, mountainous areas, national parks, and other cultural and natural resources to avoid environmental impacts, prevent damage to the balloon assembly and facilitate recovery.

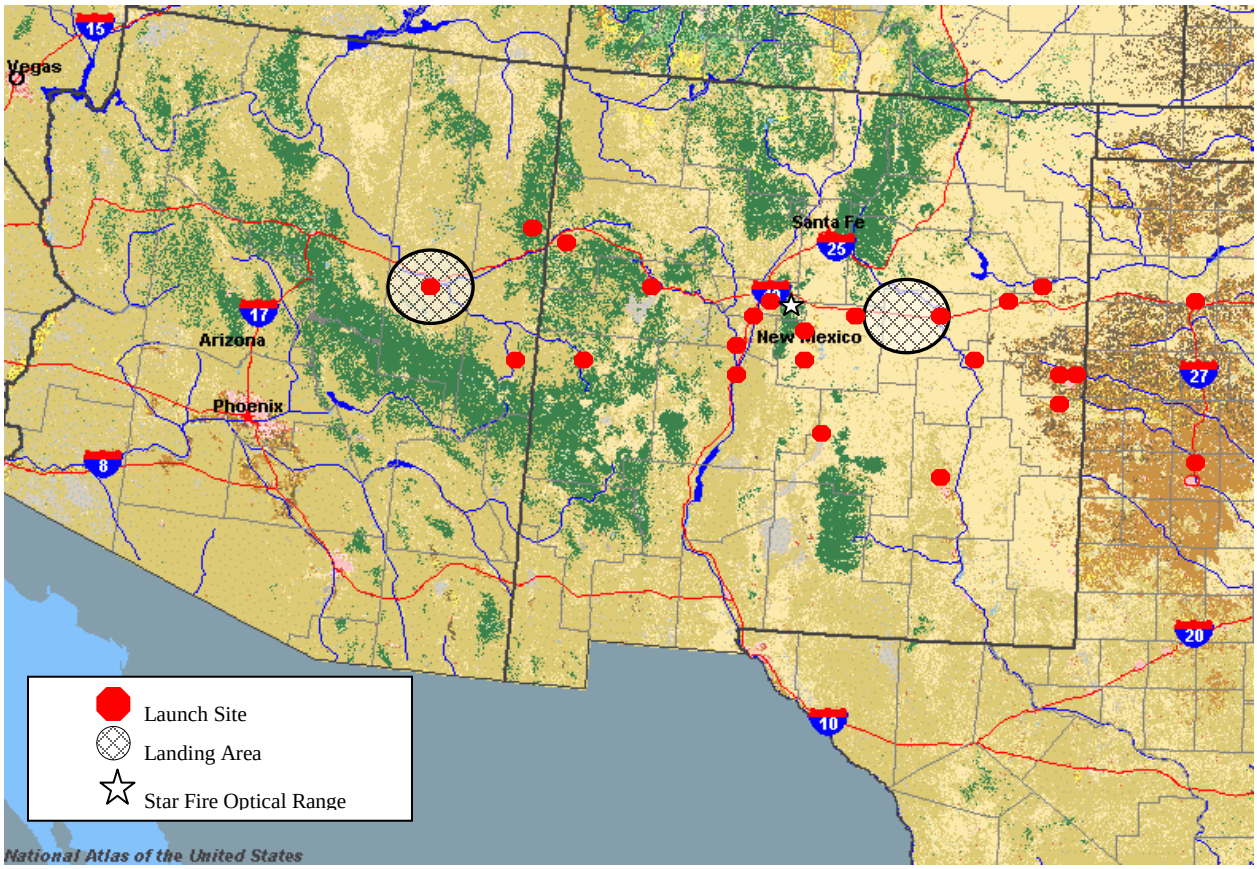
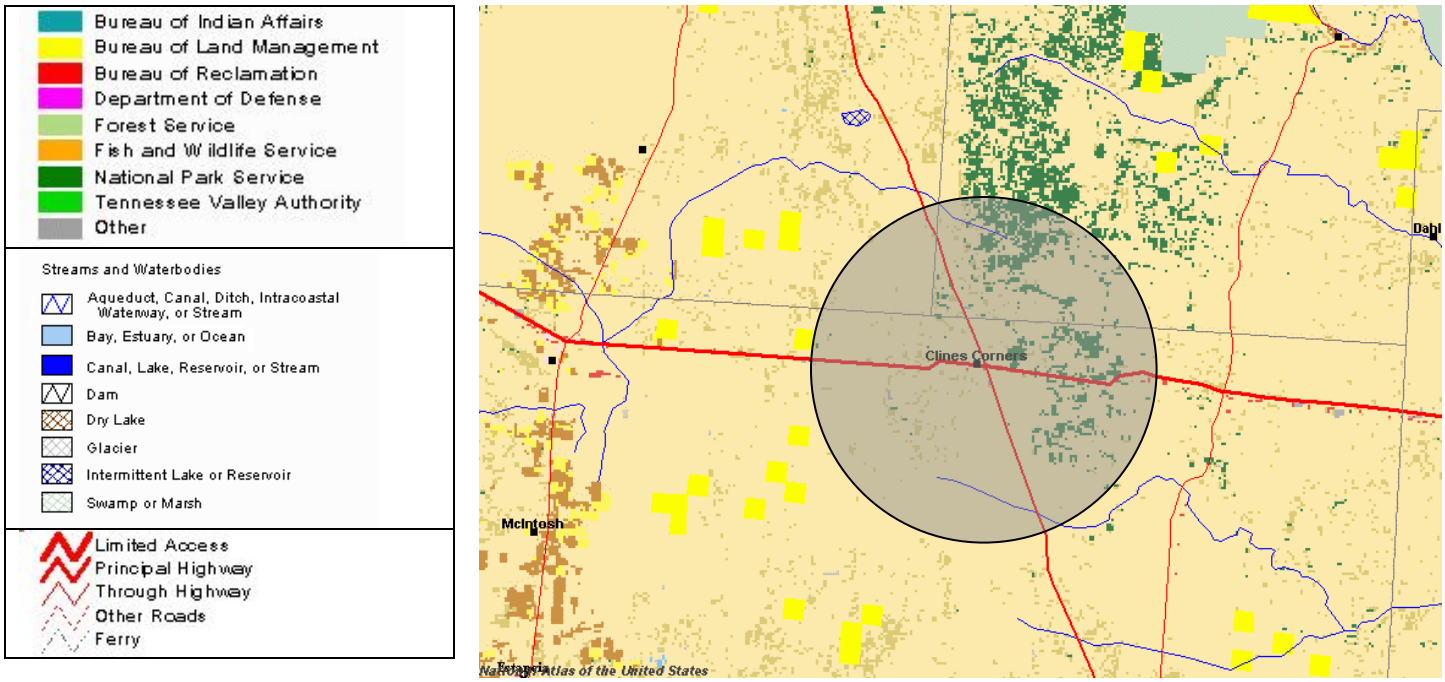
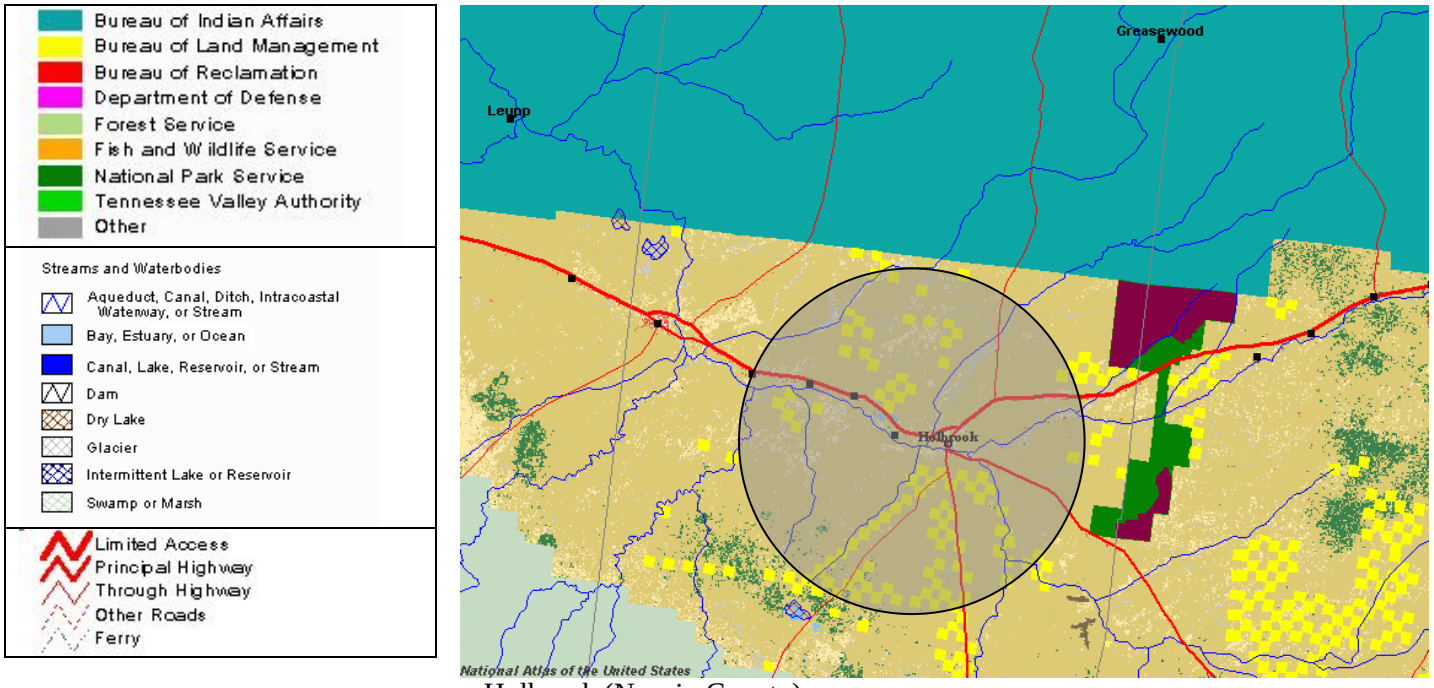


Figure 1. Proposed Launch Sites and Potential Landing Areas

Preferred landing sites shown in Figure 2, near Clines Corners and Santa Rosa, NM (Torrance County) and near Holbrook, AZ (Navajo County) are in previously impacted areas such as Bureau of Land Management (BLM) or similar properties which were disturbed by previous cattle grazing, logging and farming activities. AFRL/VS would make the final flight termination decision to release the payload based upon the foregoing requirements and public safety. Payloads typically land within five miles of designated target locations.



Clines Corners (Torrance County)



Holbrook (Navajo County)

Figure 2. Proposed Landing Locations

TEST ITEM DESCRIPTION

Balloon and Gondola

The gondola weighs about 150 lbs. HAMPP hardware weighs about 300 lbs, with 300 lbs of batteries. The total weight of HAMPP and gondola hardware or payload, control systems, parachute, and ballast approaches 1300 lbs. The gondola is rated to carry up to 2000 lbs. The balloon weighs 800 lbs. with a volume of 2 million cubic foot (mcf), see Figure 3. The dimensions and characteristics of the balloon are:

Balloon

Made of Stratofilm Polyethelene Plastic, 1.5 mil thickness (triple thickness of standard balloons)
Inflated Length: 136.1'
Inflated Diameter: 172.4' Radar reflective yarn installed by manufacturer every 3rd gore, 21 yarns total.
Satisfies FAA requirement
~80,000 cubic feet of helium required
2 Strobes required by FAA for Collision Avoidance
Satisfies FAA requirements for visibility at or beyond 5 miles
One strobe mounted atop balloon, the other on the gondola
Strobes active while balloon transiting FAA controlled airspace

Tufts Termination System

Purpose: Separate gondola from balloon, dump parachute upon landing
Used on more than 1,100 Flights
0 flight failures
Each Tufts employs two S-68 2-grain squibs[a squib is a standard device for explosive controlled cutting of these types of systems, it has ½ the charge of a .22 caliber long cartridge] to actuate mechanical release
Tufts releases even if only 1 squib fires
Load rated for 10,000 lbs

Parachute

Return Payload Safely
Built 1973
64' Diameter G-12 Cargo Parachute
Return HAMPP payload at 22.6 fps
Satisfies FAA requirement for hi-visibility
0 failures in last 30 years
In-line configuration used by every balloon program throughout the world

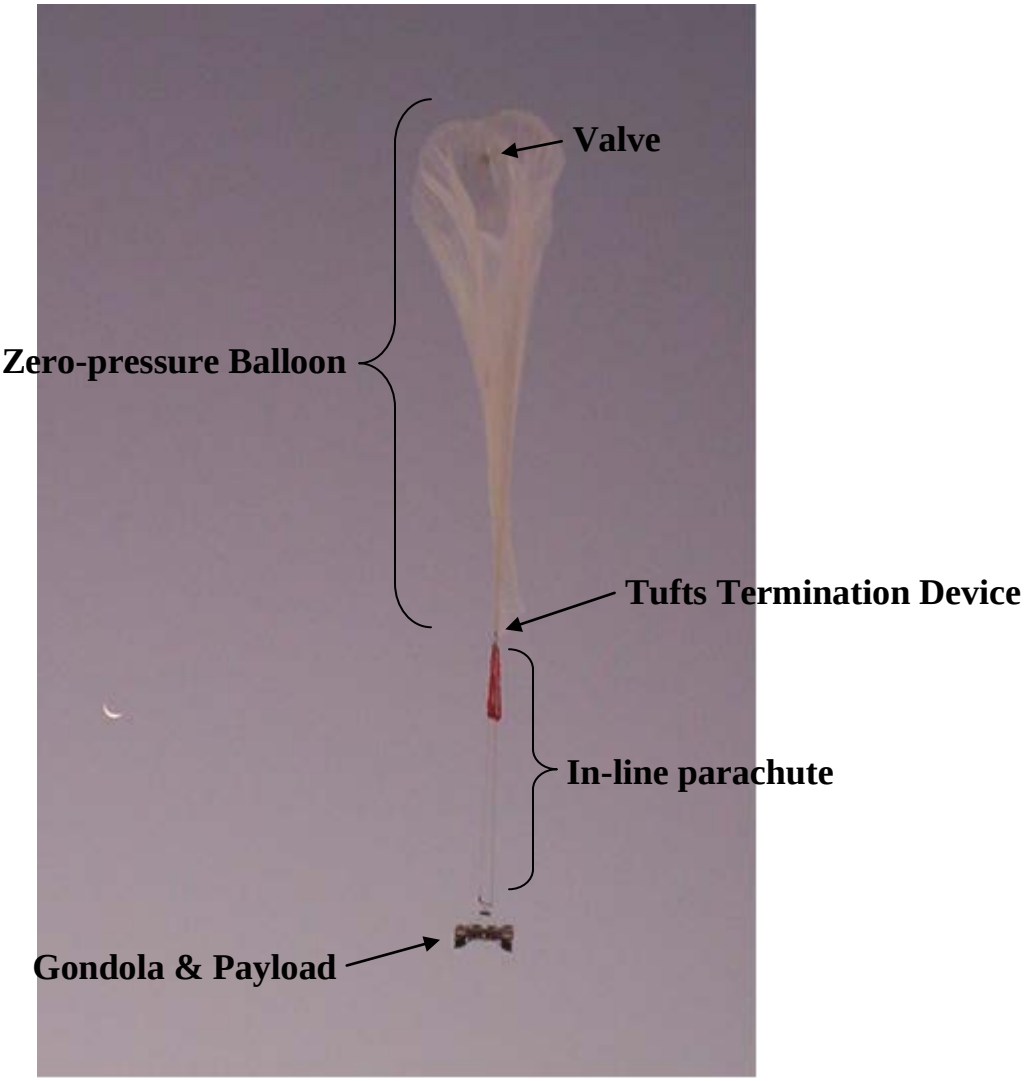


Figure 3. Typical balloon with gondola

HAMPP

The HAMPP platform shown in Figure 4 contains the following equipment:

Attitude sensor to determine orientation

GPS sensor to determine position

Power distribution system to take battery power and provide appropriate voltages to all components

HAMPP Balloon-Borne Interface Telescope (HOBBIT) – optical telescope for tracking and laser propagation

HAMPP controller to record thermal and acceleration measurements, communicate with ground station, receive data from HOBBIT and provide commands to HOBBIT

Laser transceiver and optical amplifier for laser propagation to the ground and reception of ground laser

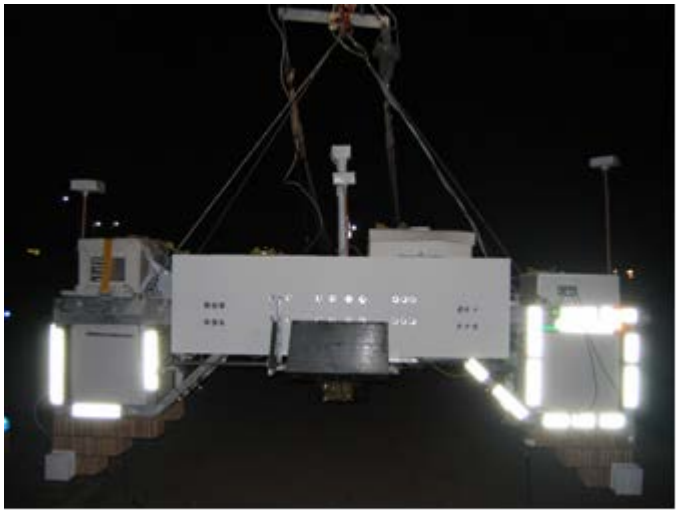


Figure 4. HAMPP system integrated on AFRL/VS gondola and ready for flight

AFRL/VS balloon control system box and battery boxes are shown on top. Crush padding is underneath ballast boxes on both sides to protect the HAMPP system.

