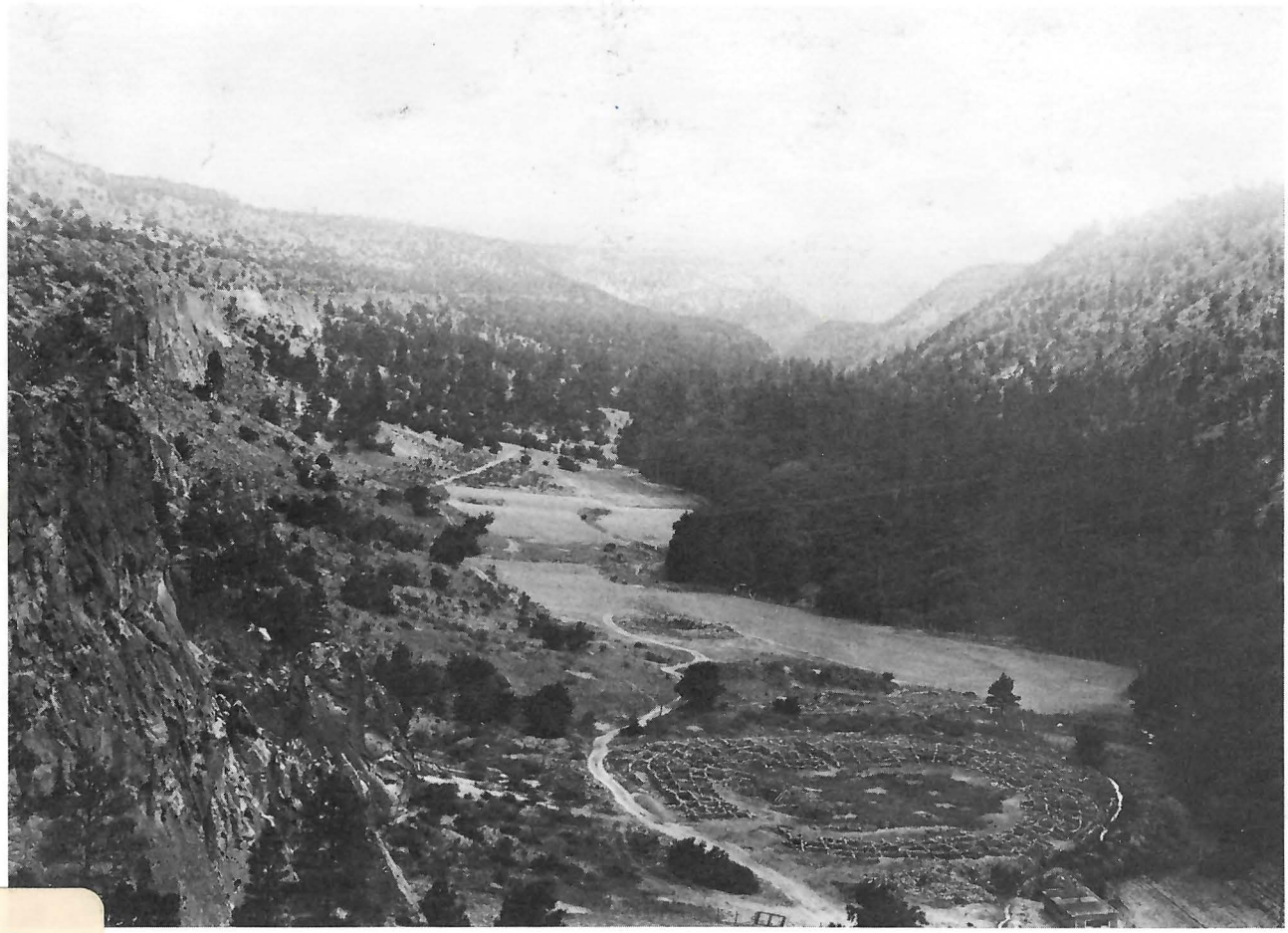
Draft
Development Concept Plans

Frijoles Canyon and Tsankawi



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Development Concept Plans

May 1995

Frijoles Canyon and Tsankawi

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SUMMARY

Facilities at Bandelier National Monument are not adequate to meet existing use levels. Increasing visitation threatens the monument's cultural and natural resources, affects the quality of the visitor experience, and highlights the inadequacy of the existing facilities. Insufficient staff and funds, the lack of baseline data on resource conditions, and resource degradation are issues at both the Frijoles Canyon unit and the separate Tsankawi unit. The protection of the cultural resources and the state's plans to widen the highway adjacent to Tsankawi (New Mexico Highway 4) are issues specific to Tsankawi. The action alternatives at both sites address the issues identified, but they are visitation-driven and not resource or goal oriented. A visitor experience / resource protection (VERP) study must be completed to determine the level of visitation that can be sustained by the monument resources so that the resources are preserved for posterity and a high-quality visitor experience can be maintained.

The preferred alternative for Frijoles Canyon addresses vehicular congestion in the canyon and on the mesa, the overcrowded visitor facilities in the canyon, and the lack of space for NPS staff and operations in the canyon. There would be a visitor contact station and parking area on the mesa top to provide orientation, information, and other visitor services. A visitor shuttle, boarded at the contact station, would operate during the peak season (currently April through October). A segment of the Frey Trail would be relocated to link with the new visitor contact station, and a new pedestrian trail would connect Juniper Campground loops and the contact station. There would be no new construction in the canyon except handicap-accessible restrooms. The CCC buildings would be used for interpretation. Most maintenance and administrative services would be placed on the mesa top in new headquarters and maintenance buildings. Minimal maintenance, law enforcement, and security services would remain in the canyon, along with a few staff offices and some housing.

Implementing this alternative would (1) help maintain the integrity of the CCC historic district because only changes in use are proposed, (2) possibly create some negative impacts on archeological resources, (3) permanently compact 7.22 acres and temporarily disturb 6.51 acres of soils, vegetation, and wildlife habitat on the mesa top for structures, roads, and parking areas, (4) significantly reduce emissions and slightly improve the air quality in the canyon during the peak season, (5) reduce the noise level in the canyon, (6) improve visitor experiences by building a new visitor contact station, improving safety conditions, ending peak-season vehicular congestion in the canyon, expanding the interpretive program, separating NPS operations and maintenance functions from visitors, and removing concessions from the monument, and (7) change the visitor experience by using a mandatory peak season shuttle.

