State of the Preserve 2002–2007

Valles Caldera National Preserve

VALLES CALDERA TRUST

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The *State of the Preserve* report is a key component of the comprehensive management of the Valles Caldera National Preserve. This report reviews, among other things, actions of the Valles Caldera Trust, operations of the Preserve and the knowledge that the staff has acquired about this unique landscape since federal acquisition in 2000. We acknowledge the work of previous Boards of Trustees, former staff and the stakeholder groups, citizens and friends who have been engaged in this 'experiment in public land management' since the beginning. We borrowed heavily and verbatim from their efforts.

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This report reflects the contributions and work of the current staff, including Jeffrey Cross (Executive Director), Dennis Trujillo (Preserve Manager), Robert Parmenter (Preserve Scientist), Marie Rodriguez (Natural Resource Coordinator), Ana Steffen (Cultural Resource Coordinator), Rob Dixon (Recreation Coordinator), Debbie Boggess (Administrative Officer), Rourke McDermott (Landscape Architect) and Kris Cope (GIS Specialist). Any errors and omissions are ours.

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EXECUTIVE SUMMARY

The *State of the Preserve* report is unique to the Valles Caldera Trust ("Trust"). It is a key component of comprehensive management of the Valles Caldera National Preserve ("Preserve"), which also includes stewardship actions implemented by the Trust and strategic guidance adopted by the Board of Trustees ("Board"). The purpose of the *State of the Preserve* is to provide the Board with the technical and scientific basis for comprehensive management. Because the Trust must prepare a *State of the Preserve* at least once every 5 years, it is also the basis for adaptive management and an important reference for interested public. This is the first *State of the Preserve* published by the Trust; it examines past, present (2002-2007) and reasonably foreseeable future stewardship actions and their cumulative effects.

Past Actions. The *State of the Preserve* considers human impacts from the late 1800s forward, including grazing, logging, road building and fire exclusion. Grazing was the first significant extractive use – at times during the summer, as many as 100,000 sheep (1910s) and 12,000 cattle (1950s) grazed on the Preserve. Natural fires apparently ceased in the 1880s. Intensive livestock grazing and subsequent active fire suppression greatly reduced fire frequency and increased the divergence of forest structure, composition and function from the natural range of variability. Over 1,400 miles of roads were built on the Preserve in the 20th century and about 60% of the forests were harvested. Subsistence hunting, which began in pre-historic times, increased in the late 19th and early 20th centuries and decimated wildlife populations.

Present Actions. The Board of Trustees assumed management of the Preserve from the U.S. Forest Service in August 2002 and implemented interim public access programs, including recreation, special uses (research, commercial and cultural) and education. The number of visitors increased from 200-300 people per year when the ranch was in private hands, to over 12,000 in 2007. Revenues from public access, commercial uses, product sales, donations and grants increased from $321,000 in 2002 to $750,000 in 2007.

Historically, the Preserve was a working ranch with a functioning summer livestock operation. There are 118 miles of fences, 136 stock tanks, eight corrals and numerous cattle guards and bypass gates. Since 2002, the Trust has grazed cattle in cow/calf, replacement heifer, conservation stewardship and yearling programs. Drought in the spring of 2006 caused the Trust to cancel the grazing program. In 2007, the Trust managed 500 yearlings for four months under a contract awarded to an owner/operator through a competitive request for proposals.

When the ranch was in private hands, only a few vehicles entered the Preserve each day; currently, 6,000-7,000 vehicles enter the Preserve from spring through fall each year. The Trust has upgraded 13 miles of ranch roads, which restored the natural hydrology to over 3,000 acres of wetlands. Upgrading roads can cost upwards of $100,000 per mile. The Preserve has three parking areas with space for about 200 cars. Existing logging roads are used for hiking programs. Two free trails are accessible from New Mexico Highway 4; there are three additional trails up to 7 miles long for hiking and eight equestrian trails up to about 20 miles long.

The majority of the 38 facilities on the Preserve were present at the time of federal acquisition. The average age of these facilities is about 60 years and the overall condition is fair to good. The facilities have a variety of uses, including workspace, visitor facilities and living quarters. They are valued at $5.5 million; deferred maintenance is estimated at $1.2 million and annual maintenance at $120,000.

The Trust planned and implemented forest thinning in two areas at risk from wildfire. Over 130 acres were thinned south of, and 90 acres north of, Highway 4 on the Banco Bonito; 150 acres were thinned around ranch Headquarters. In 2005, The Trust conducted a prescribed fire in the Valle Toledo. The fire improved forage quality with no deleterious detectable effects on plant populations, soil erosion, stream water quality and fish and invertebrate communities. Currently, all natural or human-caused ignitions are managed as wildfires and suppressed.

In 2006 and 2007, 43 groups and 1,226 people participated in educational programs on the Preserve. Education activities include K-12 students, university students, citizen groups, workshops and seminars, interpretation and educational television productions.

The Trust established a science program (inventory, monitoring and research) to provide information for adaptive management of Preserve resources and for preparation of environmental documents in 2001. Natural and cultural resources have been inventoried to establish a baseline against which to measure the impacts of operations and management actions. The Trust monitors key indicators of climate, stream water quality, ecological condition, wildlife habitat and plant and animal populations. The Trust collaborates with universities, agencies and non-profit organizations on climate change; forest, range and fire management; forest restoration; hydrological cycles; infectious diseases; carbon cycling; fire history; elk and cattle interactions; coyote and predator studies; and cattle behavior. These collaborative efforts result in over $1.5 million of research on the Preserve each year.

Reasonably Foreseeable Future Actions. Reasonably foreseeable future actions are those whose effects may contribute to the condition of the Preserve over the next 5 years. Decisions have been made to undertake these actions, or the actions are being considered.

Public Access and Use. Since 2002, the Trust has managed interim programs for public access and use for recreation, education and other purposes with existing infrastructure and temporary buildings. The Trust held public meetings in the summer of 2007 to gather information to use in developing an access and use management plan that will address visitation, visitor programs and infrastructure for the next decade. Alternatives will be developed to address capacity, scale and location of infrastructure and types of programs offered. Concomitantly, the Trust will develop a business plan that analyzes market opportunities for programs, activities and infrastructure to address the mandate of becoming financially self-sustaining by 2015.

Preserve Management. Facilities (structures and utilities), roads, ranch infrastructure (fences, corrals and earthen tanks), renewable resources (forage and timber) and fire comprise Preserve management. The Trust will consider long-term plans for preservation and maintenance of structures, including historic cabins. The Trust will consider a permanent visitor center,

administrative office and employee living quarters on the Preserve. The Trust will continue routine maintenance of roads based on safety, resource conditions, capacity and intended uses. A transportation plan will identify road access for public activities, administrative and traditional uses and unnecessary roads. The Trust will continue to maintain the 53.5 miles of boundary fences and sign the perimeter to control trespass. The effectiveness of interior fences and earthen stock tanks will be evaluated in plans for forage use by domestic livestock; unnecessary fences and stock tanks may be removed. Corrals on the Preserve are in good condition and are currently used for receiving, shipping and sorting cattle.

Renewable Resources. In December 2006, the Board authorized a stewardship action to develop a plan to allocate forage to support elk and other herbivores; to preserve and protect ecosystem processes and habitats; to support domestic livestock grazing and other commercial purposes; and to support scientific, education and other public uses. Public comments were accepted during the summer of 2007; an environmental assessment will be completed in 2008.

The Trust is working on a forest inventory. That will be followed by development of a forest and fire management plan that will include an assessment of surface and canopy fuels and values at risk. Vegetation data will be used to predict the effects of wildland fire and to determine where and when prescribed and wildland fires can be used for resource benefits. The use of wood products will be considered to defray the cost of forest management. Until the plan is complete, thinning projects along Highway 4 and in the Headquarters area probably will continue.

Inventory, Monitoring and Research. Most inventories of natural resources will be completed in 2008. Additional forest inventories may be needed to support management projects, such as the sale of forest products. Cultural resource inventories will continue as the Trust undertakes ground-disturbing projects (trails and trailheads, road upgrades and infrastructure), and as more areas are opened to public use. Data will be gathered on the characteristics of visitors to the Preserve as the Trust plans for long-term public access and use.

Monitoring programs will continue to assess management actions that affect natural resources (fishing, livestock grazing) and cultural resources (ground disturbing projects, rehabilitation of historic structures). Baseline monitoring of climate, stream water quality and plant and animal populations will continue.

Research programs will focus on the hydrologic cycle and management actions to increase water budgets. Watershed restoration projects, including forest thinning, may reduce water loss from snow sublimation, increase soil moisture (increasing tree growth and forage production), and increase groundwater recharge and spring snowmelt runoff. Wildlife projects could be developed to study interactions among elk, deer, mountain lions, bears and coyotes, and how these species respond to human activities, land use patterns, fires and habitat restoration.

Cumulative Effects. Logging, grazing, fishing, road building and road maintenance affect Preserve streams, especially during snowmelt and summer rains. Ecological condition ratings were assigned to upland and riparian areas in 28 sub-basin watersheds. Five basins show little or no departure from reference (expected) conditions and 23 show moderate departure; no sub-

basins depart greatly from reference conditions. Four streams exceed New Mexico standards for temperature and turbidity. However, the number of days that stream temperatures exceeded the standards decreased by 20% from 2001 to 2006. These improvements resulted from conservative grazing practices, a shorter grazing season and limiting or excluding livestock from sensitive areas. Road maintenance, especially the replacement of culverts and bridges and the use of permeable fills, contribute to ecological improvement.

The Trust assessed forest conditions by comparing the existing vegetative structure to the reference (expected) structure for representative plant communities. Preserve forests depart significantly from reference conditions due to the cumulative effects of fire exclusion and logging. Unlike grasslands and riparian communities, forest conditions will not improve if left alone; they will only improve from management actions, such as silvicultural treatments and prescribed fire, or as a result of unplanned natural events (fire, disease and insects).

Forage conditions on the Preserve are good; plant cover exceeds 98% in the open valles. Summer forage production, while higher than most rangelands in New Mexico, is extremely variable depending on rainfall. Between 2002 and 2007, forage production ranged from 814 to 2,246 pounds per acre. The nutritional value of forage is fair to good during the summer, but very poor in the winter. The extent of grazable pastures on the Preserve is changing. In the 1960s and 1970s, logging created large clear cuts at high elevations that reached maximum productivity in the 1980s. Since that time, more than half of the upland pastures have disappeared due to forest regeneration.

Wildlife species and abundances in the Jemez Mountains have undergone substantial changes in the 20th century. Grizzly bears, wolves and elk were extirpated from New Mexico in the early 1900s. Elk were reintroduced after World War II and the population expanded to over 7,000 animals. A considerable amount of forage is required to support the 3,000 elk estimated to be on the Preserve. The 2006 summer monsoons produced record forage (1,796 pounds per acre) and forage use averaged 19% (goal for maximum use is 40%). Forage production was much lower in 2002 (915 pounds per acre) and use was 31%. In years of below average precipitation, elk consume a large portion of available forage, potentially limiting the stocking density of domestic livestock.

Road building, logging, geothermal development, infrastructure development and herbivore grazing affect archaeological resources. Because most archaeological resources on the Preserve are soil deposits that contain the remnants of prehistoric cultural activities, their condition is correlated with the recovery of vegetation communities, stream health and reduced erosion. Actions by the Trust that improve these values will maintain and enhance the condition of intact prehistoric cultural deposits.

State of the Preserve. Reading the Valles Caldera Preservation Act of 2000, one could conclude that at the time of acquisition, the Preserve was assumed to be in a reference ecological condition. Compared to pre-acquisition periods with extreme levels of grazing and logging, the Preserve is in excellent condition. However, the Trust's analyses of the ecological condition of

watersheds and forests suggest that the current condition departs from the reference condition described in the Act. If we assume that the baseline for comparison is the reference (expected) condition, 90% of the Preserve departs moderately, and multiple use and sustained yield capacity of the land are reduced. The current condition influences the potential and realized uses of the Preserve. The Valles Caldera Preservation Act did not set restoration of Preserve communities as a goal. If restoration is a goal, then adequate funding will be required.

Many of the issues the Trust must consider in moving from interim to long-term programs extend beyond Preserve boundaries, including management of the elk population, development for public access and use, grazing by domestic livestock and forest and fire management. Regional climate change is virtually assured; most forecasts for the southern Rocky Mountains predict increasing temperatures and loss of winter snowpack. Changes in precipitation patterns are more difficult to predict, but warmer temperatures will increase evaporation and plant transpiration. A warming climate will favor lower-elevation plant and animal species, potentially resulting in shifts in dominant trees and grasses. Invasive plant and animal pests, already common on the Preserve, may take advantage of the changing ecosystem conditions to expand their distributions and abundances.

Conclusion. The Valles Caldera Preservation Act contains the goals that direct Trust management actions. These goals stretch and challenge the Trust; they are realistic and achievable and will continue to guide the Trust as it moves from interim to long-term management of the Preserve. The Act identified three key benchmarks to measure Trust performance – public access, comprehensive management and financial self-sufficiency.

(1) The Act requires the Trust to provide reasonable access to the Preserve within 2 years of acquisition. This goal has been partially met with interim programs for recreation, education, research, cultural and personal uses and commercial uses. Visitation will undoubtedly increase in the future following completion of the public access and use management plan.

(2) The Act requires the Trust to develop a comprehensive management program. With the completion of the first *State of the Preserve*, the basic components of comprehensive management are in place (stewardship actions, *State of the Preserve* and strategic guidance). The comprehensive management program for the next decade will be guided by the forage use, public access and use, and forest and fire management plans.

(3) The Act defined financial self-sufficiency as "...management and operating expenditures equal to or less than proceeds derived from fees and other receipts for resource use and development and interest on invested funds." Interim programs have grossed about 20% of current Trust appropriations (estimate of operating expenses). As long-term planning gets underway in 2008, a detailed market analysis and strategic business plan will guide the Trust. Other sources of revenue, such as grants and donations, will play an important role in restoration of the lands and facilities of the Preserve, and in support of Trust operations. The goal of financial self-sufficiency will continue to challenge not only the Trust, but also the stakeholders engaged in this experiment.

1 Introduction

The Valles Caldera Preservation Act[1] ("Act"), passed by Congress in 2000, provided for the acquisition of the Baca Location No. 1 in the Jemez Mountains of northern New Mexico. The Act designated the 88,900-acre tract as the Valles Caldera National Preserve ("Preserve") (Figure 1) and created the Valles Caldera Trust ("Trust") to manage it.

FIGURE 1

LOCATION OF VALLES CALDERA NATIONAL PRESERVE

The Act[2] directs the Trust, which is governed by a nine-member Board of Trustees, to "...develop a comprehensive program for the management of lands, resources, and facilities within the Preserve...[S]uch program shall provide for...

1) operation of the Preserve as a working ranch, consistent with paragraphs (2) through (4);
2) the protection and preservation of the scientific, scenic, geologic, watershed, fish, wildlife, historic, cultural and recreational values of the Preserve;
3) multiple use and sustained yield of renewable resources within the Preserve;

[1] Act of July 25, 2000 (Public Law 106-248; 114 Stat. 598)
[2] Public Law 106-248 § 108(d)(1-6); 16 U.S.C. § 698v-6.

4) public use of and access to the Preserve for recreation;
5) renewable resource utilization and management alternatives that, to the extent practicable—
    a) benefit local communities and small businesses;
    b) enhance coordination of management objectives with those on surrounding National Forest System land; and
    c) provide cost savings to the Trust through the exchange of services, including but not limited to labor and maintenance of facilities, for resources or services provided by the Trust; and
6) optimizing the generation of income based on existing market conditions, to the extent that it does not unreasonably diminish the long-term scenic and natural values of the area, or the multiple use and sustained yield capability of the land."

The Act mandates that the Trust become financially self-sustaining by 2015, which it defines as "management and operating expenditures equal to or less than proceeds derived from fees and...receipts...and interest on invested funds." The Act envisioned that the Trust would collect revenues from four sources:

- Fees for public access and use;
- Multiple use and sustained yield of renewable resources, such as timber and forage;
- Donations to the Trust from individuals and organizations; and
- Interest on funds deposited at the U.S. Treasury.

In 2005, Congress amended the Valles Caldera Preservation Act of 2000. Congress determined that some of the federal policies on management and personnel did not meet the needs of the Trust, and that the policy needed to be clarified so the Trust and the U.S. Forest Service could more effectively address Trust issues. The Valles Caldera Preservation Act of 2005[3] directed the Secretary to acquire the minority mineral interests on the Preserve with available funds or through a declaration of taking. It also directed the Secretary, in consultation with the Trust, to develop a fire preparedness, suppression and emergency rehabilitation services plan for the Preserve that is consistent with the management plan developed by the Trust, and to provide those services on a non-reimbursable basis. The Secretary could provide presuppression and non-emergency rehabilitation and restoration services on a reimbursable basis.

1.1 State of the Preserve

The *State of the Preserve* report is unique to the Valles Caldera Trust. The *State of the Preserve* is defined in the Trust's procedures[4] for implementing the National Environmental Policy Act[5] (NEPA; 1969 as amended) as "...a concise account of the systematic review of monitored

[3] Act of December 30, 2005 (Public Law 109-132; 119 Stat. 2570)

[4] National Environmental Policy Act Procedures for the Valles Caldera National Preserve. Federal Register / Vol. 68, No. 137 / Thursday, July 17, 2003 / Notices, pp. 42460-42472. Available at www.vallescaldera.gov/about/trust/docs/trust_NEPAProcedures.pdf

[5] 42 U.S.C. §§ 4321 et seq.

outcomes and interpretive information from, but not limited to, observations, studies, public comment, research investigations, natural resources data or information summaries, and other sources to provide the technical and scientific basis for considering the cumulative effects of the past, present, and reasonably foreseeable future actions of the Trust."

The *State of the Preserve* is a key component of the comprehensive management of the Preserve. According to the Trust's NEPA procedures, "[t]he comprehensive management of the lands, resources, and facilities of the Preserve includes all stewardship registers[6], the State of the Preserve, and the strategic guidance[7] adopted by the Board of Trustees. These documents depict the management of the Preserve and provide timely references for interested citizens...The Board of Trustees may remove, amend, and/or adopt one or more additional goals only after completing reviews of the goals adopted in strategic guidance and a current State of the Preserve...The Trust achieves comprehensive management of the Preserve by adopting strategic guidance and selecting and implementing appropriate stewardship actions[8]."

The purpose of the *State of the Preserve* is to provide the "...technical and scientific basis for the comprehensive management of the Preserve and [to aid in] the consideration of goals within strategic guidance that may be adopted by the Board of Trustees." Because "[t]he Trust must prepare the State of the Preserve at least once every 5 years after August 2, 2002," the *State of the Preserve* is a key component in the implementation of adaptive management, which the Trust's NEPA procedures defines as "...adjusting stewardship actions or strategic guidance based on knowledge gained from new information, experience, experimentation, and monitoring results, and is the preferred method for managing complex natural systems."

1.2 Cumulative Effects

The Council on Environmental Quality regulations that implement the procedural provisions of NEPA define cumulative effects as "...the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future action regardless of what agency (federal or non-federal) or person undertakes such other action..."[9]

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[6] "...a concise document, including applicable environmental documents, available to the public and readily amended over time depicting the location, development, implementation, and monitoring of a stewardship action." (National Environmental Policy Act Procedures for the Valles Caldera Trust, 2003)

[7] "...adoption by the Board of Trustees of one or more of the following elements: (a) One or more goals for all or a portion of the Preserve; or (b) Direction to the Responsible Official to consider one or more stewardship actions or an administrative matter related to the operation of the Preserve." (National Environmental Policy Act Procedures for the Valles Caldera Trust, 2003)

[8] "...an activity or group of activities consisting of at least one goal, objective, and performance requirement proposed or implemented by the Responsible Official that may: (1) Guide or prescribe alternative uses of the Preserve upon which future implementing decisions will be based; or (2) Utilize or manage the resources of the Preserve." (National Environmental Policy Act Procedures for the Valles Caldera Trust, 2003)

[9] 40 CFR § 1508.7

Analyzing the cumulative effects of actions is challenging because of the difficulty defining spatial and temporal boundaries. Determining the cumulative effects of an action requires describing the cause and effect relationships between the multiple actions (past, present and future) and the resources of concern. The significance of cumulative effects depends on how they compare with environmental baselines and relevant thresholds, such as regulatory standards (Council on Environmental Quality 1997).

The *State of the Preserve* provides the Trust with a tool to ensure that significant issues are not overlooked and that the scope of the analyses remains meaningful in management and decision-making. In the analysis of cumulative effects, the *State of the Preserve* considers human impacts dating from measurable extractive uses (late 1800s) forward. Extractive uses that contribute to the current condition of the Preserve include grazing, logging, road building, and in a more limited context (space and time), geothermal exploration. Fire exclusion had a significant impact on the forests and hunting had a significant impact on wildlife populations of the Preserve.

2 Setting

2.1 Natural Resources

2.1.1 Physical Setting

About 1.25 million years ago, a spectacular eruption created the 13-mile wide crater-shaped landscape now known as the Valles Caldera (Figure 2). The eruption tapped a vast magma chamber that exploded catastrophically, depleting the magma chamber and creating a void into which the surface landscape collapsed. The enclosed caldera filled with water forming a large freshwater lake. The subsurface remained in turmoil as new magma refilled the collapsed chamber, and within 50,000 years Redondo Peak rose up through the lake bottom. Following the resurgence of Redondo, the first of many eruptive flows from ring fractures in the caldera formed the dome at Cerro del Medio, followed by Cerro del Abrigo.[10] This continued counter clockwise around the ring fracture creating the domes in the northern half of the caldera.

FIGURE 2

MAJOR LANDSCAPE FEATURES OF THE VALLES CALDERA NATIONAL PRESERVE

By about 500,000 years ago, the southwestern rim of the caldera breached, emptying the caldera of water and sediments and forming San Diego Canyon to the southwest. Additional

[10] "cerro" is hill in Spanish; see Appendix 7.1 for a glossary of Spanish place names

flows and dome-formation on the south and west periodically prevented the drainage of water, forming lakes in what are now known as the Valle Grande and Valle San Antonio.

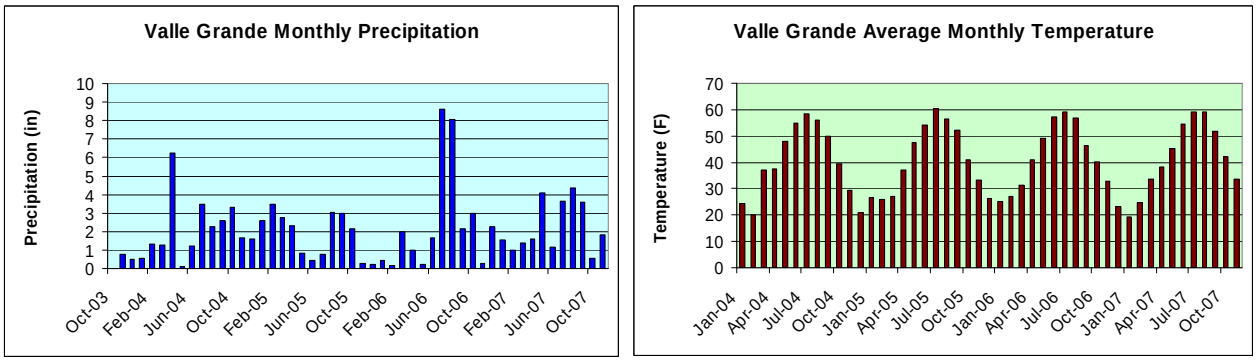
Approximately 50,000 years ago, an explosive eruption occurred in the southwest corner creating the crater known as El Cajete. The resulting pyroclastic flow produced the striking landmark known as Battleship Rock where the waters from the Valle San Antonio meet the East Fork of the Jemez River flowing from the Valle Grande. The final gasp of this eruption produced the broad sloping landform in the southwest corner known as the Banco Bonito. The Valles Caldera, while not the largest, is one of the most intact calderas in the world, making it ideal for studying the complex geology of caldera formation (Kempter and Huelster 2007).

2.1.2 Climate

The regional climate is semi-arid continental. Cyclonic storms associated with the polar jet stream bring snow in the winter and rain in the spring and fall. April through June is usually dry. The majority (60%) of the precipitation comes in the summer months (Figure 3) in the form of convectional "monsoon" storms when the Bermuda high-pressure system drives moist oceanic air into the Southwest. Periodic El Niño events bring increased winter and spring precipitation to the Southwest, while interspersed La Niña events cause droughts. El Niño events affect stream flows, wildfire activity, and plant productivity (Allen 2004).

FIGURE 3

MONTHLY PRECIPITATION (TOTAL) AND TEMPERATURE (AVERAGE) IN VALLE GRANDE (2003-2007)



The climate scenario is modified by the high elevations and topographical variability of the Preserve. The average precipitation reported for Los Alamos is 18.4 inches and over 35 inches at the caldera rim (Allen 1989). The annual average precipitation at the Valle Grande weather station (2003-2007) was 24.4 inches. Snow accumulation, while minimal at Los Alamos, can be significant on the Preserve. The temperatures at the highest elevations of the Preserve may be 25-35°F colder than Los Alamos (Figure 3), and the valles are 10-15°F colder still. The effect of the cold air drainage into the valle bottoms may drive temperatures down even further (Muldavin et. al. 2006); the record low temperature in the Valle Grande was -16.6°F.

2.1.3 Waters

Nearly 75 miles of perennial stream originate in the forests and meander through the valles of the Preserve. The headwaters of the East Fork of the Jemez River and the Rio San Antonio arise within the Preserve. These tributaries converge below Battleship Rock in San Diego Canyon to form the Jemez River, a tributary to the Rio Grande.

The Preserve was established based on watershed boundaries.[11] At the time of acquisition, the lands comprising the headwaters of the Santa Clara watershed were sold to Santa Clara Pueblo and the lands comprising the headwaters of Frijoles watershed went to Bandelier National Monument. The remaining lands lie within the Jemez Watershed.

2.1.4 Soils

The soils of the Preserve mirror its geology. Scientists from the Natural Resources Conservation Service, Sandoval County Soil Survey, mapped nearly 80 soil series that fall into forest and grassland groups. Forest soils are primarily mountain soils (Andisols, Alfisol and Inceptisol soil orders) derived from volcanic rocks and gravel (rhyolites and andesites, with some dacites and latites, tuffs and pumices) along with windblown deposition. Forest soils tend to be rocky with loamy textures in the matrix. Grassland soils are mostly Mollisols that developed in the volcanic alluvium of the alluvial fans and piedmonts, or in recent water-deposited sediments of the valle bottoms. They are deep with rich organic material and fine textures in the top layers and few rocks (Muldavin and Tonne 2003).

Soil samples collected in 2001 on the Preserve by the Jemez Pueblo Department of Resource Protection had elevated concentrations of radioisotopes.[12] Although Gross Beta radiation could be naturally occurring, Cesium-137 and Plutonium-239/240 are fission products (man-made nuclear materials) and their presence in the soil above regional background levels could indicate airborne deposition from Los Alamos National Laboratory.

2.1.5 Flora and Fauna

The Preserve is one the most diverse areas in the Southern Rocky Mountains Ecoregion (southern Wyoming to northern New Mexico). About 65% of the Preserve is forested and 30% is grasslands; shrubs, water and bare ground, including rock outcrops, account for about 1% each (Table 1). The plant associations range from high elevation, sub-alpine forests down through mixed conifer forests to open foothill pine woodlands, and high montane grasslands down to valle floor wetlands. Montane grasslands (26,000 acres) and wetlands (1,650 acres) on the Preserve are some of the largest and highest quality habitats for ecological function and biodiversity in the Southern Rocky Mountains Ecoregion (Muldavin and Tonne 2003).

The flora and ecology of the Jemez Mountains is typical of the southern Rocky Mountains. Ponderosa pine is the major tree species below 9,000 feet; ponderosa forests ring the valles,

[11] Watershed boundaries define the aerial extent of surface water drainage. The boundaries are determined by hydrologic principles as opposed to administrative or political boundaries.

[12] D. Erskine. 2001. Jemez Gradient Soil Project, Summary Report, Analytical Quality Associates, Inc.

except on some north-facing slopes where blue spruce has gained importance (Hogan and Allen 1999, Muldavin and Tonne 2003). Ponderosa forests grade into mixed-conifer forests above 10,000 feet and contain combinations of ponderosa pine, Douglas-fir, white fir, quaking aspen and limber pine. Spruce-fir forests dominated by Engelmann spruce and corkbark fir are found at the highest elevations. Aspen stands occur throughout the forests. Soil characteristics, cold air drainage, hydrology, fire and grazing contribute to the maintenance of the grasslands that span the valles in the caldera (Allen 1989, Coop 2007a,b). High elevation grasslands that were historically maintained, at least in part, by fire also occur on upper, south-facing slopes in the mixed conifer and spruce-fir zones (Allen 1989).

TABLE 1

PLANT ASSOCIATIONS AND AREA COVERED (MULDAVIN ET AL. 2006)

Vegetation Type	**Acres**	**%**
Spruce-fir forest	7,005	7.9
Mixed conifer forest and woodland	36,566	40.4
Aspen forest and woodland	5,103	5.8
Ponderosa pine forest	9,241	10.4
Gambel oak-mixed montane shrubland	1,443	1.6
Montane grasslands	19,858	22.4
Wetlands and wet meadows	6,853	7.7
Montane riparian shrubland	14	<0.1
Sparsely vegetated rock outcrop	159	0.2
Felsenmeer rock field	915	1.0
Roads-disturbed ground	1,536	1.7
Open water	56	<0.1
Post-fire bare ground	17	<0.1
Total	**88,765**	**100.0**

Vegetation data collected since 2002 show a resilient and productive riparian system with signs of moderate degradation. Grasses and sedges dominate ground cover; there is little bare soil despite prolonged regional drought conditions. Signs of past overgrazing include rushes and shallow-rooted, non-native plants, especially Kentucky bluegrass. Historical use of the riparian area is recorded in a larger stream width-to-depth ratio, as well as active headcuts in the upper drainages. Many old erosion areas appear to be healing through vegetative processes, and increased stream bank stability contributes to riparian functioning (McWilliams 2006). The system appears to have the capacity to restore itself given time and careful management.

The Preserve supports a great diversity of animals, plants and fungi. Inventories from 2001-2006 identified 69 species of mammals, 102 birds, six reptiles, three amphibians, six fish, 525 plants, 28 lichens, 11 algae and five slime molds. While inventories of insects are ongoing, 134 species of aquatic insects were collected in streams and wetlands in 2003-2004 (Vieira and Kondratieff 2004); 54 species of butterflies were identified in surveys in 2001 (Kleintjes 2001).

Below elevations of 8,500 feet, animals include elk, mule deer, coyote, bobcat, various squirrels, prairie dog, chipmunks, raccoon, skunk, cottontail, woodrat, mice, weasels, beaver, badger, black bear and mountain lion. Local birds include blue grouse, Merriam's turkey, various hawks and owls, robin, house wren, woodpeckers, nighthawk, hummingbirds, white-throated swift, sparrows, warblers, meadowlarks, chickadee and golden and bald eagles.

Between 8,500 feet and 11,000-12,000 feet, animals include elk, mule deer, black bear, lynx, weasels, squirrels, chipmunks and several mouse species. This life zone also supports the gray fox and various shrews and provides homes for grouse, woodpeckers, hummingbirds, sparrows and warblers. Other bird species include goshawk, Steller's jay, dark-eyed junco, several kinglet species and mountain bluebird.

2.2 Cultural Resources

2.2.1 Pre-History

The rich animal, plant and mineral resources of the Valles Caldera have provided materials and food for human use throughout prehistory. The earliest occupation of the Southwest began during the Paleoindian period from over 12,000 to about 7,500 years ago (5500 B.C.). These early sites can be difficult to find because the deposits in which they occur are buried or have eroded over time, or because artifacts from the period are mixed in with those from subsequent human use at the same locations.

Paleoindian spear points and other flaked stone tools are often are made from high quality lithic material such as chert and obsidian that has been transported over long distances. The most distinctive of these early artifacts, the finely-made Clovis and Folsom points, have been found as isolated artifacts at a dozen or more locations in and around the Jemez Mountains. However, only a handful of probable Paleoindian campsites have been discovered and none are within the Preserve. One the most promising opportunities for archaeological research on the Preserve is locating and documenting the character and distribution of these early sites. Ideal locations for Paleoindian sites are the grasslands and river terraces within broad valles of the caldera, as well as high-elevation saddles and ridges used as prehistoric transportation routes.

During the Archaic period (5500 B.C. through A.D. 500), the subsistence base for human groups witnessed a shift from wide-ranging hunting of large game animals and gathering of plant resources, toward a focus on harvesting and processing of region-specific plant resources such as seeds and nuts. For the first time, artifact assemblages commonly include ground stone artifacts used in processing of plant resources. Flaked stone artifacts (Figure 4) often were made of locally available materials; distinctive tool types include a variety of dart points.

A number of sites on the Preserve are dated to the Middle and Late Archaic, suggesting that human use increased progressively throughout the Archaic. Excavations in the 1980s and 1990s associated with geothermal and associated power line projects contributed substantially to what is known about the Archaic period in the Jemez Mountains. The numerous large and small scatters of stone tools and debris in the caldera represent a range of uses – from locations used

briefly to make stone tools or prepare specific resources, such as game or fish; to small, seasonal camps; to expansive sites that were occupied repeatedly over centuries.