Hardware would be bolted to the AFRL/VS gondola shown in Figure 5. The gondola, dimensions are 10' x 2' x 2', would also have protective doors that would swing closed under the HOBBIT optics subsystem before payload termination. These doors would protect the optics from landing hazards such as rocks and bushes.

Figure 5. Aluminum unistrut gondola

The HAMPP system would be suspended from a 2 million cubic foot (mcf) balloon similar to that shown in Figure 6.

Figure 6. Balloon being filled with helium for launch

The HOBBIT shown in figure 7 consists of optical components, two brushless DC motors, motor drivers, infrared (IR) camera, fast steering mirror (FSM), and optics control computer. The telescope and gimbal system is less than 1x1x1 ft^3 in size.

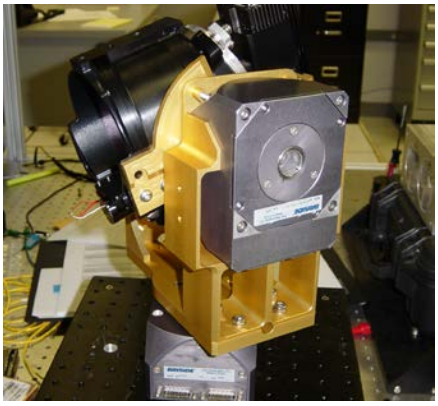


Figure 7. HOBBIT optical telescope

Lasers

HAMPP flights will utilize a laser beam for downward illumination from the HAMPP optics telescope and a laser beam for upward illumination from the 1.5m telescope located at SOR on Kirtland AFB. All lasers are eye-safe and invisible. All power will be contained in beam train or fiber until expanded as described for free space propagation.

Downward Beam:

The downward beam from the HAMPP will be from a 2W, 1530-1570nm wavelength, polarized, continuous wave laser. The beam will be Gaussian with a waist diameter of 9.0cm from a 10cm aperture, total power out of 1W waist at the aperture (no focusing). The output from this laser will be eye safe at the aperture.

Upward beam:

The upward beam is from a 4W, 1530-1570nm wavelength, polarized, continuous wave laser. The beam will be Gaussian with a waist diameter of 15.3cm from a 17cm aperture (no focusing). The output from the transmit aperture will be a total of 1.5W or less from a 17cm aperture, with a 15.3cm beam waist..

Light from the laser goes through a beam expander and is reflected upward from a mirror and passed to the telescope. The output from the telescope will be kept at an eye safe level. The irradiance is at eye safe levels throughout the path of propagation.

AFRL/VS Ground Station

The AFRL/VS ground station shown in figure 8 would be placed at the SOR on Kirtland AFB. The ground station would track the payload and receive telemetry data over an RF link. The data would be sent via Ethernet cable into the AFRL/DE ground station computer in the SOR ground station control room.

Tracking Methods:
GPS via Iridium link
GPS via RF link
FAA transponder
Sounding Rocket Tracking Beacon
Termination Redundancies:
Flight Control through PC104 System
Independent RF link
Pre-set Termination Timer

Figure 8. AFRL/VS ground station

FLIGHT TESTS

High-altitude balloon operations typically involve laying the balloon out on the ground, inflating it with helium and releasing it. The filled balloon rises as it is towed, and once vertical, is released from the tow vehicle. A series of thirty flights per year would be performed to collect data from the HAMPP system.

FLIGHT PARAMETERS

Flight tests require 75% clear skies with thin clouds, and winds of no greater than ten knots. Weather determination would be made by AFRL/VSE Program Manager.

When launched, the balloon ascends to altitude at an average rate of 1000 ft/min. Thus, it takes about 1.5—2 hours for the balloon to reach 100,000 ft. Tracking of the balloon is accomplished using GPS coordinates telemetered to the ground through Iridium, S-Band and UHF telemetry streams.

Conditions which may result in early termination are:

- Leak in balloon

- Winds shifted in a direction which would lead to a significantly more difficult or dangerous recovery
- Safety to the public or AFRL staff
- Significant impact to the environment

Termination for safety reasons would be a unilateral decision by AFRL/VS. AFRL/VS personnel would constantly monitor the balloon's flight path and evaluate potential landing sites. If the balloon appears to be heading toward a populated area, AFRL/VS would terminate the payload early to land in an unpopulated area. Payloads typically land within five miles of the target area. AFRL/VS have many years of experience determining landing sites and accurately predicting landing locations to reduce any possible threat to public health or environmental resources. The balloon flight path would be planned to ensure the payload would not drift towards a populated or area of cultural significance.

TEST AND SUPPORT VEHICLES
AFRL/VS would transport the payload to the launch site in a hitched trailer.
The AFRL/VS ground station would be located in a trailer at the SOR site at Kirtland AFB
Launch site at the airport of each launch site
AFRL/VS ground station located at the SOR site at Kirtland AFB
Facilities/Test Range
HAMPP ground station at SOR
Support Requirements
HAMPP ground support equipment at the launch site would consist of power supplies and computers.
AFRL/VS would provide ground support equipment.

MEASUREMENTS
All flights would test environmental and functional performance of the HAMPP system at high altitude. Payload would be tracked and monitored at the SOR on Kirtland AFB in Albuquerque NM. Flight goals are to gather as much data as possible on pointing, acquisition, and tracking performance.

2.2 Alternatives to the Proposed Action

Alternatives to the Proposed Action were considered, including the No Action alternative, performing flight tests at other locations, and using other flight platforms.

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY
AFRL/DE considered using an airplane to carry HAMPP equipment instead of launching with a high altitude balloon. However, the ability to place a scientific payload at an altitude above 26 km results in greatly enhanced quality of data relevant to mission success. Such altitudes are beyond the sustained capabilities of aircraft. This option is not considered viable since aircraft would not be able to loiter at 100,000 ft to collect representative test data. Aircraft would have considerably less dwell time over the target, and it would prove a more expensive option in operations and crew costs.

Other locations were considered, for example White Sands Missile Range (WSMR) and Holloman, but other locations are impractical given the fixed location of the telescope at the SOR facility on Kirtland AFB. The flight path must be line of sight to the SOR and these locations would not provide the appropriate flight path. Additionally, the flight path consistent with a one to four day test could not be contained with WSMR, and therefore would not preclude the considerations and concerns addressed by this EA.

NO ACTION ALTERNATIVE

Do not perform flight test experiments. The no action alternative would result in no impact on the environment. However this alternative would severely impact high-priority, high dollar value programs whose success is critical to the long term national defense posture of the United States.

PREFERRED ALTERNATIVE
Conduct tracking experiment flight tests in New Mexico, Arizona, and Texas, where favorable atmospheric conditions and weather exists for flight tests. There would be approximately thirty launches per year at various locations across New Mexico, Arizona, and Texas, including Portales, Socorro, Grants, Gallup, Quemado, Belen, Los Lunas, Estancia, Roswell, Carizozo, Logan, Clovis, Ft. Sumner, Cannon AFB, Farwell, Tucumcari, Santa Rosa, Moriarty, and Willard in New Mexico; Window Rock, Springerville, and Holbrook in Arizona; and Amarillo and Lubbock in Texas. To facilitate the test series, support facilities, laboratories, manpower and equipment are required in conjunction with favorable environmental conditions. AFRL/DE and AFRL/VS would provide all required resources for the preferred alternative.

3.0 Affected Environment

The scope of the environmental analysis has been limited to the environmental issues relevant to implementing the proposed action or alternatives. The following environmental parameters are appropriate and relevant for discussion on the "affected environment" and "environmental consequences" sections: land use/airspace, air quality, safety and occupational health, hazardous materials/waste, biological resources, cultural resources, geology and soils, and cumulative impacts.

Evaluation of the proposed action and alternatives reveals that several parameters/resources are not affected and do not generate relevant consideration. Parameters which have been considered but rejected from further study include surface and ground water resources, domestic and industrial waste treatment, stormwater, petroleum/oils/lubricants, herbicides and pesticides, underground storage tanks and socioeconomics.

All launch sites considered must have the following characteristics: hard packed earth surface or paved airfield with approximately a 400ft x 200ft runway, hangar space to integrate the payload, permission from airfield manager and an FAA approved balloon system. Landing and recovery sites would be planned to avoid wilderness areas, Native lands, populated areas, surface waters, mountainous areas, national parks, and other cultural and natural resources to avoid environmental impacts, prevent damage to the balloon assembly and facilitate recovery. Preferred landing sites shown in Figure 2 are primarily in Torrance County and Navajo County and would be performed in previously impacted areas such as Bureau of Land Management (BLM) or similar properties which were disturbed by previous cattle grazing, logging and farming activities.

Launches of the HAMPP balloon are proposed at only two locations in Texas, Lubbock and Amarillo, which are similar to proposed launch locations in eastern New Mexico. Specifically, performance and operational protocols require the HAMPP to be launched from level surfaces, preferably paved, that are previously disturbed. This analysis assumes previously disturbed launch surfaces in Texas are similar to previously disturbed launch surfaces in New Mexico. No landings are expected in Texas locations. As a result, this analysis primarily focuses on the New Mexico and Arizona environment.

New Mexico

TOPOGRAPHIC FEATURES – New Mexico, fifth largest State in the Union, with a total area of 121,412 square miles, is approximately 350 miles square, and lies mostly between latitudes 32° and 37° N and longitudes 103° and 109° W. The State's topography consists mainly of high plateaus or mesas, with numerous mountain ranges, canyons, valleys, and normally dry arroyos. Average elevation is about 4,700 feet above sea level. The lowest point is just above the Red Bluff Reservoir at 2,817 feet where the Pecos River flows into Texas. The highest point is Wheeler Peak at 13,161 feet. The principal sources of

moisture for the scant rains and snows that fall on the State are the Pacific Ocean, 500 miles to the west, and the Gulf of Mexico, 500 miles to the southeast. New Mexico has a mild, arid or semiarid, continental climate characterized by light precipitation totals, abundant sunshine, low relative humidity, and a relatively large annual and diurnal temperature range. The highest mountains have climate characteristics common to the Rocky Mountains.

The State is divided into three major areas by mountain ranges and highlands, oriented in general north-south directions, which merge in the north. The Northern Mountains and Central Highlands, between longitudes 105° and 106° W, are the western boundary of the Northeastern and southeastern Plains which slope gradually eastward and southeastward. The northern part of these eastern plains lies within the Arkansas River Basin and is drained mostly by the Canadian River, which flows southward then eastward into Oklahoma to its confluence with the Arkansas, and the Cimarron River in the extreme northeastern corner. The Pecos River starts in the Sangre de Cristo Mountains and flows southward through the Southeastern Plains into Texas, and then southeastward to join the Rio Grande. West of the mountain ranges that forms the Continental Divide, whose height decreases to a markedly lower elevation in southern New Mexico, rivers drain into the Gulf of California through the Colorado River system. Principal tributaries flowing westward into the Colorado River are the San Juan River in the north, the Gila River in the south, and the San Francisco tributary of the Gila and other headwater streams of the Little Colorado River in the west-central area. The largest closed basins in the west are the Plains of St. Augustine in Catron County and the Rio members Basin in Grant and Luna Countries. Between the Northern Mountains and the Central Highland system and the Continental Divide system is the Rio Grande Valley which widens toward the south. The Rio Grande begins in the San Juan Mountains of southern Colorado, flows southward through New Mexico, then southeastward along the Texas-Mexico border into the Gulf of Mexico. The closed Tularosa Basin in southern New Mexico is an intermountain area east of the Central Valley.

Mean annual temperatures range from 64° F in the extreme southeast to 40° F or lower in high mountains and valleys of the north; elevation is a greater factor in determining the temperature of any specific locality than its latitude. This is shown by only a 3° F difference in mean temperature between stations at similar elevations, one in the extreme northeast and the other in the extreme southwest; however, at two stations only 15 miles apart, but differing in elevation by 4,700 feet, the mean annual temperature are 61° and 45° F – a difference of 16° F or a little more than 3° decrease in temperature for each 1,000-foot increase in elevation.

Balloon flight path and landings are subject to wind and weather. The most probable landing locations are shown on figure 1, near Santa Rosa and Clines Corners in Torrance County.

Arizona (Window Rock, Springerville, and Holbrook– Navajo County)

TOPOGRAPHIC FEATURES - The Mogollon Rim divides the County into two distinct regions. The high country in the northern part of the county is arid and desert-like with empty flat-topped mesas, isolated buttes and valleys, and smaller plateaus. The primary vegetation is sagebrush, short grasses, and some juniper and piñon. The Little Colorado River is the key geographic feature of Navajo County. It flows generally west-northwest, from the Apache County border on the east to the Navajo Indian Reservation boundary across the northern portion of the county to the Coconino County border on the west. The southern portion of the county is rugged mountain area, heavily wooded with piñon-juniper and ponderosa pine, with many lakes and streams. Elevations vary from 4,850 feet near Winslow to 7,575 feet at the Mogollon Rim.

The climate of Navajo County is classified as semi-arid or sub-humid. This dry climate is a consequence of the low relative humidity and abundant sunshine that are prevalent for much of the year. Relative humidity may fall as low as 10% in June, when the sun shines 80% to 85% of daylight hours. Two or

three days of total cloud cover is rare at any time of the year, and five to eight consecutive days without a trace of clouds is a common occurrence during the dry months of May and June.

Balloon flight path and landings are subject to wind and weather. The most probable landing locations are shown on figure 1, near Holbrook in Navajo County.

3.1 Land Use/Airspace Use

FAA regulations designate airspace assignments and prescribe the requirements for use of restricted and prohibited areas. FAA regulations specify general operating and flight rules for aircraft within the United States. FAA Regulations also prescribe the allowable activities regarding launch, flight and recovery of unmanned balloons. (14 CFR, PART 101, Air Traffic and General Operating Rules, Subpart B Moored Balloons, Kites, Unmanned Rockets and Unmanned Free Balloons)

Launches across New Mexico, Arizona, and Texas would be performed at existing airfields and airport runways. All launch sites considered must have the following characteristics: hard packed earth surface or paved airfield with approximately a 400ft x 200ft runway, hangar space to integrate the payload, permission from airfield manager and an FAA approved balloon system.

3.2 Air Quality

Sites across New Mexico, Texas and Arizona are small towns with relatively small airfields. The HAMPP balloon launches do not emit any toxic pollutants nor will they create any fugitive dust.

3.2.1 New Mexico – Regional air quality is relatively high because of the very small number of industrial sources contributing to pollutants. New Mexico also has generally favorable dispersion conditions throughout the state. The major sources of regulated air pollutants include the Four Corners and San Jaun Electric Generating Stations near Fruitland, New Mexico and the Albuquerque metropolitan area. Since ambient pollutant levels are usually near or below the measurable limits for the six criteria pollutants regulated under the Clean Air Act., the USEPA has designated all areas being in attainment for criteria pollutants (nitrogen dioxide, carbon monoxide sulfur dioxide, ozone, lead and particulate matter PM10) except for Albuquerque, NM. Emissions within the Albuquerque/Bernalillo County are not in attainment for carbon monoxide; it is in maintenance status.

3.2.2 Arizona - Regional air quality is relatively high because of the very small number of industrial sources, and generally favorable dispersion conditions existing throughout Arizona. The major sources of regulated air pollutants are located in the larger metropolitan cities of Arizona. Ambient pollutant levels are normally below the measurable limits in Navajo County. Emissions are within the ambient air quality standards for PM10, sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, lead, known as the six criteria pollutants regulated under the Clean Air Act.

3.2.3 Texas - Regional air quality is relatively high because of the very small number of industrial sources, and generally favorable dispersion conditions existing throughout the Lubbock and Amarillo areas of Texas. The major sources of regulated air pollutants are located in the larger metropolitan cities of Texas. Ambient pollutant levels are normally below the measurable limits in Lubbock and Amarillo. Emissions are within the ambient air quality standards for PM10, sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, lead, and the six criteria pollutants regulated under the Clean Air Act.

3.4 Safety and Occupational Health

All sites would require the compliance with FAA regulations and notifications to ensure flight safety. AFRL would comply with all OSHA, Air Force OSH Standards and specific Air Force Test Safety Review instructions AFI 91-202, AFMC Sup 1 and AFRL I 91-101. Specific Air Force test and safety plans would be prepared for review and approval prior to program execution.

3.5 Hazardous Materials/Waste

The Resource Conservation and Recovery Act of 1976 establishes guidelines and standards for hazardous waste generation, transportation, treatment, storage and disposal. Transportation of hazardous materials requires the compliance with Department of Transportation regulations provided in Title 49 CFR. Although small quantities of hazardous materials used for battery power and termination devices would be used, no hazardous wastes would be generated for the flight test series. Helium is an inert gas used to fill the balloon, and batteries are used on-board the HAMPP to power equipment.

3.6 Biological Resources

The Endangered Species Act of 1973 requires that Federal Agency actions do not jeopardize the existence of threatened or endangered species or destroy or adversely impact critical habitats of such species. Threatened and endangered species that may occur near launch and recovery sites across New Mexico, Arizona and Texas are listed in Appendix A. All launches would be performed on previously disturbed areas associated with the local airfield.