The no-action alternative for Frijoles Canyon, provided as a basis for assessing the impacts of the preferred alternative, would not cause significant changes in monument management or resolve the issues identified.

Under alternative A, the preferred alternative for Tsankawi, a new visitor contact station and 30-car parking area

would be built. (The existing parking area will be removed by the state when NM Highway 4 is widened.) A staff residence and a trail between the contact station and the existing Tsankawi trail system would also be built. Two full-time rangers would be stationed at the site, and management emphasis would be on interpretation and protection of resources.

Implementing this alternative would (1) improve NPS presence and thus resource protection, (2) improve the visitor experience, (3) permanently disturb 0.88 acre and temporarily disturb up to 3.17 acres of soil, vegetation, and wildlife habitat for constructing the new facilities, (4) improve visitor safety by increasing sight distance at the parking area, and (5) make the visitor contact station accessible to visitors with disabilities.

Alternative B is the no-action alternative for Tsankawi. This alternative, also provided as a basis for assessing the impacts of the preferred alternative, would not significantly change monument management. The state will still widen the highway adjacent to Tsankawi and remove the parking area. A new parking area would be built in the southwest corner of the Tsankawi unit. The existing trail from the current parking area to the visitor contact station would be removed, and a new trail would extend southward from the contact station to the new parking area. The visitor contact station would continue its existing function. Summer interpretive walks and talks would continue, and no employee housing would be added. Accessibility for visitors with disabilities would remain as it is now.

Implementing this alternative would (1) improve visitor safety (as in the preferred alternative) with the improved sight distance to enter and leave the parking area, but (2) would not mitigate impacts on the resources.

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PURPOSE OF AND NEED FOR THE PLAN

Bandelier National Monument does not have adequate facilities to meet existing use levels. These preferred development concept plans, when implemented, would provide appropriate resource protection and visitor services at Frijoles Canyon and the separate Tsankawi unit.