While domesticated maize entered the Southwest during the Archaic period, dependence on cultivated plants and horticultural practices did not occur until the Ancestral Puebloan period (A.D. 500-1650). Pottery first appears then, initially as plain ceramics and then in a diverse range of decorated types, including the black-on-white ceramics common throughout the Jemez Mountains. Small chipped stone points suitable for use on arrows first appear at this time.

FIGURE 4

OBSIDIAN AND CHERT BIFACE ARTIFACTS AND PROJECTILES (ARROW AND SPEAR POINTS)

The characteristic round subsurface "pithouses" distinctive to the period before A.D. 1000 are not known within the Preserve. After A.D. 1000, a shift to aboveground habitation structures appears to coincide with the beginning of agricultural intensification and increased permanence in settlement that continued throughout the period and characterizes the historic pueblos across the Southwest. Small one- and two-room masonry structures known as "fieldhouses," which are ubiquitous in the Jemez area and on the Pajarito Plateau, occur only on the Banco Bonito in the southwestern part of the Preserve (Figure 5).

It is likely that the south facing, gently sloping landforms on Banco Bonito (below 8,000 feet) offer the only conditions within the Preserve suitable for maize agriculture. This also explains why there are no pueblos within the caldera. Plant foods may have been cultivated at other locations within the caldera, but the types of plants would have been quite different from those that supported Puebloan populations who relied on maize-beans-squash horticulture.

The restricted distribution of fieldhouses and large settlements is not indicative of use of the caldera by Puebloan people. Rather, sedentary agricultural people in late prehistory probably used the caldera much as it is used today – an area without large or permanent habitation, but visited or occupied briefly by the people of the region. While ceramic sherds are a small fraction of the total artifacts present on the Preserve, the decorated sherds that have been recovered represent distinctive ceramic types characteristic of the cultural groups in the region.

FIGURE 5

FIELDHOUSE WITH REMNANTS OF STANDING WALLS ON THE BANCO BONITO

One of the challenges in understanding the archaeological record is interpreting the function and age of the numerous obsidian artifact scatters found within the caldera. The abundance, high-quality and large nodule size of the volcanic glass was valued and exploited by people throughout prehistory. The artifact scatters were created while toolmakers knapped obsidian collected at geological deposits on Cerro del Medio (Figure 6), Rio San Antonio and Rabbit Mountain. Artifact scatters could represent complex habitation activities, or simpler specialized or brief activities. Obsidian scatter sites can be associated with any cultural group and they often lack artifacts that are distinctive of cultural periods. The obsidian quarries pose additional interpretive challenges because they cover large areas and contain vast quantities of obsidian artifacts accumulated over millennia of use.

2.2.2 History

The historic period in the region begins after 1540 when Spaniards first explored the Jemez Mountains (see Appendix 7.1 for a glossary of Spanish place names on the Preserve). In 1598, Spaniards under the leadership of Juan de Oñate entered several of the pueblos. Hispanic

missions were established in the pueblos around New Mexico (including Jemez Pueblo) in the 1600s. After the Pueblo Revolt and re-conquest by De Vargas (1680-1692), missions and settlements started anew in the Jemez region and a land-grant system was set up to encourage settlement. Settlers brought domesticated livestock and horses and, by the late 1700s, Hispanic settlers and Puebloan Indians were herding cattle and sheep in the valles of the caldera. Pastoral use of the land was risky; Apaches, Navajos and Utes who hunted in the Jemez Mountains often raided herds, a practice that continued into the late 1800s.

FIGURE 6

OBSIDIAN QUARRY ON CERRO DEL MEDIO

Anglo-American trappers hunted and trapped in the caldera in the 1800s, but the first detailed record of Anglo-Americans occurred in 1851 when a route between Santa Fe and a camp on the northeast portion of the Valle Grande was created. Hay was cut and sent back to Santa Fe to feed livestock owned by the U.S. Army, which had moved into New Mexico Territory in 1846 at the beginning of the war with Mexico for control of the territory (the area became a U.S. Territory in 1848). The camp was used seasonally until Navajo raiders attacked it in 1851 forcing its abandonment.

A legal claim to the caldera occurred in 1860 when the heirs of Luis Maria Cabeza de Baca (who died in 1827) gave up their land grant around Las Vegas, New Mexico, in exchange for five tracts of land in New Mexico Territory as part of a land dispute settlement arranged by the U.S. Congress. The first area the family selected was a square of 99,289 acres around the caldera, which subsequently became known as "Baca Location No. 1." The Baca family began using the land in 1876 when the property boundaries were finalized. The numerous heirs divided the land for raising sheep and stock, but most sold their land claims.

By 1881, only a handful of Baca family members still held claims, while other land entrepreneurs who had purchased claims on unclear terms bickered over boundary rights. Legal battles (and occasional violent disputes) continued until 1899 when the New Mexico Supreme Court tried to settle the matter by ordering that Baca Location No. 1 be sold at public auction and the proceeds divided among the claimants. Attorney Frank Clancey purchased the land for $16,548 and immediately sold it again to the "Valles Land Company" run by businessmen Mariano and Fredrico Otero, two of the former claimants.

The Oteros continued cattle ranching and sheep herding, and began mining sulphur at Sulphur Springs on the west side of the property. They opened a hot spring resort that continued until 1977. They also built the first roads and cabins for office and living quarters. In 1909, they sold the Baca Location to the Redondo Development Co. of Pennsylvania, but retained grazing rights on the property. Redondo Development began logging, but completed only small-scale cutting due to transportation difficulties. The company continued leasing land for grazing until two Española businessmen, Frank and George Bond, purchased the land in 1918. Redondo Development Co. retained the timber rights. The Bonds grazed thousands of sheep and built cabins for their families and hired help. They produced millions of tons of wool and dominated the market in New Mexico until World War II when the wool market weakened.

Meanwhile, Redondo Development Co. sold its timber rights in 1935 to Firesteel Lumber, who immediately sold the rights to the New Mexico Land and Timber (later named New Mexico Timber Company). The company began logging operations on the Banco Bonito in 1935, just after the Civilian Conservation Corps constructed a road (now New Mexico Highway 4) that made transportation of logs much easier. They set up a logging camp in Redondo Meadow (Figure 7) and later in the north portion of the property. They continued logging until the early 1970s, cutting trees on 50% of the property and creating over a thousand miles of logging roads.

FIGURE 7

CABIN REMNANTS FROM A LOGGING AND MILL TOWN IN REDONDO MEADOWS. THE AREA WAS USED BY THE NEW MEXICO TIMBER COMPANY FROM 1935-1939

When Frank Bond died in 1945, his son Franklin began running more cattle than sheep; by 1960, sheep had been replaced by cattle. By this time, the Bond family wanted to sell the property, expressing interest in the federal government as a potential buyer, an idea that conservationists and legislators had hoped for since the late 1800s. The plan was disrupted in 1963 when the property was sold for $2.5 million to the Baca Land and Cattle Company run by wealthy Texas oilman James Patrick Dunigan. Dunigan built cabins and a guest lodge at the north edge of Valle Grande and maintained the land as a cattle ranch and location to hunt elk.

In 1964, the Baca Land and Cattle Company filed a lawsuit against New Mexico Timber Company seeking damages for destructive logging practices, which eventually resulted in the transfer of timber rights to Dunigan by 1972. In 1973 he made a deal with Union Geothermal Company to drill several locations on the west side in hopes of harnessing geothermal steam for a power plant – a plan that was never realized because of Native American concerns about impacts to springs and aquifers outside the caldera and disturbance to sacred land around Redondo Peak, and ultimately to the lack of sufficient steam to generate the desired power.

By the late 1970s, Dunigan wanted to preserve the land for the public and began negotiations for sale of the land with the U.S. Forest Service and Park Service. His death in 1980 disrupted the process; his sons (Andrew, Michael and Brian) maintained the property, primarily as a cattle ranch, until 2000 when they sold it to the federal government to become the Valles Caldera National Preserve.

2.3 Visitors

The Valles Caldera National Preserve has a rich history as a working ranch. Historically, access to the Preserve was limited to those who owned the ranch, those who worked on the ranch and their friends and families. Recreational access during the Dunigan era was primarily through exclusive hunting opportunities. Ranch managers occasionally organized barbeques and invited locals who supported the ranch. Employees of the U.S. Forest Service and National Park Service and volunteers from local fire departments, as well as their families, were invited because they provided emergency services, such as fire suppression, law enforcement and medical assistance. During these occasions, visitors were allowed to explore the area around the Movie Set near the Valle Grande entrance and fish in the East Fork of the Jemez River. Access for special interest group tours, such as historical or geologic societies, was occasionally granted.

Since federal acquisition, public access has increased from a few hundred visitors per year to over 12,000 in 2007. The Trust's interim public access and use recreation and education programs are supported largely by existing ranch infrastructure and have limited capacity. Current visitors to the Preserve represent only a fraction of potential visitors.

Because the Trust has collected limited data on the characteristics of visitors, and because the potential level of visitation on the Preserve is several times the current number of annual visitors, the *State of the Preserve* examines the characteristics of visitors to the Santa Fe National Forest and Bandelier National Monument. These federal properties are managed differently – the national forest allows largely unregulated free access while access to the

national monument is mostly controlled and requires payment of an access fee. The demographics of visitors to these properties and their reasons for visiting will are instructive as the Trust develops visitor programs, facilities and market strategies.

2.3.1 Valles Caldera National Preserve

Visitors to the Preserve can be divided into two categories: casual and dedicated. Casual (spontaneous) visitors are on a restricted schedule and generally are not prepared for extended recreational activities. Dedicated visitors have extended time available and are prepared for recreational activities (Valles Caldera National Preserve 2005). The programs, infrastructure and information needs differ between these user groups. In the first 5 years of its existence, the Trust developed "interim" programs primarily for the dedicated visitor (e.g., hunting, fishing and van tours).

The Trust has not systematically gathered information about the characteristics of visitors to the Preserve. However, the Trust has gathered information from orders placed on the Web site, general visitor surveys and surveys at special events.

2.3.1.1 Trust Web Site. The Trust conducts most of its business on the Internet. For the past 3 years, 71% of the orders (e.g., reservations for activities and events, fishing lotteries, etc.) and 62% of the revenue came from New Mexico residents (Table 2a); the remainder came from non-residents.

TABLE 2A

ORDERS* PLACED ON THE TRUST WEB SITE BY YEAR

	2005‡	2006	2007
Number of orders	5,992	5,891	6,711
New Mexico orders (%)	71	70	73
Total sales	$400,778	$444,112	$446,513
New Mexico sales (%)	59	61	66

* Orders include reservations and lotteries for activities and events

‡ Data are for fiscal years, October 1 through September 30

The Trust conducts an on-line lottery for elk hunt permits issued by New Mexico Department of Game and Fish. About one-half of the hunters and lottery sales are from New Mexico (Table 2b).

TABLE 2B

ELK HUNT LOTTERY SALES BY YEAR

	2005*	2006	2007
Lottery participants	4,500	4,807	4,660
New Mexico residents (%)	51	54	58
Total sales	$285,675	$317,365	$321,835
New Mexico sales (%)	46	52	57

* Data are for calendar years

2.3.1.2 Visitor Surveys. In 2004, the Trust surveyed 99 recreation users. Anglers, the majority of those surveyed, appreciated the relative solitude most and, to a lesser extent, the "pristine" scenery of the Preserve. General visitors identified wildlife first followed by the natural beauty. Recreation visitors focused on the scenery. Although samples from the general and recreation surveys are too small to identify a pattern, "solitude/few people" was not identified as a particularly valuable or special characteristic of the Preserve. Solitude may have been a major draw for anglers and they may have "pre-selected" themselves for an activity where marketing focused on privacy values. When asked about an acceptable number of encounters, over 80% of the anglers said 0-5; over 70% of the general and recreation visitors said 1-12 (Valles Caldera National Preserve 2005).

2.3.1.3 Open House. On Saturday August 26, 2006, the Trust held an "Open House" when people could drive their personal vehicles on the Preserve at no cost. While the gate was open, 1,444 vehicles carrying 3,746 visitors entered the Preserve. Zip codes were collected from the first 433 (30%) vehicles. Almost 98% were from New Mexico and 80% were from five cities (Table 3); nine vehicles (2.1%) came from other states (see also section 3.2.1.4.).

TABLE 3

CITIES OF ORIGIN OF VISITORS AT THE AUGUST 2006 OPEN HOUSE

City	Number of Vehicles	Percent of Vehicles
Los Alamos	132	30.5
Albuquerque	128	29.6
Santa Fe	40	9.2
Jemez Springs	22	5.1
Española	22	5.1
Total	**344**	**79.4**

* Based on 433 Zip Codes

The Trust distributed approximately 1,500 welcome packets and received 216 comment form replies. Most people learned of the event in a newspaper (48%) or from a friend or relative (19%). Direct advertising may have accounted for up to 26% (email, brochure/poster and Web site/Internet). The majority of visitors (68%) had not participated in a previous event and the Open House was probably their first time on the Preserve. Of the people who said the Open House was their first time on the Preserve, more than one-half did not know about the Preserve, thought it was closed to the public or lacked information. The perception of high cost for events was mentioned by 13% of respondents. Nearly one-third of the respondents had participated in at least one prior event.

The Trust asked if people would participate in future events and why; 75% said yes, 22.4% said yes/maybe and 2.6% said no. People said yes because of the Preserve's beauty (59%) and the types of events offered (26%). Of the people who answered yes/maybe, 27% said it depended on

the cost and 27% said it depended on the types of events offered. Of those who said no, cost and traffic were the reasons mentioned.

The Trust asked people for additional comments. The most frequent responses were requests to have more open houses (13% of respondents), exclamations about the beauty of the Preserve (12%) and complaints that there were too many cars and people (11%). Visitors wanted the Trust to charge an entrance fee (8%), control visitation with an allocation system (7%) and limit vehicles and visitors (6%). Overall, 68% of the visitors had an 'exceptional' or 'interesting' experience; 14% said it was 'okay' or 'fair'; and 19% said it was 'poor.' 'Poor' experiences were probably due to the significant traffic jams experienced during the Open House.

2.3.2 Santa Fe National Forest

In 2003, the Santa Fe National Forest contacted visitors on the forest during the National Visitor Use Monitoring project (U.S. Forest Service 2004). The objective was to gain a better understanding of the use, importance and satisfaction with recreation opportunities. Of the 1,896 people interviewed, 87% said their primary purpose was recreation.[13] A higher portion of visitors were male (58%) than female (42%); 21% were under 20 years of age; 29% were 20-39; 39% were 40-59; and 11% were over 60 years old. Twenty-four percent of visitors came from Albuquerque, 23% from Santa Fe, 5% from Los Alamos, 4% from Rio Rancho, 1.5% from Los Lunas, 1.2% from Jemez Pueblo; less than 1% came from a foreign country.

The average number of people per vehicle was 2.4 and the average length of stay was 11.9 hours. Only 12% of the visitors stayed overnight. The top five activities were viewing natural features, hiking and walking, relaxing, viewing wildlife and driving for pleasure. The most used facilities and areas were forest trails, scenic byways, downhill ski areas, forest roads and picnic areas.

Eighty-six percent of the visitors said that participating in recreation activities on the Santa Fe National Forest was their primary trip destination. When asked to select substitute choices, if they were unable to visit the Santa Fe National Forest, 63% of visitors said that they would have gone elsewhere for the same activity. In the 12 months prior to the interview, the typical visitor came to the Santa Fe National Forest 39 times. Over 35% of the visitors said they spent less than $500 per year on outdoor recreation activities, including equipment, recreation trips, memberships and licenses; 38% spent $500-$1,999; 17% spent $2,000-$3,999; and 10% spent over $4,000 per year.

2.3.3 Bandelier National Monument

In 1995, the National Park Service conducted a visitor study in Bandelier National Monument[14] (Patterson 1996). Of 422 people surveyed, 27% were under 20 years of age; 26% were 20-39; 33% were 40-59; and 15% were over 60 years old. Eight percent of the respondents reported having a disability; of those with a disability, 85% had limited mobility and 12% had a hearing

[13] Most recreation on the Santa Fe National Forest is unregulated and unstructured, and does not require a reservation or draw in a lottery.

[14] Most recreation in Bandelier National Monument is regulated (visitors pay a fee to enter) but unstructured.

disability. Visitors to Bandelier came primarily from New Mexico (21%), Texas (16%), California (10%), Colorado (5%), and Arizona (2%); 6% came from a foreign country.

Most visitors (64%) came with family or friends (18%). The average age was 44 and the average group size was 3.7. Forty-two percent came in a group of two; 4% came as part of a tour group. Seventy-three percent of visitors were visiting Bandelier for the first time. Fifty-five percent stayed in the monument for 3-4 hours; 18% stayed 1-2 hours; 13% stayed more than 24 hours.

The most visited sites were the visitor center (91%), Ruins Trail (91%) and Ceremonial Cave (63%); the least visited site was the backcountry (4%). Sixty-one percent of the visitors stopped at the visitor center first. The top six activities were visiting the ruins (96%), viewing museum exhibits (70%), shopping (45%), day hiking (43%), viewing slide programs (40%) and viewing wildlife and nature (38%). The most commonly used facilities were restrooms (96%), Ruins Trail (92%), Ceremonial Cave (61%), directional signs (46%) and gift shop (43%).

3 Past, Present and Reasonably Foreseeable Future Actions

The Council on Environmental Quality defines cumulative effects as "...the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future action..."[15] For the analysis of cumulative effects, the *State of the Preserve* considers human impacts dating from the late 1800s. Present actions are those undertaken by the Trust after federal acquisition. Reasonably foreseeable future actions are those for which decisions have already been made, or the action is being considered and it is reasonable that a decision will be forthcoming and the action undertaken.

3.1 Past Actions

Throughout prehistory, the rich animal, botanical and mineral resources of the Valles Caldera provided materials and food for human use. The earliest occupation of the Southwest began over 10,000 years ago (Paleo-Indian period). Human use of the caldera increased throughout the Archaic period. The presence of these early hunter-gatherers in the caldera is indicated by archaeological evidence rather than by the residual environmental impacts of their occupation. Physical alterations of the landscape and ecology of the caldera by early humans probably was minimal; potential effects could have come from use of fire, harvesting of prey species and subtle alterations in plant species and wildlife habitat. The same is true during the subsequent Ancestral Puebloan period when landscape modification for agricultural enhancement (i.e., localized terracing) was practiced on the Banco Bonito.

In contrast, Allen (2004) makes the case for deforestation by Ancestral Puebloans of Bandelier-area mesa tops surrounding the Preserve through centuries of intensive woodcutting for cooking fires, heating in winter, building materials and land clearing for farming, especially from 1200-1500. Allen speculates that their intensive land use practices on the Pajarito Plateau may have triggered increased soil erosion, and that their centuries of hunting may have suppressed populations of their preferred prey (deer).

3.1.1 Domestic Livestock Grazing

Livestock grazing was the first significant extractive use of Preserve resources. Early surveyors and explorers identified the large grassy valles with their perennial waters as ideally suited for grazing. Due to the high elevation and short growing season, farming was insignificant. Prior to the 1876 survey and patent to the [Baca] land grant, the Cabeza de Baca's and their neighbors were herding small flocks through the tall grasses of the valles, "probably no larger than several hundred animals apiece" (Martin 2003:33). At that time "...the Baca family heirs permitted members of the Pueblo of Jemez to run sheep and horses in the caldera's rich grasslands."[16] The Jemez use of these valles for herding was apparently a long-lived tradition that dated back to the

[15] 40 CFR § 1508.7

[16] A misunderstanding between G. W. Bond and Brothers Company and Jemez Pueblo around 1920 led to the arrest of members from three Pueblo families for illegal grazing. Even though the court in Española found in favor of the Indian defendants, Frank Bond ended the unwritten agreement that allowed the Pueblo to pasture cattle and horses in the Valles Caldera (Anschuetz and Merlan 2004).

early Spanish colonization of New Mexico (Martin 2003). The numbers increased at the turn of the century under Frank Bond who had *partido*[17] agreements with Hispanic shepherds. Clyde Smith, who was born on a homestead at Battleship Rock in 1899 and worked on the ranch as a young man, estimated that there were over 100,000 sheep on the Baca Location during the summers of 1917 and 1918 (Anschuetz and Merlan 2004).

With the decline of wool prices in 1939-1940, Frank Bond added cattle to the Baca Location ranching operations (Anschuetz and Merlan 2004). In the early 1950s, the ranch supported 30,000 sheep and 5,000 cattle. After Franklin Bond's death at the age of 52 in 1954, the trend of replacing sheep herds owned by the family with cattle owned by lessees continued. By the late 1950s, as many as 12,000 cattle grazed on the Preserve (Martin 2003).

In 1963, the Baca Land and Cattle Company, owned by James Patrick Dunigan, purchased the Baca Location from the Bond Estate. After allowing existing grazing permits to expire, Dunigan started running his own cattle in 1965. In 1968, J. B. Harrell, Jr., an employee, stated that Dunigan ran about 7,000 yearling steers. The ranching season ran from about April 15 to November 15, depending on weather conditions (Anschuetz and Merlan 2004). Dunigan built fences and constructed earthen tanks to expand the areas of the ranch suitable for grazing and implement a rotational grazing system.

Baca Land and Cattle Company worked with the U.S. Soil Conservation Service and consulted with Texas Technological College on ways to improve Baca Location rangelands. One of these collaborations consisted of an experimental plot of 14 grasses to develop cool season varieties to inter-seed with the native species. Dunigan's intent was to reduce damage to pastures during grazing and to lengthen the livestock season by producing useful grass earlier in the spring and later in the fall. Dunigan also hoped that he could use cool-season grasses to reclaim abandoned logging road cuts and other disturbed areas (Anschuetz and Merlan 2004).

3.1.2 Wildlife

In the late 19th century, as the population in the Jemez Mountains increased, so did subsistence hunting. Cattle and sheep were sold to market; subsistence hunting put food on the table. The increased availability of modern rifles gave rise to more recreational hunting. The combination of increasing pressures soon decimated populations of mule deer and wild turkey. The popularity of elk hunting was so great that elk were eradicated across New Mexico by 1910 (Anschuetz and Merlan 2004). Grizzly bears were eliminated from the Jemez Mountains and all of New Mexico in the 1930s (Findley et al. 1975).

At the same time, a change in management policies adversely affected several other native and introduced animal populations that had become part of the caldera ecology. In the 1920s, ranchers and federal agents placed poisoned grain at prairie dog towns to rid pastures of these

[17] Under the *partido* agreement, stock served as their collateral. Bond collected a fee for range use from the *partidarios*, "usually 300 pounds of wool and 25 lambs per 100 ewes." *Partidarios* also had to outfit themselves from his store, where he charged a flat 10% interest rate. With expenses mounting, most *partidarios* were lucky to keep their sheep at the end of a contract (Martin 2003).

pests (Anschuetz and Merlan 2004 citing Pickens 1979, in Scurlock 1981). Ranchers and government officials also regarded feral burros and horses as nuisances because they competed with cattle and sheep for forage. In a concerted effort to rid the Jemez Mountains of unnecessary competition, U.S. Forest Service personnel rounded up 1,500 burros and horses from the greater Jemez district, including the Baca Location (Anschuetz and Merlan 2004 citing Tucker and Fitzpatrick 1972).

With the depletion of elk, mule deer, turkey, horse and prairie dog populations in the Jemez Mountains, gray wolves, mountain lions and coyotes killed increasing numbers of sheep and cattle (Anschuetz and Merlan 2004 citing Winter 1981). In 1916, the U.S. Forest Service initiated a predator control program (Anschuetz and Merlan 2004 citing Scurlock 1981). The U.S. Biological Service (now the U.S. Fish and Wildlife Service) sent trappers into the Jemez Mountains, including the caldera, to exterminate gray wolves and mountain lions. Homer Pickens (1979), a long-time trapper and wildlife specialist, recalled that John Davenport, one of Frank Bond's Baca Location ranch managers, killed the last New Mexican gray wolf in the Valle Grande in 1932 (Anschuetz and Merlan 2004 citing Scurlock 1981).

In 1947, New Mexico Department Game and Fish (NMDGF) released 47 elk imported from Yellowstone, Wyoming, into the Rio de las Vacas Valley west of the Baca Location (Martin 2003 citing Allen 1996). Although the Jemez Mountains grasslands provided favorable habitat, the elk herd increased slowly; the population was about 200 animals in 1961. The NMDGF introduced 58 more elk from Jackson Hole, Wyoming, between 1964 and 1965; the population increased slowly over the next decade (Martin 2003 citing Allen 1996). Dramatic ecological change that had an immediate and great impact on local elk demography occurred in 1977 – in June of that year, the 25,000-acre La Mesa fire burned in the ponderosa pine forests on the Pajarito Plateau at Bandelier National Monument. The fire converted the forest into grassland and opened up considerable winter habitat for the Jemez elk population. With favorable climatic conditions, the elk herd expanded to about 7,000 in 1989 (Martin 2003 citing Allen 1996). Currently, NMDGF estimates that there are 4440-6000 elk in the Jemez Mountains.[18] Using aerial surveys in the winter of 2001-2002, NMDGF estimated that 3,300 elk were on the Preserve.[19]

3.1.3 Timber Harvesting and Road Building

In *Assessment of Timber Resources and Logging History on the Valles Caldera National Preserve*, Balmat and Kupfer (2004) describe three distinct eras of harvest in the logging history of the Preserve. Each era is characterized by methods that reflect the technological, political and economic context of the period.

Pre-1935. Small timber firms began commercial logging operations in the Jemez Mountains in the late 1800s (Martin 2003). Limited by access, these operations easily reached ponderosa

[18] New Mexico Department of Game and Fish estimate for Jemez Mountains (Game Management Units 6A, 6B, 6C and 7); available at: www.nmcpr.state.nm.us/nmac/parts/title19/19.031.0014.htm
[19] New Mexico Department Game and Fish, 2002, unpublished data

pine stands around the village of Ponderosa, in the Cañon de San Diego Grant south of Baca Location No. 1 (Glover 1990). Harvesting within the caldera, if there was any, was insignificant.

1935-1962. The New Mexico Land and Timber Company (later the New Mexico Timber Company) bought the timber rights to the Baca Location from the Redondo Development Company in 1935, began logging and managed logging operations until 1972. From 1935 to 1962, the ponderosa pine stands were "high-graded"; the best ponderosa pine sawlogs greater than 12 inches in diameter were harvested from the lower elevations except for a few seed trees per acre (Martin 2003). Approximately 25,641 acres (38% of forested area) were harvested using light to heavy selection cutting in the southwest corner on the Banco Bonito, the northern and eastern rims (Garita and north of Valle Toledo) and around the base of Cerro del Medio, Cerro del Abrigo and Cerro de Trasquilar (U.S. Forest Service 1993). Before chainsaws became widespread, crosscut saws were used to fall timber. Logs were skidded by horses to decks where trucks waited to haul them to the mill. Toward the end of the era, middle elevation mixed conifer stands were harvested as roads and technology improved.

1963-1972. Improved technology and roads enabled clear-cutting of all species and sizes on approximately 10,589 acres (16% of forested area) of the Baca from 1963 to 1972. The New Mexico Timber Company used jammer logging where a mechanical cable winch hauled logs from the stump to roadside collection points. The trees were taken by truck to the mill and large slash piles were left in place of trees (U.S. Forest Service 1993, Martin 2003). Regulatory changes, and a new pulpwood mill in Arizona, aided intensive harvesting. Legal action halted logging by New Mexico Timber Company in 1972 (Martin 2003).

Jammer logging was supported by a dense network of nearly 1,000 miles of contour-paralleling roads, sometimes less than 300 feet apart, spiraling up the forested domes (Allen 1989). The roads allowed logging of steep and high elevation slopes and contributed to fragmentation of the remaining forests. Lack of conservation practices caused severe soil and water quality damage as well as aesthetic depreciation of the landscape. These unsustainable practices still affect the biological and aesthetic qualities of forests and the productivity of the land.

1980-2000. From 1980 until the sale of the Baca Location to the federal government in 2000, logging proceeded at a more conservative pace under the guidance of the New Mexico State Forestry Office. Approximately 2,739 acres (4% of forested area) were harvested between 1980 and 1992 (U.S. Forest Service 1993). Most harvests used selective cutting and were guided by state conservation guidelines (New Mexico State Forestry 1990). Selective cutting harvests a portion of mature trees, usually the largest and highest quality individuals of the most valuable species. The proportion of trees harvested varied widely. Some patch cutting took place (a patch is a small clear-cut). Many areas of the caldera were logged, including the Cerros del Abrigo, Cerro del Medio (much of which had been previously harvested), Sierra de los Valles on the eastern caldera rim and Banco Bonito in the southwest corner (U.S. Forest Service 1993).

3.1.4 Fire Exclusion

Most ecosystems in the Jemez Mountains experienced frequent, widespread lightning-caused fires prior to the late 1800s when intensive livestock grazing and subsequent active fire suppression greatly reduced fire frequency (Allen 2004). The removal of fuel connectivity through grazing was the initial cause of wildfire cessation in fire-adapted ecosystems in the Southwest (Balmat and Kupfer 2004 citing Madany and West 1983, Savage and Swetnam 1990, Touchan et al. 1995). Intense sheep grazing began in the late 1800s in the grasslands and forests of the Jemez Moutains (Balmat and Kupfer 2004 citing Scurlock 1981), which coincides with the cessation of fire scars on trees in the caldera around 1879 (Balmat and Kupfer 2004 citing Morino et al. 1998) and by 1893 throughout the Jemez (Balmat and Kupfer 2004 citing Touchan et al. 1996). The fire exclusion policy that characterized 20th century land management perpetuated the grazing-induced fire interruption and accentuated the deviation of forest structure, composition and function from their historic range of variability (Balmat and Kupfer 2004 citing Covington and Moore 1994, Brown et al. 2000).

3.1.5 Geothermal Exploration

The following account of geothermal resources and exploration was taken from Goff (2008 in press). Valles Caldera contains hot springs and fumaroles with characteristics similar to those at electricity-producing geothermal systems: 1) acid, sulfate-rich hot springs and hydrogen sulfide-rich fumaroles at the top of the system (Sulphur Springs) and 2) neutral, chloride-rich hot springs at the sides (Soda Dam). The first well in the caldera was an oil test completed in 1959 along Alamo Creek on the west side of Redondo Peak. The exploration team might have thought that the resurgent dome was a structural trap for oil and gas. The well struck superheated steam at several thousand feet.

Patrick Dunigan drilled three wells (Baca-1, 2, and 3) northeast of Sulphur Springs. Each well had water temperatures at or near 400°F, but none could sustain flow adequate for power production. Dunigan contracted with Union Oil of California (UNOCAL), the leading geothermal developer in the U.S., to explore the geothermal resources on the property. Around 1968, UNOCAL drilled Baca-4 in the Redondo Canyon west of Redondo Peak. The well was a "boomer," about 560°F with sustainable flow. During the next 10 years, UNOCAL drilled several more wells. Some were drilled near Baca-4 to determine if the geothermal reservoir was large enough for an electric power plant (Baca-5, 6, 9). Two wells were "step-outs" drilled in other canyons to see if the reservoir was large (Baca-7, 8). The step-out wells were hot, but neither had sustainable flow.

In 1978, UNOCAL signed a joint agreement with the U.S. Department of Energy and Public Service Co. of New Mexico (PNM) to cost share development of the Valles geothermal system. The UNOCAL claimed that 400 MW of electric power could be produced (1 MW is enough power for 1,000 people). The PNM bought two 25 MW geothermal turbines and a pad was constructed for the first 50 MW power plant in Redondo Canyon. The joint project was terminated in 1983 because UNOCAL only proved about 20 MW of power. Only five or six of

the 25 wells drilled was commercial. By 1984 the geothermal wells were plugged and abandoned. The UNOCAL left and PNM sold their turbines to the Mexican government.

Three wells were drilled for scientific purposes in 1984, 1986 and 1988 (VC-1, 2a and 2b) funded by the Continental Scientific Drilling Program (CSDP). These wells explored the configuration and roots of the geothermal system, the structure of the caldera and potential fossil ore deposits. The CSDP wells provided a continuous core (complete section of rock from top to bottom).[20] At the time, VC-2b was the deepest and hottest "core hole" in the U.S. (5,760 feet, 560°F) and penetrated a complete section of volcanic rocks in the caldera as well as several hundred feet of the Precambrian basement. The CSDP wells VC-2a and VC-2b encountered veins with ore minerals deposited from co-existing hydrothermal fluids. No wells have been drilled in Valles Caldera intending to intersect geothermal fluids since 1988.

3.1.6 Facility Development

The majority of the 38 facilities on the Preserve were present at the time of federal acquisition. Twenty-two facilities are located on the northwest side of Valle Grande in the area known as ranch Headquarters; four facilities are located in the Valle Grande. Some of the structures have been in continuous use for 100 years (Figure 8), while others were placed into use in the last 5 years. The average age of all facilities is about 60 years and the overall condition is fair to good. Only one facility meets accessibility guidelines. The facilities support resource programs and public use by providing work and meeting space, storage and repair areas, visitor information, operational bases, utility support, employee housing and rental facilities. The replacement value for all facilities in current dollars is approximately $5.5 million (Table 4). Annual operational and maintenance costs exceed $120,000 while total deferred maintenance costs exceed $1.2 million (U.S. Forest Service 2006).