3.6.1 New Mexico Vegetation

New Mexico has such a great range of elevations that all four of the zones of vegetation into which the South-West has been divided according to altitude are found within its limits; namely, the zone of cactus, yucca and agave (3000-3500 ft.), where grass is scanty; the zone of greasewood and sage-brush (3500-4900 ft.), where there is little grass, and the cactus species are less numerous; the zone of the cedar (4900-6800 ft.); and the zone of the pine and fir (6800 - 10,800 ft.), in which grass is more abundant. The total woodland area has been estimated at 23,700 sq. m., or a little more than 19% of the land area. Only the higher ranges and plateaus are timbered, and even there the forests are not dense. The lower slopes are usually covered with the scrub oak, juniper and piñon; but some mountains, especially those along the eastern border of the Rio Grande Valley, are absolutely treeless. The principal forest areas are upon the southern end of the San Juan Range, upon the Sangre de Cristo Range and in Socorro County, west of the Rio Grande. The chief varieties of timber are the red fir, Engelmann's spruce and willow. In the valleys the only trees native to the soil are the willow and cottonwood, found along the water-ways, and beyond the range of irrigation vegetation is limited to scanty grass, with sage-brush and greasewood in the north and cactus and yucca in the south. Since Torrance County is the area most probable for landing and recovery the typical vegetation affected would consist of piñon -juniper, grasses, sagebrush, and scrub oak.

3.6.2 Arizona Vegetation

Navajo County supports several woodland vegetation zones. Lower elevation areas with limited precipitation support a Chaparral woodland type with Emory (live) oak, Manzanita and a variety of shrubby woodland vegetation. Where precipitation averages between seven and sixteen inches annually, the piñon -juniper woodland type exists. Mid-elevation areas, generally between 6,000 and 8,000 feet, with precipitation averages between sixteen and twenty-four inches annually support the Pine-Oak woodland type.

In those areas where woodland types do not dominate, there are expansive areas of grassland in Navajo County. This is prairie grassland and is found in the areas boarding the Puerco and Little Colorado Rivers extending thirty or more miles to both the north and the south. This vegetative type thrives in the low moisture regions where the woodland types are not sustainable. There are a wide variety of grasses throughout this area with blue grama, black grama, cheat grass, fescue, threeawn, ring muhly, sand dropseed, Indian ricegrass, needle and thread grass, and alkali sacaton as the most important. There is a shrub, or browse, component throughout the area concentrated in draws, washes, and sandridges and in areas of saline-alkali soils. Fourwing saltbush, greasewood, white sage (winterfat), shadscale, snakeweed, rabbitbrush and Mormon tea are the dominant woody browse plants in this area. Along stream areas where there is live water, surface or subsurface, typical riparian plant communities exist. Cotton wood,

box elder, willow, salt-cedar, are the dominant trees species with a multitude of herbaceous broadleaf plants found across the landscape during the rainy season.

3.7 Cultural Resources

3.7.1 New Mexico – BLM New Mexico manages the agency's largest cultural resource program with over 30,000 sites recorded on BLM lands in New Mexico. BLM New Mexico features internationally recognized World Heritage List Chacoan Outliers, the dramatic architecture of 18th century Navajo refugee sites, dry caves and rock shelters containing remarkably well-preserved materials thousands of years old, huge lithic and ceramic scatters that can extend for over a mile in diameter, 2,000-room pueblos that dwarf Pueblo Bonito in Chaco Canyon, outstanding rock art, and many others. See Appendix B for cultural resources located in the Torrance County and Guadalupe County.

3.7.2 Arizona –The cultural resources administered by BLM Arizona are some of the most important and best preserved prehistoric and historic archaeological sites in the American Southwest. These sites span the entire range of human occupation in the New World, from 13,000 years ago to the present. They include properties as diverse as Paleo-Indian mammoth kill sites, Archaic hunting camps, giant ground figures (intaglios), pueblo ruins, rock art, ghost towns, historic ranches, and numerous historic trails and wagon roads such as the Butterfield Overland Stage Route. Nineteen individual properties and Districts are listed on the National Register of Historic Places, and one is a National Historic Landmark. More than 700,000 acres of Arizona public land have been inventoried for cultural resources, and over 10,500 sites recorded.

Eighteen cultural properties have been interpreted and developed for public visitation. Among these are the giant Blythe Intaglios along the Colorado River, the 18th Century Spanish Presidio of Santa Cruz de Terrenate, the historic copper mining town of Swansea, the turn-of-the century Harquahala Peak Smithsonian Solar Observatory, Little Black Mountain Rock Art Site, the Murray Springs Clovis Site where Early Americans killed and butchered mammoth and bison, the 1776 trail of Spanish friars Dominguez and Escalante, the Anza National Historic Trail which is a designated Millennium Trail, and the historic 130-year-old Empire Ranch.

Twelve Areas of Critical Environmental Concern (ACECs), comprising nearly 227,000 acres, were designated entirely or partly to provide special management attention to protect cultural resources. Three National Conservation Areas (NCAs): the San Pedro Riparian NCA, the Gila Box Riparian NCA, and the Las Cienegas NCA, contain numerous significant cultural properties, including the Lehner Mammoth Kill site, a National Historic Landmark. In 2000 and 2001, five new National Monuments were designated, providing special protection and recognition for nearly 2 million acres of BLM-administered lands containing hundreds of highly important cultural properties such as pueblo ruins, hunting camps, villages, trails, prehistoric agricultural fields, rock art and other remains of Arizona's past. See Appendix B for cultural resources located in Navajo County.

3.8 Geology and Soils

3.8.1 New Mexico – The HAMPP balloon experiments launched from sites west of Albuquerque would most likely terminate near Santa Rosa and Clines Corners (Torrance County). The following soils are present in these areas:

3.8.1.1 Aridisols - Approximately 53% of public land in New Mexico are mineral soils that have developed in dry regions. They are light colored; low in organic matter; and may have accumulations of sodium, soluble salts, and lime. Aridisols are common in the desert shrub, sagebrush, and lower piñon - juniper vegetation communities. Without irrigation, Aridisols are not as productive as soils that receive more precipitation and as such, they are slower to respond to changes in management. The Orthid soil suborder is a major component of Chihuahuan Desert Shrub (6%).

3.8.1.2 Entisols - Approximately 16% of public land is made up of mineral soils that lack profile development and are often called young soils. Entisols are formed in recently deposited material that

typically is coarse textured and low in nutrients. They are often found in lower elevations, and arid and semiarid environments supporting desert shrub and sagebrush communities. However they do occur in most of the vegetation cover types in New Mexico, especially sandy washes.

3.8.1.3 Mollisols - Approximately 11% of public land is made up of mineral soils that have thick, dark-colored surface horizons rich in organic matter. They are fertile and extend from mountainous terrain to grasslands where they are most abundant. The suborder Ustolls is the most abundant and they support primarily grassland, chaparral, woodland and forest vegetations types.

3.8.2 Arizona - The HAMPP balloon experiments launched from sites east of Albuquerque would most likely terminate near Holbrook and Window Rock Arizona (Navajo County). The following soils are present in these areas: There are eight basic soil conditions and associations in Navajo County: Deep Loamy and Sandy Soils; Shale Badlands; Shallow Soils on Sandstone and Sandy Shale; Brown Sandy Soils on Sandstone; Hilly, Gravelly, Shallow Soils; Shale and Sandstone Rock; Land Soil on Basalt and Cinders; and Shallow to Deep Soils on the Mogollon Plateau. Each of these soil conditions is characteristically found in association with a general set of climatic, topographic and related physical features.

3.8.2.1 Deep Loamy and Sandy Soils
These soils are mainly members of the Moffat and Sheppard series. Moffat soils are loamy or sandy on the surface, with sandy clay loam subsoil with a distinct lime layer in the lower subsoil. These soils generally develop on gently rolling topography. Sheppard soils are deep and sandy and occur on the broad, high ridges of old dunes. Both of these soil types are found at elevations of 5,000 to 5,700 feet, atop the long narrow mesas that slope sharply down to the eroded shale of the Painted Desert. Vegetation is short-grass, typically, with sparse woody plants and weeds.

3.8.2.2 Shale Badlands
This area consists of dissected sandy, silty and clay-like shale and occurs below the deep sandy loamy mesas. About 85% of the area is devoid of vegetation and classified as badlands. Because of the polychromatic nature of the eroding Chinle shale, this area is known as the Painted Desert. These occur on narrow flood plains and fans, forming a shallow soil cover over the shale where surface-water and wind erosion is mitigated by the accumulation of log gravel and other stabilizing matter. Elevation ranges from 4,500 to 5,500 feet and vegetation, when it manages to grow, is short-grass.

3.8.2.3 Shallow Soils on Sandstone and Sandy Shale
These soils consist of the shallow, very shallow, and stony phases of the Moenkopi series and are found on interbedded sandstone and shale of the Moenkopi formation. Scattered through the western and central sections of this soil-association area are outcroppings and low ridges of dense sandstone; here the soil is very shallow. Elevations in this soil-association area are between 5,000 and 5,500 feet, with short-grass vegetation growing on the gently rolling topography. Permeability is rapid to very rapid.

3.8.2.4 Brown Sandy Soils on Sandstone
These soils are generally shallow and often stony. The surface is loam or fine sandy loam and the subsoil is loam and light clay loam. Usually, soils on sandstone are calcareous throughout the profile. Certain small parcels, where the soil is on old outwash materials, have non-calcareous clay loam or clay subsoil. About 20% of this association area consists of sandstone outcroppings; these may be partially covered by thin layers of sand or loamy sand. The elevation range is 5,500 to 6,000 feet.

3.8.2.5 Hilly, Gravelly, Shallow Soils
These soils are found in association with small, rounded hills and sharp breaks over a parent material which is a mixture of old gravelly outwash deposited on shallow sandstone and on silty or clay-like shale. Thickness of the gravelly outwash material now runs from a few inches to several feet. Texture of the

surface soil ranges from loam, fine sandy loam and sandy loam to gravelly loam and gravelly sandy loam. The topography, at 5,500 to 6,000 feet, is gently to moderate rolling with 2% to 8% slopes. Vegetation is short-grass and soil permeability is slow.

3.8.2.6 Shale and Sandstone Rock Land
Small buttes, ledges and knolls with active erosion distinguish this association area. More than 70% of the land is barren shale and sandstone rock. The rest consists of very shallow soils of the Moenkopi series, supporting sparse vegetation of the piñon -juniper type.

3.8.2.7 Soil on Basalt and Cinders
In southeastern Navajo County is a 6,000- to 7,500-foot high plateau that is completely covered with basalt flows and cinder cones. Soils are very shallow to deep and textures range from clay to loam. Vegetation reflects the differences in soil textures and varies from short-grass to forest.

3.8.2.8 Shallow to Deep Soils on the Mogollon Plateau
On the Mogollon Plateau, soil associations differ greatly because of the wide variations in parent material, which progresses from sandstone to shale or limestone to sand and gravel. Some of the plateau's soils belong to the Show Low, Millard, Elledge, Chevelon, Zeniff and Overgaard series. Alluvial soils are of the Heber, Mogollon and Jacques series. Also in evidence are shallow to moderately deep soils of sand or clay loam over limestone, sandstone and shale. Elevations range from 6,000 to 7,000 feet. Vegetation is forest (primarily Ponderosa Pine) and piñon -juniper.

4.0 Environmental Consequences

This section analyzes the potential impacts to human and environmental resources resulting from the flight testing of the HAMPP balloon platform. No new structures or personnel are anticipated to be required to support the HAMPP activities. Because the launching of a balloon platform is very similar to other ongoing NASA, National Scientific Balloon Facility and past AF Balloon Programs, the proposed HAMPP activities should not result in adverse environmental impacts.

4.1 Land Use/Airspace Use

The HAMPP balloon launch program is not expected to cause any significant impacts on land use or airspace. Permission from each airfield manager would be obtained prior to considering the site for a proposed launch. Proposed launch locations would meet the minimum criteria for launching the balloon, adequate space to fill the balloon with helium, to tow and release the balloon, and hangar space for platform integration. AF personnel would coordinate all balloon launches with the FAA, issue notices to airmen (NOTAMs) and maintain communication to ensure successful mission.

Consultation with the BLM was completed and no comments or specific concerns were identified.

4.2 Air Quality

The HAMPP balloon flight test program is not expected to cause any significant impacts on air quality. HAMPP platform components use small amounts of hazardous materials, described in section 4.4, however they would not cause any air emissions. Any release of helium would occur in the upper atmosphere and would not be expected to result in significant effects on air quality. Helium is a colorless, odorless, tasteless, inert non-toxic gas that would not interact with any other air constituent or contribute to any chemical reaction. Being lighter than air, the released volume of helium would dissipate rapidly as a result of prevailing winds at altitudes of 85,000 to 100,000ft. Eventually, the helium would rise and attain equilibrium in space.

Launch and recovery operations by AFRL/VS personnel would generate temporary and routine air emissions from the launch tow vehicle and vehicles tasked to recover the HAMPP and balloon system. Given the remote locations of these activities and the limited use of search vehicles to two, their

emissions would not pose any potential for significant impact. Negligible quantities of exhaust emissions would result from these activities.

4.3 Safety and Occupational Health

AFRL/DE and AFRL/VS have established test and safety plans that define proper procedure and control of the HAMPP balloon flights in accordance with AF standards, OSHA and FAA requirements. Operations of the HAMPP balloon platform would require coordination with the FAA. The balloon expands as the atmospheric pressure surrounding it decreases and would reach its operating height of 100,000ft within 1-2 hours. Should the balloon fail for any reason, e.g., not inflate properly; AFRL/VS can vent helium to the atmosphere by commanding a valve at the top of the balloon to open. This would cause the balloon to descend to approximately 85,000ft where the gondola would be released and a recovery parachute would be deployed.

Each balloon would comply with FAA requirements; they would be fitted with an approved transponder and two strobe lights to warn nearby aircraft of the balloons presence. All equipment is inspected and tested prior to launch. Once the payload is launched, GPS tracking is maintained throughout the mission during which time possible landing sites are constantly evaluated. Additional hazards to aircraft are minimized by the issuance of NOTAMs which would describe HAMPP platform flight path.

Landing and recovery sites would be planned to avoid wilderness areas, Native lands, populated areas, surface waters, mountainous areas, national parks, and other cultural and natural resources to avoid environmental impacts, prevent damage to the balloon assembly and facilitate recovery. Preferred landing sites are in previously impacted areas such as BLM or similar properties. AFRL/VS would make the final flight termination decision to release the payload based upon the foregoing requirements and public safety. Payloads typically land within five miles of designated target locations. Consequently, the HAMPP balloon flight tests and associated safety precautions and procedures developed would be expected to result in no potentially significant impacts to public safety.

All HAMPP flights would use a laser beam for down illumination from the HAMPP optics telescope and for up illumination from the 1.5m telescope at the SOR site on Kirtland AFB. All of the lasers would be eye-safe and invisible at the aperture. Light from the ground laser goes through a beam expander and is reflected upward from a mirror and passed to the telescope. The output from the telescope would be kept at an eye safe level. The irradiance is at an eye safe level throughout the path of outdoor propagation. All laser activities have positive controls by personnel on the ground. Therefore, the HAMPP balloon flights would be expected to result in no significant impacts to public safety from the use of proposed lasers.

4.4 Hazardous Materials/Waste

There would be small quantities of lithium ion and silver zinc batteries used for battery power and S-68 2-grain squibs (a squib is a standard device for explosive controlled cutting of these types of systems, it has ½ the charge of a .22 caliber long cartridge) to actuate mechanical release or termination devices, however no hazardous wastes would be generated for this flight test series. Helium is an inert gas will be used to fill the balloon and batteries on-board the HAMPP to power the equipment. All batteries would be recovered and reused for follow on flights. Activated squibs for the termination system would be recovered and disposed of in accordance with approved procedures at Kirtland AFB. All balloon assets would be recovered, the HAMPP platform would be reused for each flight, and expended balloons would be disposed of in the solid waste units on Kirtland AFB. The HAMPP balloon flight test program would not cause any significant impacts related to hazardous materials or wastes.

4.5 Biological Resources

Proposed launch and landing sites across New Mexico, Arizona and Texas contain a large area of native plant communities, which form valuable habitat for many desert, grassland and mountain species,

including threatened and endangered biological resources. Launches would only occur on previously disturbed airfields and would cause very minimal, if any, adverse impact to biological resources. A potential hazard to biological resources would involve being struck by the balloon system upon ascent, descent or impact with the ground. The descent of the balloon and its impact point would be the most likely to encounter a biological resource. However since the descent is controlled to the maximum extent possible, every effort would be made to avoid descent into a sensitive or critical habitat. The probability of impacting threatened or endangered species on descent or impact with the ground is remote given the generally sparse populations of wildlife in desert regions, the large area in which operations would be terminated, and the ability to terminate flight at a time and general location that is most protective of the environment. Recovery would occur shortly after impact and personnel would be restricted to existing roadways. The HAMPP balloon flight tests would not be expected to cause any significant impacts on biological resources.

Consultation with the NM and AZ USFWS was completed and the USFWS has concurred that the proposed action "may affect, but is not likely to adversely affect" listed species under their jurisdiction. In cooperation with the USFWS the Air Force will avoid specific landing areas to ensure protection of endangered species.