MONUMENT PURPOSE

Monument purpose and significance were discussed at length in the alternatives formulation conference conducted with monument staff, the planning team, regional office staff, and other federal, state, and local agencies. The following purpose and significance statements summarize the consensus opinion of the meeting participants.

The purposes of the monument are to

- preserve, protect, and manage the cultural and natural resources within naturally functioning ecosystems
- provide the means and opportunity to study, understand, and enjoy the resources of the monument without unduly compromising the resources or ethnographic values
- provide public education about the cultural heritage of the San Ildefonso, Cochiti, Santa Clara, and Jemez Indians, who are descendants of the Bandelier inhabitants.

MONUMENT SIGNIFICANCE

Bandelier National Monument is significant

- for its extraordinary combination of archeological, historic, ethnographic, geological, ecological, and wilderness values in a scenic landscape
- for its high concentration and wide variety of well-preserved archeological sites
- because the descendants of this prehistoric culture live in the area today and maintain their cultural ties to the past
- because it provides outstanding natural and cultural research opportunities due to its relative integrity and high degree of resource protection
- because its geologic features are part of the world-famous Jemez volcanic field
- because this relatively small area supports many vegetation types and associated fauna due to its range of elevation and contains vital habitat for numerous threatened, endangered, and sensitive species
- because it provides rare opportunities for visitors to experience an environment rich in archeological sites and wilderness values in a relatively unaltered and scenic landscape
- because the monument's Civilian Conservation Corps (CCC) historic district, the largest concentration of CCC structures and furnishings in the national park system, retains a high level of integrity

MONUMENT OBJECTIVES

The following management objectives, identified in the monument's *Statement for Management* (NPS 1990), were considered while developing these development concept plans:

Provide long-term development plans. Address the issues of congestion, circulation, parking, recreation, visitor services, maintenance needs, and administrative/office needs in Frijoles Canyon and at Tsankawi.

Coordinate with local Indian communities, area landowners, and other agencies and individuals on issues of mutual concern.

Provide facilities that are accessible to special needs populations.

Reduce visitor congestion at Frijoles Canyon.

Enhance visitor understanding, appreciation, and enjoyment of monument resources.

Prepare a cultural landscape study for the resources and areas affected by this plan.

Define a management theme for the Tsankawi site that governs its development and use and that is compatible with the area's resources.

Develop guidelines for land use, architecture, and landscape development at the monument.

PRIMARY INTERPRETIVE THEMES

Bandelier was occupied by ancestral Puebloans from approximately A.D. 1100 to 1600; the empirical evidence of this occupation is represented by artifacts and archeological sites.

While Adolph Bandelier was studying the ancestral Puebloans in the Rio Grande area in the late 1800s, he was shown the area by a Cochiti man, whose ancestors lived on the Pajarito Plateau.

Volcanic and climatic forces shaped the monument landscape and left highly productive soils and varied topography that is conducive to a diversity of plants and animals, to agriculture, and to human habitation.

The interaction of natural processes and human activities has shaped, and continues to shape, the monument environment.

Present-day Pueblo communities retain a continuing traditional relationship to the monument.

Pueblo people actively use certain areas within the monument for a wide variety of traditional practices.

Present-day Pueblo people have maintained distinctive cultural identities while participating in today's world.

The prehistoric Pueblo people were influenced by their natural environment and altered the natural environment through their use of the resources.

- The natural features of the Bandelier area (e.g., soft tuff, water, trees, and mild climate) enabled prehistoric Pueblo communities to develop and sustain the lifestyles of the people.

- Prehistoric communities may have exhausted the resources of their area and, as a result, relocated east to the Rio Grande valley.

- The monument is one settlement area on the migration route of the prehistoric Pueblo peoples, culminating in the present-day Rio Grande Pueblos.

Preserving the resources enables the Park Service to tell the stories associated with the prehistoric, historic, and contemporary cultures and provide the public opportunities to learn more.

It is important to preserve cultural resources because they are nonrenewable, important to living people, and inform us about our heritage.

Parks are islands of relative stability embedded in larger landscapes, and parks are affected by external land use changes.