In 2006, the Trust evaluated 18 of the buildings to establish priorities for preservation based on significance, integrity and level of deterioration (Dennison et al. 2007). The report 1) assesses the physical condition of the buildings, 2) evaluates the buildings for National Register of Historic Places (NRHP) eligibility and 3) makes recommendations for repair and maintenance strategies to best preserve historic information and significance. Of the four standards for the treatment of historic properties – preservation, rehabilitation, restoration and reconstruction – developed by Secretary of Interior for federal agencies, Dennison et al. (2007) recommend preservation as the most appropriate for the historic buildings. The buildings do not need major restoration, nor do they require reconstruction of missing historic elements. At least nine structures are eligible for historic consideration (Table 4). Ranch Headquarters is eligible as a historic district. The historic and cultural significance of buildings depends on their relationship to cultural and historic themes (e.g., ranching, logging and geothermal exploration), geographical location (e.g., Headquarters historic district) and chronological context.

[20] Compared to geothermal wells that are rotary drilled and produce mostly cuttings.

Four family-owned ranching eras provide context for the construction and use of the historic or significant structures on the Preserve (Dennison et al. 2007): 1) the Baca Era (1860–1899); 2) the Otero Era (1899–1917; Otero Cabin, Commissary Cabin, Salt Barn); 3) the Bond Era (1917–1962; Bond Cabin, Ranch Foreman's House, San Antonio Cabin and Barn, Lightning Shack, Greer/Cowboy Cabin, Red Office Building); and 4) the Dunigan Era (1963–1998; Lodge, A-frame cabins, Movie Set cabins, Horse Paddocks and Barn, various sheds and outbuildings). Many of the buildings constructed before 1963 have historic significance; one building constructed after 1963 (the Lodge) is considered significant (Table 4). Certain structures in ranch Headquarters (e.g., Foreman's Cabin) may not be eligible as individual structures, but they contribute to the character and significance of the historic district.

FIGURE 8

SALT BARN IN THE RANCH HEADQUARTERS HISTORIC DISTRICT

3.2 Present Stewardship Actions

Actions taken by the Trust to manage the Preserve are called stewardship actions.[21] The term is unique to the Trust and is defined in the Trust's NEPA procedures[22] as "...an activity or group of activities consisting of at least one goal, objective, and performance requirement proposed or implemented by the Responsible Official that may: (1) Guide or prescribe alternative uses of the Preserve upon which future implementing decisions will be based; or (2) Utilize or manage the resources of the Preserve..." Planning and decision-making for stewardship actions are documented in stewardship registers that are available on the Trust's Web site.[23]

[21] Actions taken prior to publication of the Trust's NEPA 2003 procedures are also referred to as stewardship actions. Documentation, including environmental documents, did not use the term.

[22] National Environmental Policy Act Procedures for the Valles Caldera Trust 2003

[23] www.vallescaldera.gov/get_involved/stars/stars_saps.aspx

Interim management of the Preserve consists of stewardship actions that bridge the transition from a privately owned ranch to a comprehensively managed unit of public lands. Interim management has been guided by the Valles Caldera Preservation Act, the management

TABLE 4

FACILITY ELIGIBILITY, ESTIMATED VALUE, DEFERRED AND ANNUAL MAINTENANCE COSTS.

NRHP = NATIONAL REGISTER OF HISTORIC PROPERTIES

	NRHP Eligibility Recommendation*	Estimated Value	Deferred Maintenance Costs	Annual Maintenance Costs
Administrative				
Union Building	Not eligible	$677,760	$50,855	$5,080
Bond Cabin	Eligible	439,320	91,416	9,140
Office Cabin	Not eligible	127,465	75,967	8,200
Hilton Cabin	Not eligible	28,800	11,272	1,100
Main Entrance Morgan‡†		17,000	5,469	550
Visitor/Rec Center				
Gift Shop Morgan‡†		$24,480	$6,089	$600
The Missing Cabin		142,300	15,768	1,570
Banco Bonito Morgan‡†		28,560	3,459	350
Housing				
Cowboy Cabin	Eligible	$218,400	$83,602	$8,360
Otero Cabin	Eligible	169,680	70,849	7,085
Foreman's Cabin	Not eligible	336,840	95,039	9,500
Lower A Frame		203,500	31,236	3,120
Upper A Frame		203,500	33,305	3,330
Movie Set #3	Not eligible	120,990	44,360	4,430
San Antonio Cabin	Eligible	94,350	33,153	3,310
Public Rental				
Bunkhouse Cabin	Not eligible	$410,400	$41,154	$4,120
Casa de Baca Lodge		1,148,160	25,821	2,580
2 Yurts (Garita & Abrigo)‡†		25,120	-	5,240
Storage/Barns				
Commissary	Eligible	$43,800	$52,396	$5,240
Paddock (Horse Barn)	Not eligible	577,656	34,045	3,410
6 Sheds/Shops		172,100	114,388	11,440
5 Barns	Mixed eligibility	178,920	169,286	17,000
Utility Buildings				
Water System Building‡			$100	$100
Unused Facilities				
5 Out Buildings		$78,100	$100,483	$10,500
Totals		**$5,489,251**	**$1,189,512**	**$120,115**

* Based on Dennison et al. (2007)

‡ Constructed since federal acquisition

† Temporary facility

principles adopted by the Board of Trustees at a public meeting in December 2001 (Table 5), and by the *Framework and Strategic Guidance for Comprehensive Management* (Valles Caldera Trust 2003), which reflects the vision of the Board and the public following a series of listening sessions in late 2001.

TABLE 5

MANAGEMENT PRINCIPLES OF THE VALLES CALDERA TRUST*

1. **Future Generations.** We will administer the preserve with the long view in mind, directing our efforts toward the benefit of future generations.
2. **Protection.** Recognizing that the preserve imparts a rich sense of place and qualities not to be found anywhere else, we commit ourselves to the protection of its ecological, cultural, and aesthetic integrity.
3. **Integrity.** We will strive to achieve a high level of integrity in our stewardship of the lands, programs, and other assets in our care. This includes adopting an ethic of financial thrift and discipline and exercising good business sense.
4. **Science and Adaptive Management.** We will exercise restraint in the implementation of all programs, basing them on sound science and adjusting them consistent with the principles of adaptive management.
5. **Good Neighbor.** Recognizing the unique heritage of northern New Mexico's traditional cultures, we will be a good neighbor to surrounding communities, striving to avoid negative impacts from preserve activities and to generate positive impacts.
6. **Religious Significance.** Recognizing the religious significance of the preserve to Native Americans, the trust bears a special responsibility to accommodate the religious practices of nearby tribes and pueblos and to protect sites of special significance.
7. **Open Communication.** Recognizing the importance of clear and open communication, we commit ourselves to maintaining a productive dialogue with those who would advance the purposes of the preserve and, where appropriate, to developing partnerships with them.
8. **Part of a Larger Whole.** Recognizing that the preserve is part of a larger ecological whole, we will cooperate with adjacent landowners and managers to achieve a healthy regional ecosystem.
9. **Learning and Inspiration.** Recognizing the great potential of the preserve for learning and inspiration, we will strive to integrate opportunities for research, reflection, and education in the programs of the preserve.
10. **Quality of Experience.** In providing opportunities to the public, we will emphasize quality of experience over quantity of experiences. In so doing, while we reserve the right to limit participation or to maximize revenue in certain instances, we commit ourselves to providing fair and affordable access for all permitted activities.

* National Environmental Policy Act Procedures for the Valles Caldera Trust 2003

3.2.1 Public Access and Use

The Valles Caldera Board of Trustees assumed management of the Preserve from the U.S. Forest Service in August 2002. The *Framework and Strategic Guidance for Comprehensive Management* (Valles Caldera Trust 2003) established guidelines for visitor programs (Table 6) that have guided Trust management decisions thus far. The Trust is "...committed to developing

programs that provide a range of visitor activities in as timely a manner as possible...[and] to developing its programs incrementally, expanding them gradually, so that the quality of experience remains high and so that the capacity of the preserve to sustain the impacts of increasing numbers of people is not compromised" (Valles Caldera Trust 2003:106).

TABLE 6

VISITOR PROGRAM GUIDELINES (VALLES CALDERA TRUST 2003)

- The quality of the visitor experience is more important than the quantity. It may be important to limit the number of people so participants can experience the sense of expansiveness and quiet that the preserve can offer. Programs are to be initiated in a conservative fashion and phased in incrementally.
- Visitor activities must not result in serious or lasting impairment of natural systems.
- Individual activities should be planned with the entire range of preserve programs and responsibilities in mind in order to minimize conflict with landscape stewardship programs or other visitor activities.
- Visitor programs must provide income to the VCNP while including options that ensure cost accessibility to all.
- Activities must not conflict with religious and cultural priorities or uses.
- The trust will consider entering into partnerships to provide visitor opportunities, including cross-boundary activities and joint undertakings with private sector entities.
- The VCNP does not have to accommodate all possible uses of public lands, particularly when activities that might conflict with the trust's management principles may be pursued on adjacent or nearby public lands.
- The trust will offer flexible programs that can be adjusted in time and space. Restrictions may be applied to avoid conflict with episodic wildlife needs (e.g., elk calving, foraging of certain migrating raptors), weather conditions (e.g., presence or absence of winter snow), or preserve programs (e.g., elk hunts, livestock management, fishing).
- The trust will consider "quiet times" – respites from all or most visitor disturbances.
- Impacts of visitor activities will be monitored and subsequently modified if needed. Monitoring will include both visitor satisfaction and landscape impacts.

The number of visitors to the Preserve has increased from about 200-300 people per year when the ranch was in private hands to over 12,000 people in 2007 (Table 7). Revenues have also increased since 2002. Revenues include access fees; fees for commercial operations, such as advertising photo shoots; product sales at the Valle Grande staging area[24]; donations; and grants received by the Trust that offset the cost of operational activities, such as monitoring and research.

Public access and use of the Preserve has been managed through interim programs that use the existing ranch infrastructure and temporary buildings. The interim programs are categorically excluded from documentation in an environmental assessment (EA) or environmental impact

[24] The Valle Grande staging area, which consists of two Morgan buildings, several port-a-potties and small out buildings, serves as a temporary visitor center (contact station) on the Preserve.

statement (EIS) by the Trust's NEPA procedures.[25] Stewardship registers for interim public use and access can be found on the Trust's Web site.[26]

TABLE 7

ANNUAL VISITATION AND REVENUES. REVENUES INCLUDE PUBLIC ACCESS FEES, FEES FOR COMMERCIAL ACTIVITIES, PRODUCT SALES, DONATIONS AND DIRECT GRANTS TO THE TRUST

	2002*	2003	2004	2005	2006	2007
Visitors	~690	5,217	8,178	9,220	9,938	12,405
Revenues	$320,750	$647,350	$517,461	$652,219	$794,844	$749,957

* Data are for fiscal years, October 1 through September 30

commercial and cultural) and education. The number of visitors participating in Preserve programs increased over the past 3 years (Table 8). Access fees consist of a base fee of $10.00 that is adjusted for added value (e.g., guided interpretive hikes) and age (i.e., reduced for children and seniors).

TABLE 8

ANNUAL VISITOR PARTICIPATION IN PUBLIC PROGRAMS. NA = NOT AVAILABLE

	2003*	2004	2005	2006	2007
Special Events	351	1,674	3,401	5,196	3,984
Fishing	1,735	2,010	1,919	1,585	1,814
Hunting‡	840	497	1,162	1,332	1,798
Sleigh/Wagon Rides	598	1,520	891	702	516
Hiking†	1,276	1,620	565	446	1,020
Skiing/Snowshoeing	64	142	705	0	1,393
Tours	353	502	379	573	1,607
Equestrian	NA	213	198	104	273
Total	**5,217**	**8,178**	**9,220**	**9,938**	**12,405**

* Data for all programs except elk hunting are for fiscal years (October 1 through September 30); data for elk hunting are calendar years (elk hunt access permits are sold in one fiscal year and the hunting occurs in the next fiscal year).

‡ Data for 2004 through 2006 are for elk hunting; data for 2007 are for elk and turkey hunting combined.

† Includes estimates of hikers on free trails accessible from Highway 4 in 2003 (378) and 2004 (600).

Revenues from public access and use programs make up the bulk of monies received by the Trust (Table 9). Dividing the subtotal revenues for hunting, fishing, other events and concession sales by total visitation yields an average revenue per visitor of $51 in 2004, $52 in 2005, $51 in

[25] National Environmental Policy Act Procedures for the Valles Caldera Trust 2003

[26] www.vallescaldera.gov/get_involved/stars/docs/200403InterimSummerRecreationProram-SR.pdf; www.vallescaldera.gov/get_involved/stars/docs/200304WinterRecreation-SR.pdf; www.vallescaldera.gov/get_involved/stars/docs/200405InterimEquestrianProgram-SR.pdf

2006 and $45 in 2007. The annual variability in total revenues (Table 7) is due to variability in commercial rentals, grazing and miscellaneous (donations, grants, etc.).

3.2.1.1 Recreation. The Valles Caldera Preservation Act challenges the Trust to combine elements of the private and public sectors in a unique management regime for public access and use of the Preserve. The Act required the Trust to provide access for recreation within 2 years of federal acquisition. The Trust established a day-use outdoor recreation program in 2002 with programs for elk hunting, guided hiking and winter sports. While this program has grown in complexity, it continues to use existing and temporary infrastructure. No permanent facilities or new roads or trails have been constructed to support public recreation programs.

TABLE 9

ANNUAL REVENUES FROM PUBLIC PROGRAMS

	2004*	**2005**	**2006**	**2007**
Hunting‡	$210,850	$285,625	$317,365	$350,556
Fishing	62,793	71,645	60,415	67,392
Other Events	129,562	109,449	76,656	93,828
Concession Sales	13,256	9,558	48,496	42,513
Subtotal	**$416,461**	**$476,277**	**$502,932**	**$554,289**
Commercial Rental†	8,000	5,000	45,095	6,810
Grazing	42,110	39,654	0	5,800
Miscellaneous°	50,890	131,288	246,817	183,058
Total	**$517,461**	**$652,219**	**$794,844**	**$749,957**

* Data for all programs except elk hunting are for fiscal years (October 1 through September 30); data for elk hunting are calendar years (elk hunt access permits are sold in one fiscal year and the hunting occurs in the next fiscal year).

‡ Data for 2004 through 2006 are for elk hunting; data for 2007 are for elk and turkey hunting combined.

† Includes rental fees for commercial film and photography events.

° Includes donations, sales of livestock, direct grants, facilities rental, etc.

Development of the interim recreation program has been guided by public listening sessions held in 2001 (Table 10) and the public comments (Table 11) on the draft of the *Framework and Strategic Guidance for Comprehensive Management* (Valles Caldera Trust 2003). The public consistently requested that the Trust provide access while protecting the solitude, natural quiet and vistas of the Preserve. Recreation activities and programs are offered on the Preserve most of the year. The Trust provides core activities, which occur on a regular basis throughout the year, and a variety of special events.

TABLE 10

SUMMARY OF PUBLIC COMMENTS FROM SEVEN LISTENING SESSIONS IN 2001 (VALLES CALDERA TRUST 2003)

Visions for Future Use

1. Multiple uses: Preserve is large enough, and uses compatible enough, to hold a wide range of activities.
2. Working Ranch: Ranching is historical, economic and cultural continuity for the property.
3. Hunting: Elk hunting would benefit herd health; an income opportunity; important recreational opportunity.
4. Fishing: Potential for world-class fishing; may be an important income-generator.
5. Other recreation: Hiking, camping, biking, cross-country skiing, star gazing and enjoying the peacefulness.
6. Educational Opportunities: Summer nature camps to research laboratories. Develop an interpretive center with educational programs and facilities for conferences and workshops.
7. Economic Opportunities: Economic potential in development; increased, or new, business opportunities in transportation, lodging, food, recreational and tourist services, and supplies and equipment.
8. Gateway Opportunities: Surrounding communities could offer goods, services and education.

Concerns about the Impacts of Use

9. Cultural and Sacred Sites: Protect archaeological sites and sites culturally significant to the Pueblos.
10. Quality of Life: Impacts of increasing visitation on quality of life for those living and working in the area.
11. Socio-Economic Burdens: Law enforcement and emergency medical resources currently understaffed.
12. Environmental Impacts: Degradation of the Preserve from overuse and inappropriate uses, including damage to riparian areas by elk, cattle and recreationists; and use of off-road vehicles.

Management and Decision-Making

13. Management Principles: Balance and fairness for all; recognize local priorities; preserve uniqueness.
14. Move Slowly and Carefully: Inventory resources; base decisions on good science.
15. Learn from Other Experiences: Study the management history of Forest Service, NPS and BLM.
16. Coordinate with Others: Communicate and coordinate with organizations that share common goals.
17. Bigger Picture: The Preserve is a central piece in the larger Jemez puzzle. Manage appropriately.
18. Use Local Expertise: People living and working in the area have important information and deep wisdom.
19. Be Innovative: Think creatively; take advantage of the special status to do things differently.
20. Monitor: Monitor and evaluate decision-making, land and water conditions, forest and wildlife health, and public satisfaction.
21. Include Youth: Focus on the next generation; they will be the users and stewards of the Preserve.
22. Strive for Balance and Fairness: Help people realize that compromise is necessary.

Core activities. Core activities include hunting, fishing, hiking, wagon rides, equestrian trail rides and van tours from spring through fall, and cross-country skiing, snowshoeing and sleigh rides in the winter. These activities are intended primarily for dedicated visitors and require staffing, transportation, facilities, signs, information and a reservation or lottery system in addition to the physical infrastructure of the Preserve.

TABLE 11

SUMMARY OF COMMENTS FROM FIVE PUBLIC MEETINGS IN 2004. EACH THEME REPRESENTS COMMENTS MADE AT TWO OR MORE MEETINGS (VALLES CALDERA TRUST 2003)

1. The vision, values and approach articulated in the *Draft* are good. There is strong public support for the "slowly but surely" development approach.
2. There is a need for more specific, substantive information about the objectives, commitments, priorities and measurable outcomes. Next step should be more quantified planning. First define "ecological health" and acceptable levels of change, then specific program goals.
3. Clarify definition of financial self-sufficiency. This should not include the additional overhead that is required to run a federal agency.
4. Ecological health should be the basis upon which other decisions are made.
5. Emphasize the working ranch as a cultural and educational value. Develop it in ways that co-exist with recreation and other uses. It can be economical and ecological.
6. Maintain controlled access and low-density programs. It is okay to offer programs at different fee levels if higher revenue programs can balance and allow for low-cost programs.
7. Consider zoning of activities geographically and temporally.
8. Use volunteers more and better as part of research, monitoring, education and program services.
9. Improve public outreach (communication and collaboration). Use tools beyond the Web site to reach people.
10. Establish a non-profit "friends group" for fundraising and volunteer recruitment.
11. Concern about the perception of exclusiveness. Find ways for more free and low cost access, and publicize existing access opportunities more effectively.
12. Prioritize educational programs.

The demand for some core activities, such as hunting and fishing, exceeds the opportunities available. The lottery system allows the Trust to generate revenue while providing a quality experience at an affordable price. Lotteries also ensure equitable distribution of the available opportunities. The demand for other core activities, such as hiking (guided and unguided) and van tours, can generally be met the through a reservation system, which ensures that the number of visitors do not exceed the capacity for parking and staffing. Special events, such as mountain biking and marathons, are planned and conducted with assistance of organized groups and volunteers.

Elk hunting. In the 1990s, the caldera was known worldwide for elk hunting. Guided hunts for bull elk, including meals and lodging in the Casa de Baca Lodge (then known as the "Kiva Lodge"), sold for $10,000. As private landowners, the Dunigans received permits from the state

to take bull and cow elk, which they could sell or transfer; they received 265 elk permits in 1998 (Martin 2003). The Trust recognized that elk hunting and viewing are big attractions of the Valles Caldera National Preserve (Valles Caldera Trust 2003) and conducted the first public elk hunt in 2002. Successful elk hunts have been conducted every year since then. The Preserve offers some of the best elk hunting in New Mexico (80% success for bull elk hunts on average) and hunter satisfaction is consistently high.

The Trust offers opportunities to hunt elk through a lottery system to anyone with $25 and a little luck. Hunters can bring one non-hunting guest and hire a guide from an authorized list. Hunters and their guest attend a mandatory orientation session prior to the hunt. The distribution of hunters is controlled by assignment to sub-units within the Preserve. During the hunt, other uses are minimized or prohibited in hunt units. This system protects the natural and cultural resources of the Preserve, the quality of the hunt and provides for the safety of staff, visitors and hunters.

The Trust provides quality hunts for a reasonable price and currently grosses over $300,000 annually. Total annual revenues have fluctuated each year as the Trust and New Mexico Department of Game and Fish (NMDGF), which bears the responsibility for managing wildlife in the state, including the Preserve (Game Management Unit 6B), have modified the permit distribution system (Table 12). The NMDGF has worked collaboratively with the Trust to develop a unique system to distribute hunting permits on the Preserve.

TABLE 12

ELK HUNT STATISTICS. MB/ES = MATURE BULL/EITHER SEX

Year	Trust lottery MB/ES	Trust auction MB/ES	NMDGF Lottery MB/ES	Anterless lottery*	No. of Hunts	Lottery tickets sold	Revenue
2002	85	5	0	150	11	13,464	$404,250
2003	48	5	12	215	10	10,297	$335,325
2004	0	0	72	170	11	8,040	$208,00
2005	74	0	0	204	14	13,045	$285,625
2006	73	0	0	204	14	13,837	$317,365
2007	77	0	0	150	13	14,229	$327,055

* Anterless lotteries were conducted by New Mexico Department of Game and Fish (NMDGF) in 2002 and 2003 and by the Trust thereafter

In 2002 and 2003, the Trust sold or auctioned five bull elk permits each year for between $10,000 and $17,500 each. In November 2003, the New Mexico Attorney General[27] declared that the method used by the Trust to distribute bull elk permits was inconsistent with state law with regard to the distribution between residents and non-residents, which ended the private sale of permits by the Trust.

[27] 2003 Opinion New Mexico Attorney General No. 03-06

In 2004, NMDFG conducted the lottery and mature bull/either sex access coupons were sold for $25 each. The state applied the quota system for residents (78% of permits) and non-residents (22%). Revenues were 49% of revenues in 2002 because the application process, which changed dramatically from 2003, confused the public and the new rule limited non-residents to 22% of the available permits per hunt.

From 2005 through 2007, Trust conducted the lottery in cooperation with NMDGF and issued an access authorization to the winners. The NMDGF issued a permit to the winners and the state quota continued was applied to the lottery. Access authorization fees are $25 a chance for a mature bull and either sex hunt and $10 a chance for antlerless hunts. The number of coupons purchased by one individual is limited to 20 per hunt. Hunters entering the Trust lottery are eligible to be drawn for other state game management units if they were not drawn for the Preserve. The number of hunts and revenues increased each year, but revenues remained below collections in 2002 and 2003.

In 2007, elk hunts generated $327,055 in revenues and cost approximately $135,000 to market and conduct. The NMDGF issued 40 antlerless tags for the first two weeks of December because the cow elk harvest objective was not met. All 40 chances were sold within one week. The Preserve charged a $300 access fee per hunter, which increased revenues by $12,000 (these data are not included in Table 12).

Turkey hunting. Unlike big game, permits to hunt wild turkey are distributed directly by the Trust, which hosted its first turkey hunt in spring 2007. The Trust received 16 turkey permits from NMDGF. The Trust used a lottery to distribute six of the permits. Two permits were donated to the National Wild Turkey Federation for marketing. Eight permits were sold for $1,800 as deluxe packages that included meals and lodging at the Casa de Baca Lodge. Both hunts had a bag limit of one turkey with a visible beard per hunter. Turkey hunts generated $20,280 in revenues and cost approximately $19,000 to market and conduct. Over one-half of the costs associated with the turkey hunts were non-recurring, startup costs.

Fishing. Access to trout fishing has been distributed via a lottery. Each winner and their party (up to three guests) can fish on 1.0-1.5 miles of the Rio San Antonio. The Preserve can support up to 10 fishing parties per day. The program offers anglers a sense of solitude and a unique experience on public lands in New Mexico. Lottery chances cost $5 each for a specific day and winners paid a $25 rod fee ($20 for seniors, $10 for children) for each member of their party.

Hiking, horseback riding, wagon rides and tours. Hiking and equestrian trail rides (section 3.2.2.6 Trails) are limited to day use. Hikers are shuttled to three trailheads and can choose guided or unguided hikes. Trail rides originate at the Banco Bonito Staging Area, primarily due to lack of infrastructure to support overnight camping. Horse drawn wagon rides were offered in the Headquarters area and provide a unique introduction to the Preserve. Van tours are offered from the Valle Grande staging area and include wildlife viewing and interpretive tours about Preserve resources. Fees for unguided hikes are $10; $15 for guided hikes (discounts for children, seniors and groups). Fees for van tours are $30 per person (discounts for children,

seniors and groups). Equestrians are charged $20 per horse. Wagon and sleigh rides are $25 (discounts for children, seniors and groups).

Winter activities. Snowfall in the mountains of northern New Mexico is highly variable from year to year. Snowshoeing and skiing are available on the Preserve during winters with sufficient snow. The access fee is $10 and no reservation is required. Yurt-to-yurt skiing was offered through a lottery in 2007, but the demand was insufficient and a reservation system will be implemented in upcoming seasons. Horse drawn sleigh rides are offered and provide a unique introduction to the Preserve. The 2007 winter recreation program (December 29, 2006 to April 1, 2007) brought 2,100 visitors to the Preserve and grossed $24,700.

Spontaneous activities. The Trust provides limited opportunities for spontaneous activities for the casual visitor. Two hiking trails are accessible from Highway 4. These trails are free, require no reservation and are open from spring through fall (Valle Grande) or year round (Coyote Call) (see 3.2.2.6 Trails). In 2007, the Trust offered 1-hour van tours on Saturdays and Sundays for $5 per person to visitors driving to the Valle Grande staging area from Highway 4. The tours focused on the geology, history or cultural resources of Valle Grande and the Headquarters district. The tours were popular and resulted in an increase in total tour participants (see Table 8 page 29).

Quiet days. Early on, the Trust envisioned "quiet days" when disturbances from vehicles and visitor activities would be limited "...to give a rest to the landscape and the creatures living there" (Valles Caldera Trust 2003:116). Generally, Tuesdays and Wednesdays have been the quiet days on the Preserve. The Trust has also closed areas to vehicle traffic to limit disturbance to bald eagles that visit the Preserve during the winter.

Special events. In 2007, special events included mountain bike rides, runs (marathon), star and solar viewing and custom group tours. Clinics and workshops conducted on the Preserve include photography, outdoor skills, fly-fishing and flint knapping. These events offer a unique experience on public lands in the region, and they are becoming increasingly popular. Special events often include expert instructors or guides as well as meals and lodging. Other special events include youth clinics and antler collection by youth groups. One-third to one-half of visitors to the Preserve participate in special events.

Volunteers. Volunteers from the Rocky Mountain Elk Foundation, National Wild Turkey Federation and other volunteers donated 1,012 hours to help hunters on the youth, mobility impaired and antlerless elk hunts and 450 hours on the turkey hunts. At an hourly rate of $15 per, volunteers offset about $22,000 in Trust labor costs.

3.2.1.2 Special Uses. The Trust foresaw the need for flexible management to accommodate a range of special uses and to generate income (Valles Caldera Trust 2003). The Trust often receives requests for use of the Preserve; these requests can be grouped into three categories: research, commercial use and personal and cultural uses.

Research activities. Scientists conduct research with or permitted by the Trust using external funding. Many of these projects provide important and useful information for understanding

and managing resources and for implementing adaptive management. Appendix 7.2 contains a list of research projects conducted on the Preserve.

Commercial uses. These include filming, magazine advertising shoots and services such as catering or commercially offered tours or events. Two Public Broadcasting Service television shows were produced on the Preserve. New Mexico Museum of Natural History, Albuquerque, produced *Sacred Fires, Sleeping Monsters,* which presented the geologic history of the Preserve, including the role of volcanic obsidian as a source for human weapons and tools. The University of Arizona produced *The Desert Speaks,* which featured the Preserve's scientific studies on the impacts of climate change in the Southwest. The Preserve was used for several commercial filming and photography activities in 2006, including still pictures for magazine and catalog advertisements and one major motion picture. These activities generated $45,095 in revenues.

Personal and cultural uses. The Valles Caldera Preservation Act[28] specifically authorizes use of the Preserve by Native Americans for religious and cultural purposes. The Trust's policy on Tribal Access and Use allows "Pueblos and Indian tribes that have a cultural affiliation to the Preserve to have access to the Preserve and to allow those Pueblos and Indian tribes use of the lands within the Preserve for cultural and religious practices." The Trust allows access for the use, collection, gathering and transport of plants, minerals, wildlife and other resources, and the restoration, repatriation, preservation and protection of sites for ceremonial activities. A Pueblo or Tribal Governor, or the executive branch of a Pueblo or Indian Tribe, makes a request for access and use to the Preserve Manager. Under federal management, the Preserve is restoring to these communities access that was restricted under private ownership.

Many individuals in surrounding communities have deep personal ties to the Preserve. They may have worked on the land during the era of logging and road building. They may have spent their childhoods fishing and exploring while their parents or grandparents cared for livestock or performed other work. The Trust respects their requests to visit the Preserve and values their knowledge of places and people, which contributes to understanding the history of the landscape. People are creating new ties to the landscape as they hold their personal life events, including weddings and family reunions, on the Preserve.

3.2.1.3 Education. The Trust values the Preserve as a place of learning and inspiration and commits to this value in the Management Principles adopted in 2002. Education activities fall into the following categories: K-12 students, university students, citizen groups, workshops and seminars, interpretation and educational television productions. In 2006 and 2007, 43 groups and 1,226 people participated in educational activities on the Preserve.

K-12 students. Students learn about the Preserve through formal as well and informal programs. In 2006 and 2007, six groups and 281 students and teachers participated in these activities. The Parajito Environmental Education Center (PEEC) brought public school students on field trips to the Preserve to learn about the environment in collaboration with the Trust and

[28] Public Law 106-248 § 108(f)(5); 16 U.S.C. § 698v-6.

Los Alamos National Laboratory (LANL). In 2006 and 2007, a summer field camp entitled "Nature Odyssey" operated by PEEC provided environmental education to public school students, teaching them about plants, invertebrates, wildlife, riparian environments and water quality (Figure 9). Two LANL science camps provided instruction to students from the Pueblos of Jemez, Santa Clara, San Ildefonso and Cochiti.

FIGURE 9

STUDENTS SAMPLING INSECTS IN THE EAST FORK OF THE JEMEZ RIVER

University students. Students from all over the country have had the opportunity to work and learn in the Trust's science program. In 2006 and 2007, 16 groups and 198 students and teachers participated in these activities. Students have played a role in nearly all major inventory, monitoring and research programs on the Preserve. Universities arrange group tours through the recreation program mixing the interpretive tours of the recreation staff with their professor's lectures on geology, archaeology, hydrology, ecology or other subjects. Trust staff has presented papers and posters at national and international meetings for scientists and students; these include results from Preserve studies in anthropology, archaeology, wildlife, hydrology and geology.

Citizen groups. The public comes to the Preserve to learn about the environment and land management issues. In 2006 and 2007, seven community groups and 235 people and three non-governmental organizations and 41 people participated in activities on the Preserve. Some of these groups worked in monitoring programs and collected data used by the Trust.

Workshops and seminars. Agencies, museums, universities, non-government organizations and private sector groups increasingly use the Preserve as a setting for workshops and seminars.

In 2006 and 2007, five agencies and 137 people and six professional societies and 334 people participated in these activities.

Interpretative activities. Most recreation and special use activities involve some level of interpretation by Trust staff. It is generally informal and is sometimes described as "free-choice learning" (Valles Caldera National Preserve 2005). Visitors learn about, and become inspired by, the Preserve. They explore the Preserve with all of their senses and consider the connections between people and place. Through clinics, workshops and other activities, visitors learn about the history of the Preserve, domestic livestock operations, how to fly fish and hunt and track wildlife, use a compass and survive in the wilderness. The objectives of interpretive activities are to impart knowledge, establish emotional connections and alter behaviors (Valles Caldera National Preserve 2005).

3.2.1.4 Open House. On Saturday August 26, 2006, the Trust held an "Open House" when people could drive their vehicles on the Preserve at no cost. The Trust had planned to open a long loop (26 miles) and a short loop (13 miles) between 9:00 AM and 4:00 PM. Over seven inches of rain fell on the Preserve between August 1 and August 25 and damaged parts of the long loop on the west side of the Preserve. High water in the East Fork of the Jemez River made the short loop impassable. On the morning of August 25, Trust staff changed the plan for two one-way routes to one two-way route. The two-way route was approximately 16 miles from the main entrance on Highway 4 to the San Antonio cabin.

The main gate on Highway 4 was opened at 8:15 AM to allow traffic that had lined up along the highway to enter the Preserve. Due to the large volume of traffic, and implementation of two-way traffic, vehicles on the Preserve became gridlocked at the History Grove around mid-day. The Trust closed the main gate at Highway 4 at about 1:00 PM (instead of the scheduled 4:00 PM). Before the main gate was closed, 1,444 vehicles carrying 3,746 passengers entered the Preserve; 500-800 vehicles were turned away. While the gate was open, vehicles entered the Preserve at a rate of one vehicle every 11 seconds for the 4.5 hours. The average number of passengers per car was 2.65. Vehicle density on the 16-mile road from Highway 4 to the San Antonio cabin was at 91 vehicles per mile (Figure 10). However, significant clumping of vehicles occurred that resulted in traffic back-ups and delays.