4.6 Cultural Resources

The HAMPP balloon flight tests would not be expected to cause any significant impacts on cultural resources. Historic and archaeological resources at proposed launch and landing sites across New Mexico, Arizona and Texas are potentially extensive. However the proposed launches would only occur at previously disturbed airfields resulting in a very remote possibility of impact on cultural resources. Since the location of the balloon is known at all times using GPS the test conductor can select the best location to terminate the flight for a safe landing. Landing and recovery sites would be planned to avoid wilderness areas, Native American resources, populated areas, surface waters, mountainous areas, national parks, and other cultural and natural resources to avoid environmental impacts, prevent damage to the balloon assembly and facilitate recovery.

Recognizing that not all cultural resources have been mapped or identified in New Mexico and Arizona, there is a slight chance that the balloon or gondola-parachute would land near an area of archeological interest. Careful adherence to resource management and responsible decision-making in accordance with proposed procedures would control the potential for impact to cultural resources. All recovery efforts would be performed to ensure site integrity. Vehicles would use existing roadways as much as possible; however there may be times when the team would have to travel off-road to recover balloon equipment. Personnel would contact the local authorities before entering any properties. Personnel would notify AFRL and Kirtland environmental offices should a potential resource be discovered that is not already identified.

Consultations with the NM State Historic Preservation Office and the Navajo Nation were completed. A plan to minimize the impact to cultural resources from HAMPP balloon/gondola landings has been submitted to State Historic Preservation Office. Additionally AFRL will notify the Navajo Nation of planned balloon launches from sites located in western NM or eastern AZ.

4.7 Geology and Soils

The HAMPP balloon flight tests would not be expected to cause any significant impacts on geology and soils. Launches would only occur on previously disturbed airfields, resulting in no adverse impact to geology and soils. A potential hazard to soils would involve being struck by the balloon system upon impact with the ground. However since the descent is controlled to the maximum extent possible, every effort would be made to avoid descent into a sensitive area. Recovery would occur shortly after impact and recovery vehicles would use existing roadways to the maximum extent possible.

4.8 Cumulative Impact

Launches of the HAMPP balloon are proposed at only two locations in Texas, Lubbock and Amarillo, which are similar to proposed launch locations in eastern New Mexico. This analysis assumes previously disturbed launch surfaces in Texas are similar to previously disturbed launch surfaces in New Mexico. No landings are expected in Texas. As a result, this analysis primarily focuses on the New Mexico and Arizona environment. Based on this analysis, no significant or cumulative impacts on the two launch sites in Texas would be expected.

The incremental impact of approximately thirty balloon flights per year over the next 2 years in the areas of New Mexico, Arizona, and Texas combined with similar research activities (i.e. approximately 30 scientific balloon flights per year in NM of which approximately 19 are launched from Ft Sumner) and the aggregate of commercial and government aerial activity in the proposed areas indicates the action would have negligible incremental impact on the human environment. This action would only increase the launches from 1-2/month at a single location to approximately 3-4/month dispersed across New Mexico, Arizona and Texas. The proposed laser tracking activities are similar to and do not significantly increase activities currently ongoing at the SOR on Kirtland AFB. The laser propagation would be eye-safe at the aperture and would not adversely impact the public. The proposed activities for HAMPP would last only 2 years. The cumulative impact on the environmental attributes; land use/airspace, air quality, safety and occupational health, hazardous materials/waste, biological resources, cultural resources, geology and soils and cumulative impacts from this proposed action would be negligible.

5.0 REFERENCES

New Mexico Environmental Department website
Arizona Environmental Department website
Torrance County website
Navajo County Comprehensive Plan
Ballistic Missile Defense Organization Balloon Program Environmental Assessment June 1993

6.0 LIST OF PREPARERS

Michelle Hedrick	Lead Safety & Environment Engineer		
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		Environmental Engineer (WERC Certificate)	
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		BS Industrial Hygienist	10 yr
Melissa Corley	Laser Test Engineer		
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7.0 DISTRIBUTION

Federal Agencies
- Department of the Interior
  Bureau of Land Management

- Department of the Interior
  U.S. Fish and Wildlife Service

- Federal Aviation Administration

State of New Mexico
- State Historic Preservation Office

New Mexico Native American Tribal Organizations

State of Arizona
- State Historic Preservation Office

Arizona Native American Tribal Organizations

APPENDIX A Threatened and Endangered Species Lists

All Arizona Species

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Apache (Arizona) trout	*Oncorhynchus apache*	Threatened	This yellowish or yellow-olive cutthroat-like trout has large dark spots on body. Its dorsal, anal, and caudal fins are edged with white. It has no red lateral band.	Apache, Coconino, Gila, Graham, Greenlee, Navajo	>5000 ft	Presently restricted to cold mountain streams with many low gradient meadow reaches.	Occupies stream habitats with substrates of boulders, rocks, and gravel with some sand or silt through mixed conifer and spruce-fir forests, and montane meadows and grasslands in the White Mountains. Also managed as a sport fish under special regulations.
Arizona agave	*Agave arizonica*	Endangered	Has attractive rosettes of bright green leaves with dark mahogany margins. Flower: Borne on sub-umbellate inflorescences.	Gila, Maricopa, Yavapai	3000-6000 ft	Transition zone between oak-juniper woodland & mountain mahogany-oak scrub.	Scattered clones in New River mountains and Sierra Ancha. Usually found on steep, rocky slopes. Possibly Mazatal mountains. Should be looked for wherever the ranges of Agave toumeyana var. bella and Agave chrysantha overlap.
Arizona cliffrose	*Purshia subintegra*	Endangered	Evergreen shrub of the rose family (Roseaceae). Bark pale shreddy. Young twigs with dense hairs. Leaves 1-5 lobes and edges curl downward (revolute). Flowers: 5 white or yellow petals <0.5 inches long.	Graham, Maricopa, Mohave, Yavapai	< 4,000 ft	Characteristic white soils of tertiary limestone lakebed deposits.	White soils of teritiary limestone lakebed deposits can be seen from a distance.
Arizona hedgehog	*Echinocereus triglochidiatus var. arizonicus*	Endangered	Dark green cylindroid 2.5-12 inches tall, 2-10 inches in diameter, single or in clusters. 1-3 gray or pinkish central spines largest deflexed and 5-11 shorter radial spines. Flower: brilliant red, side of stem in April-May.	Gila, Pinal	3,700-5,200 ft	Ecotone between interior chapparal and madrean evergreen woodland.	Open slopes, in narrow cracks between boulders, and in understory of shrubs. Additional genetic studies have determined that the species does not occur outside of the type locality.
Apache (Arizona) trout	*Oncorhynchus apache*	Threatened	This yellowish or yellow-olive cutthroat-like trout has large dark spots on body. Its dorsal, anal, and caudal fins are edged with white. It has no red lateral band.	Apache, Coconino, Gila, Graham, Greenlee, Navajo	>5000 ft	Presently restricted to cold mountain streams with many low gradient meadow reaches.	Occupies stream habitats with substrates of boulders, rocks, and gravel with some sand or silt through mixed conifer and spruce-fir forests, and montane meadows and grasslands in the White Mountains. Also managed as a sport fish under special regulations.
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Brady pincushion cactus	*Pediocactus bradyi*	Endangered	Small, semi-globose cactus, 2.4 inches tall and 2 inches in diameter. Spines are white or yellowish-tan. The spine clusters 1-2 central spines and 14-15 spreading radial spines. Flower: straw yellow produced at top of the stem.	Coconino	3850-4500 ft	Benches and terraces in Navajo desert near Marble Gorge.	Substrate is Kaibab limestone chips over moenkopi shale and sandstone soil. Plant community dominated by shadscale (Atriplex confertifolia), snakeweed (Guteierrezia sarothrae), mormon tea (Ephedra viridis), and desert trumpet (Eriogonum inflatum). Protected by CITES and Arizona Native Plant Law.
Cactus ferruginous pygmy-owl	*Glaucidium brasilianum cactorum*	Endangered	Small (Approx. 7inches), diurnal owl reddish brown overall with cream-colored belly streaked with reddish brown. Some individuals are grayish brown.	Cochise, Gila, Graham, Greenlee, Maricopa, Pima, Pinal, Santa Cruz, Yuma	<4000 ft	Mature cottonwood/willow, mesquite bosques, and Sonoran desertscrub.	Historical distribution in Arizona is from New River (North) to Gila Box (East) to Cabeza Prieta Mountains (West). Only a few documented sites where this species persists are known, additional surveys are needed. Species has been proposed for delisting (70 FR 44547) but still receives full protection under the ESA.
California Brown pelican	*Pelecanus occidentalis californicus*	Endangered	Large dark gray-brown water bird with a pouch underneath long bill and webbed feet. Adults have a white head and neck, brownish black breast, and silver gray upper parts.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma	Varies	Coastal land and islands; species found around many Arizona lakes and rivers.	Subspecies is found on Pacific Coast and is endangered due to pesticides. It is an uncommon transient in Arizona on many Arizona lakes and rivers. Individuals wander up from Mexico in summer and fall. No breeding records in Arizona.
California condor	*Gymnogyps californianus*	Endangered	Very large vulture (47 in., wingspan to 9 1/2 ft, weight to 22 lbs); adult plumage blackish, immature more brownish; adult wing linings white, immature mottled; head and upper parts of neck bare; yellow-orange in adults, grayish in mature.	Apache, Coconino, Mohave, Navajo	Varies	High desert canyonlands and plateaus.	Recovery program has reintroduced condors to Northern Arizona, with the first release (6 birds) in December 1996. Release site located at the Vermillion Cliffs (Coconino County), with an experimental/nonessential area designated for most of Northern Arizona and Southern Utah. Breeding documented in Arizona. Experimental/nonessential area in Arizona is within a polygon formed by Hwy 191, Interstate 40, and Hwy 93, and extends north of the Arizona-Utah and Nevada borders.
Canelo Hills ladies'-tressess	*Spiranthes delitescens*	Endangered	Slender erect member of the orchid family (Orchidaceae). Flower stalk 20 inches tall, may contain 40 white flowers spirally arranged on the flowering stalk.	Cochise, Santa Cruz	~ 5000 ft	Finely grained, highly organic, staurated soils of cienegas.	Potential habitat occurs in Sonora, Mexico, but no populations have been found.
Chiricahua leopard frog	*Rana chiricahuensis*	Threatened	Cream colored tubercules (spots) on a dark background on the rear of the thigh, dorsolateral folds that are interrupted and deflected medially, and a call given out of water distinguish this spotted frog from other leopard frogs.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, Navajo, Pima, Santa Cruz, Yavapai	3300-8900 ft	Streams, rivers, backwaters, ponds, and stock tanks that are mostly free from introduced fish, crayfish, and bullfrogs.	Require permanent or nearly permanent water sources. Populations north of the Gila River may be a closely-related, but distinct, undescribed species. A special rule allows take of frogs due to operation and maintenance of livestock tanks on State and private lands.
Cochise pincushion cactus	*Coryphantha robbinsorum*	Threatened	A small unbranched cactus with no central spines and 11-17 white radial spines. The bell-shaped flowers are borne on the ends of tubercules (protrusions). Flowers: bell shaped, plae yellow-green. Fruits: orange-red to red.	Cochise, Sonora Mexico	> 4200 ft	Semidesert grassland with small shrubs, agave, other cacti, and grama grass.	Grows on gray limestone hills.
Colorado pikeminnow	*Ptychocheilus lucius*	Endangered	Largest american minnow (up to 6 feet and 80 lbs) dusky-green, slender body has gold flecks on the dorsal surface. Head long and slender.	Gila, Yavapai	< 4,000 ft	Warm, swift, turbid mainstem rivers. Prefers eddies and pools.	Experimental non-essential (treated as proposed threatened). No critical habitat in Arizona.
Desert pupfish	*Cyprinodon macularius*	Endangered	Small (2 inches) smoothly rounded body shape with narrow vertical bars on the sides. Breeding males blue on head and sides with yellow on tail. Females and juveniles tan to olive colored back and silvery sides.	Graham, La Paz, Maricopa, Pima, Pinal, Santa Cruz, Yavapai	< 5,000 ft	Shallow springs, small streams, and marshes. Tolerates saline and warm water.	Critical habitat includes Quitobaquito Springs, Pima County, portions of San Felipe Creek, Carrizo Wash, and Fish Creek Wash, Imperial County, California. Two subspeices are recognized: Desert Pupfish (C.m.macularis) and Quitobaquito Pupfish (C.m.eremus).

Desert tortoise, Mohave population	*Gopherus agassizii (Xerobates)*	Threatened	Large herbivorous reptile has domed shell and round stumpy hind legs. Most active during the spring when plants are most abundant. Some activity in late summer following monsoons. Remainder of year spent in burrows.	Mohave	500-5100 ft	Mohave desertscrub north & west of the Colorado River.	Habitat ranges from flatlands to rocky slopes and Bajadas. Species still found throughout range, but populations are fragmented and declining. The Sonoran Desert population (found south and east of the Colorado River) was considered a Category 2 candidate but currently has no status.
Gila chub	*Gila intermedia*	Endangered	Deep compressed body, flat head. Dark olive-gray color above, silver sides. Endemic to Gila River Basin.	Cochise, Gila, Graham, Greenlee, Maricopa, Pima, Pinal, Santa Cruz, Yavapai	2,000 - 4,500 ft	Pools, springs, cienegas, and streams.	Found on multiple private lands, including the Nature Conservancy, the Audubon Society, and others. Also occurs on Federal and state lands and in Sonora, Mexico. Critical habitat occurs in Cochise, Gila, Graham, Greenlee, Pima, Pinal, Santa Cruz and Yavapai counties.
Gila topminnow	*Poeciliopsis occidentalis occidentalis*	Endangered	Small (2 inches), guppy-like, live bearing, lacks dark spots on its fins. Breeding males are jet black with yellow fins.	Gila, Graham, La Paz, Maricopa, Pima, Pinal, Santa Cruz, Yavapai	< 4,500 ft	Small streams, springs, and cienegas vegetated shallows.	Species historically occurred in backwaters of large rivers but is currently isolated to small streams and springs.
Gila trout	*Oncorhynchus gilae*	Endangered	Deep bodied with fine profuse spotting on the body, dorsal, and adipose fins. Dorsal, anal, and pelvic fins edged in white.	Gila, Greenlee	5,000-10,000 ft	Small high mountain streams.	Fish stocked into Dude Creek in Sept 1999 and into Raspberry Creek in Nov 2000. Also occurs in New Mexico.
Holmgren (Paradox) milk vetch	*Astragalus holmgreniorum*	Endangered	Stemless herbaceous (non-woody) perennial that produces leaves and small purple flowers in the spring, both of which die back to its root after the flowering season. Compound leaves, blue-green below and yellowish-green above, arise directly from the root crown.	Mohave	2,700-2,800 ft	Just under limestone ridges and along draws in gravelly clay hills.	Two additional populations known near St. George, Utah. Species also known as Paradox Milk-Vetch.
Huachuca water umbel	*Lilaeopsis schaffneriana ssp. recurva*	Endangered	Herbaceous, semi-aquatic perennial in the parsley family (Umbelliferae) with slender erect, hollow, leaves that grow from the nodes of creeping rhizomes. Flower: 3 to 10 flowered umbels arise from root nodes.	Cochise, Pima, Santa Cruz	3500-6500 ft	Cienegas, perennial low gradient streams, wetlands.	Species also occurs in adjacent Sonora, Mexico, west of the continental divide. Critical habitat in Cochise and Santa Cruz counties (64 FR 37441, July 12, 1999).
Hualapai Mexican vole	*Microtus mexicanus hualpaiensis*	Endangered	Small, cinnamon-brown mouse-sized with short tail and long fur that nearly covers its small round ears.	Mohave	3500-7000	Grass/forb habitats in ponderosa pine, typically near water.	Also found in pinyon-juniper and pine oak associations wtih a variety of shrubs and grasses. Species confirmed only in the Hualapai Mountain Range and possible in the Prospect Valley and Music Mountains. Ongoing research suggests that populations may occur in the Hualapai Nation, Aubrey Cliffs, Chino Wash, Santa Maria Mountains, Bradshaw Mountains, Round Mountain, and Sierra Prieta Mountains. The taxon may ultimately be renamed.
Humpback chub	*Gila cypha*	Endangered	Large (18 inches) minnow flattened head long fleshy snout, large fins, and a very large hump between the head and the dorsal fin.	Coconino, Mohave	< 4, 000 ft	Large warm turbid rivers especially canyon areas with deep fast water.	Critical habitat in Grand Canyon. Species also found in Upper Basin.
Jaguar	*Panthera onca*	Endangered	Largest species of cat native to Southwest. Muscular, with relatively short, massive limbs, and a deep-chested body. Usually cinnamon-buff in color with many black spots. Weights ranges from 40-135 kg (90-300 lbs).	Cochise, Santa Cruz, Pima	1,600 - >9,000 ft	Found in Sonoran desertscrub up through subalpine conifer forest.	Also occurs in New Mexico. A Jaguar conservation team is being formed that is being led by Arizona and New Mexico state entities along with private organizations.
Jones cycladenia	*Cycladenia humilis var. jonesii*	Threatened	A long lived perennial herb in the dogbane family (Apocynaceae) with pinkish-rose flowers. Plants reach 4-6 inches tall and have orbicular, wide-oval or elliptical leaves. Plants over winter as subterranean rhizomes (roots).	Mohave	4,390-6,000 ft	Mixed desert scrub, juniper, or wild buckwheat-mormon tea.	It is found on gypsiferous, saline soils of the Cutler, Summerville, and Chinle formations.