The Bandelier National Monument Civilian Conservation Corps Historic District demonstrates NPS design values.

ISSUES

The issues at Frijoles Canyon/Mesa and Tsankawi stem from increased visitation and congestion. Increasing use threatens the monument's cultural and natural resources, affects the quality of the visitor experience, and highlights the inadequacy of the existing facilities.

Increasing visitation, lack of adequate staff and funds for site protection, lack of baseline resource condition data, and resource degradation are issues at both the Frijoles Canyon and Tsankawi sites. Resource sensitivities, the rate of resource degradation, desired visitor experiences, and management factors help determine visitor capacity. The ability of the Frijoles Canyon and Tsankawi resources to withstand visitor use is not known. The optimum sustainable visitation level of the resources must be determined to protect them from the detrimental impacts of overuse.

Frijoles Canyon/Mesa

Inadequate Visitor Facilities. The museum, auditorium, and interpretive facilities are inadequate to appropriately serve visitors during peak periods, which detracts from the quality of the visitor experience. Existing parking in the canyon area is not adequate. Backups periodically occur that force cars to line up at the monument entrance on the mesa and on New Mexico Highway 4 (NM 4). This situation is inconvenient and threatens the safety of the visitors. Facilities are not universally accessible.

Inadequate NPS Facilities. The maintenance and headquarters/ administrative facilities for the monument are in the CCC historic district in Frijoles Canyon and are too small to serve current needs. Although some maintenance functions may need to remain in the canyon for operational efficiency, others do not. Space for offices, general maintenance work, vehicle storage, tool storage, and materials storage is extremely limited.

Modern Use and Space Allocation. Interior building space in the canyon is at full use, and during the peak season visitor demand for many services exceeds the space available to provide these services.

Utility Service Capacity. Utility services in the canyon often operate at peak capacity, especially the sanitary sewage treatment and telephone service. Some facilities, such as the water storage tank on the mesa, need to be replaced. Sewage treatment capacity has been expanded, and at this time the capacity of existing treatment lagoons has been maximized at 5% over the average visitation level of the

last five years. The expansion of services and facilities in the canyon is constrained by the sanitary sewage treatment capacity shortage.

Tsankawi

Issues at Tsankawi concern the cultural resources. This site is unexcavated and not yet fully inventoried by archeologists. Nonetheless, Tsankawi is open to the public and therefore at risk from visitor use and relic hunters. Ancient Indian trails, eroded in the soft rock, still exist; they have been eroded even more by present-day visitors. Modern visitors have also created other trails, more deeply eroded than the trails of the ancient ones, and have degraded the resource.

The state highway department is considering four new highway routes to link Los Alamos with Albuquerque more directly. All four would pass between the main monument and the Tsankawi unit. One route would abut the southern border of Tsankawi. Because NM 4 already forms the northern and western borders of Tsankawi, selecting this option would place highways on three sides of Tsankawi and visually intrude on its southern viewshed.

No guiding management philosophy directs the operation of Tsankawi. Development has been accomplished without the benefit of an overall plan or goal, and the existing facilities are inadequate for their intended purposes. Facilities consist of unpaved roads, de parking, a small substandard visitor contact station, and three portable toilets with permanent plumbing. These factors result in a poor-quality visitor experience.

Visitor Safety. Short sight distances and heavy commuter traffic threaten the safety of those entering and exiting the parking lot at NM 4. Trails on the site pose some risks due to their locations, slopes, narrow widths, and the physical effort required to use them.

Resource Protection. The effects of relic hunting, unauthorized artifact removal, vandalism, graffiti, and pedestrian traffic and its resulting erosion of the soft rock (called tuff) are clear in the pueblo sites and petroglyph areas. These are major resource protection problems. The archeological resources have not been fully surveyed and inventoried, placing the resource information at risk of being lost and making it difficult to determine the severity and rate of erosion. Baseline resource data and monitoring systems are needed for proper resource protection and management.

RELATED PLANS AND STUDIES

The National Park Service has developed numerous plans and public documents that address the management of Bandelier National Monument.