The Trust had 10 visitor information stations along the route to educate and inform the public about current programs and future opportunities, and to give the public the opportunity to meet and discuss ideas and concerns with the Board of Trustees and Trust staff. Impacts from the event were monitored, including surveys of road conditions, litter and trash, road-killed wildlife, stream water quality, elk, and cultural and visual resources. The large numbers of vehicles caused some damage to roads, but overall, road damage was minimal. After the event, there was relatively little trash (less than one bag) and road-killed wildlife (three snakes), and there were

no effects on stream water quality or the elk population. There was evidence of social trailing[29] at the archaeological demonstration station and impacts to visual quality from the large number of cars bumper-to-bumper on Preserve roads.

FIGURE 10

VEHICLES ON THE PRESERVE DURING THE AUGUST 2006 OPEN HOUSE

3.2.1.5 Master Plan for Interpretation. In 2005, the Trust completed an assessment of major themes, messages and interpretive components for the Valles Caldera National Preserve. The *Master Plan for Interpretation* (Valles Caldera National Preserve 2005) proposes an interpretive theme for the Preserve and three sub-themes (Table 13), and explores how and where they could be conveyed. The Trust is seeking to affect the hearts, minds and behavior of Preserve visitors without impacting the cultural, ecological and aesthetic integrity of the landscape. This plan is used as a tool to ensure experiential and interpretive continuity across the Preserve and in Trust programs. Because it was developed prior to comprehensive planning, it will allow the Trust to consider the effects and the opportunities of all activities and programs on interpretive themes. This will be especially useful in transportation planning and the development of facilities and services.

The Valles Caldera National Preserve is described as an experiment in public land management. One of the unique components of the experiment is the goal to operate as a working ranch. The *Master Plan for Interpretation* defined working ranch "...as an operation that places its primary

[29] Social trailing is the creation of noticeable trails by people walking in areas with no existing trail infrastructure. Social trails can cause temporary impacts if use is short-term (e.g., trampling of vegetation); long-term use of social trails can cause impacts on vegetation and soil erosion.

emphasis on the stewardship of resources as the foundation for both ecological and economic sustainability. A working ranch:

- Runs a sustainable level of livestock, adjusting numbers as necessary;
- Makes resources available for other revenue generating activities such as bird watching, hunting, fishing and other low-impact recreational activities;
- Applies adaptive management on a day-to-day basis to ensure resource protection; and
- Monitors the impact of ranch activities."

TABLE 13

INTERPRETIVE THEMES FROM THE *MASTER PLAN FOR INTERPRETATION* (VALLES CALDERA NATIONAL PRESERVE 2005)

Interpretive Theme
The Preserve is a bold experiment in managing a working ranch in a way that offers a broad range of public activities, preserves cultural practices and sustains ecological integrity.
Sub-Themes
1. The Preserve preserves key components of the human history of the Jemez Mountains.
2. The Preserve protects a remarkably diverse ecosystem of great biotic and abiotic significance.
3. The Preserve inspires new directions in public land management by serving as an experiment in balancing natural processes with human uses.

3.2.2 Preserve Management

The Trust focuses on the infrastructure (facilities, utilities, communications, roads, trails, corrals, fences, tanks), natural resources (forests, forage), programs (grazing) and processes (fire) necessary to manage and operate the Preserve and preserve and protect its resources. The *Framework and Strategic Guidance for Comprehensive Management* (Valles Caldera Trust 2003) established guidelines for landscape stewardship (Table 14) that have guided Trust programs, activities and management decisions thus far.

3.2.2.1 Facilities Management. Planning, programming and actions related to maintenance and upkeep of the buildings associated with the operation of the Preserve comprise facilities management. Planning includes forecasting the development, disposal and major alterations and renovations needed to support the Trust's long-term goals.

Historically, the Preserve has been a working landscape with a functioning livestock operation. The facilities on the Preserve have a wide variety of uses, ranging from workspaces, to visitor facilities, to living quarters. Twenty-six of these facilities are located in and around Valle Grande. Most facilities on the Preserve are between 50 and 100 years old, and because of their age, require a high amount of annual maintenance to keep them functional. The maintenance backlog (deferred maintenance) is estimated at about $1.2 million (see Table 4 page 26). Most

of the older buildings on the Preserve have similar problems, including the structural integrity of foundations, roofs, roof trusses, floor joists and chimneys; outdated electrical, mechanical and ventilation systems; poor site drainage; and rodent and bat hazards. Deferred maintenance is needed to prevent on-going deterioration and to bring these buildings up to standards to allow their use by Trust staff and the public.

TABLE 14

LANDSCAPE STEWARDSHIP GUIDELINES (VALLES CALDERA TRUST 2003)

- All significant management activities will be monitored and will proceed adaptively, utilizing the knowledge produced through monitoring and experimentation to adjust management toward better achievement of explicit goals.
- The learning generated through inventory, monitoring, and adaptive management should be widely and freely shared.
- A central goal of all management efforts shall be the achievement of the landscape vision.
- Another central goal shall be to contribute to soil and water conservation.
- Landscape stewardship at the VCNP should not be bound by existing approaches but where necessary should pursue goals based on fresh thinking and innovation.
- Landscape stewardship activities will be fiscally prudent and financially accountable and shall where possible generate income for the trust—but not at the risk of impairing ecological systems.
- Where landscape stewardship involves transboundary issues or dynamics, the Trust will work in partnership with its neighbors.
- Managers will acknowledge that they "nudge" natural systems more than they "manage" them. Accordingly, management efforts will encourage the operation of natural process to achieve the landscape vision.

3.2.2.2 Headquarters Potable Water System. At the time of acquisition, facilities on the Preserve did not have potable water. Untreated surface water was piped into the buildings in the Headquarters district. The U.S. Forest Service planned and constructed a water treatment facility and the old water distribution system was replaced with over a mile of larger and heavier gauge plastic pipe. The existing water system serves buildings in the Headquarters district and consists of water from springs that is piped to a collection gallery that is in turn fed into the water treatment building.[30] Up to 30,000 gallons can be stored in a tank after treatment. Potable water is available in all buildings in the Headquarters district, although the source often freezes in the winter, and occasionally runs dry in the summer, reducing the water supply and limiting use of the buildings. The water meets state health and safety standard requirements. The stewardship register for the facilities upgrade action is available on the Trust's web site.[31]

[30] The water treatment building is the only permanent structure the Trust has constructed on the Preserve.

[31] www.vallescaldera.gov/get_involved/stars/docs/200401PreserveHeadquartersWaterDistributionSystem-SR.pdf

3.2.2.3 Communications. At the time of acquisition, the Preserve had one radio repeater on the northeast rim that covered approximately 34% of the Preserve, but did not cover the Headquarters area. A geospatial analysis determined that by moving the repeater to Cerro del Abrigo, radio coverage would increase to approximately 45% and include most of the Headquarters area. The repeater was moved to Abrigo in the 2005. In 2007 the Trust added a repeater to Cerro Pelado (on the Santa Fe National Forest) that increased radio coverage approximately 19%. This repeater facilitates radio communications between the Preserve and the Trust administrative office in Jemez Springs. The combined radio coverage is approximately 64% of the Preserve. The geospatial analysis predicted that 10 repeaters would be required to cover 90% of the Preserve. Cell phone coverage is available on less than 30% of the Preserve, most of which is also covered by the radio network. There are landline telephones in the Headquarters area and the Union building. Approximately 46% of the Preserve has no reliable radio or cell phone communications.

3.2.2.4 Roads. New Mexico Highway 4 bisects the south portion of the Preserve. It is an all-weather, hard surface, fully maintained two-lane paved highway that averages 1.6 million travelers annually (U.S. Forest Service 2002). Highway 4 in the southeast corner of the Preserve has six turnouts with outdated signs and breathtaking views of Valle Grande, the largest valle in the caldera. Highway 4 is the initial point of contact with the Preserve for those traveling the route between Los Alamos and Jemez Springs. It offers superb opportunities for wildlife viewing, visitor orientation and interpretation (Valles Caldera Trust 2003).

There are five ways to access the Preserve from Highway 4 – a main entrance for visitors and four administrative gates. Signage is minimal and needs to be upgraded to appropriate highway standards. The main entrance has been inadequate for the volumes of traffic that are entering the Preserve (see section 3.2.2.5 page 44).

At the time of purchase, the Preserve had more than 1,400 miles of roads (Figure 11), but did not have a road location database. The majority of the roads are only suitable for high clearance vehicles and four-wheel drive is necessary in inclement weather. The road network did not have a systematic numbering system and the main roads, although mapped using Global Positioning System, did not have data on width, number of culverts, stream crossings and other features.

At present, the Valles Caldera Trust uses a network of open and administrative roads totaling 184 miles (Table 15). The Trust characterizes roads on the Preserve as follows:

Arterial – provides service to large land areas;

Collector – serves smaller areas and connects arterials to local roads; and

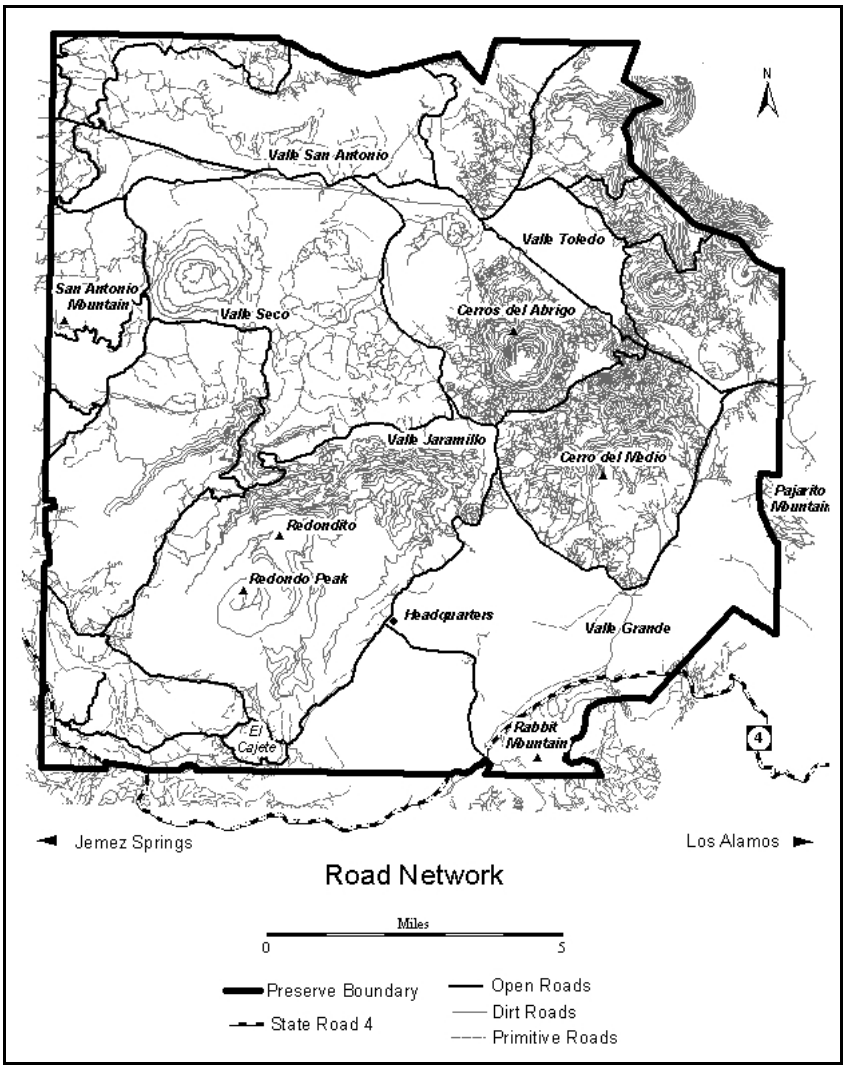
Local – single purpose road that connects terminal facilities with collectors or arterials.

The numbering system for the network of administrative roads consists of six digits representing the arterial (e.g., VC02), collector (e.g., VC0201) and local roads (e.g., VC020102) (Figure 12). This allows quick and accurate location for public, administrative and emergency use. There is minimal signage along interior roads. Cultural resources surveys have been completed for 122 miles of roads, including all of the arterial roads.

Historically, Preserve roads have been the cause of erosion, sediment build up in Preserve streams, intrusion into archaeological deposits and visual disturbance. Since 2002, the Trust has upgraded approximately 13 miles of ranch roads to arterial classification to improve safety for administrative and public use and to mitigate impacts to natural and cultural resources. The road upgrades enhanced the natural hydrology and returned natural flows to approximately 3,000 acres of wetlands.

FIGURE 11

ROADS ON THE PRESERVE. MOST OPEN ROADS WERE BUILT DURING 1935-1962 TO FACILITATE HARVEST OF FORESTS NEAR THE VALLES. MOST DIRT AND PRIMITIVE ROADS WERE BUILT DURING 1963-1972 TO FACILITATE CLEARCUTTING



Upgrading ranch roads to the present design (i.e., one-lane, all-weather road with turnouts to accommodate passenger cars) can cost upwards of $100,000 per mile (Valles Caldera Trust 2003). Costs will continue to increase in the future and do not include the cost of cultural

resources surveys and mitigation measures (some roads pass through archaeological sites).[32] Road maintenance activities are categorically excluded from documentation in an EA or EIS[33]; stewardship registers for road maintenance are available on the Trust's Web site.[34]

TABLE 15

CLASS AND MILES OF ADMINISTRATIVE AND PUBLIC ROADS

	Class	Miles
Administrative Use Roads	Arterial	1.8
	Collector	14.0
	Local	36.9
	Total	**52.7**
Public Open Roads	Arterial	87.9
	Collector	34.5
	Local	8.9
	Total	**131.3**
Grand Total		**184.0**

Roads always lead to something, usually a parking lot, staging area or trailhead. The Preserve only has three staging or parking areas with space for about 200 cars. This is the greatest limitation on the capacity of the Preserve recreation and education programs.

FIGURE 12

ARTERIAL (LEFT), COLLECTOR (CENTER) AND LOCAL (RIGHT) ROADS

3.2.2.5 Valle Grande Entrance. The Valle Grande entrance, the main entrance to the Preserve, is located near mile-marker 39 along New Mexico Highway 4. Before federal acquisition, approximately 200-300 people visited the Baca Ranch each year. Currently, about

[32] The costs to comply with Section 106 of the National Historic Preservation Act range from $1,000 to $3,000 per mile for cultural resource surveys for road maintenance to $10,000 to $20,000 per mile to mitigate adverse effects from road upgrades.

[33] National Environmental Policy Act Procedures for the Valles Caldera Trust 2003

[34] www.vallescaldera.gov/get_involved/stars/docs/200402Road%20Maintenance-SR.pdf

10,000-12,000 people visit the Preserve each year (6,000-7,000 vehicles). During the August 2006 Open House, nearly 1,500 vehicles entered and left the Preserve in one day.

In summer 2007, the Trust, New Mexico Department of Transportation (NMDOT) and the U.S. Forest Service began a project to upgrade the entrance to provide safe access to and from the Preserve and increase the safety for motorists traveling on Highway 4. The entrance upgrade will meet standards established by NMDOT and the American Association of State Highway and Transportation Officials. The project footprint is just under 12-acres; eight acres are on the Preserve and about four acres are in the Highway 4 easement under the jurisdiction of NMDOT. The project includes reconstruction of the entrance and widening of Highway 4; the project will be completed in 2008 (Sato and Associates 2005). The upgrade to the Valle Grande Entrance was documented in an Environmental Assessment (EA), which along with the implementing decision is available on the Trust's Web site.[35]

3.2.2.6 Trails. The Trust uses sections of existing logging roads for a hiking program for the Preserve. Two free trails are accessible from Highway 4; no reservations are needed. Visitors access the Valle Grande Trail (open spring through fall) by parking at a pullout along the south side of Highway 4 at mile marker 43. This trail is 2 miles roundtrip and has an elevation change of 450 feet. The average hiking time is 3 hours. Visitors access the Coyote Call Trail (open all year) by parking at a pullout along Highway 4 at mile marker 41. This is a 3-mile loop trail with an elevation change of 250 feet. Both hikes are rated easy and offer scenic glimpses of the Valle Grande and the caldera.

There are three trails on the Preserve for guided and unguided hikes – Abrigo, Cerro Seco and La Garita. The Trust provides transportation to and from the trailheads (parking is not available). The drives to Abrigo and La Garita pass through the Valle Grande, the Historic District and valles and forests not visible from Highway 4. The 7-mile Abrigo Trail circumnavigates Cerros Abrigo, an eruptive dome in the center of the Preserve. Hikers get scenic views of the Valle Grande, Valle Jaramillo and the Valle San Antonio. La Garita Trail offers a scenic 6.5-mile hike up to the north rim of the caldera. Climbing the Garita Ridge provides stunning views of Valle Grande, Valle Jaramillo, Valle Toledo and the Valle San Antonio. Both trails are moderately difficult.

The Cerro Seco Trail hike begins with a van ride along the western boundary of the Preserve through Sulphur Springs. This trail circles Cerro Seco, an eruptive dome and offers magnificent views of the Valle San Antonio while hikers wander in and out of tall pines and aspens. This trail is 7 miles long and rated moderately difficult.

There are eight equestrian trails staged out of Banco Bonito on old logging roads (Figure 13).

- The Duke Trail is the most used trail. It begins at Banco Bonito, takes riders to El Cajete meadow beneath Redondo Peak and then back. This trail is approximately 12 miles long, moderate in difficulty and takes about 3-4 hours to complete.

[35] www.vallescaldera.gov/get_involved/stars/stars_saps.aspx

- The El Cajete Loop off of the Duke Trail begins and ends at El Cajete. It is about 3 miles long, moderate to difficult and takes about 1 hour.
- The Remuda Grande begins on the El Cajete Loop, takes riders to the historic district in the Valle Grande and back to the El Cajete Loop. The trail is moderate to difficult, and adds 3-4 miles to the El Cajete Loop and Duke Trails for a total of 18 miles and 6 hours.
- The Los Vaqueros Trail takes riders to Redondo Meadow and follows Redondo Creek. It is approximately 6 miles long, easy and takes 2.5-3.5 hours to complete.
- City Slicker, All Hat No Horse and Weekend Rider trails begin on the Duke Trail, are easy and take less than 2 hours. The trails return in a loop to Banco Bonito.
- Smokin Reata begins on the Weekend Rider trail, takes riders to the bottom of Redondo Peak and returns via the Duke trail to Banco Bonito. This trail is easy and takes 2-3 hours.

FIGURE 13

EQUESTRIAN TRAIL RIDERS

3.2.2.7 Fences. Over years of use as a working ranch, 118 miles of fence, eight corral areas and numerous cattle guards and bypass gates have been constructed on the Preserve. Fences on the Preserve consist of exterior (boundary) and interior fences. There are 53.5 miles of exterior fences and 64.1 miles of interior fences. Boundary fences are typically four- to seven-strand barbwire. About 43 miles (68%) of fences are in good or fair condition and 15 miles (22%) are in poor condition or in need of repair; 10% of the fences have yet to be surveyed. Interior fences are typically barbwire with some older sections of sheep fencing constructed in the 1930s and 1940s. These fences were constructed and used to separate pastures for livestock. Along sections of Highway 4, snowdrift fencing is used to prevent heavy snow accumulations along the highway right-of-way. Currently, the exterior and a major portion of the interior fences are maintained throughout the year for interim Trust programs.

3.2.2.8 Earthen Tanks. There are 136 earthen tanks on the Preserve and their location, size and condition have been assessed (Table 16). The tanks were constructed to hold water for livestock operations and wildlife. Sixty-nine percent of the tanks are functional (hold water); their average surface area is 1.37 acres. Twenty (21%) of the functional tanks are in good or excellent condition; eight (9%) have headcuts that are a source of resource impacts. There are six tanks with a surface area of 4-6 acres; four are functional and two are non-functional. Thirty-one percent of the tanks are non-functional; their average surface area is 0.59 acres. Sixteen (38%) of the non-functional tanks are silted in and seven (17%) are breached; 11 (26%) have headcuts. The majority of earthen tanks require maintenance.

TABLE 16

LOCATION, NUMBER AND CONDITION OF EARTHEN TANKS

	Tank Condition (number)		
Location	**Functional**	**Non-Functional**	**Total**
Grazable Woodlands	20	5	25
Mountain Meadow	55	26	81
Mountain Valley	11	6	17
Riparian	8	5	13
Total	**94**	**42**	**136**

Since the larger valles contain free-flowing streams, most tanks are located in mountain meadows (60%) and grazable woodlands (18%). By constructing earthen tanks within the wooded areas, the cattle operations were able to expand beyond the major valles and make use of forage in upland areas where the water is not as abundant and available. Earthen tanks can be used to distribute herbivores, especially domestic livestock, away from sensitive riparian areas. Earthen tanks can also be used to support wildfire suppression – helicopters equipped with buckets can access the larger tanks to dip water.

3.2.2.9 Natural Gas Pipeline. In 1949, the Atomic Energy Commission built a 12-inch high-pressure natural gas pipeline from Cuba to Los Alamos. The buried pipeline runs 13.6 miles through the northern valleys of the Preserve (Valle San Antonio, Valle Toledo and Valle de los Posos). Paralleling the pipeline is an access and maintenance road. Prior to federal acquisition, PNM purchased the pipeline from the Department of Energy (DOE); PNM now has sole responsibility for its use and maintenance. Archaeological sites and other cultural resources along the pipeline corridor are managed under a Memorandum of Agreement among the Trust, PNM, Santa Fe National Forest and the NM State Historic Preservation Office. Since 2000, safety improvements to the pipeline include anode installation for cathodic protection from corrosion and spot excavations for installation.

3.2.2.10 Forest Management. The Trust implemented hazardous fuels reduction activities (forest thinning and slash disposal) within two areas at risk from wildfire – the southwest corner of the Preserve along Highway 4 (Banco Bonito) and the area around ranch Headquarters.

Banco Bonito is an area of risk due to the high incidence of human-caused fires on the Santa Fe National Forest adjacent to the Preserve. Under hot, dry and windy conditions, the dense forests could easily support an active[36] or independent[37] crown fires. A wildland fire escaping initial attack could quickly spread throughout the southwest corner of the Preserve and have long-term impacts on the watershed, especially in the steep topography of Redondo Canyon.

Just over 130 acres were thinned south of the Highway 4 on Banco Bonito. Ninety acres north of Highway 4 were thinned in 2007. The thinned forest adjacent to the highway will provide fire fighters with a safe area from which to fight fires. The remaining trees have less competition for water, light and nutrients. Over time, these healthy young trees will grow and replace large, old trees removed during the historic logging era (Figure 14). Thinning was accomplished through grants from the Collaborative Forest Restoration Program. The Walatowa Woodlands Initiative (WWI), an economic development project of Jemez Pueblo, received a grant for project implementation, personnel training and equipment, and did the thinning south of the highway. The Nature Conservancy received the grant for thinning north of the highway, which also provided money for education. The cost of thinning Preserve forests to reduce the risk of wildfires and to protect historic structures is considerable (Table 17).

FIGURE 14

RESULTS OF FOREST THINNING ALONG NEW MEXICO HIGHWAY 4. BEFORE (LEFT) AND AFTER (RIGHT)

The area surrounding the historic ranch Headquarters has a much lower incidence of fire; however, the historic cabins and the Casa de Baca Lodge would be difficult to defend in the event of a fire. The turn of the century cabins are constructed almost entirely of wood and the lodge has a wood shingle roof. To date, 150 acres have been thinned around Headquarters. Defensible space was created around the structures and dense seedlings were removed from

[36] A fire in which a solid flame develops in the crowns of trees, but the surface and crown phases advance as a linked unit dependent on each other.

[37] A fire that advances in the tree crowns alone, not requiring any energy from the surface fire to sustain combustion or movement. Also called running crown fire.

beneath the old growth stands that surround the buildings. Planning and decision-making for this stewardship action are available on the Trust's Web site.[38]

TABLE 17

COST OF FOREST THINNING PROJECTS*

	Cost/Acre	Trust Funding	Grant Funding
Headquarters	$500	$75,000	
Banco Bonito	$1200		$156,000
Banco Bonito	$743		$66,870

* Costs include project implementation, training and equipment purchase. The Pueblo of Jemez, Walatowa Woodlands Initiative and The Nature Conservancy received grants to implement thinning.

3.2.2.11 Wildland Fire Use. Human use of the Jemez Mountains dates back approximately 10,000 years, and natural and anthropogenic fires in forests and grasslands have been a common occurrence (Martin 2003). Data from soil cores in Alamo Bog on the Preserve, and tree rings and fire scars from trees surrounding the valles, indicate that fires were regular and common in pre-settlement times. Grassland fire return frequencies averaged 9-11.6 years between 1679 and 1896. Soil core samples have frequent charcoal layers dating back 9,000 years (C. Allen, USGS, unpublished data 2004). Fires apparently ceased in the 1880s due to livestock activities (fine fuel removal) and active fire suppression. Occasional wildfires and human-caused fires occurred on the Preserve during the 20th century.

Wildland fire refers to any non-structure fire that occurs in the wildland. Three distinct types have been defined: 1) prescribed fires are ignited by management to meet resource objectives based on a written, approved fire plan and NEPA documentation (prior to ignition); 2) wildland fire use are naturally ignited fires managed to meet resource objectives in pre-defined areas outlined in fire management plans; and 3) wildfires are unplanned, unwanted fires that include human-caused fires, escaped wildland fire use fires, escaped prescribed fires and other fires where the objective is suppression. Currently, all unplanned ignitions (natural or human-caused) on the Preserve are managed as wildfires. The management response determines the safest and most cost effective means to suppress unplanned fires.

In 2005, the Trust conducted a prescribed fire in the Valle Toledo to evaluate the benefits of fire in the valles. The experiment was based on a paired watershed comparison – one watershed (Valle Toledo, drained by Rio San Antonio) was subjected to prescribed fire, while the other watershed (Indios Creek) was not burned. Scientists and managers tested the effects of fire on elk and domestic livestock grazing, plant mortality, plant reproduction, forage production, forage nutritional quality, insect populations and diversity, soil erosion, soil nutrient content, stream water quality, fish populations and aquatic invertebrate communities. Results indicate

[38]www.vallescaldera.gov/get_involved/stars/docs/200302VCNPVegetationManagementandFuelReduction-DM.pdf

that the prescribed fire enhanced forage quality with no detectable deleterious effects on plant population demographics, soil erosion, stream water quality or fish and invertebrate communities.

3.2.2.12 Noxious Weed Control and Eradication. The Trust identified the control and elimination of invasive weeds an essential action to maintain the health of Preserve grasslands (Valles Caldera Trust 2003). Invasive weeds, including Canada, musk and bull thistles, are found along roads, turnouts and in disturbed areas on the Preserve. Due to the potential of these weeds to spread, herbicide treatments were implemented over approximately five acres beginning in 2003 (herbicide application complies with federal regulations). Hand, mechanical and chemical treatments have been used to control the spread and eradicate known populations.

The State Department of Agriculture Noxious Weed Act of 1998 lists the Canada thistle as a Class A weed; with a limited distribution, eradication is the highest priority. Musk thistle is a Class B weed; the management priority is to contain infestations. Bull thistle is a Class C weed that is widespread and suppression is encouraged. The Federal Noxious Weed Act of 1974 encourages elimination or containment of these weeds.

Canada thistle is a deep-rooted perennial that reproduces successfully from seeds and root sprouts. Entire plants can re-grow from a root fragment. Dense patches can form and the plant produces photo toxins that inhibit the growth of other plants. Canada thistle is an aggressive colonizer that can cover a 6-foot diameter area within 1-2 years from a single plant.

Musk and bull thistles are typically biennials, but they may also complete their life cycle in 1 year. Reproduction occurs entirely from seeds. An average plant can produce 10,000 seeds in a year. They can quickly colonize disturbed areas where there are few native plants to prevent germination. Weed infestations often occur along roads. Visitors and staff can increase the transport of plant seeds and parts to areas in the Preserve or to adjacent lands. Control and eradication before they spread is important to protecting native plant communities.

Hand cutting, pulling and grubbing are not effective methods to eradicate these thistles. The Bureau of Land Management has excellent success using clopyralid to eradicate these weeds in New Mexico. For 3 years, the Trust used hand application of liquid clopyralid (™Transline) with the surfactant LI 700 and colorant Hi-Light along with hand pulling of individual plants to control the spread and eradicate thistle infestations along Preserve roads. The objective was to eliminate 70% or more of the infestations by the end of the first year and eradicate them by November 2006. Inventories found additional populations in 2005 and 2006, so the program is continuing. The EA and decision document are available on the Trust's Web site.[39]

3.2.2.13 Livestock Grazing. Since 2002, the Trust has grazed cattle in a variety of programs from late spring to early fall under an interim grazing strategy[40] (Tables 18a and 18b). The Trust has worked with local communities and neighbors on a number of programs. From 2002

[39]www.vallescaldera.gov/get_involved/stars/docs/200303NoxiousWeedControlandEradicationProject.pdf

[40] www.vallescaldera.gov/get_involved/stars/stars_saps.aspx

through 2005, livestock programs offered drought relief (e.g., grassbank) and grazing opportunities to local to between 28 and 42 local and regional ranchers with grazing allotments on surrounding national forests (Table 18a).

TABLE 18A

INTERIM DOMESTIC LIVESTOCK GRAZING PROGRAMS FROM 2002 THROUGH 2005. CATTLE ARE BROUGHT ONTO THE PRESERVE IN LATE SPRING AND REMOVED IN EARLY FALL

	2002		2003		2004		2005	
	Head*	AUM†	Head	AUM	Head	AUM	Head	AUM
Cow/Calf	703	879	305	1,220				
Replacement Heifer			375	1,050	461	1,290	402	1,126
Conservation Stewardship					205	820	198	792
Months	1.25		4		4		4	
Operators	42		42		28		39	
Revenues	$8,790		$28,450		$42,110		$39,654	
Operating Costs	$41,200		$116,000		$145,561[C]		$148,000‡	

* Head = cow/calf pair or individual heifer, steer or bull; used by the Trust for billing

† AUM = Animal unit months (number of animal units times the number of months grazed). Animal units are used by the Trust to determine capacity and use. One cow/calf pair = 1 AU; one bull = 1 AU; one heifer, steer or yearling = 0.7 AU

‡ Herding contract included horses and personnel; the Trust provided vehicles, equipment and supplies

TABLE 18B

INTERIM DOMESTIC LIVESTOCK GRAZING PROGRAM FEES FROM 2002 THROUGH 2005. NA = NOT APPLICABLE

	Cow/Calf	CSP†	RHP‡
Grazing Fee per Head or Pair per Month	$10	$12	$10
Bull Fee per Head per Season	NA	NA	$30

† Conservation stewardship program

‡ Replacement heifer program

Drought conditions in the winter-spring of 2006 caused the Trust to cancel the grazing program; however, New Mexico State University ran 200 yearlings on the Preserve to continue monitoring the effects of the Valle Toledo prescribed fire. Prior to 2007, the costs of Trust grazing programs exceeded the revenues generated. From 2003 through 2005, the Trust received $119,004 in revenues from the grazing program, but spent $450,761.

In 2007, the Trust managed a program of 500 yearlings for four months (1,400 AUMs). A contract was awarded to a New Mexico owner/operator through a competitive request for proposals. All personnel, vehicles supplies and equipment were provided by the owner/operator.

Total revenues from the grazing program were $5,800 marking the first year that the grazing program ended with revenues exceeding operating costs.

3.2.2.14 Mineral Rights. In July 2000 when the federal government bought the Baca Ranch, it acquired 100% of the surface estate and 87.5% of the subsurface estate. A group of private individuals (Harrell Group) owned the remaining 12.5% of the mineral rights. The major values of the subsurface mineral estate are pumice and the potential use of geothermal steam to generate electricity. Prior to federal acquisition, the Harrell Group leased their share of the mineral estate to GeoProducts of New Mexico, a geothermal development company, which ran a highly visible campaign to develop geothermal resources on the Preserve.

The Valles Caldera Preservation Act of 2000[41] instructed the U.S. Forest Service to negotiate with the owners of the outstanding mineral rights, and to acquire those rights on a willing seller basis. The Forest Service obtained an appraisal of the mineral estate and offered to purchase all outstanding mineral and geothermal rights for $1.875 million. The offer was rejected. GeoProducts continued its efforts to develop the geothermal resources and filed an application for a permit to drill with the Oil Conservation Division of the New Mexico Department of Energy, Minerals, and Natural Resources in December 2003. The application was denied pending an agreement from the Forest Service and the Trust.

The Valles Caldera Preservation Act of 2005[42] amended the provisions of the 2000 Act on mineral acquisition and required the U.S. Forest Service to acquire the outstanding rights by condemnation. The Secretary of Agriculture filed a declaration of taking of the outstanding mineral estate on September 6, 2006. Upon filing the declaration in the U.S. District Court for the District of New Mexico, legal title in the mineral estate vested in the United States.

Under the Constitution, the owner of lands taken for public purposes through condemnation is entitled to payment of just compensation. The Harrell Group and the Forest Service were unable to reach an agreement on value, so the court will determine the matter.