Kanab ambersnail	*Oxyloma haydeni kanabensis*	Endangered	Small <0.7 inch, light amber color, sometimes grayish-amber mottled; right handed shell.	Coconino	2,900 ft	Travertine seeps and springs in Grand Canyon National Park.	Extremely geographically isolated. Three historical populations; two remaining; one on private property in Utah and one in Grand Canyon National Park; species affected by operations by Glen Canyon Dam. Associated with watercress, monkey flower, and other wetland vegetation.
Kearney blue star	*Amsonia kearneyana*	Endangered	A herbaceous perennial about 2 feet tall in the dogbane family (Apocynaceae). Thickened woody root and many pubescent (hairy) stems that rarely branch. Flowers: white terminal inflorescence in April and May.	Pima	3600-3800 ft	West-facing drainages in the Baboquivari Mountains.	Plants grow in stable, partially shaded, coarse alluvium along a dry wash in the Baboquivari Mountains. Range is extremely limited. Protected by Arizona Native Plant Law.
Lesser long-nosed bat	*Leptonycteris curasoae yerbabuenae*	Endangered	Elongated muzzle, small leaf nose, and long tongue. Yellowish brown or gray above and cinnamon brown below. Tail minute and appears to be lacking. Easily disturbed.	Cochise, Gila, Graham, Greenlee, Pima, Pinal, Maricopa, Santa Cruz	< 6000 ft	Desert scrub habitat with agave and columnar cacti present as food plants.	Day roosts in caves and abandoned tunnels. Forages at night on nectar, pollen, and fruit of paniculate agaves and columnar cacti. This species is migratory and is present in Arizona usually from April to September and south of the border the remainder of the year.
Little Colorado spinedace	*Lepidomeda vittata*	Threatened	Small (<4 inches long) silvery minnow which is darker on the back than the belly.	Apache, Coconino, Navajo	4000-8000 ft	Moderate to small streams in pools and riffles with water flowing over gravel and silt.	Critical habitat includes eighteen miles of East Clear Creek, eight miles of Chevelon Creek, and five miles of Nutrioso Creek.
Loach minnow	*Tiaroga cobitis*	Threatened	Small (<3 inches) slender, elongated fish, olive colored with dirty white spots at the base of the dorsal and caudal fins. Breeding males vivid red on mouth and base of fins.	Apache, Graham, Greenlee, Pinal, Navajo, Gila	<8000 ft	Benthic species of small to large perennial streams with swift shallow water over cobble and gravel. Recurrent flooding and natural hydrograph important.	Presently found in Aravaipa Creek, Blue River, Campbell Blue Creek, San Francisco River, Dry Blue River, and the mainstem upper Gila River. The New Mexico District Court recently vacated the critical habitat designation for the spikedace and loach minnow. Species also found in Catron, Grant, and Hidalgo counties in New Mexico.
Masked bobwhite	*Colinus virginianus ridgewayi*	Endangered	Males brick-red breast and black head and throat. Females are generally nondescript but resemble other races such as the Texas bobwhite.	Pima	1000-4000 ft	Desert grasslands with diversity of dense native grasses, forbs, and brush.	Species is closely associated with Acacia angustissima. Formerly occurred in Altar and Santa Cruz valleys, as well as Sonora, Mexico. Presently only known from reintroduced populations on Buenos Aires NWR.
Mexican gray wolf	*Canis lupus baileyi*	Endangered	Large dog-like carnivore with varying color, but usually a shade of gray. Distinct white lip line around mouth. Weight 60-90 pounds.	Apache, Graham, Greenlee	4,000 -12,000 ft	Chapparal, woodland, and forested areas. May cross desert areas.	Historical range is considered to be larger than the counties listed above. Unconfirmed reports of individuals in the southern part of the state (Cochise, Pima, Santa Cruz) continue to be received. Individuals may still persist in Mexico. Experimental nonessential population introduced in the Blue Primitive Area of Greenlee and Apache counties.
Mexican spotted owl	*Strix occidentalis lucida*	Threatened	Medium sized with dark eyes and no ear tufts. Brownish and heavily spotted with white or beige.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai	4100-9000 ft	Nests in canyons and dense forests with multi-layered foliage structure.	Generally nest in older forests of mixed conifer or ponderosa pine/gambel oak type, in canyons, and use variety of habitats for foraging. Sites with cool microclimates appear to be of importance or are preferred. Critical habitat was finalized on August 31, 2004 (69 FR 53182). Critical habitat in Arizona occurs in Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Navajo, Pima, Pinal, Santa Cruz, and Yavapai counties.
Mount Graham red squirrel	*Tamiasciurus hudsonicus grahamensis*	Endangered	Grayish-brown tinged rusty or yellowish on the back. Summer-dark lateral line separates the light undersides from the gray sides. Ears are slightly tufted in the winter and the tail is bushy. Diet primarily conifer seeds.	Graham	> 8,300 ft	Montane upper elevation mature to old-growth conifer forest.	Distribution limited to the mixed conifer and spruce-fir associations in the Pinaleno Mountains. Critical habitat has been designated for this species.
Navajo sedge	*Carex specuicola*	Threatened	Perennial forb with triangular stems, elongated rhizomes. Flower: white June and July.	Apache, Coconino, Navajo	5700-6000 ft	Silty soils at shady seeps and springs.	Designated critical habitat is on the Navajo Nation near Inscription House Ruins. Found at seep springs on vertical cliffs of pink-red Navajo sandstone.

New Mexico ridge-nosed rattlesnake	*Crotalus willardi obscurus*	Threatened	Small 12-24 inches, secretive grayish-brown with distinct ridge on the end of the snout. The dorsal surface has obscure, irregularly spaced white crossbars edged with brown (not a bold pattern).	Cochise	5000-6600 ft	Primarily canyon bottoms in pine-oak communities.	The subspecies has been documented in the Peloncillo Mountains in Arizona. There are only three known records from Arizona. Also occurs in Animas Mountains of New Mexico and Sierra San Luis in Sonora/Chihuahua.
Nichol Turk's head cactus	*Echinocactus horizonthalonius var. nicholii*	Endangered	Blue-green to yellowish-green, columnar, 18 inches tall, 8 inches in diameter. Spine clusters have 5 radial and 3 central spines; one downward short; 2 spines upward and red or vasally gray. Flower: pink fruit: woolly white.	Pima, Pinal	2400-4100 ft	Sonoran desertscrub.	Found in unshaded microsites in Sonoran desertscrub on dissected alluvial fans at the foot of limestone mountains and on inclined terraces and saddles on limestone mountain sides.
Northern aplomado falcon	*Falco femoralis septentrionalis*	Endangered	Rufous underparts, gray back, long banded tail, and a distinct black and white facial pattern. Smaller than peregrine falcon but larger than a kestrel. Breeds between March and June.	Cochise, Santa Cruz	3500-9000 ft	Grassland and savannah	Species formerly nested in southwestern U.S. Now occurs rarely. Good habitat has low ground cover and mesquite or yucca for nesting platforms. Continued use of pesticides in Mexico endangers this species. No recent confirmed reports for Arizona. Reintroduced in Texas.
Ocelot	*Leopardus (=Felis) pardalis*	Endangered	Medium-sized spotted cat whose tail is about 1/2 the length of head and body. Yellowish with black streaks and stripes running from front to back. Tail is spotted and face is less heavily streaked than the back and sides.	Cochise, Pima, Santa Cruz	< 8000 ft	Humid tropical and sub-tropical forests, savannahs, and semi-arid thornscrub.	May persist in partly-cleared forests, second-growth woodland, and abandoned cultivated areas reverted to brush. Universal component is presence of dense cover. Unconfirmed reports of individuals in the southern part of the State continue to be received.
Peebles Navajo cactus	*Pediocactus peeblesianus var. peeblesianus*	Endangered	Very small globose 1 inch tall and about 0.75 inch in diameter. The 4 (3-5) radial spines are arranged in a twisted cross and central spines are absent. Flowers yellow-green 1 inch diameter spring.	Navajo	5400-5600 ft	Gravely soils of the shinarump conglomerate of the Chinle Formation.	Extremely limited geographic range. Difficult to grow in cultivation.
Pima pineapple cactus	*Coryphantha scheeri var. robustispina*	Endangered	Hemispherical stems 4-7 inches tall 3-4 inches diameter. Central spine 1 inch long straw colored hooked surrounded by 6-15 radial spines. Flower: yellow, salmon, or rarely white narrow floral tube..	Pima, Santa Cruz	2300-5000 ft	Sonoran desertscrub or semi-desert grassland communities.	Occurs in alluvial valleys or on hillsides in rocky to sandy or silty soils. This species can be confused with juvenile barrel cactus (Ferocactus). However, the spines of the later are flattened, in contrast with the round cross-section of the Coryphanta spines. 80-90% of individuals on state or private land.
Razorback sucker	*Xyrauchen texanus*	Endangered	Large, up to 3 feet long and up to 6 lbs, high sharp-edged keel-like hump behind the head. Head flattened on top. Olive-brown above to yellowish below.	Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Pinal, Yavapai, Yuma	< 6000 ft	Riverine and lacustrine areas, generally not in fast moving water and may use backwaters.	Species is also found in Horseshoe reservoir (Maricopa County). Critical habitat includes the 100-year floodplain of the river through the Grand Canyon from confluence with Paria River to Hoover Dam; Hoover Dam to Davis Dam; Parker Dam to Imperial Dam. Also Gila River from Arizon/New Mexico border to Coolidge Dam; and Salt River from Hwy 60/SR77 Bridge to Roosevelt Dam; Verde River from FS boundary to Horseshoe Lake.
San Francisco Peaks groundsel	*Senecio franciscanus*	Threatened	Member of sunflower family, dwarf alpine species 1.2-4 inches tall. Leaves deeply lobed. Flowers: 0.5 inch diameter 1-6 yellow-gold flowers.	Coconino	10900+ ft	Alpine tundra	Designated critical habitat is San Francisco Peaks. Found above spruce-fir and pine forests on talus slopes.
Sentry milk vetch	*Astragalus cremnophylax var. cremnophylax*	Endangered	< 1 inch high forming a mat 1-10 inches in diameter. Flowers: pale purple April to May.	Coconino	>4,000 ft	Pinyon-juniper-cliffrose on a white layer of limestone.	Grows on Kaibab limestone with little soil in an unshaded opening in pinyon-juniper. Possibly more populations to be found on south rim of Grand Canyon and east rim of Marble Gorge.
Siler pincushion cactus	*Pediocactus sileri*	Threatened	Small solitary or clustered cactus globose shaped about 5 inches tall and 3-4 inches in diameter. Flowers: yellow with maroon veins.	Coconino, Mohave	2,800-5,400 ft	Desertscrub transitional areas of Navajo, sagebrush and Mohave Deserts.	Grows on gypsiferous clay and sandy soils of Moenkopi formation.

Sonora chub	*Gila ditaenia*	Threatened	Minnow (<5 inches long) moderately chubby, dark-colored fish with two prominent black lateral bands on the sides and a dark oval spot at the base of the tail. Breeding males have red lower fins and a orange belly.	Santa Cruz	3900 ft	Perennial and intermittent small to moderate streams with boulders and cliffs.	Critical habitat in Sycamore Creek (Santa Cruz County, Arizona). Yank Spring to international border, 2.0 km of Penasco Creek, and lower half of unnamed stream entering Sycamore Creek about 2.4 km downstream from Yank Spring. Species extends into Mexico (Altar and Magdelena rivers).
Sonora tiger salamander	*Ambystoma tigrinum stebbinsi*	Endangered	2.6 to 4.9" snout-vent length with light-colored bands on a dark background. Aquatic larvae are uniform dark color with plume-like gills and tail fins.	Cochise, Santa Cruz	4000-6300 ft	Stock tanks and impounded cienegas in San Rafael Valley, Huachuca Mountains.	Also occurs in the foothills of the east slope of the Patagonia and Huachuca Mountains. Populations are also known on Fort Huachuca.
Sonoran pronghorn	*Antilocapra americana sonoriensis*	Endangered	Buff on back and white below, hoofed with slightly curved black horns having a single prong. Smallest and palest of the pronghorn subspecies	Maricopa, Pima, Yuma	500 - 2,000 ft	Broad intermountain alluvial valleys with creosote-bursage and palo verde-mixed cacti associations.	Typically, bajadas are used as fawning areas and sandy dune areas provide food seasonally. Historical range was probably larger than exists today. This subspecies also occurs in Mexico.
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Small passerine (about 6 inches) grayish-green back and wings, whitish throat, light olive-gray breast and pale yellowish belly. Two wingbars visible. Eye-ring faint or absent.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma	<8500 ft	Cottonwood/willow and tamarisk vegetation communities along rivers and streams.	Migratory riparian-obligate species that occupies breeding habitat from late April to September. Distribution within its range is restricted to riparian corridors. Difficult to distinguish from other members of the Empidonax complex by sight alone. Training seminar required for those conducting flycatcher surveys. Critical habitat was finalized on October 19, 2005 (50 CFR 60886) and can be viewed at http://arizonaes.fws.gov. In Arizona there are critical habitat segments in Apache, Cochise, Gila, Graham, Greenlee, Maricopa, Mohave, Pima, Pinal, and Yavapai counties.
Spikedace	*Meda fulgida*	Threatened	Small (<3 inches) slim with silvery sides and "spine" on dorsal fin. Breeding males brassy golden color.	Graham, Greenlee, Gila, Navajo, Pinal, Yavapai	< 6000 ft	Moderate to large perennial streams with gravel cobble substrates and moderate to swift velocities over sand and gravel substrates. Recurrent flooding and natural hydrograph important.	Presently found in Aravaipa Creek, Eagle Creek, Verde River, East-West-Main and Middle Forks of the Gila River in New Mexico, and Gila River from San Pedro River to Ashurst Hayden Dam. The New Mexico District Court recently vacated the critical habitat designation for the spikedace and loach minnow. Species also found in Catron, Grant, and Hidalgo counties in New Mexico.
Virgin River chub	*Gila seminuda*	Endangered	Slender, silvery minnow (8-18 inches) with small embedded scales giving a smooth appearance to the body.	Mohave (AZ), Washington (UT), Clark (NV)	< 4,500 ft	Deep swift waters but not turbulent sand and gravel with boulders or instream cover.	Proposed critical habitat main channel of the Virgin River and its 100-year floodplain. Presently found in the Virgin and Moapa (=Muddy) rivers and the mouth of Beaver Dam Wash.
Welsh's milkweed	*Asclepias welshii*	Threatened	Milkweed family (Asclepiadaceae), rhizomatous, herbaceous perennial, 10-40 inches tall with large oval leaves. Flowers: cream colored, rose tinged in center.	Coconino	VARIES	Open stabilized desertscrub dunes and lee side of active dunes.	Designated critical habitat is in Utah.
Woundfin	*Plagopterus argentissimus*	Endangered	Small (4 inches) silver minnow with fairly large fins and a sharp dorsal fin spine.	Mohave (AZ), Washington (UT), Clark (NV)	< 4,500 ft	Runs and quiet waters adjacent to riffles over sand and gravel substrates.	Experimental populations (50 FR 30193, 07-24-1985) designated, but not yet introduced, in portions of Verde, Gila, San Francisco, and Hassayampa rivers and Tonto Creek. Proposed critical habitat on Virgin River and its 100-year floodplain.
Yaqui catfish	*Ictalurus pricei*	Threatened	Similar to channel catfish (Ictalurus punctatus) except anal fin base is shorter and the distal margin of the anal fin is broadly rounded with 23-25 soft rays. Body usually profusely speckled.	Cochise	4000-5000 ft	Moderate to large streams with slow current over sand and rock bottoms.	Critical habitat includes all aquatic habitats in the main portion of San Bernadino National Wildlife Refuge.
Yaqui chub	*Gila purpurea*	Endangered	Medium sized minnow (<6 inches) dark colored, lighter below. Dark triangular caudal spot.	Cochise	4000-6000 ft	Deep pools of small streams, pools, or ponds near undercut banks.	Critical habitat includes all aquatic habitats in the main portion of San Bernadino National Wildlife Refuge.