The current *Resource Management Plan and Environmental Assessment* (NPS 1988c) was completed in 1988 and approved in 1989. This plan is currently being revised and updated. The plan identified the status of natural and cultural resources, current program and needs, and annual project priorities.

The *Final Master Plan* for Bandelier National Monument (NPS 1976b), approved in 1977, identified broad objectives for the area. These objectives emphasized reducing detrimental effects on the monument's resources and provided for development consistent with NPS policies, guidelines, and the intent of the enabling legislation. This development concept plan is the next major planning document after the 1977 *Master Plan* and

follows the direction established in more recent documents, specifically the *Statement for Management* (NPS 1990)

The *Historic Structures Report* (NPS 1988b) assessed the CCC historic district and made recommendations for preserving the structures within the district.

The current *Statement for Management* was completed and approved in 1990. It identifies the concerns and issues confronting the monument, evaluates the monument's condition and management practices, and serves as a basis for future planning and research.

The latest *Interpretive Prospectus* for the monument was completed and approved in 1992. This document prescribes how the story of the monument and its resources will be told, including the content and placement of exhibits, waysides, audiovisual programs, publications, and personal services.

The *Housing Management Plan* for the monument was completed and approved in 1993. It assesses the quantity and condition of monument housing, reviews the need for such housing within the monument, presents an overview of the local housing market, and gives a strategy for providing housing for the monument staff.

DESCRIPTION OF THE MONUMENT

SIZE AND LOCATION

Bandelier National Monument (32,737 acres) is on the Pajarito Plateau of the Jemez Mountains in north-central New Mexico. The monument is approximately 90 miles north of Albuquerque, 45 miles northwest of Santa Fe, and 12 miles south of Los Alamos (see Location and Vicinity maps).

The monument is in three counties: Los Alamos, Sandoval, and Santa Fe. It is bordered by Santa Fe National Forest on the west, Los Alamos National Laboratory on the north and east, a large private ranch (known as Baca Location Number 1) on the northwest, and the Cañada de Cochiti Grant on the south.

The 826-acre Tsankawi unit is 12 miles northeast of the main Bandelier unit and abuts the Los Alamos National Laboratory on the north and west and San Ildefonso Pueblo land on the south and east

Los Alamos (10 miles from the monument entrance) is the largest nearby community, with a 1990 population of 11,830 people. The town of White Rock is about 8 miles northeast of Bandelier and had a 1990 population of 6,285. Both communities are primarily residential neighborhoods for the Department of Energy's Los Alamos National Laboratory. Primary access to the towns is provided by New Mexico Highways 502 and 4 and U.S. Route 285.

The U.S. Forest Service administered Bandelier's original 22,352 acres from 1916 until the National Park Service assumed jurisdiction over the monument in 1932. The monument has grown in several stages to its current size of 32,737 acres. Congress authorized an additional 4,234 acres of the Cañada de Cochiti Grant for addition to the monument in 1976, but that acreage currently remains outside NPS control.