The U.S. now owns the mineral estate and, except for stone, sand and gravel, future development of those minerals by the Trust is precluded by withdrawal under section 105(e) of the Act, which states:

> Upon acquisition of all interests in minerals within the boundaries of the Baca ranch... subject to valid existing rights, the lands comprising the Preserve are thereby withdrawn from disposition under all laws pertaining to mineral leasing, including geothermal leasing...Nothing...shall preclude the...Trust...from allowing the utilization of common varieties of mineral materials such as sand, stone, and gravel as necessary for construction and maintenance of roads and facilities within the Preserve.

[41] Public Law 106-248 § 104(e); 16 U.S.C. § 698v-2.
[42] Public Law 109-132 § 2; 16 U.S.C. § 698v.

3.2.3 Inventory, Monitoring and Research

The Trust established a science program to provide information for adaptive management of Preserve resources and for preparation of environmental documents. The program comprises three categories: inventory, monitoring and research.

Inventory is the assessment of natural and cultural resources to determine presence and distribution of vegetation, animals, soils, geologic formations, water resources, archaeological resources and historic resources. Future inventories will include systematic data collection on the characteristics of visitors to the Preserve.

Monitoring measures temporal changes in natural and cultural resources as a result of Trust operations and management (recreation, hunting, fishing, fire management, forest thinning, livestock grazing, etc.), and natural variations in weather and climate. Monitoring includes experimental and applied projects that assess the impacts of management actions, the interactions among the actions and the cumulative effects of all actions.

Research activities include projects undertaken by scientists with extramural funding. Research projects are distinct from projects funded internally for specific management goals or actions. Many of the externally funded projects provide important and useful information for understanding and managing Preserve resources.

Natural and cultural resource data must be converted into information to inform management decisions. Resource data comprise systematic measurements of biotic and abiotic characteristics. The Trust uses a Geographic Information System (GIS) to store, edit, integrate, analyze, share and display geographically referenced information. For example, the Trust placed Global Positioning System (GPS) radio collars on 29 coyotes in the Valle Grande that collect location information every five minutes. The locations can be displayed on a map, and home ranges, hunting areas and habitat preferences can be identified. Other data, such as vegetation, topography, elevation or water, can be added to the map. Managers can analyze patterns in diurnal, seasonal and annual movements and activities of coyotes.

Key data sets are analyzed to address complex resource management issues. Annual mapping of disease outbreaks can be correlated with weather or the pattern of spread to anticipate and prevent epidemic episodes. Artifacts observed during cultural resource surveys can be mapped to identify distribution patterns and use areas. Statistical analyses of natural resource data are done in consultation with statisticians at the University of New Mexico. These data sets and analyses are available to the public, scientists and other agencies upon request.

3.2.3.1 Inventory. At the time of federal acquisition, only cursory information was available about the property and its resources. Following acquisition, the Trust began inventorying the natural and cultural resources of the Preserve to establish a baseline for against which to measure the impacts of operations and management actions for adaptive management.

Natural Resources. Inventories completed or in progress include the following: geology map (to be completed in 2008); soils map (2008); vegetation map (2006); assessments of watershed health, stream condition and fish habitats (2000-2007); stream and ground water quality (1998,

2001, 2005-2007); forest stand condition and fuels (2003-ongoing); forest logging history (2004); and roads (2007, ongoing). Biodiversity inventories produced species lists for plants (2004), mammals (2005), birds (2004), reptiles (2003), amphibians (2003), fish (2003), aquatic insects (2004), terrestrial insects (2004, ongoing), other invertebrates (ongoing) and fungi, lichens and algae (2007, ongoing). The inventory of invasive, non-native plants identified 53 species (10.1%) among the 524 plant taxa found on the Preserve.

Vegetation communities provide habitat for wildlife and renewable resources for sustained yield. These communities are dynamic across the landscape; their composition and structure, are constantly changing due to successional processes and natural and anthropogenic disturbances. Vegetation and ground cover data are maintained in the *R2VEG* geodatabase, which was developed by the U.S. Forest Service for vegetation mapping and data management. The Trust identified 2,278 homogenous vegetation polygons, or forest stands, where species composition, structure and physical characteristics were measured. The data will be used to develop stand-specific prescriptions for treatment, and they can be used in computer models to predict the behavior of wildland fires, forest stand dynamics, wood volumes and suitable habitat for wildlife species.

Cultural Resources. Little was known about the cultural resources on the Preserve at the time of federal acquisition. Between 1981 and 2000, 2,585 acres (2.9%) had been surveyed at a planning level. Since acquisition, an additional 5,440 acres (6.1%) have been surveyed at a compliance level (Appendix 7.3). Planning level surveys identify the presence of cultural resources, but are not sufficient to document compliance with Section 106 of the National Historic Preservation Act (NHPA). Compliance level surveys identify the presence and absence of cultural resources and are sufficient to document Section 106 compliance. The Trust has conducted compliance surveys in advance of all projects with the potential for ground disturbance (e.g., road maintenance and upgrades, earthen tanks, potable water system, facilities development and maintenance, forest thinning and fire use, and interim programs such as livestock grazing and hiking trails). "Non-project" inventories have also been conducted that contribute to fulfilling Trust obligations under Section 110 of NHPA, including surveys on Cerro del Medio and Banco Bonito in 2005. The 2005 project in the Valle Toledo prior to and after the prescribed grassland fire was designed, in part, to pursue Section 110 goals of knowledge building and preservation. In 2007, non-project survey was conducted at Rabbit Mountain on the south side of the Valle Grande.

Beginning in 2000, the Trust operated under the U.S. Forest Service programmatic agreement for the treatment of cultural resources. The Trust is finalizing formal procedures for NHPA compliance in consultation with the New Mexico State Historic Preservation Office and the Advisory Council on Historic Preservation. The Trust also consults with Pueblos and Tribes that have cultural affiliations or historic connections with the Preserve and surrounding lands. Tribal consultation elicits comments, concerns and collaboration from Pueblos and Tribes for Trust planning and projects.

The Trust takes a multidisciplinary approach to cultural resource management that integrates scientific and cultural values and interpretative potential with recreation, resource use, conservation and public concerns. The Trust is developing information on the nature, distribution and quantity of cultural resources; that information is evaluated with data from adjoining federal lands. The Trust will manage cultural resources within the context of historic and ethnographic themes defined at a landscape scale.

Between federal acquisition and the end of fiscal year 2007, over 430 historic and archaeological sites were documented, including one National Register of Historic Places eligible district (ranch Headquarters), and 7.5% of the Preserve was surveyed. The caldera is renowned for obsidian quarries, but the most common sites are "lithic scatters" (Table 19). Based on observations to date, obsidian artifacts (see Figure 4 page 10) are distributed across the Preserve; in contrast, "fieldhouses" (see Figure 5 page 11) are present in abundance, but only on Banco Bonito. These one- and two-room masonry structures probably were associated with prehistoric agriculture possible only at the lower elevations in the southwest corner. The Preserve is surrounded by numerous prehistoric, historic and modern Puebloan communities (i.e., large multi-room settlements, such as at Bandelier National Monument), but there are no known pueblos in the caldera.

TABLE 19

HISTORIC AND PREHISTORIC RESOURCES DOCUMENTED THROUGH 2006. THE TOTAL IS HIGHER THAN THE NUMBER OF SITES (354) BECAUSE SOME SITES HAVE MULTIPLE COMPONENTS

Cultural Component	Number of Sites
Lithic scatters	180
Obsidian quarries	20
Rockshelters	9
One- and two-room fieldhouses	75
Multi-room prehistoric structures	3
Historic sites (including corrals)	70
Historic standing cabins	13
Total	**370**

3.2.3.2 Monitoring. Adaptive management requires the Trust to adjust actions based on monitored outcomes. The Trust's monitoring programs measure the effects, as well as effectiveness, of stewardship actions. The Trust has also established long-term programs to monitor key indicators for ecological condition, climate, stream water quality, wildlife habitat and populations of plants and animals.

The Trust established five weather stations in the four major valles and at one high elevation site to monitor temporal and spatial patterns of precipitation, temperature, humidity, wind speed and direction, solar radiation, soil temperature and soil moisture in the plant rooting zone. The National Oceanic and Atmospheric Administration installed a sixth weather station as part of its

climate change network across North America.[43] Analyses have shown large variability in rainfall and snowpack among the valles, and even greater variability between years (see Figure 3 page 6). Climate data will be incorporated into management plans for renewable resources (e.g., forage and timber), livestock grazing, wildlife, and forest and fires.

The Trust measures water quality in the major streams of the Preserve, including the East Fork of the Jemez River, Rio San Antonio, Indios Creek and Redondo Creek. Temperature, dissolved oxygen, pH, conductivity and turbidity, nutrient loads, dissolved salts and minerals and suspended solids are measured at each site. The New Mexico Environment Department (2006) determined that Preserve streams are impaired due to high water temperatures and high levels of turbidity (due mostly to soil erosion and high levels of algal growth). The Trust will continue to monitor water quality as it works to restore Preserve watersheds and riparian ecosystems.

Riparian zones are monitored for changes in vegetation and stream geomorphology. The major cause of the stream water quality impairments (high water temperatures and turbidity) relate to the structure of the stream banks. High stocking rates of sheep (up to 100,000) and cattle (up to 12,000) in the 20th century, coupled with a large increase in the elk population, resulted in "scalloping" of stream banks (Figure 15). Stream channels became wide and shallow (the natural condition is narrow and deep). With the reduction of livestock densities since 2000, stream banks have revegetated and stream channels are narrower and deeper. If this trend continues, water temperatures will cool, stream banks will stabilize and erosion will decrease.

The Trust monitors vegetation for livestock grazing, wildlife management, forest management and prescribed fire use. Plant species diversity, percent cover and forage use by livestock and elk are monitored across the Preserve in riparian areas, in valles grasslands and in grazable woodlands (forested areas with substantial grass understory). Results have shown the following: 1) forage use objectives[44] are met by current cattle stocking rates and elk population management (by New Mexico Department of Game and Fish); 2) forest thinning projects promote understory grass and forb recruitment; and 3) prescribed fire has a positive effect on rangeland forage quality without negatively impacting soils or stream water quality.

Wildlife and fishes are monitored to track the impacts of hunting and fishing programs on population abundance and distribution. Trout and native fishes have been monitored in the Rio San Antonio and East Fork of the Jemez River since 2003; results indicate that the fishing program on the Rio San Antonio has not impacted resident fish populations. In 2007, the Trust began monitoring the wild turkey population prior to implementing a spring turkey hunt.

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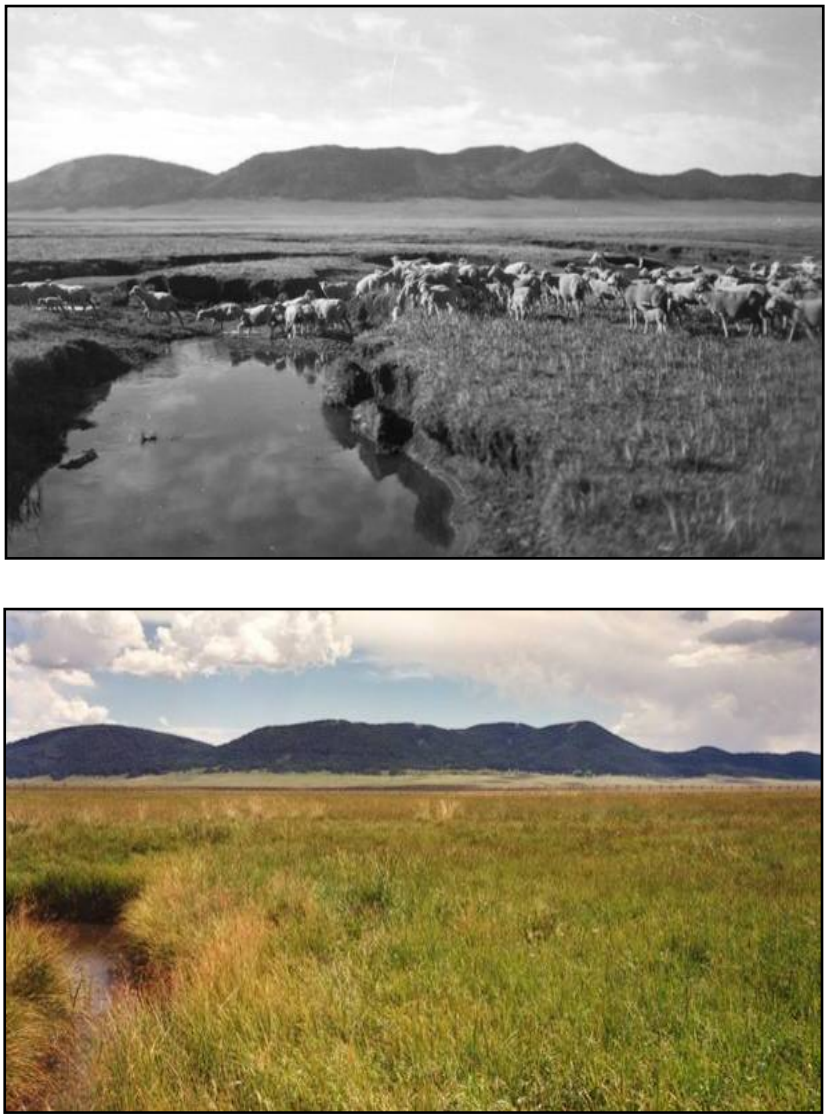
[43] www.ncdc.noaa.gov/crn/hourly?station_id=1138 (real time weather data for the Valle Grande)

[44] The Trust's 2002 interim grazing environmental assessment established 40% use of annual forage as a goal. Grazing individual grasses beyond 40% of annual production can result in cessation of growth, insufficient photosynthetic leaf area required for carbohydrate production and nutrient storage in roots and physiological damage to the plant. Removal of more than 40% of the available forage may not allow for accumulations of leaf litter on the soil surface reducing effective ground cover and impacting soil ecology.

FIGURE 15

REPEAT PHOTOGRAPHS OF THE VALLE GRANDE. DEGRADATION OF STREAM BANKS AND RIPARIAN VEGETATION BY SHEEP IN MID-1930S (TOP); RECOVERY OF THE AREA IN 2001 (BOTTOM)



Elk abundance, distribution, forage use, reproduction (calf:cow ratios), age distribution and movement patterns are monitored. The program includes elk/livestock exclosures on the Preserve and in Bandelier National Monument, monthly field surveys for population demographics, teeth and tissue samples collected in the fall for herd age and health, analysis of radio telemetry data collected by scientists with Los Alamos National Laboratory and the National Park Service, diet analyses and forage plant nutrient analyses (summer and winter range), predator impacts on calves by coyotes and diet monitoring, computer modeling to determine carrying capacity, and monitoring browse availability with the National Park Service.

Citizen volunteers play a major role in all Trust monitoring activities. Examples include annual breeding bird survey and atlas, and the bi-annual monitoring of forage (Figure 16). Both programs are conducted entirely by volunteers interested in the ecology of the Preserve.

FIGURE 16

VOLUNTEERS MONITORING GRASSES AND FORBS

3.2.3.3 Research. The Valles Caldera Preservation Act acknowledges the need to protect and preserve the scientific values of the Preserve. The management principles[45] adopted by the Board of Trustees establish a commitment to learning. The Trust has collaborated at local, regional, national and international levels with universities, agencies and organizations in areas such as climate change; forest, range and fire management; forest restoration; hydrological cycles; infectious diseases; carbon cycling; fire history; elk and cattle interactions; coyote and predator studies; and cattle behavior. These collaborative efforts comprise over $1.5 million of outside annual research funds expended on the Preserve (Appendix 7.2).

The research results benefit management and stewardship of Preserve resources, and contribute directly to adaptive management. For example, research hydrologists with the University of Arizona's Science and Technology Center for Sustainability of Semi-Arid Hydrology and Riparian Areas (SAHRA)[46] are developing a process-based water budget and hydrologic model for the Preserve that is driven by climate and stream data collected by the Trust. Results show the following: 1) the Preserve is a major contributor to ground water recharge, 2) the hydrology system is "flashy" (i.e., a rapid, short period water cycle from snow-melt to ground water to spring-fed surface water) and highly susceptible to winter and summer drought, and 3) evaporation of snow to the atmosphere (sublimation) results in a 50% loss of winter

[45] National Environmental Policy Act Procedures for the Valles Caldera Trust 2003

[46] www.sahra.arizona.edu/valles/

precipitation from the water cycle. The models indicate that thinning young, second-growth forests could reduce sublimation losses by half (snow would reach the ground instead of remaining in trees where it evaporates) and provide partial shade to reduce sublimation losses until spring snowmelt. Thinning high-density forests could result in greater than 10% increases in annual spring runoff to the Jemez River and the Rio Grande Valley (approximately 2,000-3,000 acre-feet of water per year). At current valuations for leased water rights, this would equal $2-3 million annually[47] of "ecosystem services" to New Mexico.

Other research projects have documented the presence (or absence) of wildlife diseases on the Preserve. Tests of elk and trout tissues found no evidence of Chronic Wasting Disease in elk or whirling disease in trout. Research on rodents and coyotes identified several common wildlife diseases in the Southwest, including Hantavirus in deer mice; plague in prairie dog colonies; and plague, distemper and parvo virus in coyotes.

At the national level, research on long-term climate change by Los Alamos National Laboratory (LANL) and National Oceanic and Atmospheric Administration (NOAA) is underway on the Preserve. The LANL scientists are measuring rates of carbon exchange between the atmosphere and Preserve vegetation, including daily fluctuations and build-up of CO_2 in the valles during the night. The NOAA researchers established a high-resolution climate station in the Valle Grande as part of their nation-wide Climate Reference Network to measure long-term global warming and shifts in rainfall and snowfall.

In 2005, the University of New Mexico (UNM) Archaeological Fieldschool surveyed 200 acres on the Banco Bonito for archaeological sites and trained undergraduate and graduate students in site documentation strategies. Benefits to the Trust include the completion of inventory for this part of the Banco Bonito and documentation of 26 archaeological sites, including the discovery of prehistoric agricultural terraces (Figure 17) at the upper elevation for maize agriculture in the Jemez Mountains. The UNM survey significantly expanded the knowledge of prehistoric agricultural occupations and landscape modification practices on the Preserve.

3.3 Reasonably Foreseeable Future Stewardship Actions

Reasonably foreseeable future actions are actions whose effects may well contribute to the condition of the Preserve over the next 5 years. Decisions have already been made to undertake these actions, or the actions are being considered and it is reasonable that decisions will be forthcoming and the action will be undertaken. Reasonably foreseeable actions must be funded, or it is reasonable to think that they will be funded. Actions undertaken by other agencies are

[47] According to recent SAHRA estimates, the Preserve loses 50% of winter snowpack through sublimation. If forests were thinned to reduce sublimation by 50%, the Preserve could produce about 25% more spring runoff. Total annual water production could increase by about 10%. In 2004, the city of Rio Rancho paid $11,000 per acre-foot for water rights in the Jemez Valley. The Preserve produces about 20,000 acre-feet per year; a 10% increase would equal 2,000 acre-feet. At $11,000 per acre-foot, the capital cost of those water rights would equal $22,000,000. If the water were leased at a rate of 10% of the total capital value per year, the lease amount would be valued at $2,200,000 per year.

considered if they could create impacts within the affected area of the Preserve and within the life of this *State of the Preserve*.

FIGURE 17

ROCK ALIGNMENTS FORM HILL SLOPE TERRACES ON THE BANCO BONITO

3.3.1 Public Access and Use

Public programs on the Preserve include recreation, special uses (research, commercial[48] and cultural) and education. Since 2002, the Trust has managed public access and use for recreation, education and other purposes as "interim" programs using existing infrastructure and temporary buildings. The Trust has learned a great deal from planning and implementing these programs and is ready to begin an access and use management plan that addresses visitation, visitor programs and infrastructure for the next decade. Concomitant with the development of the access and use management plan, the Trust will develop a business plan that analyses market options for programs, activities and infrastructure to address the mandate in the Valles Caldera Preservation Act of 2000 to become financially self-sustaining by 2015.

3.3.1.1 Interim Recreation Programs. The public demand for access to the Preserve is high and is not being met by current interim programs. Public demand for access and use will increase as the regional population increases and as additional programs and opportunities are developed by the Trust**.** From 2000 to 2006, the population of Sandoval County grew by 26% compared with a statewide growth of 8%. By 2030, the U.S. Census Bureau predicts a 42% increase in the population of Sandoval County where the Preserve is located. Strong growth is also predicted in the adjacent counties of Santa Fe (30.7%), Bernalillo (15.8%) and Rio Arriba (19.9%). The population of Los Alamos County is expected to increase less than 2% (Bureau of Business and Economic Research 2004).

[48] Commercial activities include events such as fishing and hunting clinics, artist workshops, agency meetings and training sessions.

The State of New Mexico and Sandoval County view the Jemez area as a major asset for tourism. With the rapid growth of Albuquerque and Rio Rancho, pressure on the resources and infrastructure of public lands in the Jemez area has increased. The *Jemez Valley Corridor Assessment*[49] prepared by the by the Mid-Region Council of Governments of New Mexico reports that visitors from these cities contribute to most of the traffic along New Mexico Highway 4, which runs through the Preserve. Traffic surveillance recorded an increase in the average volume of 1,200 vehicles per day to 2,400 vehicles per day during a holiday weekend along Highway 4 south of the Preserve (Mid-Region Council of Governments 2006).

With an increase in traffic, there is an increased demand for outdoor recreation opportunities. The Preserve currently offers a variety of recreation programs (e.g., hiking, fishing, hunting, van tours, wildlife viewing, educational seminars and tours) and numerous special events (e.g., mountain biking, running marathons, star gazing, outdoor skill clinics, photo and landscape painting workshops). These programs were established to provide the public access to the Preserve after the Trust assumed management (August 2002) without investing large amounts of money on capital improvements. The programs are popular and attendance continues to increase. Planning and analysis are underway to include overnight camping. Visitor capacity and use will continue to be limited by the existing infrastructure.

3.3.1.2 Comprehensive Planning for Public Access and Use. In the summer of 2007, the Trust held a series of public meetings to gather information on public access and use of the Preserve. The information will be valuable for developing alternatives that address the capacity for use, the scale and location of infrastructure development and the types of programs offered. Planning will culminate in implementation plans for project level activities and provide management direction for the next decade. The scope of this analysis will include:

- Visitor capacity;
- Types of programs and activities to be developed for recreation, education and other purposes;
- Facilities and infrastructure to be developed in support of public access and use for recreation, education and other purposes;
- Scale, location and timing of development;
- Goals,[50] objectives[51] and monitored outcomes[52] for public activities and programs developed and implemented on the Preserve; and
- Performance requirements[53] to guide the development and management of programs and facilities for public access and use.

[49] Available at: www.mrcog-nm.gov/content/view/64/191/

[50] Goal is a desirable condition sought by the Trust and/or a desirable condition described in the Valles Caldera Preservation Act or in the management principles adopted by the Trust.

[51] Objective is a desired outcome that can be meaningfully evaluated by location and timing.

[52] Monitored outcome is the short-, mid- or long-term outcome selected for evaluation.

3.3.1.3 New Mexico Highway 4. Approximately 2 miles of Highway 4 lie within the southwest corner and 4 miles lie within the southeast part of the Preserve. The New Mexico Department of Transportation (NMDOT) classifies Highway 4 as a minor arterial. An arterial is a continuous long-distance travel route that connects urban and rural communities. Public use of the Highway 4 corridor through the Preserve will undoubtedly increase in the future.

There are seven highway pullouts (viewing areas) in the southeast part of the Preserve that offer outstanding scenic vistas and superb opportunities to view wildlife. Three pullouts contain small kiosks with information on the history and programs of the Preserve. The pullouts are a great venue for a roadside education and interpretation program. The pullouts will be considered for future infrastructure development because of their public accessibility and great views. In cooperation with NMDOT, the Trust will plan, design and construct appropriate signage, improve existing pullouts, improve vehicle and pedestrian safety and install interpretive displays. The analysis will occur during planning for public access and use.

3.3.2 Preserve Management

The Trust will focus on managing the natural and cultural resources, infrastructure, programs and processes necessary to operate the Preserve, and preserve and protect its resources.

3.3.2.1 Facilities Management. "Ultimately, the trust expects to develop visitor contact and science, interpretive, and educational facilities for the preserve and will seek partners to assist in funding and carrying out this goal" (Valles Caldera Trust 2003:121). The Trust will consider a permanent visitor center,[54] administrative office and employee living quarters located within the boundaries of the Preserve. "The trust will need to develop plans for facilities to serve the growing administrative functions on the preserve..." (Valles Caldera Trust 2003:123). Currently, the administrative office is located in Jemez Springs, 21 miles southwest of the main entrance to the Preserve.

"Many of the buildings constructed on the preserve have been used historically for lodging of guests...The goals of the trust include creating revenue-generating lodging and rentals from existing preserve buildings..." (Valles Caldera Trust 2003:122). Based on the structural and historical assessments of Preserve facilities, the Trust will consider long-term plans for preservation and maintenance of structures consistent with the standards established by the Valles Caldera Preservation Act of 2000.

Historically, the Preserve has been a working landscape with a functioning livestock operation. The facilities on the Preserve have a wide variety of uses, ranging from workspaces, to visitor facilities, to living quarters. Twenty-six of these facilities are located in and around Valle Grande. Most facilities on the Preserve are between 50 and 100 years old, and because of their

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[53] Performance requirement is the limitation placed on implementation of a stewardship action necessary for compliance with applicable laws, regulations, standards, mitigating measures or generally accepted practices.

[54] The existing visitor center (visitor contact station) consists of two Morgan buildings, several port-a-potties and small outbuildings; there is no running water or electricity.

age, require about $1.2 million in deferred maintenance, as well as $120,000 in annual maintenance to keep them functional. Deferred maintenance is needed to prevent on-going deterioration and to bring these buildings up to standards to allow their use by Trust staff for administrative purposes and the public for revenue generation.

The Trust will consider the infrastructure that already exists in the region, including campgrounds, day use areas and other developed and undeveloped recreation sites (Valles Caldera Trust 2003). Decisions regarding the location, scale and purpose of new facilities for the Preserve will be made within the next 5 years in planning for public access and use.

In addition to facilities for visitors and administrative use, the Trust will need to maintain or develop utilities, including water and wastewater systems and emergency power systems; communication systems; roads and bridges; trails and trailheads; corrals and fences; and information and interpretive signs (Valles Caldera Trust 2003). Because the water supply in the Headquarters area often freezes in the winter, the Trust may drill one or more wells to provide a reliable source of potable water to administrative and public buildings.

3.3.2.2 Rehabilitation of Historic Structures. Recommendations for preservation of the historic structures on the Preserve focus on halting or reversing damage from wood decay of the log structures and improving drainage to diminish roof run-off and ground saturation (Dennison et al. 2007). The highest priority actions are the repair of foundations (including repair or consolidation of sill logs, removal of sediment accumulation) and repair of drainage problems, including installation of French drains and repair or replacement of gutters.

Three of the historic log cabins at ranch Headquarters are targeted for the first preservation actions: the Bond Cabin, Otero Cabin and Ranch Foreman's Cabin. All were built in the first two decades of the 20th century and embody the historic character of ranch Headquarters. Each is suitable for administrative and public uses. The central location of these cabins adjacent to the VC02 road makes them visually prominent to visitors. Common to all three cabins is the need for window and roofing repair; rodent control; replacement and upgrade of electrical, plumbing and heating systems; and improved site drainage. Drainage problems require the installation of French drains to reduce moisture retention, and construction of retaining walls or other water deflection structures. The estimated total estimated deferred maintenance cost for these three structures is over $200,000 (see Table 4 page 26).

3.3.2.3 Preserve Roads. Road inventories of the Preserve reveal approximately 12 miles of road per square mile of land. The U.S. Forest Service maximum objective is about 2.5 miles of road per square mile of land. Data from the road inventory, which will be completed in 2008, will be used to develop a transportation plan for a system that addresses administrative and public access needs and eliminates unnecessary roads. The plan will identify road access for public activities, administrative uses and traditional uses. The plan for the transportation network must meet administrative, public and emergency access requirements "...while remaining true to core principles of the trust and providing coordination to enhance interpretation of the preserve" (Valles Caldera Trust 2003:119-120).

Since 2002, the Trust has upgraded approximately 13 miles of ranch roads to the present arterial classification (i.e., one-lane, all-weather road with turnouts to accommodate passenger cars) at a cost of up to $100,000 per mile (Valles Caldera Trust 2003). These roads (VC01 and VC02) are the first half of the long loop (26 miles) that the Trust planned to use during the August 2006 Open House (section 3.2.1.4). The cost to upgrade the remaining roads of the long loop (VC09, VC08, VC06, VC03 and VC02) is estimated at $1.3 million (excluding the cost of cultural resource compliance). The Trust will consider upgrading the entire route to allow the public to drive through the Preserve in their personal vehicles.

The Trust will continue routine maintenance of roads currently used on the Preserve based on safety, resource conditions and values, capacity and intended uses. Roads will be managed to conserve, protect and restore the recreational, ecological, cultural, religious and wildlife resource values of the Preserve. The Trust will continue to upgrade and sign open roads to U.S. Forest Service and state of New Mexico standards as required by the Valles Caldera National Preservation Act of 2000.[55]

3.3.2.4 Working Ranch Infrastructure. Fences on the Preserve have served as a management tool for livestock operations for several decades (some for nearly a century). The fences are in different condition stages. The 53.5 miles of exterior boundary fence have always been maintained; the Trust will continue to reconstruct and maintain it. A well-maintained perimeter fence clearly identifies the Preserve boundary (the fence is signed to control trespass). Several of the iron gates along the exterior fence will be modified to meet a standard similar to the U.S. Forest Service. The purpose and effectiveness of interior fencing will be evaluated in plans for forage use by domestic livestock. The Trust will consider removing unnecessary interior fences and ensure that remaining or new fences are compatible with wildlife objectives.

The corrals in the Valle Grande and the Valle San Antonio are in good condition. They are used several times a year for receiving, shipping, treating and sorting cattle. They are also used to hold unauthorized or trespass livestock from adjoining lands. The Trust will continue to maintain these corrals for operators that participate in livestock programs on the Preserve. The corrals could be used for livestock workshops or as holding facilities for livestock in support of recreation, education or other programs.

The paddocks and 18-stall horse barn were built in 1965 and cover 8,023 square feet. There is office space (1,160 square feet) and a covered bay, but no utilities. The barn has had some minor structural work and is in fair to good condition. The Trust uses this facility to support special equestrian events. This activity was well received and may be expanded in coming years.

The 136 earthen tanks on the Preserve were constructed to hold water for livestock operations and wildlife; 94 are functional (hold water), but only 20 are in good or excellent condition. The majority of earthen tanks require maintenance in the next 3-5 years. The Trust will evaluate the need for earthen tanks during planning for the grazing program and develop a repair and

[55] Public Law 106-248 § 108(e)(1); 16 U.S.C. § 698v-6.

maintenance strategy. Six of the earthen tanks have a surface area of 4-6 acres; the Trust will explore options to use one or more of these tanks for recreational flatwater fisheries.

3.3.2.5 Multiple Use and Sustained Yield of Forage Resources. In December 2006, the Board of Trustees authorized a stewardship action to develop a plan to allocate forage within the Preserve to support elk and other herbivores; to preserve and protect ecosystem processes and habitats; to support domestic livestock grazing and other commercial purposes; and to support scientific, education and other public uses. The domestic livestock programs could be one year or multiple years, and could include grazing by cattle or other domestic herbivores such as horses. The Trust will also consider other commercial uses of forage, including harvesting native seeds and plants. The Trust proposed to manage infrastructure associated with the allocation and use of forage, including the repair, maintenance, removal, obliteration and rehabilitation, or construction of earthen and other water tanks, water distribution systems, fences and corrals. The proposed stewardship action can be found on the Trust's Web site.[56] The goal is to complete the new environmental analysis in 2008.

Trust plans will include objectives, monitored outcomes and performance requirements for management of forage, riparian resources and associated habitats, which will provide useful metrics for adaptive management. They will also guide future activities on the Preserve that may affect forage and riparian resources and associated habitats. Alternatives developed for this stewardship action will consider different levels of investment in infrastructure; varying the allocation and use of forage in time, space and quantity; as well as taking no action.

3.3.2.6 Forest and Fire Management and Multiple Use and Sustained Yield of Forest Resources. The abundance distributions of the major forest species on the Preserve have a high proportion of small (young) trees; there are few trees greater than 24 inches and very few over 30 inches in diameter. Past logging focused on ponderosa pine and Douglas-fir, the most economically valuable species and the most heavily harvested, but all major conifer species were logged to some extent (Balmat and Kupfer 2004). There is relatively little 'merchantable' timber remaining on the Preserve – trees larger than 16 inches in diameter dominate only about five percent of Preserve forests.

Even old-growth stands that escaped logging have been altered as a result of disturbance and require active management to maintain their structure and health. In old-growth ponderosa pine forests under a natural disturbance regime, there would be 90 percent fewer trees and a higher proportion of large trees (Balmat and Kupfer 2004). Restoration and maintenance of the structural patterns and ecological processes of Preserve forests will require active management intervention.