Yaqui topminnow	*Poeciliopsis occidentalis sonoriensis*	Endangered	Small (2 inches) topminnow guppy-like, live bearing, lacking dark spots. Breeding males jet black with yellow fins.	Cochise	< 4500 ft	Small to moderate sized streams, springs, and cienegas generally in shallows.	Currently occurs only on San Bernardino National Wildlife Refuge.
Yuma clapper rail	*Rallus longirostris yumanensis*	Endangered	Water bird with long legs and short tail. Long, slender decurved bill. Mottled brown or gray on its rump. Flanks and undersides are dark gray with narrow vertical stripes producing a barring effect.	Gila, La Paz, Maricopa, Mohave, Pinal, Yuma	< 4,500 ft	Fresh water and brackish marshes.	Species is associated with dense emergent riparian vegetation. Requires wet substrate (mudflat, sandbar) with dense herbaceous or woody vegetation for nesting and foraging. Channelization and marsh destruction are primary sources of habitat loss.
Zuni fleabane	*Erigeron rhizomatus*	Threatened	Herbaceous perennial that grows in clusters of numerous erect unbranced stems up to 2.0 feet tall. Flower heads solitary; pale blue ray flowers and yellow disk flowers.	Apache	7,300 - 8,000 ft	Selinium-rich red or gray detrital clay soils derived from the Chinle and Baca formations.	Only one Arizona location; other 28 sites in Sawtooth Mountains and northwestern part of the Datil Moutains in Catron County, New Mexico. Two sites also on the northwest side of the Zuni Mountains in McKinley County, New Mexico.
Flat-tailed horned lizard	*Phrynosoma mcallii*	Proposed	Typical flattened body shape of horned lizards; dark vertebral stripe; lacks external ear openings; color is cryptic ranging from pale gray to light rust brown; has two rows of fringed scales on each side of body.	Yuma	500 ft	Sandy flats or areas with fine, windblown sand; creosote-white bursage series of Sonoran Desert.	Proposed rule reinstated on August 30, 2005 (Tucson Herpetological Society v. Norton, 04-75 PHX NVW, D. Ariz). Conservation Agreement finalized in May 1997. Species also found in portions of San Diego County, central Riverside County, and Imperial County, California; also Sonora and Baja California, Mexico.
Acuna cactus	*Echinomastus erectocentrus var. acunensis*	Candidate	<12 inches high; spine clusters borne on tubercles, each with a groove on the upper surface. 2-3 central spines and 12 radial spines. Flowers pink to purple.	Pima, Pinal	1300-2000 ft	Well drained knolls and gravel ridges in Sonoran desertscrub.	Immature plants distinctly different from mature plants. They are disc-shaped or spherical and have no central spines until they are about 1.5 inches. Radial spines are dirty white with maroon tips.
Fickeisen plains cactus	*Pediocactus peeblesianus var. fickeiseniae*	Candidate	Very small (3 inches tall - 1.5 inches diameter) unbranched cactus that retreats into gravely soils after flowering and fruiting. Tubercles form a spiral pattern around plant. Central spine 3/8 inch long flowers cream/yellow.	Coconino, Mohave	4,000-5,000 ft	Exposed layers of Kaibab limestone on canyon margins or hills of Navajoan Desert.	
Gunnison Sage Grouse	*Centrocercus minimus*	Candidate	About 2/3 the size of the greater grouse (which is approximately 31 inches long),and with greater grouse males weighing up to 8 lbs. Striking brown, black and white bird, with sharply pointed tail feathers. Males have large mustard-colored throat sacs that are inflated with air during mating displays, surrounded by a collar of bright white feathers. Females are a mottled brown color.		<9,200 ft	Use a variety of habitats but the primary component necessary is species of Artemisia spp. (sagebrush).	Although no records of this species exist for this state, Arizona contains appropriate habitat, and the species occurs in nearby Monticello, Utah. 1937 Arizona unconfirmed reports for sage grouse was likely greater sage grouse not Gunnison (One seen near Nixon Sping, Mount Trumbell region, 29, 1937 (Monson and Phillips 1981)).
Huachuca springsnail	*Pyrgulopsis thompsoni*	Candidate	Very small (.06-.12 inches) conical shell. Identification must be verified by characteristics of reporductive organs.	Cochise, Santa Cruz	4500-7200 ft	Aquatic areas, small springs with vegetation and slow to moderate flow.	Individuals found on firm substances (roots, wood, and rocks). Other populations found on Fort Huachuca.
Lemmon fleabane	*Erigeron lemmonii*	Candidate	A prostrate perennial in the sunflower family. Stems and leaves are densely hairy. Flowers look like small delicate daisies, with white to light purple outer petals and yellow inner petals.	Cochise	1500-6000 ft	Grows in dense clumps in crevices, ledges, and boulders in canyon bottoms in pine-oak woodland.	One site on Fort Huachuca.
Page springsnail	*Pyrgulopsis morrisoni*	Candidate	Small (<.11 inches) snail with ovate shell with fine growth lines.	Yavapai	3300-3600 ft	Aquatic, slow, or still freshwater usually head springs and upper section of outflows.	Can be found on firm substances like rock, wood, or aquatic vegetation.
Relict leopard frog	*Rana onca*	Candidate	Medium-sized brownish grey frog in the family Ranidae.	Mohave			

Sonoyta mud turtle	*Kinosternon sonoriense longifemorale*	Candidate	Primarily a pond turtle, prefers mud or sandy bottoms. Body 3 1/2 to 6 1/2 inches. Head and neck mottled with contrasting light and dark markings. Found in Quitobaquito Springs.	Pima	1,100 ft	Ponds and streams.	Species also found in Rio Sonoyta, Sonora, Mexico.
Stephan,s riffle beetle	*Heterelmis stephani*	Candidate	Small aquatic beetle, typically less than .11 inches in total length.	Santa Cruz	5,100-6,600 ft	Free-flowing springs and seeps, commonly referred to as rheocrenes.	Current distribution is limited to Sylvester Spring. Historically known from Bog Springs, the type locality. Both springs located in Madera Canyon on the Coronado National Forest.
Three Forks springsnail	*Pyrgulopsis trivialis*	Candidate	Minute hydrobiid snail; shell ovate to narrowly conic; height .05 - .17 inches; whorls 2.5-5.0	Apache	8000-8500 ft	Rheocrene springs, seeps, marshes, spring pools, outflows and diverse lotic waters commonly referred to as cienegas.	Distribution limited to Three Forks and Boneyard Spring complexes in the North Fork East Fork Black River watershed of east-central Arizona.
Yellow-billed cuckoo	*Coccyzus americanus*	Candidate	Medium-sized bird with a slender, long-tailed profile, slightly down-curved bill, which is blue-black with yellow on the lower half of the bill. Plumage is grayish-brown above and white below, with rufous primary flight feathers.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma	< 6,500 ft	Large blocks of riparain woodlands (cottonwood, willow, or tamarisk galleries).	Listing was found warranted, but precluded as a distinct vertebrate population segment in the western U.S. on July 25, 2001. This finding indicates that the Service has sufficient information to list the bird, but other, higher priority listing actions prevent the Service from addressing the listing of the cuckoo at this time.
Zuni bluehead sucker	*Catostomus discorbolus yarrowi*	Candidate	Fusiform, slender, with a terminal mouth. Bluish head with a silvery tan to dark green back with sides and abdomen yellowish to silvery white. Most individuals do not exceed 8 inches, however some individuals exceed 9 inches.	Apache	>6,000 ft	Stream reaches having shade and pool riffle habitats with coarse substrates. Young prefer quiet shallow areas.	In Arizona, Smith (1966) reported the subspecies in four small streams. By the late 1970s-early 1980s, the range in Arizona was apparently reduced to Kin Li Chee Creek (Apache County) on the Navajo Nation. Surveys in April 2000, confirmed that bluehead suckers were still found there. Genetic analysis is ongoing to verify that this is the Zuni bluehead sub-species. Historically, it is believed to be the same species, but morphological and preliminary genetic analysis indicates that is not a member of the Zuni bluehead sucker sub-species Zuni. Also called Zuni mountain sucker.
Arizona bugbane	*Cimicifuga arizonica*	Conservation Agreement	Perennial herb in the buttercup family up to 6-7 feet tall. Small white petal-less flowers appear in July-August. Fruit a follicle that splits open on one side as it dries.	Coconino, Gila	5,300-7,000 ft	Moist, loamy soil between coniferous and riparian ecotones.	Rich, fertile soils high in humus content, deep shade, and high humidity appears to be primary habitat requirements for this species. Conservation Agreement signed in June 1999.
Arizona willow	*Salix arizonica*	Conservation Agreement	Scraggly or rounded shrub, prostrate mat or single stem, and large hedge or thicket plant; may be 10 feet high, usually 2-4 feet; branches yellow-green, red-brown, or brownish; previous years growth bright red.	Apache	> 8,500 ft	Unshaded or partially shaded wet meadows, streamsides, cienegas; in or adjacent to water, some dry.	Conservation agreement between the Service, Forest Service, and National Park Service finalized in April 1995.
Gooddings onion	*Allium gooddingii*	Conservation Agreement	Herbaceous perenial plant; broad, flat, rather blunt leaves; flowering stalk 14-17 inches tall, flattened, and narrowly winged toward apex; fruit is broader than long; seeds are short and thick.	Apache, Greenlee, Pima	> 7,500 ft	Forested drainage bottoms and on moist north facing slopes of mixed conifer and spruce fir forests.	Conservation agreement between the Service and the Forest Service signed in February 1998. In New Mexico on the Lincoln and Gila National Forests.
Paradine (Kaibab) plains cactus	*Pediocactus paradinei*	Conservation Agreement	Small, green, globose cactus; usually less than 40 mm tall with half of its stem underground. Plant diameters can reach 60-80 mm. 4-6 spines per aereole; flowers are 19-25 mm with cream to pale yellow petals and pink midrib.	Coconino	>4,500 ft	Pinyon-juniper woodland, and shrub/grassland	Conservation Agreement between the Service, Kaibab National Forest, and the Bureau of Land Management finalized in October 1996; signed in February 1998.
Ramsey Canyon leopard frog	*Rana subaquavocalis*	Conservation Agreement	Brown or green frog, 2.5 to 4 inches long; spots rounded with light borders; dorsolateral folds are interrupted posteriorly and deflected medially; yellowish pigmentation on the groin which may extend into the posterior vent.	Cochise	5,000 ft	Artifical ponds in Tinker, Brown, and Ramsey canyons on the east slope of the Huachuca Mountains.	Conservation agreement between the Service, Arizona Game and Fish Department, the Nature Conservancy, Bureau of Land Mangament, Coronado National Forest, the US Army Intelligence Center and Fort Huachuca, and a private landowner was signed in August 1996.

San Xavier talussnail	*Sonorella eremita*	Conservation Agreement	Land snail, less than one inch in diameter (about .75 inches), 4.5 whorls, round shell, white to pinkish tint.	Pima	3,850-3,920 ft	Deep, limestone rockslide with outcrops of limestone and decomposed granite.	Conservation agreement signed by the Service, Arizona Game and Fish Department, El Paso Natural Gas Company, and Arizona Electric Power Cooperative, Inc. in September 1998.
Virgin spinedace	*Lepidomeda mollispinis mollispinis*	Conservation Agreement	Small fish, about 5 inches, rounded snout; large terminal mouth with two large spines at front of dorsal fin; compressed body with gray-black blotches and specks.	Mohave (AZ), Washington (UT), Clark (NV)	< 4,500 ft	Aquatic	Conservation agreement between the Service, Utah Division of Wildlife Resources, Washington County Water Conservancy District, and others finalized in 1995.
Wet Canyon talussnail	*Sonorella macrophallus*	Conservation Agreement	Very small (<1 inch) light brown pill-shaped shells. Brown stripe encircles outside perimeter of shell.	Graham	6050	Talus slopes in heavily vegetated area of Wet Canyon (Pinaleno Mountains).	Talus must be deep and largely free of excess sedimentation with stable moisture conditions. This species cannot be distinguished from other Sonorella species without dissection.
American peregrine falcon	*Falco peregrinus anatum*	Delisted	A crow-sized falcon with slate blue-gray on the back and wings, and white on the underside; a black head with vertical "bandit's mask" pattern over the eyes; long pointed wings; and a long wailing call made during breeding. Very adept flyers and hunters, reaching diving speeds of 200 mph.		3,500 - 9,000 ft	Areas with rocky, steep cliffs, primarily near water, where prey (primarily shorebirds, songbirds, and waterfowl) concentrations are high. Nests are found on ledges of cliffs, and sometimes on man-made structures such as office towers and bridge abutments.	Delisted

All Listed and Sensitive Species in New Mexico

Total number of species: 179

Print

Common Name	Scientific Name	Group	Status	Counties
Lesser prairie chicken	*Tympanuchus pallidicinctus*	Bird	Candidate	Chaves, Curry, De Baca, Eddy, Guadalupe, Harding, Lea, Quay, Roosevelt, Union.
Yellow-billed cuckoo	*Coccyzus americanus*	Bird	Candidate	Bernalillo, Catron, Cibola, Dona Ana, Grant, Hidalgo, Los Alamos, Luna, McKinley, Mora, Rio Arriba, San Juan, San Miguel, Sandoval, Santa Fe, Sierra, Socorro, Taos, Valencia.
Zuni bluehead sucker	*Catostomus discobolus yarrowi*	Fish	Candidate	Cibola, McKinley.
Chupadera springsnail	*Pyrgulopsis chupaderae*	Mollusc - Invertebrate	Candidate	Socorro.
Gila springsnail	*Pyrgulopsis gilae*	Mollusc - Invertebrate	Candidate	Grant, Catron.

New Mexico hotspring snail	*Pyrgulopsis thermalis*	Mollusc - Invertebrate	Candidate	Grant.
Texas hornshell (mussel)	*Popenaias popei*	Mollusc - Invertebrate	Candidate	Chaves, Eddy.
Sand dune lizard	*Sceloporus arenicolus*	Reptile	Candidate	Chaves, Eddy, Lea, Roosevelt.
Noel's amphipod	*Gammarus desperatus*	Arthropod - Invertebrate	Endangered	Chaves.
Socorro isopod	*Thermosphaeroma thermophilus*	Arthropod - Invertebrate	Endangered	Socorro.
Least Tern (Interior Population)	*Sterna antillarum*	Bird	Endangered	Catron, Chaves, Curry, De Baca, Dona Ana, Eddy, Otero, Rio Arriba, Socorro, Quay.
Northern aplomado falcon	*Falco femoralis septentrionalis*	Bird	Endangered	Chaves, Dona Ana, Eddy, Grant, Hidalgo, Lea, Lincoln, Luna, Otero, Sierra, Socorro.
Southwestern willow flycatcher	*Empidonax traillii extimus*	Bird	Endangered	Bernalillo, Catron, Cibola, Colfax, Dona Ana, Grant[D], Guadalupe, Hidalgo[D], Los Alamos, Luna, McKinley, Mora[D], Otero, Rio Arriba[D], San Juan, San Miguel, Santa Fe, Sierra, Socorro[D], Taos[D], Valencia[D].
Colorado pikeminnow	*Ptychocheilus lucius*	Fish	Endangered	San Juan.
Gila chub	*Gila intermedia*	Fish	Endangered	Grant[D].
Gila topminnow	*Poeciliopsis occidentalis*	Fish	Endangered	Grant[3].
Gila trout	*Oncorhynchus gilae*	Fish	Endangered	Catron, Grant, Sierra.
Pecos gambusia	*Gambusia nobilis*	Fish	Endangered	Chaves, Eddy.
Razorback sucker	*Xyrauchen texanus*	Fish	Endangered	San Juan.

Rio Grande silvery minnow	*Hybognathus amarus*	Fish	Endangered	Bernalillo[D], Dona Ana[3], Rio Arriba[3], Sandoval[D], Santa Fe[3], Sierra[3], Socorro[D], Valencia[D].
Black-footed ferret	*Mustela nigripes*	Mammal	Endangered	Bernalillo, Catron, Chaves, Cibola, Colfax, Curry, De Baca, Eddy, Grant, Guadalupe, Harding, Lea, Lincoln, Los Alamos, McKinley, Mora, Otero, Quay, Rio Arriba, Roosevelt, San Juan, San Miguel, Sandoval, Santa Fe, Sierra, Socorro, Taos, Torrance, Union, Valencia.
Gray Wolf (Mexican Gray Wolf)	*Canis lupus baileyi*	Mammal	Endangered	Catron, Grant, Hidalgo, Luna.
Jaguar	*Panthera onca*	Mammal	Endangered	Hidalgo.
Lesser long-nosed bat	*Leptonycteris curasoae yerbabuenae*	Mammal	Endangered	Hidalgo.
Mexican long-nosed bat	*Leptonycteris nivalis*	Mammal	Endangered	Hidalgo.
Alamosa springsnail	*Psuedotryonia alamosae*	Mollusc - Invertebrate	Endangered	Socorro.
Koster's springsnail	*Juturnia kosteri*	Mollusc - Invertebrate	Endangered	Chaves.
Pecos assiminea snail	*Assiminea pecos*	Mollusc - Invertebrate	Endangered	Chaves.
Roswell springsnail	*Pyrgulopsis roswellensis*	Mollusc - Invertebrate	Endangered	Chaves.
Socorro springsnail	*Pyrgulopsis neomexicana*	Mollusc - Invertebrate	Endangered	Socorro.
Holy Ghost ipomopsis	*Ipomopsis sancti-spiritus*	Plant	Endangered	San Miguel.
Knowlton cactus	*Pediocactus knowltonii*	Plant	Endangered	San Juan.

Kuenzler hedgehog cactus	*Echinocereus fendleri var. kuenzleri*	Plant	Endangered	Chaves, Eddy, Lincoln, Otero.
Mancos milk-vetch	*Astragalus humillimus*	Plant	Endangered	San Juan.
Sacramento prickly poppy	*Argemone pleiacantha spp. pinnatisecta*	Plant	Endangered	Otero.
Sneed pincushion cactus	*Coryphantha sneedii var. sneedii*	Plant	Endangered	Dona Ana, Eddy.
Todsen's pennyroyal	*Hedeoma todsenii*	Plant	Endangered	Otero[D], Sierra[D].
Chiricahua leopard frog	*Rana chiricahuensis*	Amphibian	Threatened	Catron, Grant, Hidalgo, Luna, Sierra, Socorro.
Bald eagle	*Haliaeetus leucocephalus*	Bird	Threatened	Bernalillo, Catron, Chaves, Cibola, Colfax, Curry, De Baca, Dona Ana, Eddy, Grant, Guadalupe, Harding, Hidalgo, Lea, Lincoln, Los Alamos, Luna, McKinley, Mora, Otero, Quay, Rio Arriba, Roosevelt, San Juan, San Miguel, Sandoval, Santa Fe, Sierra, Socorro, Taos, Torrance, Union, Valencia.
Mexican spotted owl	*Strix occidentalis lucida*	Bird	Threatened	Bernalillo[D], Catron[D], Chaves[D], Cibola[D], Colfax[D], Dona Ana[D], Eddy[D], Grant[D], Hidalgo[D], Lincoln[D], Los Alamos[D], McKinley[D], Mora[D], Otero[D], Rio Arriba[D], San Juan[D], San Miguel[D], Sandoval[D], Santa Fe[D], Sierra[D], Socorro[D], Taos[D], Torrance[D], Valencia[D].