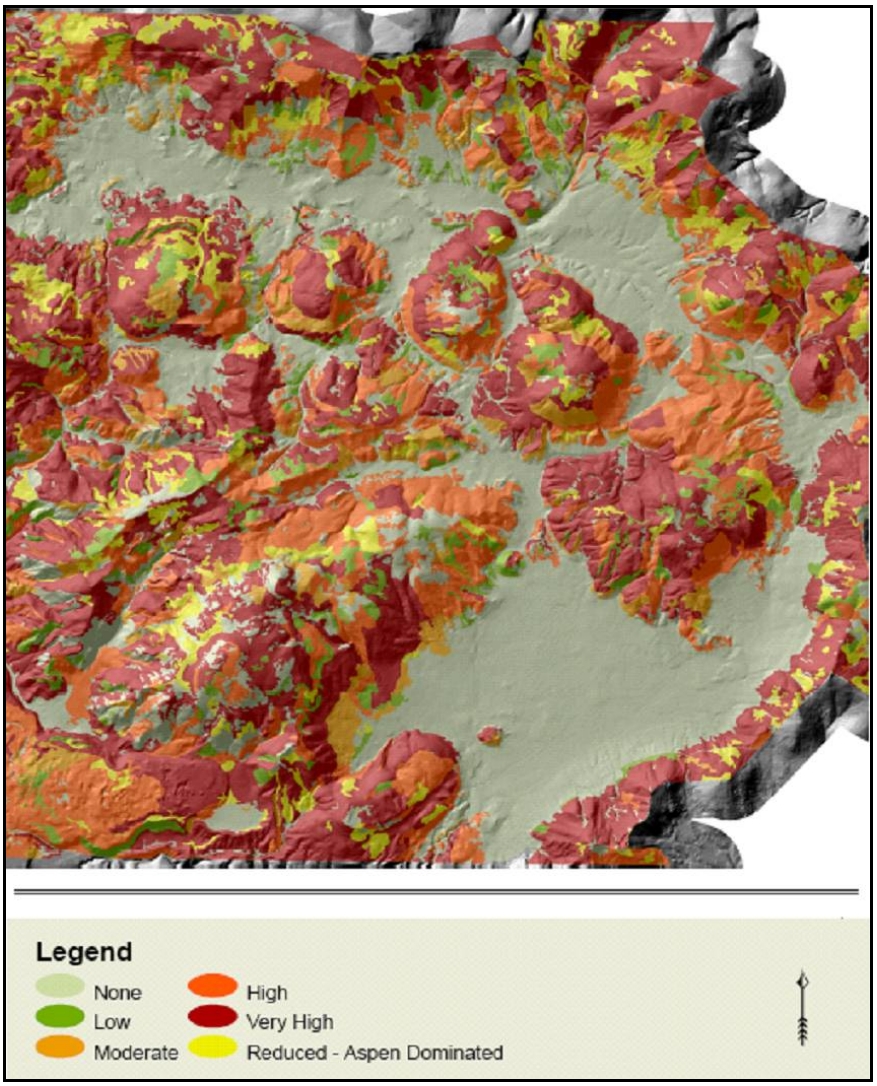
Under the right conditions, much of the Preserve's forests could burn as a crown fire (Figure 18). A plan to manage wildland fire risk will include an assessment of surface and canopy fuels, topography and values at risk (e.g., structures, natural and cultural resources, wildlife habitat,

[56] www.vallescaldera.gov/get_involved/stars/stars_saps.aspx

etc.). Forest structure and history, plant associations and species cover will be used in computer models to predict the environmental effects of wildland fire, and to determine where and under what conditions prescribed fire and wildland fire use can be considered for resource benefits.

FIGURE 18

RISK OF CROWN FIRES IN PRESERVE FORESTS



The Trust is completing an inventory of Preserve forests. Once that is finished, the Trust will work with the public to develop objectives for forests and habitats and explore alternatives for long-term management. These alternatives will vary in the intensity of treatment, the method of treatment (fire and mechanical treatments) and priorities for treatment. The sale of wood products (e.g., poles, vigas, latillas, mulch, pellets, etc.) will be considered to defray the cost of forest management and to provide revenue to the Trust. Until that time, thinning will continue along Highway 4 on the Banco Bonito and at the Headquarters area based on monitored outcomes of previous efforts.

3.3.3 Inventory, Monitoring and Research

Land managers and scientists generally agree that site-specific scientific knowledge improves management decisions and that this knowledge is particularly valuable in managing natural systems. Such knowledge must be gathered continuously or at least regularly "...so that managers, scientists, and the public...can inform themselves of the impact of activities on systems of concern and make management adjustments accordingly...This approach to the stewardship of natural systems is...referred to as 'science-based adaptive management.' Its chief characteristic is a commitment to monitor natural systems and the human activities that impinge on them, coupled with an equal commitment to use the monitoring information thus gained to guide and, when necessary, revise the goals and activities of management" (Valles Caldera Trust 2003:61).

According to the Trust's NEPA procedures,[57] "'Adaptive management' means adjusting stewardship actions or strategic guidance based on knowledge gained from new information, experience, experimentation, and monitoring results, and is the preferred method for managing complex natural systems." Further, the NEPA procedures state "The outcomes of implemented stewardship actions are monitored to aid future choices, consistent with the adaptive management."

3.3.3.1 Inventory. The Trust anticipates that most natural resource inventories will be completed in 2008. Some inventories (e.g., fungi, algae and insects) will continue beyond 2008 using volunteers and external funding. Additional forest and fuel inventories may be necessary to support resource management projects, including the sale of forest products.

Cultural resource inventories will continue as the Trust undertakes ground-disturbing projects, and as more areas are opened to public use. Trail-building and designation of new recreation routes will require surveys and assessments to document resources, minimize short- and long-term effects and avoid areas that are sensitive to tribal and Pueblo communities. Road building and road upgrades, construction or expansion of parking areas, construction of facilities and trailheads will require archaeological investigations. Large projects, such as forest thinning and fire use, may be suitable for sample inventory. Some cultural resources inventories (e.g., rockshelter surveys, historic aspen carvings and rock art) are suitable for volunteer projects.

The nature of the archaeological sites on the Preserve, and the demands on a new federal entity, pose challenges for managing cultural resources. Prehistoric sites are often obscured by vegetation and deep soils, and rarely have stone features to signal their presence. Site discovery and documentation often require subsurface investigations. For ground-disturbing projects, such as construction or facilities improvement, shovel probe surveys may be necessary to determine the presence and boundaries of site deposits. Prehistoric lithic scatters, the most common type of archaeological site (see Table 19 page 55), are abundant and extensive, and difficult to avoid in project planning and implementation, while buried deposits are protected

[57] National Environmental Policy Act Procedures for the Valles Caldera Trust 2003

from the impacts of surface activities. Due to limited public access throughout the last century, surface artifact assemblages retain a greater number of prized artifacts such as arrowheads. The surface record is not only rich in information, but also vulnerable to unauthorized collection.

The Trust has not systematically gathered information on the socio-economic characteristics of visitors to the Preserve. These data become increasingly important as the Trust moves into planning for public access and use (section 3.3.1.2). The type of information the Trust is likely to collect includes the following: visitors satisfaction surveys; visitor demographics and place of origin; quality of experience surveys; area use measures, such as vehicle and visitor counts; recreation experience evaluations; travel costs and expenditures; regional socio-economic impacts; and public attitudes toward the Trust.

3.3.3.2 Monitoring. Monitoring programs will continue into the foreseeable future. Management actions that affect natural or cultural resources must include a monitoring component to assess the desired outcomes of each stewardship action.[58] Baseline monitoring of climate, stream water quality and plant and animal populations will continue, although modifications in scope and intensity may be required as long-term programs are developed.

Cultural resources. The Trust will continue to monitor: 1) the gradual effects of increased or concentrated public access and use on cultural resources; 2) the efficacy of actions to avoid impacts to buried cultural deposits during road maintenance, road upgrade and pipeline maintenance; 3) the impacts of fires on obsidian artifacts (especially the chronometric potential of these artifacts, called obsidian hydration dating); and 4) the presence of livestock and elk on archaeological sites.

Climate and forage. The Trust will continue to monitor climate conditions to understand the relationship between climate and precipitation (timing and extent) and forage production for wildlife and livestock (conditions that determine the carrying capacity of elk and livestock). These data will be used to ensure sustainable use of forage resources to ensure long-term operations that contribute to financial self-sufficiency.

Fisheries. The Trust will continue to monitor the abundance, distribution and body condition of the sportfish (rainbow and brown trout) and native fishes (minnows and suckers) to ensure the sustainability of the Preserve's fisheries. Water quality monitoring will continue to document long-term trends in stream condition and impacts from livestock, forestry, recreation and watershed restoration programs.

Forests and fire. Given the large proportion of second-growth forests and extremely high fuel loads on the Preserve, management actions are necessary to restore and maintain forest ecological health. The Trust anticipates the continued use of thinning, as well as use of prescribed fires and natural fires. The monitoring program will evaluate whether these actions meet the goals and desired outcomes, especially improving wildlife habitat, reducing fuel loads and fire hazards, controlling forest pests and diseases, and improving future timber harvests.

[58] National Environmental Policy Act Procedures for the Valles Caldera Trust 2003

Established inventory plots will be used to monitor effects of management actions; natural events, such as fire, insects or disease; and changes resulting from climate trends. Additional monitoring plots may be added if there are none in a target area. Vegetation inventories will be used to monitor direct effects on understory and overstory vegetation, as well as indirect effects to wildlife habitat or ecosystem services.

3.3.3.3 Research. Future research programs will focus on the hydrologic cycle and how management actions can increase water budgets in the Jemez River watershed. Watershed restoration projects are expected to decrease water loss from snow sublimation. More water will percolate into the soil for use by plants [increasing tree growth (timber production) and grass/forb forage productivity] and result in greater groundwater recharge and spring snowmelt runoff into the Jemez River and Rio Grande. Research projects on wildlife management will be developed to document interactions among elk, deer, mountain lions, bears and coyotes, and how these big game species respond to human activities, land use patterns, fires and habitat restoration projects. These data are critical to developing a comprehensive regional wildlife management plan to deal with the societal, cultural and economic issues associated with wildlife, livestock and recreation programs. Investigators with extramural funding will conduct most research projects with logistical support from the Trust.

4 Cumulative Effects

The Trust selected seven resource areas that are meaningful to measure cumulative effects. The existing condition of each resource is summarized relative to a baseline condition influenced by past, present and reasonably foreseeable actions or events.[59]

4.1 Water Quality

Water quality and stream bank condition are important indicators of cumulative effects in a landscape like the Preserve. Activities such as logging, grazing, fishing, road building and road maintenance affect Preserve streams, especially during snowmelt and summer rains. Some activities have additive effects on water and riparian resources. Over-grazing of riparian areas creates bare ground and breaks down stream banks, which increases the amount of sediments washed into the stream. Clear cutting and road building also contribute to sediment deposition in streams. Some activities have cumulative effects on water resources. The discharge of nutrients and warm water into a river can cause algal blooms and loss of oxygen.

The New Mexico Environment Department measured pollutant loads in the East Fork of the Jemez River, Jaramillo Creek, Redondo Creek, Rito de los Indios, Rio San Antonio, La Jara Creek and Sulphur Creek (Table 20). Pollutant loads were compared to Total Maximum Daily Loads (TMDL), the total amount of pollutants that could be assimilated naturally by a stream and still meet state water quality standards. Streams with loads that exceed the TMDLs are classified as "impaired." The East Fork of the Jemez River, Jaramillo Creek, Redondo Creek and Rio San Antonio exceed TMDLs for temperature and turbidity (suspended materials usually derived from soil erosion). All Preserve streams exceed the standard for aluminum, which has a natural source in volcanic rocks.

These conditions resulted primarily from degradation of watersheds during 20th century forestry and livestock operations, coupled with a large increase in the elk population in the 1980s and 1990s. High stocking rates of sheep (pre-World War II) and cattle (1950s onward), and an expanding elk population, caused a reduction of riparian vegetation and scalloping of stream banks (see Figure 15 page 57). Streams became wider and shallower than normal, which led to increased heating from sunlight and increased erosion from unvegetated stream banks. Algae production in these shallow, sun-lit streams was exceedingly high, which caused extreme fluctuations in diel (day-night) concentrations of dissolved oxygen and acidity (pH). Water chemistry cycles adversely affect fish and aquatic invertebrates in some stream reaches.

Shortly after federal acquisition in 2000, members of the New Mexico Cadre of the Creeks and Community Strategy assessed the watersheds of the Preserve. The Cadre used the Proper Functioning Condition Method of the Accelerated Cooperative Riparian Restoration and Management, a collaborative effort among the Bureau of Land Management, U.S. Forest Service and Natural Resource Conservation Service. The report identified a large number of stream

[59] An "event" is a natural or unplanned or otherwise uncontrollable incident such as climate change, wildfire or the outbreak of forest pest or disease.

reaches as either Non-Functioning or Functioning At Risk (McWilliams et al. 2000, 2001). The watersheds were re-evaluated using the same methods in 2006. After 6 years of Trust management, watershed condition significantly improved (McWilliams 2006). During that time, livestock stocking rates were reduced from 5,000-7,000 cattle under private management to 500-800 under Trust management, and the grazing period was shortened from six months (May through October) to four months (June through September). With more riparian shading, stream water temperatures on the East Fork Jemez River decreased between 2001 and 2006 – in 2001, temperatures exceeded TMDLs on 76 days; in 2006, temperatures exceeded TMDLs on 61 days (20% decline).

TABLE 20

RESULTS OF THE 2003 AND 2006 NEW MEXICO STREAM POLLUTION SURVEYS (NEW MEXICO ENVIRONMENT DEPARTMENT 2006).

Stream	Designated Uses†	Impairment	Potential Sources
East Fork Jemez River (Preserve boundary to headwaters)	HQCWAL, DWS, FC, IRR, LW, WH, SC	Temperature (#), Turbidity (&), Aluminum, Dissolved Oxygen, pH	Natural sources, recreational sources, grazing, silviculture harvesting, stream bank modifications and/or destabilization, upstream impoundments, wildlife other than waterfowl
Jaramillo Creek (East Fork Jemez to headwaters)	HQCWAL, DWS, FC, IRR, LW, WH, SC	Temperature (#), Turbidity (#), Aluminum	Highway/road/bridge runoff (non-construction), natural sources, rangeland grazing, stream bank modifications and/or destabilization, wildlife other than waterfowl
Redondo Creek (above Preserve boundary)	HQCWAL, DWS, FC, IRR, LW, WH, SC	Temperature (&), Turbidity (&), Aluminum	Natural sources
Rito de los Indios (above Rio San Antonio)	HQCWAL, DWS, FC, IRR, LW, WH, SC	Aluminum	Natural sources
Rio San Antonio (below Warm Springs)	HQCWAL, DWS, FC, IRR, LW, WH, SC	Temperature (&), Turbidity (&), Aluminum	Natural sources
La Jara Creek (East Fork Jemez to headwaters)	HQCWAL, DWS, FC, IRR, LW, WH, SC	Aluminum	Natural sources
Sulphur Creek (Preserve boundary to headwaters)	Limited aquatic life, WH, LW, SC	PH (&), Conductivity (&), Aluminum	Natural sources

† HQCWAL = High Quality Cold Water Aquatic Life; DWS = Drinking Water Source; FC = Fish Culture; IRR = Irrigation; LLW = Livestock Watering; WH = Wildlife Habitat; SC = Secondary Contact; # = TMDLs written in 2006; & = TMDLs written in 2003

4.2 Watershed Condition

The Trust uses an ecological condition rating to measure cumulative effects on grassland and riparian ecosystems. Land managers find it useful to compare the existing condition of natural

systems with the condition that would be expected if the system remained unaltered by the large-scale actions and human interference, including natural disturbances, especially fire. This condition, commonly known as the reference condition, is defined as the composition of vegetation and disturbance attributes that, to the best of collective knowledge, can sustain native ecological systems and reduce future hazards to biodiversity (Hann et al. 2005). The difference between the existing condition and the reference condition is the degree of departure.

The Trust used ecological site descriptions developed by the New Mexico Natural Resources Conservation Service (NRCS) as reference conditions for estimating the condition of riparian and grassland ecosystems. The NRCS has conducted ecological site inventories for various soils and habitats of New Mexico (descriptions are available in the NRCS Field Office Technical Guide[60]). Based on soil surveys and plant associations (Muldavin and Tonne 2003), the following four ecological sites were identified: mountain valley, mountain meadow, pine grassland and mountain breaks.

To estimate the current ecological condition, three quantitative indicators were measured on 672 plots. Muldavin and Tonne (2003) collected data for vegetation mapping, Barnes (2001-2005) for range monitoring and the U.S. Forest Service (2000 and 2006) for Terrestrial Ecosystem Survey.[61] Key indicators were measures of cover by bare ground, litter and grass or forbs; soil erosion; and presence of non-native species. The measured values of each plot were compared to reference condition values and each plot was given an upland condition rating. Data collected on the perennial streams were combined to give a riparian condition rating for each stream reach. Upland and riparian ratings were grouped within 28 sub-basin watersheds and each sub-basin was assigned an overall condition rating. The ratings describe the ecological condition and indicate the departure from the reference condition (Table 21). Most (82%) Preserve watersheds are in moderate condition; 18% are in high condition and none are in low condition.

TABLE 21

ECOLOGICAL CONDITION OF 28 SUB-BASIN WATERSHEDS

	Condition Rating		
	Low	**Medium**	**High**
Departure from reference condition*	Great departure	Moderate departure	Little or no departure
Number of sub-basins	0	23	5
Acres	0	80,072	9,381

* Reference condition is the composition of vegetation and disturbance that can sustain native ecological systems and reduce future hazards to native biodiversity.

[60] www.nm.nrcs.usda.gov/technical/fotg/section-2/esd.html

[61] A terrestrial ecosystem is an integrated representation of the ecological relationship between climate, soil and vegetation. A terrestrial ecosystem survey is the systematic analysis, classification and mapping of terrestrial ecosystems.

Scientists and experts (New Mexico Environment Department, Will Barnes, National Riparian Team, Jornada Experimental Range Station) have predicted and documented measurable improvements in the ecological condition of the Preserve since federal acquisition. These improvements are attributed to conservative grazing practices, including a 10-fold reduction in livestock numbers, a shorter grazing season and limiting or excluding cattle from sensitive areas. Road maintenance and repair, especially the replacement of culverts and bridges and the use of permeable fills, are major contributors to ecological improvement.

The Trust "...goals for aquatic and riparian communities include attainment of high levels of water quality and restoration of stream health, including woody riparian vegetation where appropriate and improved stream channel morphology (i.e., deeper, narrower channels with more pools" (Valles Caldera Trust 2003:103). The current trends in improving watershed conditions and stream water quality on the Preserve were achieved under interim management programs. Future activities on the Preserve will include strategies and actions to continue recovery and restoration of watersheds, riparian habitats and water quality. Restoration programs will be initiated to accelerate improvements in watershed health, including stabilization of banks, reductions in sedimentation and restoration of riparian vegetation (Valles Caldera Trust 2003).

4.3 Forest Condition

The Trust used a stand delineation map[62] to assess forest condition. The Preserve was divided into homogenous polygons based on vegetative structure, including size, species and density of all life form layers. The existing vegetative structure was compared to the expected vegetative structure for the representative plant community and biophysical setting. The difference between the existing and reference condition is the degree of departure. These data were also used to identify areas of high fire risk, potential wildlife habitat, water yield, forage production and timber potential.

The vegetation data were synthesized to compare the existing seral (ecological succession) state of the forests and shrublands to the reference condition. The structure of Preserve forests, which is the cumulative effects of historic logging, grazing and fire exclusion, departs significantly from reference conditions (Table 22). The structure, dominated by dense stands of small- to mid-diameter trees, impacts the composition and function of Preserve ecosystems and creates specific risks, which are described as follows:

- Composition – conversion to more shade tolerant species in forest and understory.
- Function – precipitation is intercepted by the dense canopy and lost through sublimation significantly reducing water yield.
- Risks – wildland fire impacts dense forests at an intensity and scale far greater than an open forest. Dense forests provide continuous fuel for fire to spread through the tree

[62] Produced by Photo Sciences, Inc.

crowns under "average worst conditions."[63] Trees in dense forests compete for water, and are more severely affected by drought and short-term hot, dry conditions than trees in an open forest. The reduction in available moisture and the increased competition for moisture makes the forest more vulnerable to fire, outbreaks of insects and disease, and climatic events such as drought.

Unlike the ecological condition of grasslands and riparian communities, forest conditions will not improve if left alone, they will only improve as a result of deliberate management actions (e.g., silvicultural treatments and prescribed fire) or as a result of unplanned natural events (e.g., fire, disease, insects, etc.).

TABLE 22

EXISTING FOREST STRUCTURE COMPARED WITH REFERENCE CONDITIONS.* TREE DIAMETERS AND CANOPY CLOSURE VARY BETWEEN FOREST TYPES

Forest Type	ED[1]	MDC[2]	MDO[3]	LDC[4]	LDO[5]
Spruce Fir – 8,207 Acres					
Existing condition (%)	0	91	9	0	0
Reference condition (%)	15	20	15	20	30
Departure (%)	-100	355	-40	-100	-100
Mixed Conifer – 37,102 Acres					
Existing condition (%)	0	94	5	<1	<1
Reference condition (%)	10	30	30	20	10
Departure (%)	-100	213	-83	-99	-99
Aspen – 6,755 Acres					
Existing condition (%)	0	97	2	0	1
Reference condition (%)	60	25	4	10	1
Departure (%)	-100	288	-50	-100	0
Ponderosa Pine – 2,588 Acres					
Existing condition (%)	0	75	25	0	0
Reference condition (%)	10	5	20	60	5
Departure (%)	-100	1400	25	-100	-100

* Reference condition is the composition of vegetation and disturbance that can sustain native ecological systems and reduce future hazards to native biodiversity; reference condition data are from Hann et al. (2005).

[1] Early development (seedlings <5 inches diameter)

[2] Mid development; closed (pole sized trees; closed canopy)

[3] Mid development; open (pole sized; trees open canopy)

[4] Late development; closed (mature trees; closed canopy)

[5] Late development; open (mature trees; open)

The Trust "...goals in the management of forests include reducing vulnerability to stand-replacing fires in many ponderosa pine and some mixed-conifer stands, restoration of natural fire regimes, aspen regeneration, and protection and restoration of old growth-stands.

[63] Average worst conditions are the average conditions that occur during the summer wildland fire season.

Eventually the trust hopes to harvest reasonable amounts of sawtimber on a sustainable basis and thereby to generate income" (Valles Caldera Trust 2003:102).

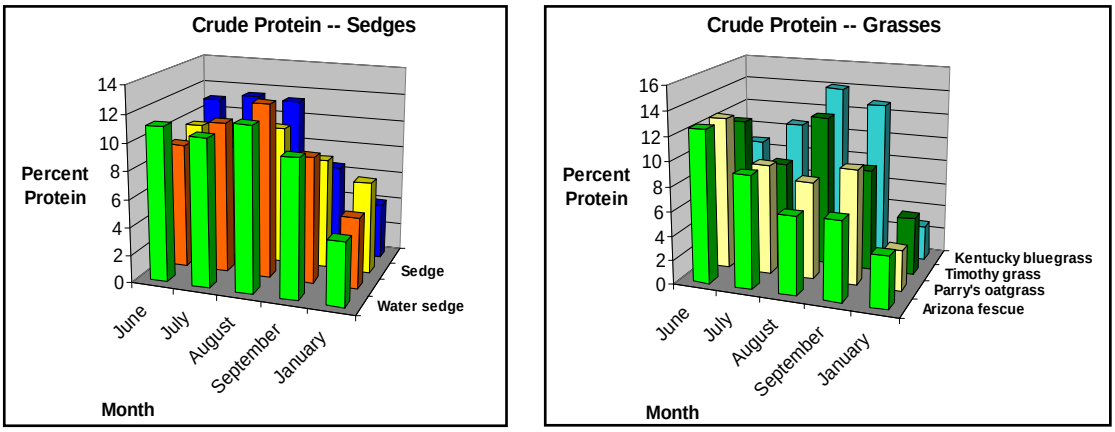
4.4 Grassland Condition

"The grasslands of the Valles Caldera are a valuable renewable resource that must be managed to maintain the health of the grasses to feed both cattle and wildlife populations on the preserve. Control and elimination of invasive weeds is also essential" (Valles Caldera Trust 2003:103).

Grassland condition on the Preserve is good – plant cover exceeds 98% in the valles. Summer forage production, while higher than most rangelands in New Mexico, is extremely variable depending on rainfall. Between 2002 and 2007, summer forage net production ranged from 814 to 2,246 pounds per acre. The nutritional value of different forage species is fair to good during the summer, but very poor in the winter (Figure 19). Elk require at least 4% dietary protein to maintain digestive physiology and will lose body weight unless diet quality is higher. When snowpack is low, elk remain on the Preserve and do not migrate to winter ranges at lower elevations. While forage quantity may be sufficient to support the elk herd, forage quality is not. As a result, elk selectively browse aspen and shrubs, and when browsing pressure is high, woody plant growth is reduced (Figure 20).

FIGURE 19

FORAGE QUALITY OF COMMON PLANT SPECIES



The extent of grazable pastures on the Preserve has changed over time. In the 1960s and 1970s, logging created large clear cuts, particularly at higher elevations (Figure 21). Once trees were removed, grasses and forbs began to colonize the exposed soils, creating open pasture where forests once stood. In the Rocky Mountains, clear cuts generally reach maximum forage production 6-10 years after logging. The clear cuts of the Preserve would have attained maximum productivity in the 1980s. Since that time, trees have re-established in the clear cuts reducing available forage. More than half of the upland pastures available in the 1980s have disappeared due to forest regeneration (Figure 21).

Approximately 10% of the plant taxa on the Preserve are non-native, invasive species. Some of these species provide good quality forage (e.g., Kentucky blue grass and dandelions); others are poor forage species (e.g., bull and Canada thistles). Control programs for the non-native thistles are underway. Trust programs will consider the potential introduction or spread of non-native species.

FIGURE 20

ELK IMPACTS ON ASPENS IN MIXED CONIFER FOREST IN BANDELIER NATIONAL MONUMENT ADJACENT TO THE VALLES CALDERA NATIONAL PRESERVE. ASPENS INSIDE THE FENCE (RIGHT) ARE PROTECTED FROM BROWSING ELK; ASPENS OUTSIDE THE FENCE (LEFT) ARE NOT. THIS AREA BURNED IN THE 2000 CERRO GRANDE FIRE; THE FENCE WAS ERECTED IN 2000

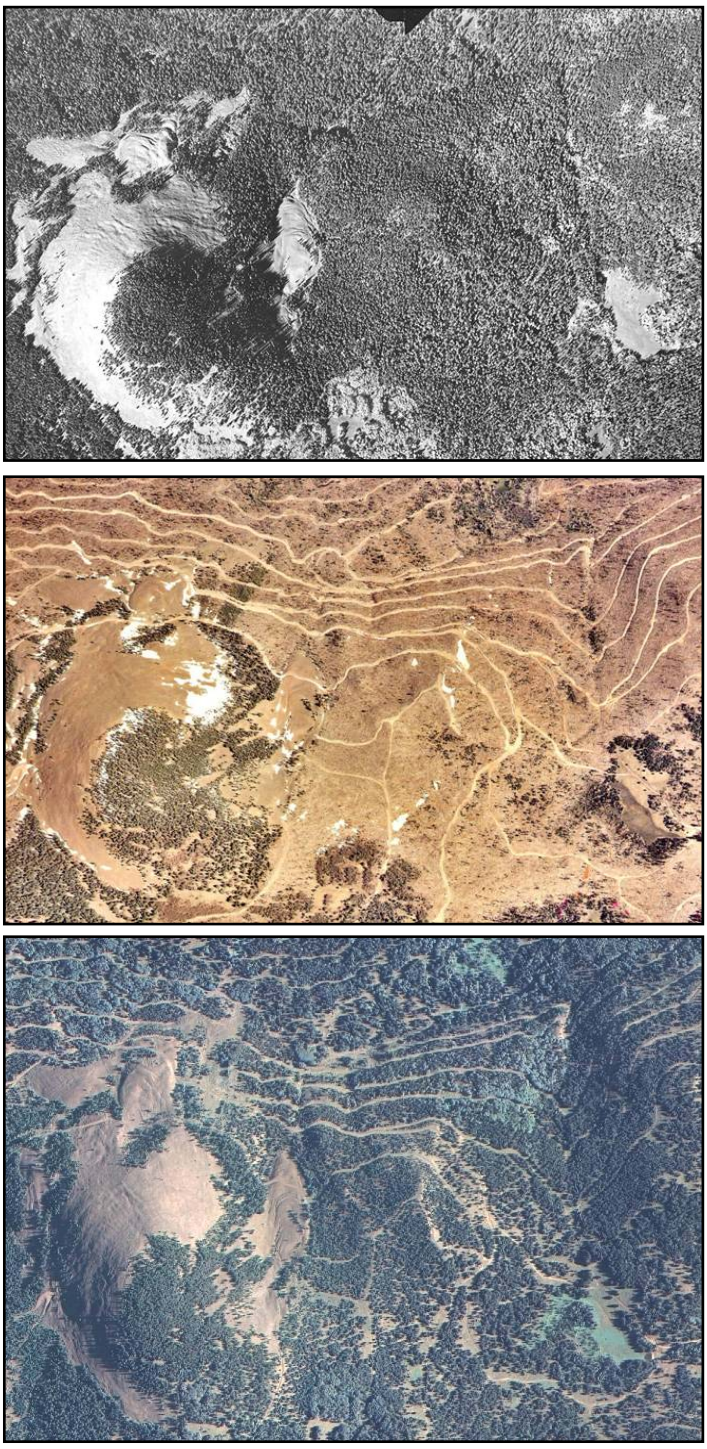
Riparian vegetation is an important forage source for livestock, elk and other wildlife species (e.g., rabbits, rodents, grasshoppers, etc.). Riparian plant cover is important for stream bank stabilization, stream shading and habitat for riparian species (e.g., muskrat and waterfowl), including the New Mexico endangered jumping mouse. Trust programs will consider impacts to vegetation to maintain riparian health and promote recovery of degraded areas.

4.5 Wildlife

Wildlife species and abundances in the Jemez Mountains have undergone substantial changes in the 20th century. Grizzly bears, wolves and elk were extirpated from New Mexico in the early 1900s. Elk were subsequently reintroduced to the Jemez Mountains after World War II, and the population expanded to over 7,000 animals by the late 1990s. The current elk population in the

FIGURE 21

REPEAT AERIAL PHOTOGRAPHS OF REDONDITO PEAK. TOP: PRIOR TO LOGGING IN 1963; MIDDLE: AFTER LOGGING IN 1975 (SHOWING TYPICAL JAMMER LOGGING ROAD SYSTEM); BOTTOM: NEAR-CLOSURE OF TREE CANOPY IN 2005



Jemez Mountains (4,440-6,400[64]) is probably the highest it has been for at least 3,000 years (Allen 2004) due to controlled hunting and lack of natural predators.

The high densities of elk impact the natural resources and Trust programs. A considerable amount of forage is required to support elk that occur on the Preserve. The summer 2006 monsoons resulted in a record production of forage (1,796 pounds per acre). With fewer than 200 head of cattle on the Preserve, forage use averaged 19% (40% use is the current maximum Trust goal[65]). Forage production was much lower in 2002 (915 pounds per acre). With about 700 head of cattle on the Preserve for 1.25 months, use was 31%, mostly due to the elk. In years of low to average precipitation, elk consume a large percentage of available forage, potentially limiting the stocking density of domestic livestock. Elk also have measurable impacts on browse plant species (aspen and shrubs) (see Figure 20 page 76) and riparian areas (vegetation and stream geomorphology) (Figure 22).

FIGURE 22

AERIAL VIEW OF ELK/LIVESTOCK EXCLOSURE ON THE RIO SAN ANTONIO. TALLER GRASSES AND SEDGES INSIDE THE FENCE (DARK BROWN AREA) ALLOW SNOW TO FALL BENEATH THE PLANT CANOPY

The Trust has monitored the population demographics of the elk herd on the Preserve for several years. In some years, reproduction appears to be lower than surrounding areas; calf:cow ratios (i.e., number of calves born relative to the number of adult cows) have been less than 20:100, while normal ratios are about 40:100. Body condition of the herd is excellent (based on organs taken from hunt killed elk each autumn). The cow elk population has a high percentage

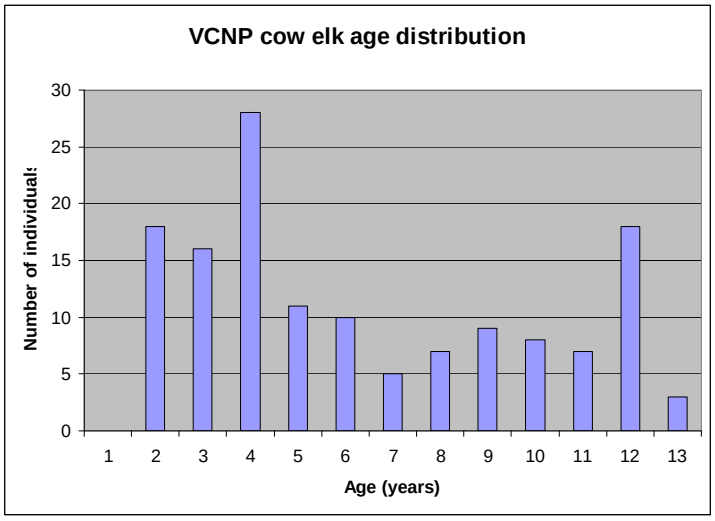
[64] New Mexico Department of Game and Fish estimate for Jemez Mountains (Game Management Units 6A, 6B, 6C and 7); available at: www.nmcpr.state.nm.us/nmac/parts/title19/19.031.0014.htm

[65] www.vallescaldera.gov/get_involved/stars/stars_saps.aspx

of older animals (based on teeth collected during the hunts) (Figure 23). Lower herd reproduction is due in part to the "elderly" age structure; female elk over 9 years of age have decreasing reproductive success (Table 23). Environmental factors (weather, condition of winter and summer range, predators) also influence elk reproduction. With better precipitation from 2005 to 2007, calf:cow ratios increased to 28:100 in 2006 and 43:100 in mid-2007. Predator studies of the elk herd indicate that coyotes take some calves, but overall predation rates are low. Climate, habitat condition and population age structure appear to be the major factors that regulate elk numbers in the Preserve.

FIGURE 23

AGE DISTRIBUTION OF HUNT-KILLED COW ELK



The Trust goals for wildlife management[66] are "...to determine and then attain population levels of elk that do not impair the natural communities of the preserve... and maintaining and enhancing the natural biodiversity of the preserve and improving the vigor of wildlife populations, such as mule deer, that have declined below long-term historical levels" (Valles Caldera Trust 2003:104).

TABLE 23

REPRODUCTIVE SUCCESS OF COW ELK. BASED ON THE PRESENCE OF CORPUS LUTEUM IN OVARIES

Age Group (years)	Sample Size	Percent Pregnant	Percent with Corpus Luteum
1-4	12	42	92
5-8	19	42	90
9-12	8	63	88
13+	9	22	56

[66] The elk population in the Jemez Mountains is managed by the New Mexico Department of Game and Fish; the Trust cooperates with the department in setting hunt quotas and defining hunt programs on the Preserve.

The Rio Grande cutthroat trout was extirpated from the Jemez Mountains and replaced by introduced brown trout and rainbow trout. The Preserve is potential habitat for the reintroduction of the Rio Grande cutthroat trout. Two other non-game wildlife species found in the Jemez Mountains are classified by New Mexico as endangered – the Jemez Mountains salamander and the meadow jumping mouse. The Jemez Mountains salamander occurs on the Preserve; the meadow jumping mouse has not been found, although there is extensive potential habitat. Other significant and protected species inhabiting the Preserve include the goshawk and bald eagle; spotted owls occur nearby, but surveys have not found them on the Preserve.

4.6 Cultural Resources

In its programs, activities and management actions, the Trust seeks to avoid adverse effects to cultural resources on the Preserve. The cumulative effects of road building, logging, geothermal development, infrastructure development and livestock and elk grazing have impacted archaeological resources. Because most archaeological resources are soil deposits that contain the remnants of prehistoric cultural activities, their condition is correlated with the recovery of vegetation communities, stream health and reduced erosion. Actions by the Trust that improve these values will maintain and enhance the condition of intact prehistoric cultural deposits.

Other cultural resources include historic buildings; historic remnants of mills, homesteads, logging towns and camps; and ranching activities. The value of the historic resources is enriched by their cultural contexts. Information can be gathered from archives, photographs and oral histories and stories. For example, Jemez Pueblo has expressed a interest in including their history and use of the caldera in Trust interpretive programs. Understanding the past increases as the inventory grows. Over the next several years, the Trust will synthesize past human uses of the Preserve with patterns of resource use and landscape modification, and place the role of the Preserve in the historic and prehistoric patterns in the region and North America.

The Trust goals for cultural resource management are "...maintaining constructive consultation with tribes that are culturally affiliated with the preserve...to ensure protection of culturally significant sites and to provide the tribes with appropriate access to them. The trust will strive to protect the preserve's archaeology in compliance with the National Historic Preservation Act; to launch, in partnership with appropriate research institutions, a vigorous program of archaeological research; and to channel the understandings thus attained into the preserve's interpretive and educational programs. Additional goals...include protective maintenance and, in some cases, the renovation of historic structures and the development of a strong interpretive program in the cultural history of the caldera" (Valles Caldera Trust 2003:105).

4.7 Sensory Resources

Sensory resources have a direct relationship with the natural and cultural resources of the Preserve. They are the values and significance of personal experience realized through vision, sound, touch, smell, taste and feelings about a particular landscape or setting. It is the human senses that solidify the memories of life-changing and emotionally stirring events and

experiences. The real value of the experience becomes significant in post-experience recollection. Interpretation plays an importance role with sensory resources – the promotion and awareness of the resource message, the natural and built setting for the promotion and awareness of these resources to visitors, and how the messages about these resources are conveyed to the visitors (Valles Caldera National Preserve 2005). Most visitors comment on the visual quality and soundscape of the Preserve and consistently identify scenery and natural quiet as values to be protected (Valles Caldera Trust 2003). As the Trust moves into planning for public access and use, attention will be focused on how visitation levels, programs and infrastructure affect the sensory resources of visitors.

The Valles Caldera sits atop the Jemez Mountain in north central New Mexico. The Jemez Mountains are surrounded by a high desert of sagebrush, rabbit brush, juniper and piñon pine. This high desert landscape is dominated by brown dry earth with scattered patches of green vegetation, leveled mesas and the dramatic canyons of the Rio Grande. The Jemez Mountains rise out of this dry brown landscape to over 11,000 feet at Redondo Peak. As the elevation increases, the vegetation changes to ponderosa pine, mixed conifers, aspen and spruce-fir forests. The mountains are a different visual experience than the dry brown landscape below. The valles of the Preserve are extensive, naturally irrigated meadows and lush grasslands framed by soft rolling hills covered with evergreens creating a unique, visually attractive landscape.

This landscape also incorporates the human footprint. Historically this is a working landscape; it experienced resource extraction and ranching activities that resulted in unnatural visual elements that are now part of this place. Arrow straight fence lines extend across the grasslands, cabins huddled along the edges of evergreen forests and grasslands create subtle foci. Stock tanks dot the landscape and flattened, well-drilling pads sit on canyon slopes.

Since federal acquisition, temporary structures (two Morgan buildings and several port-a-potties and small out buildings) and parking lots have impacted the view in the Valle Grande. The first Valle Grande Staging Area was located in the La Jara (upper) parking lot, which is not visible from Highway 4 or most viewpoints within the Preserve. Signs were used on the entrance road (VC01) to direct visitors to the parking area. However, the signs were ineffective and most visitors continued driving into the Preserve. To control access and improve security, the visitor staging buildings and parking area was moved to the present location at the corrals, which is visible from Highway 4. While logistically favorable, the location of this temporary facility detracts from the scenic values of the Valle Grande and the Trust will consider relocating it in the future.

5 State of the Preserve Synthesis

5.1 Reference Conditions

In the Valles Caldera Preservation Act of 2000,[67] Congress found that "...selective timbering, limited grazing...have preserved a mix of healthy range and timber land, with significant species diversity, thereby serving as a model for sustainable land development and use." The Act also lists six goals for the comprehensive management of the Preserve. Goal six emphasizes "...optimizing the generation of income based on existing market conditions, to the extent that it does not unreasonably diminish the long-term scenic and natural values of the area, or the multiple use and sustained yield capability of the land."[68]

From these statements, one can conclude that, at the time of acquisition, the ecological condition of the Preserve was assumed to be in a reference condition. However, after completing quantitative analyses of the ecological conditions of watersheds and forests affected by past and present actions, the Trust finds that the current condition of the Preserve departs from the reference condition described in the Act.

Compared to pre-acquisition periods with extreme levels of grazing and logging, the Preserve is in excellent condition. However, assuming that the baseline for comparison is the reference condition,[69] 90% of the Preserve departs moderately, and multiple use and sustained yield capacity of the land are diminished. The current condition influences the potential and realized uses of the Preserve. The Valles Caldera Preservation Act did not set restoration of Preserve communities as a goal. If restoration is a goal, then adequate funding will be required.

5.2 Regional Context

Many of the issues the Preserve must consider in moving from interim to long-term planning and programs are regional in context. These include development for public access and use, management of the Jemez Mountains elk population, grazing by domestic livestock and forest and fire management.

5.2.1 Public Use and Access

The scale and location of programs and infrastructure for public access and use of the Preserve for recreation, education, scientific and other purposes must occur in a regional context. Development on the Preserve could enhance and support the goals and activities in the surrounding communities and landscapes through the appropriate scale and type of development. The Preserve could seek to complement existing uses and transportation and provide opportunities that do not exist today.

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[67] Public Law 106-248 § 102(a)(5); 16 USC 698v.
[68] Public Law 106-248 § 108(d)(6); 16 USC 698v-6.
[69] Reference condition is the composition of vegetation and disturbance attributes that can sustain native ecological systems and reduce future hazards to native biodiversity (Hann et al. 2005).

5.2.2 Elk

Elk, which are managed by New Mexico Department of Game and Fish, affect the lands and people of the Jemez Mountains creating beneficial and detrimental outcomes. The Preserve is often the focus of controversy because the elk herd prominently uses the valles during summer. However, the winter range (off the Preserve), regional hunting, livestock grazing and regional populations of predators and mule deer must be considered in the management of elk and their habitats. The elk population is currently at a historic, and possibly prehistoric, high level. Elk activities (grazing, browsing, trampling) have measurable impacts on Preserve resources, and interact with Trust programs (livestock grazing, forestry, hunting and recreation) in positive and negative ways.

5.2.3 Livestock Grazing

Since 2002, domestic livestock programs implemented by the Trust have reduced cattle stocking rates by approximately 90% over historic grazing levels. Interim stocking levels have met forage use goals and have allowed streams to begin recovering from the impacts of 20th century overgrazing. Future stocking rate determinations will incorporate these findings and integrate grazing pressure from elk (and other herbivores) with sound business practices. The Preserve has not benefited local producers since the *partido* period. Even then, grazing provided only a subsistence income with the greatest benefits going to the landowners. Since federal acquisition, programs that have benefited local producers have not been economically sustainable. While the Trust cannot provide grazing to all the producers who desire it, an equitable distribution of grazing opportunities that support the goals of the Trust and benefit local communities is desirable. Indirect benefits could also be provided from education and research.

5.2.4 Forest Management

Commercial timber harvesting was one of the major revenue-generating sources envisioned for the Preserve. However, extensive logging in the 20th century nearly eliminated commercially viable forests, replacing them with dense, small-diameter stands. Current forest conditions are unlikely to support profitable commercial logging for many years. Forest restoration to reduce fire hazards and improve wildlife habitats and watershed health will be a costly undertaking in the coming decades. The condition of Preserve forests replicates issues facing surrounding National Forest System lands. Solutions could lie in increasing the capacity of local communities and developing uses and markets for small diameter wood products. The issues of water quantity and quality, and wildland fire management defy administrative boundaries and must be considered in a regional context.

5.3 Climate Change and Sustainability

Changes in regional and global climate are virtually assured in the coming decades. Most forecasts for the southern Rocky Mountains predict increasing temperatures and concomitant loss of winter snowpack. Changes in precipitation patterns are more difficult to predict, but warmer temperatures will certainly increase evaporation and plant transpiration demands. A

warming climate will favor lower-elevation plant and animal species, potentially resulting in shifts in dominant trees and grasses on the Preserve. Invasive plant and animal pest species, already common on the Preserve, may take advantage of the changing ecosystem conditions and expand their distributions and abundances. Climatic trends are also likely to affect the use of fire as well as the frequency and intensity of wildfires in the region.

Ecological and economic sustainability of the Preserve are dynamic goals that reflect global climate changes. The Trust with its focus on adaptive management can retain flexibility in its land management decisions. Adaptive management can be used to intercept trends and make adjustments. New facilities and infrastructure will consider energy saving designs. Programs that support and use mass transit can reduce carbon output from Preserve activities.

5.4 Meeting the Goals of the Valles Caldera Preservation Act

The Valles Caldera Preservation Act contains the goals that direct the Trust efforts. These goals are challenging; they are realistic and achievable and will continue to guide the Trust as it moves from interim to long-term management of the Preserve. The Act identified three key benchmarks to measure Trust performance – public access, development of a comprehensive management program and financial self-sufficiency.

5.4.1. Public Access

The Act required the Trust to provide reasonable access to the Preserve within 2 years of acquisition. In the 2001 "listening sessions" held by the Trust in communities surrounding the Preserve, "...many people spoke of having looked over the fence of the Baca Ranch for years, wishing they could enter the Valle Grande to hunt, camp, hike, and engage in the range of activities that this extraordinary place can offer" (Valles Caldera Trust 2003:106). The goal of increasing public access has been met with a variety of interim programs for recreation, education, scientific research, cultural and personal uses and commercial uses, such as livestock grazing, artist workshops, instructional clinics, agency meetings, weddings and filming. Pre-acquisition visitation levels have increased from about 200-300 visitors per year to over 12,000 visitors in 2007. The number of visitors will undoubtedly increase in the future as the Trust completes the public access and use management plan, and as the demands of a growing population for outdoor recreation increase and as leisure time expands.

5.4.2. Comprehensive Management Program

The Act directs the Trust to "...develop a comprehensive program for the management of lands, resources, and facilities within the Preserve..." within 2 years of assuming management. The procedures for comprehensive management were published in the Federal Register in 2003 and meet the requirements of the National Environmental Policy Act of 1969 as amended. "The comprehensive management of the lands, resources, and facilities of the Preserve includes all stewardship registers, the State of the Preserve, and the strategic guidance adopted by the Board of Trustees."[70]

[70] National Environmental Policy Act Procedures for the Valles Caldera Trust 2003

With the completion of the first *State of the Preserve*, the three components of comprehensive management are in place. Stewardship registers and strategic guidance of the Board of Trustees (recorded in minutes of the public meetings) can be found on the Trust's Web site.[71] The comprehensive management program will be guided for the next decade by the forage use, public access and use, and forest and fire management plans.

According to the Valles Caldera Preservation Act,[72] the Trust's management "...program shall provide for—

(1) operation of the Preserve as a working ranch, consistent with paragraphs (2) through (4);

(2) the protection and preservation of the scientific, scenic, geologic, watershed, fish, wildlife, historic, cultural and recreational values of the Preserve;

(3) multiple use and sustained yield of renewable resources within the Preserve;

(4) public use of and access to the Preserve for recreation;

(5) renewable resource utilization and management alternatives that, to the extent practicable—

(A) benefit local communities and small businesses;

(B) enhance coordination of management objectives with those on surrounding National Forest System land; and

(C) provide cost savings to the Trust through the exchange of services, including but not limited to labor and maintenance of facilities, for resources or services provided by the Trust; and

(6) optimizing the generation of income based on existing market conditions, to the extent that it does not unreasonably diminish the long-term scenic and natural values of the area, or the multiple use and sustained yield capability of the land."

5.4.2.1. Operation of the Preserve as a Working Ranch. The *Framework and Strategic Guidance for Comprehensive Management* (Valles Caldera Trust 2003:57) defined working ranch as "...an operation placing its primary emphasis on stewardship of the resource as the foundation for both ecological and economic sustainability. A working ranch

- Runs a sustainable level of livestock, adjusting numbers as necessary;
- Makes resources available for other revenue-generating activities such as bird watching, hunting, fishing, and other low-impact recreational activities;
- Applies adaptive management on a day-to-day basis to ensure resource protection; and
- Monitors the impact of its activities."

[71] www.vallescaldera.gov

[72] Public Law 106-248 § 108(d); 16 USC 698v–6.

Since 2002, the Trust has operated the Preserve as a working ranch managing an ecologically (but not economically) sustainable number of livestock and making resources available for other programs, including hunting, fishing and various public recreation and education programs. The Trust developed monitoring programs that provide data for adaptively managing forage and other resources. For example, the 2006 commercial livestock program was cancelled after the spring range assessment revealed that forage biomass was insufficient to sustain the 1,500 steers that the Trust had set as a target in fall 2005.

The livestock programs have met the sustainable use and other goals of the Valles Caldera Preservation Act (2000), including aiding local communities (e.g., grassbank and replacement heifer livestock programs), increased the scientific knowledge of Preserve resources (e.g., forage monitoring and range assessments, Valle Toledo prescribed burn) and improved the ecological values for which the Preserve was established (e.g., improvements in watershed condition due to a reduction in grazing pressure by domestic livestock).

5.4.2.2. Protect and preserve the scientific, scenic, geologic, watershed, fish, wildlife, historic, cultural and recreational values. The Trust has worked vigorously to develop inventory and monitoring programs for natural and cultural resources, and to attract research scientists, to describe their attributes. Inventories have determined the presence and distribution of soils, geologic formations, water resources, plant and animal populations, archaeological resources and historic resources. Future inventories will include systematic data collection on the characteristics of visitors to the Preserve.

The Trust developed monitoring programs to measure temporal changes in resources in response to changing operations and management decisions (e.g., recreation, hunting, fishing, forest thinning, fire management, livestock grazing), and to assess the effects of natural variability in weather and climate (e.g., water quantity and quality, rangeland, forest and watershed condition).

Each year, the Preserve has attracted over a million dollars of extramurally funded research by academic institutions and other agencies. Data collected in these programs are used, and will be used in the future, to assess the impacts of management actions, the interactions among the actions and the cumulative effects of all actions in environmental documents to ensure that the values recognized in the Act are protected.

The Trust consults with the affiliated Pueblos and Tribes on management actions and programs that take place on the Preserve, and is working to finalize a programmatic agreement on management of cultural resources with the New Mexico State Historic Preservation Office and the Advisory Council on Historic Preservation. The Trust met with the public in meetings in 2001, 2003 and 2007 to hear their views on management of the Preserve and public access and use. The Board of Trustees met in public 45 times between January 23, 2001 and December 11, 2007 to make decisions about managing the Preserve and take comments from the public.

5.4.2.3. Multiple use and sustained yield of renewable resources. The Trust has successfully managed domestic livestock grazing programs, albeit at a cumulative financial loss.

The livestock programs have met the sustainable use and other goals of the Valles Caldera Preservation Act, increased the scientific knowledge of Preserve resources (e.g., forage monitoring and range assessments, Valle Toledo prescribed burn) and enhanced the ecological values for which the Preserve was established (e.g., improvements in watershed condition due to a reduction in grazing pressure by domestic livestock).

In 2007, the Trust proposed a stewardship action to allocate forage to support elk and other herbivores; to preserve and protect ecosystem processes and habitats; to support domestic livestock grazing and other commercial purposes; and to support scientific, education and other public uses. The Trust will also consider other commercial uses of forage, including harvesting native seeds and plants. The new environmental analysis and forage management plan will be completed in 2008.

The Trust is working toward sustainable use of timber resources. Preserve forests are dominated by second growth, pole-sized trees of limited economic value. The challenge for the Trust is to reduce the vulnerability of the forests to stand replacing fires, and to restore natural fire regimes and forest health. The Trust has collected the data on forest structure and fire history that is necessary for a forest and fire management plan. Data collection (stand exams) will be completed in early 2008 and the management planning process will begin thereafter.

5.4.2.4. Public use of and access for recreation. The number of visitors to the Preserve increased from about 200-300 people per year when the ranch was in private hands to over 12,000 people in 2007. Since 2002, the Trust has managed public programs for recreation, education and other purposes using existing infrastructure and temporary buildings. The programs fall into three overlapping categories: recreation, special uses (research, commercial and cultural) and education.

In the summer of 2007, the Trust held four public meetings to gather information on public access and use of the Preserve. The information will be used to develop alternatives that address visitor capacity, infrastructure development (facilities, roads, utilities, etc.) and the types of programs offered. The Trust is ready to begin an access and use management plan that addresses visitation, programs and infrastructure for the next decade. Concomitant with the development of the access and use management plan, the Trust will develop a business plan that analyses market options for programs, activities and infrastructure.

5.4.2.5. Renewable resource utilization and management alternatives that benefit local communities, enhance coordination with surrounding National Forest System land and provide a cost saving to the Trust. The Trust has worked with local communities and neighbors on a number of management programs. From 2002 through 2005, livestock programs offered drought relief (e.g., grassbank) and additional grazing opportunities to between 28 and 42 local ranchers with grazing allotments on surrounding national forests (see Table 18a page 51). The Trust worked cooperatively with the Walatowa Woodlands Initiative at Jemez Pueblo and the Nature Conservancy to obtain grants to thin forests and reduce wildfire risks and produce products that could generate revenue. The Trust has a

cooperative agreement with the Parajito Environmental Education Center of Los Alamos to provide training to teachers and learning opportunities to students about Preserve resources. The Trust has provided free and low cost education opportunities to teachers and students at Pueblos and schools in northern New Mexico. The Trust has worked cooperatively with the Santa Fe National Forest and Bandelier National Monument to establish vegetation-monitoring plots across the Jemez Mountains to obtain a better understanding of forage dynamics and herbivore impacts in a system of complex jurisdictions. The Trust has also worked with local businesses to provide visitor and other services.

5.4.2.6. Optimize the generation of income to the extent that it does not unreasonably diminish the long-term scenic and natural values, or the multiple use and sustained yield capability. The Trust has yet to optimize the generation of income from its programs. Revenues are about 20% of current appropriations, the best estimate of operational costs. Revenues from public recreation programs equal about 75% of program operating costs. Clearly the Trust has to increase the efficiency of existing revenue generating programs, offer additional recreation opportunities to the public and find ways to cover the costs of non-revenue generating programs (e.g., complying with "...all laws pertaining to the National Forest System, except the Forest and Rangeland Renewable Resources Planning Act of 1974..."[73]). In 2008, the Trust will develop a business plan that analyzes market options for programs, activities and infrastructure to address the mandate in the Valles Caldera Preservation Act of 2000 to become financially self-sustaining by 2015.[74]

5.4.3 Financial Self-Sufficiency

In the Valles Caldera Preservation Act, Congress found that the "...Baca ranch can be protected for current and future generations by continued operation as a working ranch under a unique management regime which would protect the land and resource values of the property and surrounding ecosystem while, allowing and providing for the ranch to eventually become financially self-sustaining..." Congress defined financially self-sustaining as "...management and operating expenditures equal to or less than proceeds derived from fees and other receipts for resource use and development and interest on invested funds."

The Act stipulated that "Within two years after the first meeting of the Board, the Trust shall submit to Congress a plan which includes a schedule of annual decreasing appropriated funds that will achieve, at a minimum, the financially self-sustained operation of the Trust within 15 full fiscal years after the date of acquisition..." The Board submitted the plan to Congress in November 2003[75] that contained a three-phase strategy:

1) Institution building (2001-2005) – Hire staff, establish management controls and financial system and develop science-based adaptive management. Produce business plans for infrastructure and public programs with public input.

[73] Public Law 106-248 § 108(f)(1); 16 USC 698v–6.
[74] Public Law 106-248 § 111(b); 16 USC 698v–9.
[75] Appendix B: "2000-15 Plan for Decreasing Appropriations" in Valles Caldera Trust (2003)

2) Infrastructure development (2005-2010) – Develop infrastructure to support land stewardship, public access and revenue generation, including road and trail system, visitor facility, administrative/science facility and interpretive plan for Highway 4. Develop permanent recreation and public access programs.
3) Program refinement (2010-2015) – Develop alternative sources of funds and streamline Preserve programs to permit decreasing appropriations. Implement business plans developed in earlier phases, streamline business operations and develop infrastructure to support revenue-generating programs.

The plan for decreasing appropriations called "...for receiving appropriations to fund operations and to develop the infrastructure necessary to support a variety of revenue-generating public programs. This model should allow gradual achievement of financial self-sufficiency, assuming infrastructure can be developed fast enough for programs to grow and substantial annual revenues to be realized..." (Valles Caldera Trust 2003:55).

The Act envisioned that the Trust would receive revenues from four sources: fees from public access and use, sustainable use of renewable resources (e.g., forage and timber), donations and interest earned on revenues deposited at U.S. Treasury. In addition, the Trust receives services that offset operational costs from grants (e.g., forest thinning), extramurally funded research projects (provide information for science-based adaptive management) and volunteers working on many programs and activities.

Fees charged for public access and use have dominated revenues thus far. Sustainable use of renewable resources has generated little revenue. The grazing program broke even in 2007 for the first time since 2002. Timber resources are likely to generate revenues (use of small diameter trees for poles, vigas, latillas, mulch and pellets for wood stoves), but not for several years in the future. Direct donations to the Trust have totaled less than $75,000. Los Amigos de Valles Caldera, a 501(c)(3), was established in 2007 to raise funds through donations and grants for Preserve management and to provide volunteers to offset labor costs.[76] Extramural research has significantly increased knowledge of Preserve resources and provided important data for management plans and decisions. Except for overhead costs, the $7 million expended on research between 2001 and 2007 does not contribute directly to Trust receipts. Volunteers have reduced the operating costs of Preserve programs, especially hunting and other recreation programs. The sale of merchandise related to the Preserve (e.g., hats, sweatshirts, tee-shirts, maps, books, etc.) has increased as the product line has expanded; the Trust now operates two small gift shops at the visitor contact sites – Valle Grande staging area and the office in Jemez Springs.

From fiscal year 2003 through 2007, the Trust received $16.9 million in appropriations (net of rescissions), $2.3 million in federal highways funds and $1.5 million in special appropriations for planning and infrastructure. Revenues during that period totaled $3.35 million. Using

[76] In 2007, Los Amigos de Valles Caldera received a three-year grant for $143,000 from the New Mexico Environment Department for wetland restoration on the Preserve.

current annual appropriations ($3.5 million) as an estimate of operating expenses, revenues have averaged about 20% of appropriations. The Congressional goals as set for the in the Valles Caldera Preservation Act of 2000 – operation of the Preserve as a working ranch, protection and preservation of the values of the Preserve, public use and access to the Preserve for recreation at a reasonable cost, and compliance with environmental and other laws, coupled with the mandate of financial self-sufficiency by 2015 – will continue to challenge not only the Trust, but also the stakeholders engaged in this experiment.

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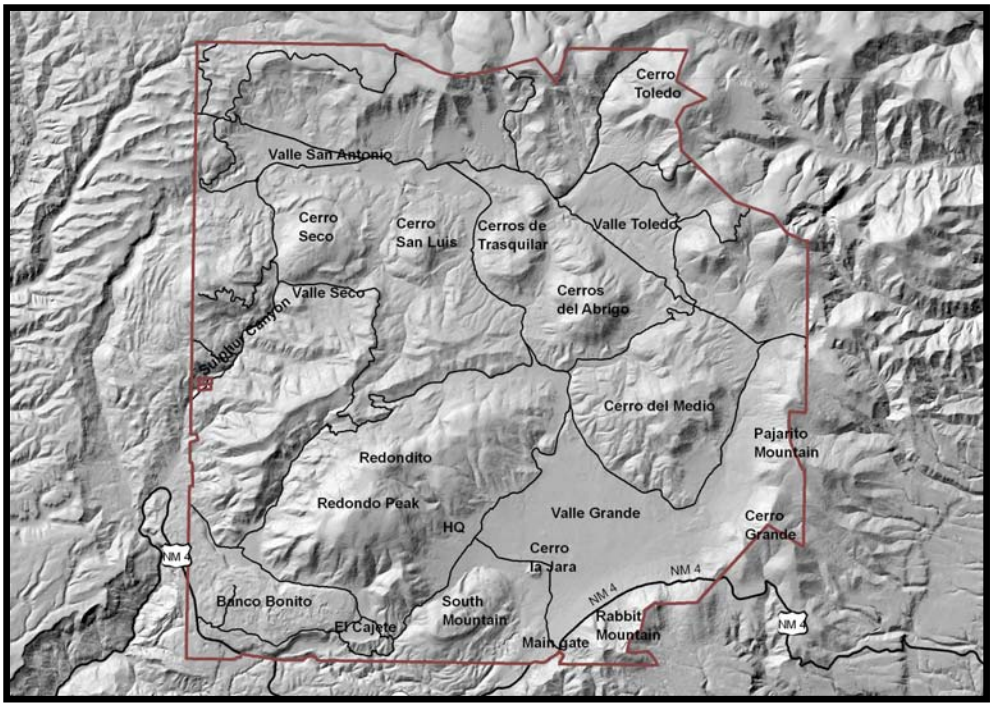
7 Appendices

7.1 Spanish Place Names



Cerro = hill or dome; Valle = valley			
Place name	**Elev. (ft)**	**Landform**	**Notes on the Spanish-English translation**
Redondo Peak	11,254	mountain	Redondo = round
Cerro del Medio	9,848	mountain	del Medio = in the middle, central
Cerro la Jara	8,745	mountain	la Jara = willow (may also mean jar/bowl)
Banco Bonito	8,610	mountain	Banco = bench; bonito =pretty, beautiful
South Mountain	9,795	mountain	also known as Willow Mountain
Valle San Antonio	8,500	valley	San Antonio Valley
Valle Toledo	8,600	valley	Toledo = family name
Redondo Meadows	8,070	valley	Redondo = round
Rincon de los Soldados	8,650	valley	Canyon/Corner of the Soldiers
Cerros del Abrigo	10,332	mountain	Abrigo = raincoat/shelter
Obsidian Valley	8,800	valley	(this is a recent name, after 2000)
Cerros de Trasquilar	9,701	mountain	Trasquilar = sheep shearing
Cerros de los Posos	10,049	mountain	Posos = pot, hole, pit
Cerro Grande	10,170	mountain	Grande = large
Pajarito Mountain	10,441	mountain	Pajarito = small bird, titmouse, bluebird
Cerro Seco	9,931	mountain	Seco = dry
Valle Grande	8,520	valley	Grande = large
Cerro Toledo	10,800	mountain	Toledo = family name
Redondito	10,898	mountain	Little Redondo
Valle Seco	8,800	valley	Seco = dry
El Cajete	8,670	valley	Cajete = large pot/tub, internally drained valley
Valle de los Posos	8,960	valley	Posos = pot, hole, pit
Valle Jaramillo	8,772	valley	Jaramillo = family name

7.2 Extramural Research Projects and Grants, 2001-2007

PROJECT TITLE	RESEARCH GROUP	VALUE
2001		
Inventory of Water Quality Assessment	NM Environment Department	$281,000
A study of elk migration in the Jemez Mountains	USGS, Los Alamos National Laboratory, Texas Tech Univ.	$300,000
Inventory of fishery and stream habitats on the Valles Caldera National Preserve	U.S. Forest Service	$15,000
Fishery inventory of Rio San Antonio and East Fork Jemez River	NM Environment Department	$10,000
Inventory of potential whirling disease in trout on the Valles Caldera National Preserve	NM Department of Game and Fish	$5,000
Inventory of bats of the Valles Caldera National Preserve	U.S. Geological Survey, University of New Mexico	$8,000
Inventory of butterflies of the Valles Caldera National Preserve	University of Wisconsin, Eau Claire	$5,000
Inventory of populations of the Jemez Mountain salamander	NM Department of Game and Fish, NM State University	$3,000
Breeding Bird Atlas of the Valles Caldera National Preserve	S. Fettig and volunteers	$1,500
Inventory of lizard species on the Valles Caldera National Preserve	Los Alamos National Laboratory	$5,000
Ecosystem survey and condition assessment of the Valles Caldera National Preserve	University of New Mexico, The Nature Conservancy	$15,000
Vegetation and fuels mapping of the Valles Caldera National Preserve	University of Arizona	$10,000
Assessment of environmental controls on tree invasion in the valles of the Valles Caldera National Preserve	University of Wisconsin, Madison	$15,000
Paleoecology and fire history in the Valles Caldera National Preserve	Northern Arizona University	$5,000
Inventory of plant species in the Valles Caldera National Preserve	University of Wyoming, Bandelier National Monument	$15,000
Monitoring of range utilization by elk and livestock on the Valles Caldera National Preserve	USDA ARS Jornada Experimental Range	$15,000
Historical ranch management of the Valles Caldera National Preserve	National Resources Conservation Service	$1,000
Range assessment and weed control	Bureau of Land Management, U.S. Geological Survey	$2,000
Inventory and assessment of forest insect pests and tree health status	U.S. Forest Service	$1,500
Assessment of forest fuels and condition in Jemez Mountains	DOE, Los Alamos National Laboratory	$12,000
Inventory and assessment of riparian conditions on the Valles Caldera National Preserve	BLM, National Riparian Service Team	$15,000
Establishment of interim rain gauge network on the Valles Caldera National Preserve	U.S. Geological Survey, Colorado State University	$3,000
Vegetation change assessment on the Valles Caldera National Preserve using repeat photographs	U.S. Geological Survey	$1,000
Development of initial data layers for the Geographical Information System of the VCNP	Bandelier National Monument	$15,000
Initial oversight and coordination of research, inventory and monitoring on the Valles Caldera National Preserve	U.S. Geological Survey	$20,000
Administration and contracting support for science programs on the Valles Caldera National Preserve	U.S. Geological Survey	$53,000
Assessment of road-related watershed conditions on	U.S. Forest Service	$5,000