Piping plover	*Charadrius melodus*	Bird	Threatened	Colfax, Socorro.
Arkansas River shiner	*Notropis girardi*	Fish	Threatened	Colfax[3], Harding, Mora[3], Quay, San Miguel, Union[3].
Beautiful shiner	*Cyprinella formosa*	Fish	Threatened	Grant[3], Luna[3].
Chihuahua chub	*Gila nigrescens*	Fish	Threatened	Grant.
Loach minnow	*Tiaroga cobitis*	Fish	Threatened	Catron, Grant, Hidalgo.
Pecos bluntnose shiner	*Notropis simus pecosensis*	Fish	Threatened	Chaves[D], De Baca[D], Eddy[D].
Spikedace	*Meda fulgida*	Fish	Threatened	Catron, Grant, Hidalgo.
Gypsum wild-buckwheat	*Eriogonum gypsophilum*	Plant	Threatened	Eddy[D].
Lee pincushion cactus	*Coryphantha sneedii var. leei*	Plant	Threatened	Eddy.
Mesa Verde cactus	*Sclerocactus mesae-verdae*	Plant	Threatened	San Juan.
Pecos sunflower	*Helianthus paradoxus*	Plant	Threatened	Chaves, Cibola, Guadalupe, Valencia.
Sacramento Mountains thistle	*Cirsium vinaceum*	Plant	Threatened	Otero.
Zuni fleabane	*Erigeron rhizomatus*	Plant	Threatened	Catron, Cibola, McKinley.
New Mexican ridge-nosed rattlesnake	*Crotalus willardi obscurus*	Reptile	Threatened	Hidalgo[D].

Species of Concern

Species of Concern are included for planning purposes only.

Common Name	Scientific Name	Group	Status	Counties
Boreal western toad	*Bufo boreas boreas*	Amphibian	Species of Concern	Rio Arriba.
Jemez Mountains salamander	*Plethodon neomexicanus*	Amphibian	Species of Concern	Los Alamos, Rio Arriba, Sandoval.
Lowland leopard frog	*Rana yavapaiensis*	Amphibian	Species of Concern	Catron, Grant, Hidalgo.
Sacramento mountain salamander	*Aneides hardii*	Amphibian	Species of Concern	Lincoln, Otero.

Animas minute moss beetle	*Limnebius aridus*	Arthropod - Invertebrate	Species of Concern	Hidalgo.
Anthony blister beetle	*Lytta mirifica*	Arthropod - Invertebrate	Species of Concern	Dona Ana.
Bonita diving beetle	*Deronectes neomexicana*	Arthropod - Invertebrate	Species of Concern	Lincoln.
Desert viceroy butterfly	*Limenitis archippus obsoleta*	Arthropod - Invertebrate	Species of Concern	Dona Ana, Grant, Lincoln, Sierra, Socorro.
Limestone tiger beetle	*Cicindela politula petrophila*	Arthropod - Invertebrate	Species of Concern	Eddy.
Millipede	*Comanchelus chihuanus*	Arthropod - Invertebrate	Species of Concern	Bernalillo, Valencia.
New Mexico silverspot butterfly	*Speyeria nokomis nitocris*	Arthropod - Invertebrate	Species of Concern	Catron, Cibola, Grant, Los Alamos, McKinley, Mora, Rio Arriba, San Juan, San Miguel, Sandoval, Taos.
Regal silverspot butterfly	*Speyeria idalia*	Arthropod - Invertebrate	Species of Concern	Union.
Sacramento Mountains blue butterfly	*Icaricia icariodes*	Arthropod - Invertebrate	Species of Concern	Lincoln, Otero.
Sacramento Mountains silverspot butterfly	*Speyeria atlantis capitanensis*	Arthropod - Invertebrate	Species of Concern	Catron, Lincoln, Otero.
San Juan checkerspot butterfly	*Euphydryas anicia chuskae*	Arthropod - Invertebrate	Species of Concern	McKinley, San Juan.
American peregrine falcon	*Falco peregrinus anatum*	Bird	Species of Concern	Bernalillo, Catron, Chaves, Cibola, Colfax, Curry, De Baca, Dona Ana, Eddy, Grant, Guadalupe, Harding, Hidalgo, Lea, Lincoln, Los Alamos, Luna, McKinley, Mora, Otero, Quay, Rio Arriba, Roosevelt, San Juan, San Miguel, Sandoval, Santa Fe, Sierra, Socorro, Taos, Torrance, Union

				Valencia.
Arctic peregrine falcon	*Falco peregrinus tundrius*	Bird	Species of Concern	Bernalillo, Catron, Chaves, Cibola, Colfax, Curry, De Baca, Dona Ana, Eddy, Grant, Guadalupe, Harding, Hidalgo, Lea, Lincoln, Los Alamos, Luna, McKinley, Mora, Otero, Quay, Rio Arriba, Roosevelt, San Juan, San Miguel, Sandoval, Santa Fe, Sierra, Socorro, Taos, Torrance, Union, Valencia.
Baird's sparrow	*Ammodramus bairdii*	Bird	Species of Concern	Bernalillo, Catron, Chaves, Cibola, Colfax, Curry, De Baca, Dona Ana, Eddy, Grant, Guadalupe, Harding, Hidalgo, Lea, Lincoln, Luna, McKinley, Mora, Otero, Quay, Rio Arriba, Roosevelt, San Juan, San Miguel, Sandoval, Santa Fe, Sierra, Socorro, Taos, Torrance, Union, Valencia.
Bell’s vireo	*Vireo bellii*	Bird	Species of Concern	Catron, Chaves, Dona Ana, Grant, Hidalgo, Lea, Luna, Otero, Sierra, Socorro, Valencia.
Black tern	*Chlidonias niger*	Bird	Species of Concern	Bernalillo, Chaves, Dona Ana, Eddy, McKinley, Otero, Quay, Rio Arriba, San Juan, San

				Miguel, Sierra, Socorro, Torrance.
Common black hawk	*Buteogallus anthracinus*	Bird	Species of Concern	Catron, Dona Ana, Grant, Hidalgo, Lincoln, Luna.
Gould's turkey	*Meleagris gallopavo mexiana*	Bird	Species of Concern	Hidalgo.
Mountain plover	*Charadrius montanus*	Bird	Species of Concern	Bernalillo, Catron, Chaves, Cibola, Colfax, Curry, De Baca, Guadalupe, Harding, Hidalgo, Lincoln, Luna, McKinley, Mora, Otero, Quay, Rio Arriba, Roosevelt, San Juan, San Miguel, Sandoval, Santa Fe, Sierra, Socorro, Taos, Torrance, Union, Valencia.
Northern goshawk	*Accipiter gentilis*	Bird	Species of Concern	Bernalillo, Catron, Chaves, Cibola, Colfax, Eddy, Grant, Guadalupe, Hidalgo, Lincoln, Los Alamos, McKinley, Mora, Otero, Rio Arriba, Roosevelt, San Juan, San Miguel, Sandoval, Santa Fe, Sierra, Socorro, Taos, Torrance, Union, Valencia.
Northern gray hawk	*Buteo nitidus maximus*	Bird	Species of Concern	Grant, Hidalgo, Luna.
Western burrowing owl	*Athene cunicularia hypugea*	Bird	Species of Concern	Bernalillo, Catron, Chaves, Cibola, Colfax, Curry, De Baca, Dona Ana, Eddy

				Grant, Guadalupe, Harding, Hidalgo, Lea, Lincoln, Luna, McKinley, Mora, Otero, Quay, Rio Arriba, Roosevelt, San Juan, San Miguel, Sandoval, Santa Fe, Sierra, Socorro, Taos, Torrance, Union, Valencia.
Whiskered screech owl	*Otus trichopsis*	Bird	Species of Concern	Hidalgo.
Yellow-billed cuckoo	*Coccyzus americanus*	Bird	Species of Concern	Chaves, Colfax, Curry, De Baca, Eddy, Guadalupe, Harding, Lea, Lincoln, Otero, Quay, Roosevelt, Torrance, Union.
Arkansas River speckled chub	*Macrhyobopsis aestivalis tetranemus*	Fish	Species of Concern	Quay.
Blue sucker	*Cycleptus elongatus*	Fish	Species of Concern	Eddy.
Chihuahua catfish	*Ictalurus sp.*	Fish	Species of Concern	Catron[1].
Desert sucker	*Catostomus clarki*	Fish	Species of Concern	Catron, Grant, Hidalgo, Sierra.
Gray redhorse	*Scartomyzon congestum*	Fish	Species of Concern	Eddy.
Greenthroat darter	*Etheostoma lepidum*	Fish	Species of Concern	Chaves, Eddy.
Headwater catfish	*Ictalurus lupus*	Fish	Species of Concern	Chaves, De Baca, Eddy.
Pecos pupfish	*Cyprinodon pecosensis*	Fish	Species of Concern	Chaves, Eddy.
Rio Grande cutthroat trout	*Oncorhynchus clarki virginalis*	Fish	Species of Concern	Colfax, Mora, Otero, Rio Arriba, Sandoval, Sierra, Taos.
Rio Grande shiner	*Notropis jemezanus*	Fish	Species of Concern	Chaves, De Baca, Eddy, Guadalupe.

Roundtail chub	*Gila robusta*	Fish	Species of Concern	Catron, Grant, Hidalgo, Rio Arriba, San Juan.
Sonora sucker	*Catostomus insignis*	Fish	Species of Concern	Catron, Grant, Hidalgo, Sierra.
White Sands pupfish	*Cyprinodon tularosa*	Fish	Species of Concern	Lincoln, Otero, Sierra.
Allen's big-eared bat	*Idionycteris phyllotis*	Mammal	Species of Concern	Catron, Socorro.
Arizona shrew	*Sorex arizonae*	Mammal	Species of Concern	Hidalgo.
Black-tailed prairie dog	*Cynomys ludovicianus*	Mammal	Species of Concern	Chaves, Colfax, Curry, De Baca, Eddy, Guadalupe, Harding, Hidalgo[1], Lea, Lincoln, Mora, Otero, Quay, Roosevelt, San Miguel, Sierra[1], Socorro, Torrance, Union[2].
Cebolleta southern pocket gopher	*Thomomys umbrinus paguatae*	Mammal	Species of Concern	Cibola.
Desert pocket gopher	*Geomys bursarius arenarius*	Mammal	Species of Concern	Chaves, Dona Ana, Luna, Otero, Socorro.
Goat Peak pika	*Ochotona princeps nigrescens*	Mammal	Species of Concern	Los Alamos, Rio Arriba, Sandoval.
Guadalupe southern pocket gopher	*Thomomys umbrinus guadalupensis*	Mammal	Species of Concern	Eddy, Otero.
Mearns' southern pocket gopher	*Thomomys umbrinus mearnsi*	Mammal	Species of Concern	Hidalgo.
Mexican long-tongued bat	*Choenycteris mexicana*	Mammal	Species of Concern	Hidalgo.
New Mexican meadow jumping mouse	*Zapus hudsonius luteus*	Mammal	Species of Concern	Bernalillo, Colfax, Lincoln, Los Alamos, Mora, Otero, Rio Arriba, San Miguel, Sandoval, Santa Fe, Socorro, Taos, Valencia.
Organ Mountains	*Eutamias*	Mammal	Species of	Dona Ana

Colorado chipmunk	*quadrivittatus australis*		Concern	Lincoln, Sierra, Socorro.
Pecos River muskrat	*Ondatra zibethicus ripensis*	Mammal	Species of Concern	Bernalillo, Chaves, Dona Ana, Eddy, Guadalupe, Lincoln, San Miguel, Socorro, Valencia.
Penasco (Least) chipmunk	*Tamias minimus atristriatus*	Mammal	Species of Concern	Lincoln, Otero.
Southwestern otter	*Lutra canadensis sonorae*	Mammal	Species of Concern	Catron, Rio Arriba, Sierra, Taos.
Swift fox	*Vulpes velox*	Mammal	Species of Concern	Chaves, Colfax, Curry, De Baca, Eddy, Guadalupe, Harding, Lea, Mora, Quay, Roosevelt, San Miguel, Union.
Townsend's big-eared bat	*Corynorhinus townsendii*	Mammal	Species of Concern	Bernalillo, Catron, Chaves, Dona Ana, Eddy, Grant, Hidalgo, Lincoln, Los Alamos, Luna, Mora, Otero, Rio Arriba, San Juan, San Miguel, Sandoval, Santa Fe, Sierra, Socorro, Taos, Union.
Western red bat	*Lasiurus blossevillii*	Mammal	Species of Concern	Catron, Chaves, Dona Ana, Eddy, Hidalgo, Roosevelt.
White Sands woodrat	*Neotoma micropus leucophaea*	Mammal	Species of Concern	Dona Ana, Otero, Sierra.
White-sided jack rabbit	*Lepus callotis gaillardi*	Mammal	Species of Concern	Grant, Hidalgo, Luna.
Yellow-nosed cotton rat	*Sigmodon ochrognathus*	Mammal	Species of Concern	Hidalgo.
Cockerell's striate disc (snail)	*Discus shemeki cockerelli*	Mollusc - Invertebrate	Species of Concern	Taos.

Cook's Peak woodlandsnail	*Ashmunella macromphala*	Mollusc - Invertebrate	Species of Concern	Luna.
Doña Ana talussnail	*Sonorella todseni*	Mollusc - Invertebrate	Species of Concern	Dona Ana.
Florida mountainsnail	*Oreohelix florida*	Mollusc - Invertebrate	Species of Concern	Luna.
Hacheta Grande woodlandsnail	*Ashmunella hebardi*	Mollusc - Invertebrate	Species of Concern	Hidalgo.
Mineral Creek mountainsnail	*Oreohelix pilsbryi*	Mollusc - Invertebrate	Species of Concern	Sierra.
Ovate vertigo (snail)	*Vertigo ovata*	Mollusc - Invertebrate	Species of Concern	Eddy.
Pecos springsnail	*Pyrgulopsis pecosensis*	Mollusc - Invertebrate	Species of Concern	Eddy.
Sangre de Cristo peaclam	*Pisidium sanquinichristi*	Mollusc - Invertebrate	Species of Concern	Taos.
Shortneck snaggletooth (snail)	*Gastrocopta dalliana dalliana*	Mollusc - Invertebrate	Species of Concern	Grant, Hidalgo, Luna.
Acoma fleabane	*Erigeron acomanus*	Plant	Species of Concern	Cibola, McKinley.
Alamo beard tongue	*Penstemon alamosensis*	Plant	Species of Concern	Dona Ana, Otero.
Arizona willow	*Salix arizonica*	Plant	Species of Concern	Rio Arriba, Taos.
Beautiful gilia	*Gilia formosa*	Plant	Species of Concern	San Juan.
Bisti fleabane	*Erigeron bistiensis*	Plant	Species of Concern	San Juan.
Brack's fishhook cactus	*Sclerocactus cloveriae ssp. brackii*	Plant	Species of Concern	San Juan.
Chiricahua mudwort	*Limosella publiflora*	Plant	Species of Concern	Hidalgo.
Cinder phacelia	*Phacelia serrata*	Plant	Species of Concern	Cibola.
Contra yerba	*Pediomelum pentaphyllum*	Plant	Species of Concern	Hidalgo.
Coppermine milk-vetch	*Astragalus cobrensis var. maguirei*	Plant	Species of Concern	Hidalgo.
Desert night-blooming cereus	*Cereus greggii var. greggii*	Plant	Species of Concern	Dona Ana, Grant, Hidalgo, Luna.

				Otero.
Duncan's pincushion cactus	*Coryphantha duncanii*	Plant	Species of Concern	Sierra.
Dwarf milkweed	*Asclepias uncialis var. uncialis*	Plant	Species of Concern	Colfax, Grant, San Miguel, Torrance, Union.
Few-flowered jewelflower	*Streptanthus sparsiflorus*	Plant	Species of Concern	Eddy.
Fugate's blue-star	*Amsonia fugatei*	Plant	Species of Concern	Socorro.
Gila groundsel	*Senecio quaerens*	Plant	Species of Concern	Catron.
Glass Mountain coral-root	*Hexalectris nitida*	Plant	Species of Concern	Eddy.
Goodding's onion	*Allium gooddingii*	Plant	Species of Concern	Catron, Lincoln, Otero, San Juan.
Griffith's saltbush	*Atriplex griffithsii*	Plant	Species of Concern	Hidalgo.
Guadalupe rabbitbrush	*Chrysothamnus nauseosus var. texensis*	Plant	Species of Concern	Eddy, Otero.
Gypsum hotspring aster	*Machaeranthera gypsitherma*	Plant	Species of Concern	Hidalgo.
Gypsum phacelia	*Phacelia sp. nov.*	Plant	Species of Concern	Cibola, Sandoval.
Gypsum scalebroom	*Lepidospartum burgessii*	Plant	Species of Concern	Otero.
Gypsum townsendia	*Townsendia gypsophila*	Plant	Species of Concern	Sandoval.
Hess' fleabane	*Erigeron hessii*	Plant	Species of Concern	Catron.
Knight's milk-vetch	*Astragalus knightii*	Plant	Species of Concern	Sandoval.
Limestone rosewood	*Vauquelinia californica ssp. pauciflora*	Plant	Species of Concern	Hidalgo.
Mat leastdaisy	*Chaetopappa hersheyi*	Plant	Species of Concern	Eddy.
Mescalero milkwort	*Polygala rimulicola var. mescalerorum*	Plant	Species of Concern	Dona Ana.
Mogollon clover	*Trifolium longipes var.*	Plant	Species of	Catron.

	neurophyllum		Concern	
Nodding rock-daisy	*Perityle cernua*	Plant	Species of Concern	Dona Ana.
Organ Mountain evening-primrose	*Oenothera organensis*	Plant	Species of Concern	Dona Ana.
Organ Mountain figwort	*Scrophularia laevis*	Plant	Species of Concern	Dona Ana.
Ornate paintbrush	*Castilleja ornata*	Plant	Species of Concern	Hidalgo.
Parish's alkali grass	*Puccinellia parishii*	Plant	Species of Concern	Catron, Grant, Hidalgo, McKinley, San Juan, Sandoval.
Pinos Altos flame flower	*Talinum humile*	Plant	Species of Concern	Grant, Sierra.
Porsild's starwort	*Stellaria porsildii*	Plant	Species of Concern	Grant.
Ripley milk-vetch	*Astragalus ripleyi*	Plant	Species of Concern	Rio Arriba, Taos.
San Carlos wild-buckwheat	*Eriogonum capillare*	Plant	Species of Concern	Grant, Hidalgo.
Sand prickly pear	*Opuntia arenaria*	Plant	Species of Concern	Dona Ana, Luna.
Sandhill goosefoot	*Chenopodium cycloides*	Plant	Species of Concern	Dona Ana, Roosevelt, Sierra, Socorro.
Santa Fe cholla	*Opuntia viridiflora*	Plant	Species of Concern	Catron, Cibola, Harding, San Juan, Santa Fe.
Sierra Blanca cliff daisy	*Chaetopappa elegans*	Plant	Species of Concern	Lincoln, Otero.
Sivinski's fleabane	*Erigeron sivinskii*	Plant	Species of Concern	McKinley.
Slender spiderflower	*Cleome multicaulis*	Plant	Species of Concern	Grant.
Spellenberg's groundsel	*Senecio spellenbergii*	Plant	Species of Concern	Harding.
Standley whitlow-grass	*Draba standleyi*	Plant	Species of Concern	Dona Ana.
Tharp's blue-star	*Amsonia tharpii*	Plant	Species of Concern	Eddy.

Villard's pincushion cactus	*Escobaria villardii*	Plant	Species of Concern	Otero.
Wright's dogweed	*Adenophyllum wrightii var. wrightii*	Plant	Species of Concern	Grant.
Wright's marsh thistle	*Cirsium wrightii*	Plant	Species of Concern	Chaves, Guadalupe, Lincoln, Otero.
Wright's water-willow	*Justicia wrightii*	Plant	Species of Concern	Eddy.
Gray-checkered whiptail	*Cnemidophorus dixoni*	Reptile	Species of Concern	Hidalgo.
Mexican garter snake	*Thamnophis eques*	Reptile	Species of Concern	Catron, Grant, Hidalgo.
Narrowhead garter snake	*Thamnophis rufipunctatus*	Reptile	Species of Concern	Catron, Grant, Hidalgo.

Endangered	Any species which is in danger of extinction throughout all or a significant portion of its range.	**Threatened**	Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
Candidate	Candidate Species (taxa for which the Service has sufficient information to propose that they be added to list of endangered and threatened species, but the listing action has been precluded by other higher priority listing activities).	**Proposed**	Any species of fish, wildlife or plant that is proposed in the Federal Register to be listed under section 4 of the Act. This could be either proposed for endangered or threatened status.
Species of Concern	Taxa for which further biological research and field study are needed to resolve their conservation status OR are considered sensitive, rare, or declining on lists maintained by Natural Heritage Programs, State wildlife agencies, other Federal agencies, or professional/academic scientific societies. Species of Concern are included for planning purposes only.		

Foot Notes:

D Designated Critical Habitat.

P Proposed Critical Habitat.

1 Introduced population.	**3** Extirpated in this county.
2 Survey should be conducted if project involves impacts to prairie dog towns or complexes of 200-acres or more for the Gunnison's prairie dog (*Cynomys gunnisoni*) and/or 80-acres or more for any subspecies of Black-tailed prairie dog (*Cynomys ludovicianus*). A complex consists of two or more neighboring prairie dog towns within 4.3 miles (7 kilometers) of each other.	

APPENDIX B Cultural Resources

NM Registered Cultural Properties By County: Torrance

HPD ID #	*County*	*City*	*Name Of Cultural Property*	*SR List Date*	*NR List Date*
427	Torrance	Estancia	Berkshire Hotel	1/30/1976	
	Not For Publication ☐				
64	Torrance	Gran Quivira	Gran Quivira National Monument and Collections	5/21/1971	10/15/1966
	Not For Publication ☐				
565	Torrance	Moriarty	Eclipse Windmill, Moriarty	1/20/1978	6/4/1979
	Not For Publication ☐				
1574	Torrance	Moriarty	Evans, Greene, Garage	9/17/1993	11/22/1993
	Not For Publication ☐		Broadway & Route 66		
349	Torrance	Mountainair	Atchison, Topeka & Santa Fe Rwy Depot, Mountainair	9/27/1974	
	Not For Publication ☐				
1371	Torrance	Mountainair	Mountainair Municipal Auditorium	2/6/1987	4/30/1987
	Not For Publication ☐		Roosevelt Ave. & Beal St.		
514	Torrance	Mountainair	Rancho Bonito	7/15/1977	11/29/1978
	Not For Publication ☐				
517	Torrance	Mountainair	Shaffer Hotel	7/15/1977	11/15/1978
	Not For Publication ☐		Broadway St.		
108	Torrance	Progresso	Pueblo Colorado (South)	9/12/1969	
	Not For Publication ☐		Forest Road 458		
1	Torrance	Scholle	Abo Mission Ruin NHL	12/20/1968	10/15/1966
	Not For Publication ☐				
1811	Torrance	Various towns	Neon Signs Along Route 66 in New Mexico	4/5/2002	2/17/2003
	Not For Publication ☐		Various locations		

NM Registered Cultural Properties By County: Guadalupe

HPD ID #	County	City	Name Of Cultural Property	SR List Date	NR List Date
1176	Guadalupe	Anton Chico	Anton Chico de Abajo National Register Historic District	9/20/1985	9/29/1986
	Not For Publication ☐		State Road 119		
1779	Guadalupe	Anton Chico	Anton Chico Land Grant		9/29/1986
	Not For Publication ☐				
555	Guadalupe	Anton Chico	Hormigoso Irrigation Ditch and Dam	1/20/1978	
	Not For Publication ☐				
1177	Guadalupe	Colonias	Colonias de San Jose National Register Historic District	9/20/1985	9/29/1986
	Not For Publication ☐		State Road 379		
1178	Guadalupe	Colonias	La Placita de Abajo National Register District	9/20/1985	9/29/1986
	Not For Publication ☐				
1576	Guadalupe	Cuervo	Route 66, abandoned: Cuervo to SR 156	9/17/1993	11/22/1993
	Not For Publication ☐		Cuervo to State Road 156 Junction		
1676	Guadalupe	Cuervo	State maint. Route 66: Montoya to Cuervo	5/9/1997	11/19/1997
	Not For Publication ☐		I-40		
176	Guadalupe	Puerto de Luna	Grzelachowski, Alexander House and Store	4/24/1970	6/24/1993
	Not For Publication ☐		SW of jct. of NM 91 and NM 203		
1264	Guadalupe	Puerto de Luna	Guadalupe County Courthouse (Form.) Puerto de Luna	5/9/1986	
	Not For Publication ☐		State Road 91		
848	Guadalupe	Santa Rosa	Casaus, Jesus M., House	12/18/1981	4/1/1982
	Not For Publication ☐		628 Third St.		
1265	Guadalupe	Santa Rosa	Guadalupe County Courthouse (Former) in Santa Rosa	5/9/1986	12/7/1987
	Not For Publication ☐		S. Fourth St.		

HPD ID #	County	City	Name Of Cultural Property	SR List Date	NR List Date
426	Guadalupe	Santa Rosa	Hidden Lake Pictographs	10/31/1975	
	Not For Publication ☐				
177	Guadalupe	Santa Rosa	La Capilla de Santa Rosa	4/24/1970	
	Not For Publication ☐		900 South Third St.		
1110	Guadalupe	Santa Rosa	Moise, Julius J., House	10/17/1984	12/27/1984
	Not For Publication ☐		400 Capitan St.		
1620	Guadalupe	Santa Rosa	Park Lake National Register Historic District	1/26/1996	3/15/1996
	Not For Publication ☐		Will Rogers & Lake Dr.		
1811	Guadalupe	Various towns	Neon Signs Along Route 66 in New Mexico	4/5/2002	2/17/2003
	Not For Publication ☐		Various locations		

STATE	COUNTY	RESNAME	ADDRESS	CITY	CERT
AZ	Navajo	Amos Ranch at Big Spring	vicinity of junction of Faught Ridge Rd. and State Rte. 7, Fort Apache Indian Reservation	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Historic Site NA-14,803		N of Lakeside	ELIGIBLE
AZ	Navajo	Archeological Site #11		Low Mountain	ELIGIBLE
AZ	Navajo	Archeological Site #15		Low Mountain	ELIGIBLE
AZ	Navajo	Archeological Site #17		Low Mountain	ELIGIBLE
AZ	Navajo	Archeological Site #34		Low Mountain	ELIGIBLE
AZ	Navajo	Archeological Site #34		Low Mountain	ELIGIBLE
AZ	Navajo	Archeological Site #36		Low Mountain	ELIGIBLE
AZ	Navajo	Archeological Site #CE-2		Low Mountain	ELIGIBLE
AZ	Navajo	Archeological Site #CE-7		Low Mountain	ELIGIBLE
AZ	Navajo	Archeological Site APS-CS-2		Holbrook	ELIGIBLE
AZ	Navajo	Archeological Site APS-CS-222		Heber	ELIGIBLE
AZ	Navajo	Archeological Site APS-CS-3		Holbrook	ELIGIBLE
AZ	Navajo	Archeological Site APS-CS-81		Herber	ELIGIBLE
AZ	Navajo	Archeological Site AS-J-19-9		Inscription	ELIGIBLE
AZ	Navajo	Archeological Site AZ D-10-17		City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-D-10-16		City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-D-10-22		City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-J-19-10		Inscription	ELIGIBLE
AZ	Navajo	Archeological Site AZ-J-19-11		Inscription	ELIGIBLE
AZ	Navajo	Archeological Site AZ-J-19-12		Inscription	ELIGIBLE

AZ	Navajo	Archeological Site AZ-J-19-3	Inscription	ELIGIBLE
AZ	Navajo	Archeological Site AZ-J-19-6	Inscription	ELIGIBLE
AZ	Navajo	Archeological Site AZ-P-16-10 (ASU)	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-P-16-11 (ASU)	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-P-16-12 (ASU)	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-P-16-13 (ASU)	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-P-16-16 (ASU)	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-P-16-5 (ASU)	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-P-16-8	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-P-16-9 (ASU)	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-P:16:3 (ASU)	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-Q-13-1 (ASU)	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-Q-13-12 (ASU)	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-Q-13-16 (ASU)	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-Q-13-4 (ASU)	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-Q-13-5 (ASU)	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site AZ-Q-13-9 (ASU)	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site CS-218	Heber	ELIGIBLE
AZ	Navajo	Archeological Site CS-219	Heber	ELIGIBLE
AZ	Navajo	Archeological Site CS-220	Heber	ELIGIBLE
AZ	Navajo	Archeological Site CS-221	Herber	ELIGIBLE
AZ	Navajo	Archeological Site CS-224	Heber	ELIGIBLE
AZ	Navajo	Archeological Site D-11-2001	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-11-2002 Address Restricted	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-11-2003	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-11-3001	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-11-3002	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-11-3003	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-11-3004	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-11-3005	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-7-2001	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-7-2002	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-7-2003	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-7-2004	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-7-2005	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-7-2006	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-7-2007	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-7-2008	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-7-2009	City	ELIGIBLE

				unavailable	
AZ	Navajo	Archeological Site D-7-2010		City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-7-2011		City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-7-2012		City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-7-2013		City unavailable	ELIGIBLE
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AZ	Navajo	Archeological Site D-7-2019		City unavailable	ELIGIBLE
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AZ	Navajo	Archeological Site D-7-3028		City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site D-7-3029		City unavailable	ELIGIBLE
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AZ	Navajo	Archeological Site D-7-4041		City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site No. CE44	Address Restricted	City unavailable	ELIGIBLE
AZ	Navajo	Archeological Site P-3-11		Joseph	ELIGIBLE
AZ	Navajo	Archeological Sites along Navajo 41		Black Mesa	ELIGIBLE
AZ	Navajo	Rainbow Forest Historic Landscape	Petrified Forest National Park	Puerco River Valley	ELIGIBLE
AZ	Navajo	Site AZ-P-3-11		Joseph City	ELIGIBLE

AZ	Navajo	Site NA-14, 495		City unavailable	ELIGIBLE
AZ	Navajo	Site NA-14, 605		City unavailable	ELIGIBLE
AZ	Navajo	Site NA-14, 614		City unavailable	ELIGIBLE
AZ	Navajo	Site NA-14, 617	Address Restricted	City unavailable	ELIGIBLE
AZ	Navajo	Site NA-14,615		City unavailable	ELIGIBLE

APPENDIX C Draft Environmental Assessment Comments

Hi Michelle:
I saw the ad in the Albuquerque Journal about the" balloon borne tests" to advance technology for "laser beam propogation through the atmosphere." I went to the website and read the information there. But I felt a little like the boy in one of Dylan Thomas's stories about a boy in Wales who got a book about wasps for Xmas. He said, "It told me everything but why." I felt that way after reading the website.

So, why? What does "propagation" mean in the context you are using? Many balloons with lasers if the testing is successful?
The draft environmental assessment says you are "developing" a program called "High Altitude Mobile Pointing Platform (HAMPP)to facilitate laser propagation testing." What do you mean by a "program?" Does that mean an actual piece of technology (in addition to a balloon) to be sent aloft? Are you testing the "technology" first, so that then you can test the laser propagation next? And is all this together designed to "collect health and status data from payload components?" I assume this means bombs, or some kind of assistance to planes or missiles? Am I wrong? And in terms of environmental issues, what does "landing of the balloon assets would be controlled as much as possible" mean in terms of assets? Does this mean you want to recover "assets" to be used in additional tests? What are the overall objectives of the HAMPP program?
What is your estimate now of the costs of developing the program?

As a new resident of Santa Fe (moved from North Dartmouth, MA) I'm curious about the various nearby test facilties and the research that is underway. Many thanks. David

APPENDIX D Response to Comments

So, why? What does "propagation" mean in the context you are using?

Propagation is a term used to describe the act of a Laser emitting light. It means that the laser is on and fully functioning. The laser used here is very common in the telecommunication industry and is a low power and invisible laser. This means that it is safe and will not cause harm to any person, place, or thing.

Many balloons with lasers if the testing is successful?

At this point, the testing is evaluating the propagation technology. The long term scope and application of this technology has not been determined.

The draft environmental assessment says you are "developing" a program called "High Altitude Mobile Pointing Platform (HAMPP)to facilitate laser propagation testing." What do you mean by a "program?"

The program here is referring to the series of experiments for atmospheric characterization using a High Altitude Mobile Pointing Platform. To properly perform an experiment, the instruments involved need to be carefully developed, tested and employed to provide meaningful data. In this case we have developed a system to analyze laser light propagated through the atmosphere to characterize how atmospheric turbulence may affect light transmission.

Does that mean an actual piece of technology (in addition to a balloon) to be sent aloft?

Yes.

Are you testing the "technology" first, so that then you can test the laser propagation next?

The laser is used to perform the test, and the technology is the result.

And is all this together designed to "collect health and status data from payload components?" I assume this means bombs, or some kind of assistance to planes or missiles? Am I wrong?

The “health and status data” that is being collected is from the instruments located on the balloon’s payload component or gondola. The payload components are incorporated into the actual HAMPP equipment. There is no missile or bomb incorporated into the HAMPP equipment. HAMPP is not an active weapon system and does not incorporate an active weapon system.

And in terms of environmental issues, what does "landing of the balloon assets would be controlled as much as possible" mean in terms of assets? Does this mean you want to recover "assets" to be used in additional tests?

This means that we would like to land the balloon in a location that minimizes damage to the balloon, HAMPP equipment, human health and the environment. Landing the balloon is dependent upon the weather, so we use our experienced flight crew and modeling software to as accurately as possible determine the precise landing location.

The assets that are referenced are the actual balloon and the HAMPP equipment which we most certainly want to recover and reuse.

What are the overall objectives of the HAMPP program?

The overall objective of the HAMPP program is to characterize how the atmosphere affects the laser beam as it moves from our balloon assembly to our facility.

What is your estimate now of the costs of developing the program?

The cost of this program, including the HAMPP equipment and the balloon flights, are about 2 million dollars.