PROJECT TITLE	RESEARCH GROUP	VALUE
the Valles Caldera National Preserve		
Forest assessment on the Valles Caldera National Preserve	USFS, USGS, U. AZ, U. NM, Wildlife Society, volunteers	$5,000
2001 Total Projects: 28	**2001 Total Groups: 22**	**2001 Total: $842,000**
2002		
Breeding Bird Atlas of the Valles Caldera National Preserve	S. Fettig and volunteers	$10,000
Soils mapping and Terrestrial Ecosystem Survey of the Valles Caldera National Preserve	U.S. Forest Service	$25,000
Soils map (Level-2) inventory of the Valles Caldera National Preserve (50% cost-share with VCT)	National Resources Conservation Service	$30,000
Monitoring of range utilization by elk and livestock on the Valles Caldera National Preserve	USDA ARS Jornada Experimental Range	$15,000
Inventory and assessment of forest insect pests and tree health status	U.S. Forest Service	$1,500
Inventory of elk populations via aerial survey of the Valles Caldera National Preserve	NM Department of Game and Fish	$10,000
Range assessment and weed control	Bureau of Land Management, U.S. Geological Survey	$2,000
Inventory of Water Quality Assessment (continued from 2001)	NM Environment Department	$30,000
Inventory of plant species in the Valles Caldera National Preserve	University of Wyoming, Bandelier National Monument	$15,000
Operation of rain gauge network on the Valles Caldera National Preserve	U.S. Geological Survey	$3,000
Inventory of prairie dog colonies on the Valles Caldera National Preserve	U.S. Geological Survey	$5,000
Assessment of fire frequencies based on tree fire scar sampling on the Valles Caldera National Preserve	U.S. Geological Survey	$3,000
Assessment of environmental controls on tree invasion in the valles of the Valles Caldera National Preserve	University of Wisconsin, Madison	$15,000
Assessment of forest fuels and condition in Jemez Mountains	DOE, Los Alamos National Laboratory	$12,000
Inventory of populations of the Jemez Mountain salamander	NM Department of Game and Fish, NM State University	$3,000
2002 Total Projects: 15	**2002 Total Groups: 12**	**2002 Total: $179,500**
2003		
Breeding Bird Atlas of the Valles Caldera National Preserve	S. Fettig and volunteers	$10,000
Soils mapping and Terrestrial Ecosystem Survey of the Valles Caldera National Preserve	U.S. Forest Service	$25,000
Soils map (Level-2) inventory of the Valles Caldera National Preserve (50% cost-share with VCT)	National Resources Conservation Service	$30,000
Monitoring of range utilization by elk and livestock on the Valles Caldera National Preserve	USDA ARS Jornada Experimental Range	$15,000
Inventory and assessment of forest insect pests and tree health status	U.S. Forest Service	$1,500
Assessment of environmental controls on tree invasion in the valles of the Valles Caldera National Preserve	University of Wisconsin, Madison	$15,000
Sustainability of Semi-arid Hydrology and Riparian Areas (SAHRA) – planning operations	National Science Foundation, Univ. Arizona, Los Alamos National Laboratory	$10,000
Geologic mapping and related topics of the Valles Caldera National Preserve	DOE, Los Alamos National Laboratory	$60,000

PROJECT TITLE	RESEARCH GROUP	VALUE
Historic roads mapping on the Valles Caldera National Preserve	D. Hoard and volunteers	$2,000
Historic telegraph/telephone line survey and map of the Valles Caldera National Preserve	J. O'Rourke and volunteers	$2,000
Inventory of plant species in the Valles Caldera National Preserve	University of Wyoming, Bandelier National Monument	$15,000
Climate change and vegetation dynamics over the last 50,000 years (earth-coring project) on the VCNP	DOE, Los Alamos National Laboratory	$35,000
Operation of rain gauge network on the Valles Caldera National Preserve	U.S. Geological Survey	$3,000
2003 Total Projects: 13	**2003 Total Groups: 10**	**2003 Total: $223,500**
2004		
Ecological drivers of rodent-borne disease outbreaks.	National Science Foundation, National Institutes of Health	$429,250
Breeding Bird Atlas of the Valles Caldera National Preserve	S. Fettig and volunteers	$10,000
Soils mapping and Terrestrial Ecosystem Survey of the Valles Caldera National Preserve	U.S. Forest Service	$25,000
Soils map (Level-2) inventory of the Valles Caldera National Preserve (50% cost-share with VCT)	National Resources Conservation Service	$30,000
A Retrospective Study of Habitat Change Using Satellite Imagery of the VCNP	DOE, Los Alamos National Laboratory	$16,000
Survey for spotted owls on the Valles Caldera National Preserve	DOE, Los Alamos National Laboratory	$15,000
Sustainability of Semi-arid Hydrology and Riparian Areas (SAHRA)	NSF, Univ. Arizona, Los Alamos National Laboratory	$100,000
Monitoring of range utilization by elk and livestock on the Valles Caldera National Preserve	USDA ARS Jornada Experimental Range	$15,000
Inventory and assessment of forest insect pests and tree health status	U.S. Forest Service	$1,500
Establishment of a NOAA Climate Reference Network meteorological station for assessing global climate change	National Oceanic and Atmospheric Administration	$75,000
Geologic mapping and related topics of the Valles Caldera National Preserve	DOE, Los Alamos National Laboratory	$60,000
Inventory of plant species in the Valles Caldera National Preserve	University of Wyoming, Bandelier National Monument	$15,000
Operation of rain gauge network on the Valles Caldera National Preserve	U.S. Geological Survey	$3,000
CO_2 and H_2O flux in the Valle Grande and relationship to nutrient distribution	DOE, Los Alamos National Laboratory	$20,000
Historic roads mapping on the Valles Caldera National Preserve	D. Hoard and volunteers	$2,000
Historic telegraph/telephone line survey and map of the Valles Caldera National Preserve	J. O'Rourke and volunteers	$2,000
Climate change and vegetation dynamics over the last 50,000 years (earth-coring project) on the Valles Caldera National Preserve	USGS, NSF, LANL, University of New Mexico	$181,700
Assessment of environmental controls on tree invasion in the valles of the Valles Caldera National Preserve	University of Wisconsin, Madison	$15,000
2004 Total Projects: 18	**2004 Total Groups: 14**	**2004 Total: $1,015,450**
2005		
Ecological drivers of rodent-borne disease outbreaks.	National Science Foundation, National Institutes of Health	$429,250

PROJECT TITLE	RESEARCH GROUP	VALUE
Survey of the Cryptogams of the Valles Caldera National Preserve	Dr. R. Price and volunteers	$50,000
Petrologic and geochemical evaluation of the South Mountain Rhyolite, Valles Caldera National Preserve	Fort Lewis College, CO	$5,000
Geologic mapping and related topics of the Valles Caldera National Preserve	DOE, Los Alamos National Laboratory	$60,000
Operation of the NOAA Climate Reference Network meteorological station for assessing global climate change	National Oceanic and Atmospheric Administration	$24,000
Breeding Bird Atlas of the Valles Caldera National Preserve	S. Fettig and volunteers	$10,000
Small mammal survey of the Valles Caldera National Preserve	University of New Mexico	$14,000
Monitoring of range utilization by elk and livestock on the Valles Caldera National Preserve	USDA, ARS Jornada Experimental Range	$15,000
Soils mapping and Terrestrial Ecosystem Survey of the Valles Caldera National Preserve	U.S. Forest Service	$25,000
Soils map (Level-2) inventory of the Valles Caldera National Preserve (50% cost-share with VCT)	National Resources Conservation Service	$30,000
Sustainability of Semi-arid Hydrology and Riparian Areas (SAHRA)	National Science Foundation, Univ. Arizona, LANL	$425,000
Hazard fuels mapping and post-Cerro Grande fire responses	DOE, Los Alamos National Laboratory	$15,000
Ecosystem Responses to Prescribed Fire and Elk/Cattle Grazing in an Upland Watershed of the Middle Rio Grande Basin	USFS, Rocky Mt Research Station	$69,095
Conservation of Endangered, Threatened, and Sensitive Mollusks and Crustaceans	NM Dept. of Game and Fish, U.S. Fish and Wildlife Service	$109,333
Natural Perchlorate in High-Alpine Springs	DOE, Los Alamos National Laboratory	$90,000
Mapping of Browsing Impacts on Woody Vegetation in Mixed-Conifer Habitats	National Park Service	$2,400
Postcollapse volcanism in the Valles Caldera, New Mexico: The Transition from Large Volume Explosive to Small Volume Effusive Eruptions	University of Nevada, Las Vegas	$2,000
Surface Survey on Banco Bonito, Valles Caldera National Preserve, and Lower Dome, Santa Fe National Forest	UNM Archaeological Field School	$22,000
Baseline mapping of Bebb Willow (*Salix bebbiana*), bog birch (*Betula glandulosa*) and historic beaver (*Castor canadensis*) dams	U.S. Geological Survey, Jemez Mountains Field Station	$4,000
Operation of rain gauge network on the Valles Caldera National Preserve	U.S. Geological Survey	$3,000
Phylogenetic systematics of the caddisfly genus *Oligophlebodes* Ulmer (Trichoptera: Uernoidae): Morphological and molecular analysis.	University of California, Berkeley	$1,000
CO_2 and H_2O flux in the Valle Grande and relationship to nutrient distribution	DOE, Los Alamos National Laboratory	$20,000
Zoonotic disease surveillance on the Valles Caldera National Preserve	Johns Hopkins University, School of Public Health	$15,000
Elk population studies for management planning in the Jemez Mountains	DOE, Los Alamos National Laboratory	$60,000
Inventory and assessment of forest insect pests and tree health status	U.S. Forest Service	$1,500
Climate change and vegetation dynamics over the last 50,000 years (earth-coring project) on the Valles Caldera National Preserve	DOE, Los Alamos National Laboratory, U.S. Geological Survey	$122,250

PROJECT TITLE	RESEARCH GROUP	VALUE
Vegetation model for livestock/elk forage production	DOE, Los Alamos National Laboratory	$41,000
2005 Total Projects: 27	**2005 Total Groups: 19**	**2005 Total: $1,664,828**
2006		
Ecological drivers of rodent-borne disease outbreaks.	National Science Foundation, National Institutes of Health	$429,250
Survey of the Cryptogams of the Valles Caldera National Preserve	Dr. R. Price and volunteers	$50,000
Sustainability of Semi-arid Hydrology and Riparian Areas (SAHRA)	National Science Foundation, Univ. Arizona, DOE, Los Alamos National Laboratory	$700,000
Operation of the NOAA Climate Reference Network meteorological station for assessing global climate change	National Oceanic and Atmospheric Administration	$24,000
Operation of rain gauge network on the Valles Caldera National Preserve	U.S. Geological Survey	$3,000
Ecosystem Responses to Prescribed Fire and Elk/Cattle Grazing in an Upland Watershed of the Middle Rio Grande Basin	USFS, Rocky Mt Research Station	$60,000
Inventory and assessment of riparian conditions on the Valles Caldera National Preserve	BLM, National Riparian Service Team	$15,000
Monitoring of range utilization by elk and livestock on the Valles Caldera National Preserve	USDA ARS Jornada Experimental Range	$15,000
CO_2 and H_2O flux in the Valle Grande and relationship to nutrient distribution	DOE, Los Alamos National Laboratory	$20,000
Zoonotic disease surveillance on the Valles Caldera National Preserve	Johns Hopkins University, School of Public Health	$15,000
Inventory and assessment of forest insect pests and tree health status	U.S. Forest Service	$1,500
Natural Perchlorate in High-Alpine Springs	DOE, Los Alamos National Laboratory	$90,000
Soils mapping and Terrestrial Ecosystem Survey of the Valles Caldera National Preserve	U.S. Forest Service	$25,000
Summer weather stations operations and fencing of bog birch (*Betula glandulosa*) populations	USGS, Jemez Mountains Field Station	$4,000
A Snail Survey and Parasite Assessment of the Aquatic Habitats of the Valles Caldera National Preserve	University of New Mexico	$2,000
Climate change and vegetation dynamics over the last 50,000 years (earth-coring project) on the Valles Caldera National Preserve	DOE, Los Alamos National Laboratory	$119,000
Breeding Bird Atlas of the VCNP Preserve	S. Fettig and volunteers	$10,000
2006 Total Projects: 17	**2006 Total Groups: 14**	**2006 Total: $1,582,750**
2007		
Ecological drivers of rodent-borne disease outbreaks.	National Science Foundation, National Institutes of Health	$429,250
Survey of the Cryptogams of the Valles Caldera National Preserve	Dr. R. Price and volunteers	$50,000
Sustainability of Semi-arid Hydrology and Riparian Areas (SAHRA)	National Science Foundation, Univ. Arizona, Los Alamos National Laboratory	$700,000
Operation of the NOAA Climate Reference Network meteorological station to assess global climate change	National Oceanic and Atmospheric Administration	$24,000
Soils mapping and Terrestrial Ecosystem Survey of the Valles Caldera National Preserve	U.S. Forest Service	$25,000

PROJECT TITLE	RESEARCH GROUP	VALUE
Soils map (Level-2) inventory of the Valles Caldera National Preserve (50% cost-share with VCT)	National Resources Conservation Service	$30,000
Ecosystem Responses to Prescribed Fire and Elk/Cattle Grazing in an Upland Watershed of the Middle Rio Grande Basin.	USFS, Rocky Mt Research Station	$60,000
Breeding Bird Atlas of the Valles Caldera National Preserve	S. Fettig and volunteers	$10,000
Coyote-elk and ecosystem interactions in the Jemez Mountains of northern New Mexico	USFS, Rocky Mt Research Station	$16,900
Monitoring of range utilization by elk and livestock on the Valles Caldera National Preserve	USDA, ARS Jornada Experimental Range	$15,000
Application of daily MODIS remote sensing imagery to grassland fuels management in northern New Mexico.	USFS, Rocky Mt Research Station	$13,500
Responses of Wild Turkey (*Meleagris gallopavo*) to forest thinning and prescribed fire in northern New Mexico.	USFS, Rocky Mt Research Station; National Wild Turkey Federation volunteers	$66,409
Beaver habitat restoration in the Jemez Mountains	CFRP, Santa Clara Pueblo	$132,969
CO_2 and H_2O flux in the Valle Grande and relationship to nutrient distribution	DOE, Los Alamos National Laboratory	$20,000
Climate change and vegetation dynamics over the last 50,000 years (earth-coring project) on the Valles Caldera National Preserve	Los Alamos National Laboratory, U.S. Geological Survey, Northern Arizona University	$137,935
Zoonotic disease surveillance on the Valles Caldera National Preserve	Johns Hopkins University, School of Public Health	$15,000
Fire history of the Valles Caldera National Preserve	BLM Joint Fire Sciences Program, University of Arizona	$74,996
Geologic survey of the Valles Caldera National Preserve	Dr. Fraser Goff (volunteer)	$5,000
Inventory of Hemiptera insects on the Valles Caldera National Preserve	Dr. Al Wheeler, Clemson University	$5,000
Survey of snail and algal populations in springs and streams of the Valles Caldera National Preserve.	University of Alabama, National Science Foundation	$10,000
Inventory and assessment of forest insect pests and tree health status	U.S. Forest Service	$1,500
Investigation of short-range dispersal of Juvenile Gray-headed Juncos	S. Fettig and volunteers	$6,642
Continuation of floral survey of the Valles Caldera National Preserve	B. Jacobs, NPS and volunteers	$1,500
Documenting the Forest Service Telephone Line that connected the Fire Lookouts and Ranger Stations on the Western Half of the Santa Fe National Forest, circa 1905-1940s	J. O'Rourke and volunteers	$4,000
Inventory of high elevation shrew species in the Valles Caldera National Preserve	J. Findley and volunteers	$2,200
Comparative seasonal field metabolic rates of free-living woodrats (*Neotoma* spp.).	University of New Mexico	$1,400
Owl migration banding station at the Valles Caldera National Preserve	DOE, Los Alamos National Laboratory and volunteers	$2,000
Assessment of environmental controls on tree invasion in the valles of the Valles Caldera National Preserve	J. Coop (Colorado State University) and volunteers	$2,000
2007 Total Projects: 28	**2007 Total Groups: 21**	**2007 Total: $1,862,201**
2001-2007 Total Extramural Science Research		**$7,370,229**

7.3 Cultural Resource Project Survey Reports, 2000-2007

Report Number	Year	Report Title	Report Type*	Author(s)	Report Status	Organization
R2000-001	2000	Loop Tour Road Repairs (Roads A, B, & East Road)	-SURV	A. Steffen	On file at VCT	VCT/USFS
R2000-002	2000	Loop Tour Road Repair - Monitoring	MON	A. Steffen	On file at VCT	VCT/USFS
R2001-001	2001	PNM Letter Report: Monitoring and Anode Protection	INFO	D. Jones-Bartholomew	On file at VCT	PNM/TRC
R2001-002	2001	Winter-Spring Road Maintenance (VC01) Project-Original survey	+SURV	A. Steffen	On file at VCT	VCT/USFS
R2001-003	2001	Willow/South Mountain Timber Road Closing Survey	+SURV	A. Steffen	On file at VCT	VCT/USFS
R2001-004	2001	Winter Spring Road Maintenance -- Survey Completion	+SURV	A. Steffen	On file at VCT	VCT/USFS
R2001-005	2001	Survey of PNM DOE Pipeline on the SFNF & VCNP	+SURV	J. C. Acklen et al.	On file at VCT	PNM/TRC
R2001-006	2001	Roads Maintenance and Repair: Roads J, L, N, & 2	+SURV	A. Steffen	On file at VCT	VCT/USFS
R2001-007	2001	Roads Maintenance and Repair: Roads C & 7	+SURV	A. Steffen & T. Roberts	On file at VCT	VCT/USFS
R2002-001	2002	Roads J, L, N, & 2 Roadwork Monitoring	MON	A. Steffen & T. Roberts	On file at VCT	VCT/USFS
R2002-002	2002	Road A (VC01) Entrance Road Maintenance--Monitoring	MON	A. Steffen	On file at VCT	VCT/USFS
R2002-003	2002	HQ Water System Project: Testing & Data Recover	TEST	A. Steffen	On file at VCT	VCT/USFS
R2002-004	2002	Buildings in the Headquarters Area	INFO	C. Martin	On file at VCT	Martin
R2002-005	2002	Bridge & Culvert Replacement on Roads A, B, J, & L	PLAN	A. Steffen	On file at VCT	VCT/USFS
R2002-006	2002	Borrow Pit in the Redondo Meadows Area	+SURV	T. Roberts	On file at VCT	VCT/USFS
R2002-007	2002	HQ Water System Replacement Project: Testing at LA 135604	DATA RECOV	A. Steffen & K. P. Cannon	On file at VCT	VCT/USFS
R2002-008	2002	2002 Interim Cattle Grazing Initiative	PLAN	A. Steffen & R. Skinner	On file at VCT	VCT/USFS
R2002-009	2002	2002 Grazing Exclosure Report	+SURV	C. K. Helton & T. M. Roberts	On file at VCT	VCT/USFS
R2002-010	2002	Otero Headquarters/Cupid Cabin Septic System	+SURV	D. D. Hayes	On file at VCT	VCT/USFS
R2002-011	2002	Entrance Road (Road A/VC01) Repair and Reconstruction	TEST	A. Steffen	On file at VCT	VCT/USFS
R2002-012	2002	2002 Grazing Exclosure Revised Excluding Upper Jaramillo	PLAN	A. Steffen	On file at VCT	VCT/USFS
R2002-013	2002	Otero Headquarters/Cupid Cabin Septic System: Monitoring	MON	T. Roberts	On file at VCT	VCT/USFS
R2002-014	2002	Roads Maintenance and Repair C & 7--Monitoring	MON	T. Roberts	On file at VCT	VCT/USFS
R2002-015	2002	Road A (VC01) Movie Set Drive Erosion Berms	-SURV	D. D. Hayes	On file at VCT	VCT/USFS
R2002-016	2002	GIS/Archaeology Internship Project (Data Analysis)	INFO	C. A. Hermans	On file at VCT	VCT
R2002-017	2002	2002 VCNP Inventory of HQ Buildings	PLAN	D. D. Hayes	DRAFT on file at VCT	VCT/USFS
R2002-018	2002	Report to the BOT on Historic Routes: San I./Jemez, Valle Pass	INFO	D. Hoard	On file at VCT	Hoard/Martin
R2002-019	2002	Addendum: Historic Routes: Valle Grande Road	INFO	D. Hoard	On file at VCT	Hoard/Martin

REPORT NUMBER	YEAR	REPORT TITLE	REPORT TYPE*	AUTHOR(S)	REPORT STATUS	ORGANIZATION
R2002-020	2002	Report to the BOT: Historic Cabins on the VCNP	INFO	D. Hoard & C. Martin	On file at VCT	Hoard/Martin
R2003-001	2003	2003 Borrow Pit Parking Lot at Cerro La Jara	+SURV	C. K. Helton	On file at VCT	VCT
R2003-002	2003	Data Recovery Plan: PNM Pipeline	PLAN	A. J. Schilz	On file at VCT	PNM/LG Group
R2003-003	2004	Road D (VC04) Maintenance - Survey Report	+SURV	M. J. Thomas & A. Steffen	On file at VCT	VCT
R2003-004	2003	MWAC Work Plan for Road B Sites (VC02)	TEST	K. Cannon	On file at VCT	MWAC
R2003-005	2004	Headquarters Watersystem LA135604 Data Recovery	DATA RECOV	K. Cannon	On file at VCT	MWAC
R2003-006	2003	Route 7 Winter Parking Facility	-SURV	S. Chomko	On file at VCT	VCT
R2003-007	2003	State Road 4 Turnout 3	-SURV	M. J. Thomas	On file at VCT	VCT
R2003-008	2003	Jemez Pueblo Soil Testing Locations	-SURV	M. J. Thomas	On file at VCT	VCT
R2003-009		Road F and Pipeline Road Survey	+SURV	D. D. Hayes & C. A. Hermans	No final report (docs on file)	VCT
R2003-010	2003	2003 Implemented Recreation Trails	+SURV	C. K. Helton	On file at VCT	VCT
R2003-011	2003	2003 Proposed Recreation Trails	+SURV	C. K. Helton	On file at VCT	VCT
R2003-012	2003	Valle Grande Movie Set, 2003 Filming Project	-SURV	A. Steffen	On file at VCT	VCT
R2003-013	2003	Valle Grande Movie Set: Gravelling of Access Drive	-SURV	A. Steffen	On file at VCT	VCT
R2003-014	2003	2003 Amendment to the Interim Grazing Initiative	PLAN	A. Steffen	On file at VCT	VCT
R2003-015	2003	Banco Bonito Hazardous Fuels Reduction Survey	+SURV	J. Kulisheck	On file at VCT	VCT
R2003-016	2003	Bridge Replacement on Road 9	-SURV	C. K. Helton	On file at VCT	VCT
R2003-017	2003	Installation of Turnstyle Gates and Signs at VCNP Trails	-SURV	C. K. Helton	On file at VCT	VCT
R2003-018	2003	2003 Middle San Antonio Grazing Exclosure Project	+SURV	C. K. Helton	On file at VCT	VCT
R2003-019	2003	Modified Upper Jaramillo Grazing Exclosure Project	+SURV	C. K. Helton	On file at VCT	VCT
R2003-020	2003	Road B (VC02) Roads Maintenance & Repair Survey	+SURV	T. Roberts & A. Steffen	On file at VCT	VCT
R2003-021	2003	San Antonio Cabin Repairs Site Documentation	+SURV	C. K. Helton	On file at VCT	VCT
R2003-022	2003	NRCS-USFS Soils-TES MOA for 2003	PLAN	A. Steffen	On file at VCT	VCT
R2003-023	2003	Banco Bonito Hazardous Fuels Reduction: SR 4 ROW	PLAN	A. Steffen	On file at VCT	VCT
R2003-025	2003	Rehab Borrow Pit on VCNP Road A	-SURV	C. K. Helton	On file at VCT	VCT
R2003-026	2003	Addendum: Hist Routes: Valle Pass and Scooter Pass	INFO	D. Hoard	On file at VCT	Hoard/Martin
R2004-001	2005	Road M (VC03) Maintenance Survey	+SURV	C. K. Helton	On file at VCT	VCT
R2004-002	2004	USGS Core Drilling location	-SURV	S. Chomko	On file at VCT	VCT
R2004-004	2004	Maintenance of Roads H & G (VC11 & VC12)	PLAN	A. Steffen	On file at VCT	VCT

REPORT NUMBER	YEAR	REPORT TITLE	REPORT TYPE*	AUTHOR(S)	REPORT STATUS	ORGANIZATION
R2004-006	2004	Valle Toledo Burn: Survey Strategy and Fire Effects Study	PLAN	S. Chomko	On file at VCT	VCT
R2004-007	2004	Valles Caldera National Preserve Land-Use History	INFO	K. F. Anschuetz & T. Merlan	On file at VCT	RMRS
R2004-009	2004	MOA for Road B Data Recovery (LA26917)	PLAN	D. McCaig	On file at VCT	MWAC/ VCT
R2004-010	2004	Final MWAC Testing Report for Road B (VC02)	TEST	K. Cannon	On file at VCT	MWAC
R2004-011	2004	NRCS-TES 2004 Soil Pits	-SURV	W. Barfuss	On file at VCT	VCT
R2004-012	2004	NRCS-TES Redondo Soil Pits	-SURV	W. Barfuss	On file at VCT	VCT
R2005-001	2005	Movieset Outhouse	-SURV	W. Barfuss	On file at VCT	VCT
R2005-002	2005	Headquarters Historic District	PLAN	J. Civitello	Final draft complete	VCT
R2005-003	2005	Headquarters Trees	PLAN	J. Civitello	Final draft complete	VCT
R2005-004	2005	Valle Toledo Burn: Report on Pre-burn Fieldwork	+SURV	J. Civitello	On file @ VCT	VCT
R2005-005	2005	Monitoring Report: Headquarters Waterline	MON	J. Civitello	Final draft complete	VCT
R2005-006	2005	Road D Revisits	PLAN	W. Barfuss	Final draft complete	VCT
R2005-007	2005	Banco Staging Area Parking Lot Expansion	+SURV	W. Barfuss	On file @ VCT	VCT
R2005-008	2005	Valle Toledo Weather Station	-SURV	J. Civitello	Final draft complete	VCT
R2005-009	2005	Equestrian Trails Survey	+SURV	W. Barfuss	Final draft complete	VCT
R2005-010	2005	Initiation of Intensive Trails Monitoring at 4 Sites	MON	J. Civitello	In preparation	VCT
R2005-011	2005	VC02/Road B Borrow Pits	+SURV	A. Steffen	On file at VCT	VCT
R2005-012	2005	VC401 Re-Route	+SURV	A. Steffen & J. Civitello	On file at VCT	VCT
R2005-013	2005	Data Recovery along PNM-DOE Pipeline	DATA RECOV	A. Schilz et al.	On file at VCT	PNM/LG Group
R2005-014	2005	Main Entrance Upgrade	+SURV	J. A. Civitello	On file at VCT	VCT
R2005-015	2006	Highway 4 Viewing Area	+SURV	J. A. Civitello	In preparation	VCT
R2005-016	2006	Survey of Four Stocktanks	-SURV	R. Soto	In preparation	VCT
R2005-017	2005	Valle Fire Incident	MON	A. Steffen	On file at VCT	VCT
R2005-018	2005	Amended MOA for Cathodic Protection of PNM Pipeline	PLAN	S. Chomko	On file at VCT	VCT
R2005-019	2005	Dome Fire Obsidian Study	MON	A. Steffen	On file at VCT	Steffen
R2006-001	2006	Headquarters Rockpile Monitoring	MON	W. Barfuss	Final draft complete	VCT
R2006-002	2006	Seraphim Falls Movieset Survey	-SURV	W. Barfuss	Final draft complete	VCT
R2006-003	2006	2005 Testing at LA132045: La Jara Parking	TEST	J. Civitello	Final draft complete	VCT
R2006-004	2006	VC02 Borrow Pit Expansion	-SURV	R. Soto	On file at VCT	VCT

Report Number	Year	Report Title	Report Type*	Author(s)	Report Status	Organization
R2006-005	2006	Banco Thin Firewood Removal	MON	R. Soto	In preparation	VCT
R2006-006	2006	Perimeter Gate Survey	-SURV	R. Soto	In preparation	VCT
R2006-007	2006	UNM Banco Bonito Survey (UNM Fieldschool)	+SURV	A. Ramenofsky	On file at VCT	UNM Anth Dept
R2006-008	2006	Cerro del Medio Sect 110 survey	+SURV	A. Steffen	In preparation	VCT
R2006-009	2006	VC02 History Grove Berm Removal	-SURV	J. Civitello	Final draft complete	VCT
R2006-010	2006	NRCS-TES 2006 Soil Pits	-SURV	W. Barfuss	In preparation	VCT
R2006-011	2007	Main Entrance Upgrade: 2006 Investigations	TEST	J. Civitello	On file at VCT	VCT
R2006-012	2006	2005 Anode Replacement Monitor, Updates,& Geomorphology	MON	A. Minjares et al.	Final draft complete	PNM/TRC
R2007-001	2007	2006 Testing at LA132045: La Jara Parking	TEST	J. Civitello	In preparation	VCT
R2007-002	2007	Exploratory Drill Holes for Boundary Signs	-SURV	J. Civitello	On file at VCT	VCT
R2007-003	2007	Historic Structures Documentation	PLAN	S. Dennison	Final draft complete	SWCA
R2007-004	2007	LA26917: 2005 VCT Excavations	DATA RECOV	J. Civitello	On file at VCT	VCT
R2007-005	2007	VC05 & VC501 Road Survey	+SURV	J. Civitello	In preparation	VCT
R2007-006	2007	LA26917: UNM-OCA 2007 Research Design & Data Recovery Plan	DATA RECOV	R. C. Chapman	On file at VCT	UNM-OCA
R2007-007	2007	VC13 Road Survey	+SURV	J. Civitello	In preparation	VCT
R2007-008	2007	VC0201 Road Survey	+SURV	J. Civitello	In preparation	VCT
R2007-009	2007	Long Route Borrow Pits (1)	-SURV	W. Barfuss & J. Swigart	Final draft complete	VCT

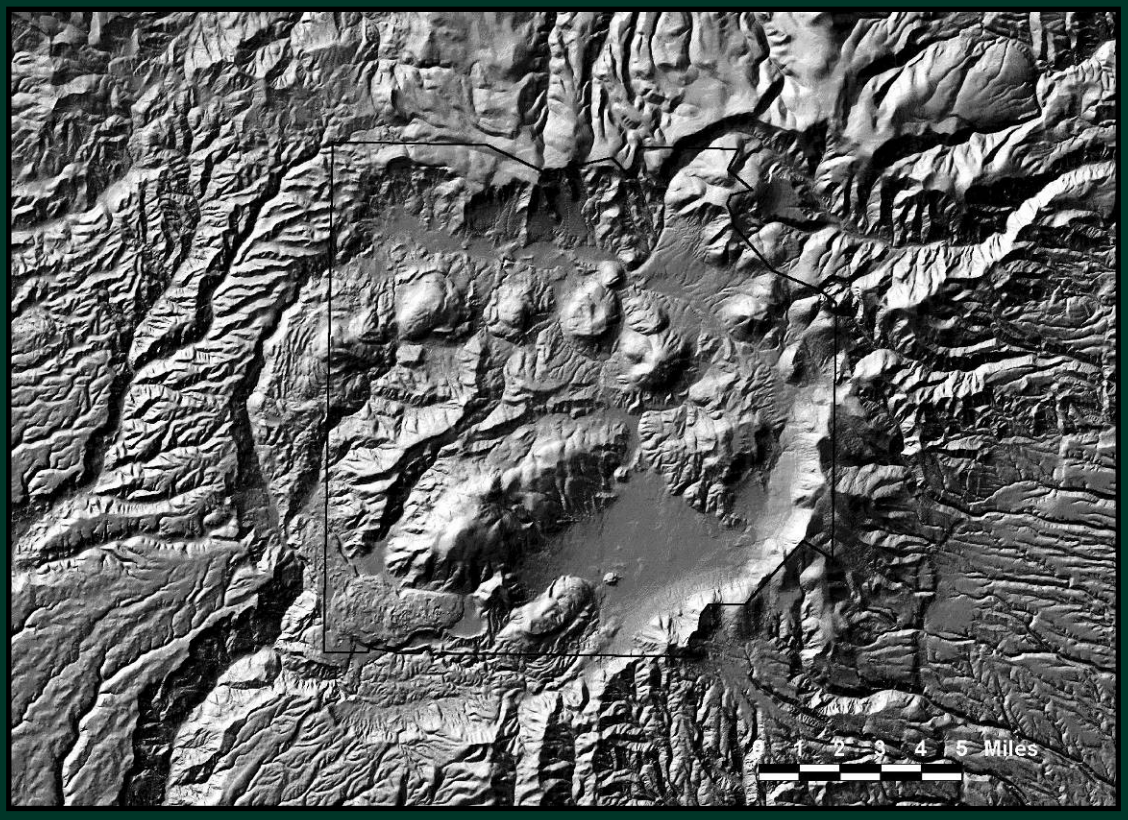
* -SURV = negative survey (no sites); +SURV = positive survey (sites present); INFO = information report; DATA RECOV = data recovery excavations; PLAN = planning report; TEST = archaeological testing; MON = monitoring

Road Gazetteer

Current road number	Pre-2004 road number	Current road number	Pre-2004 road number
VC01	A (Main Entrance)	VC08	J (Sulphur Canyon to Valle San Antonio)
VC02	B and C	VC09	F (Pipeline)
VC03	M (Redondo)	VC10	N
VC04	D	VC11	H (Hilton)
VC05	E (through Obsidian Valley)	VC12	G (Gareta)
VC06	2	VC13	I (Rito de los Indios)
VC07	7 (El Cajete and Banco)	VC14	9 and O

Back cover: false color Landsat photo of the Jemez Mountains and Valles Caldera

Boundary of the Valles Caldera National Preserve shown in black



Valles Caldera Trust

www.vallescaldera.gov