EXISTING DEVELOPMENT

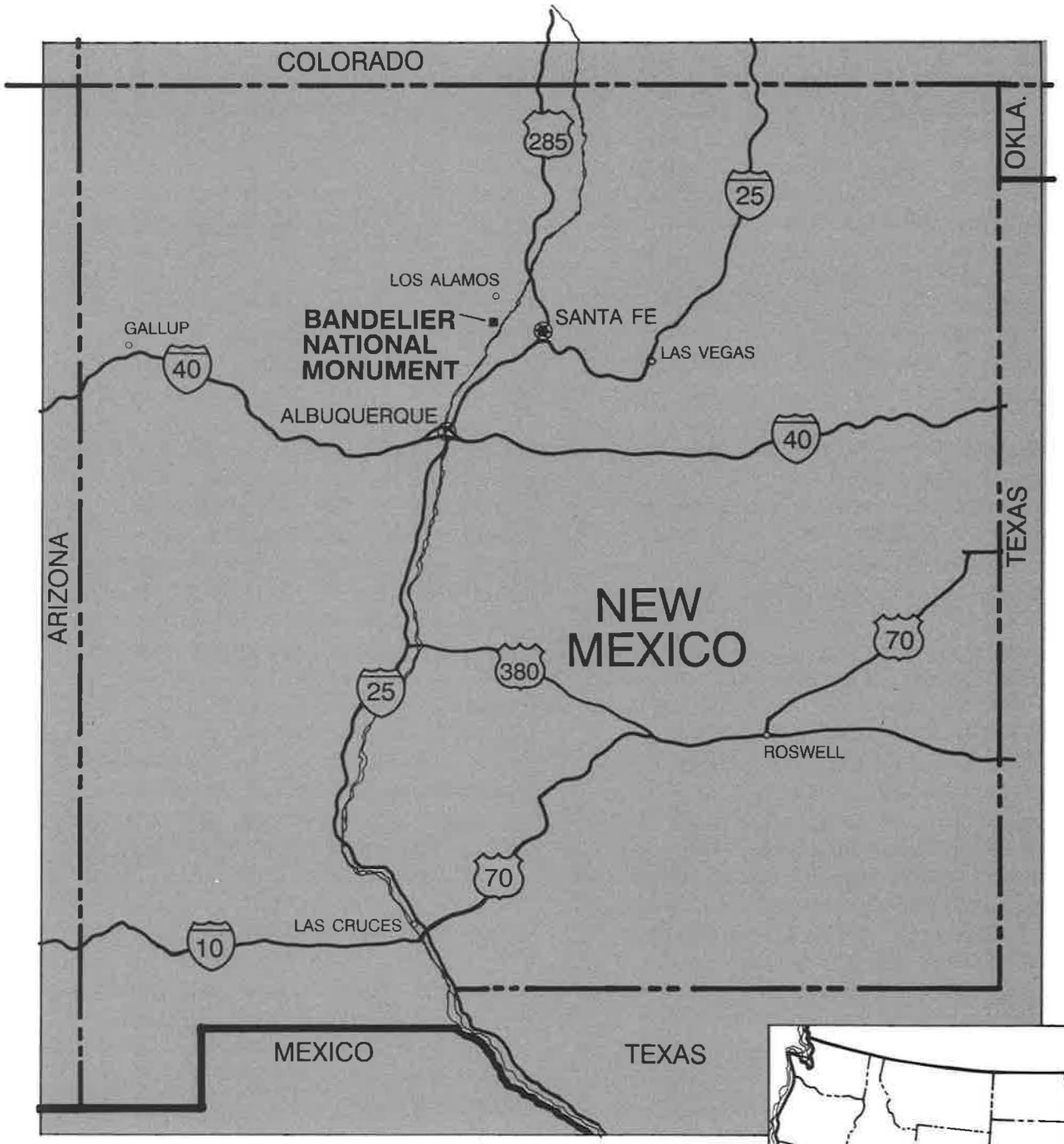
Frijoles Canyon

The Frijoles Canyon developed area (see Frijoles Canyon/Mesa Existing Conditions map) includes most of the monument facilities, including administrative offices, visitor center, maintenance facilities, and employee housing. Frijoles Canyon is at the end of the monument entrance road, which extends from NM 4 to the canyon. Most NPS facilities were built by the Civilian Conservation Corps (CCC) between 1934 and 1941 and are generally structurally sound but in fair to poor condition. Site erosion control measures need to be completed.

The CCC structures were built to conform to and complement the topography. This enhances their appeal but makes it difficult to meet universal accessibility requirements. Recent modifications were made to improve accessibility for the mobility impaired. There is a curb cut near the visitor center with a ramp from the parking lot level to the walk level. Another ramp connects the walk level with the visitor center floor level. Once inside, one can talk to the ranger or buy a book, but the exhibits are two steps up from the lobby. A temporary ramp is provided to the exhibit area, but it is too steep to meet access requirements.

The restrooms, audiovisual presentation room, concession facilities (both food and gifts), and most of the administration area remain inaccessible due to level changes and narrow entrances.

LOCATION



NO SCALE



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Architectural Style. All canyon structures are built in the southwestern Pueblo Revival style. They incorporate characteristic design elements, including battered stone walls, *vigas*, *portals*, parapet roofs, *canales*, and changes in elevation to conform to the local topography. Structures are linked together with masonry walls, portalled patios, and terraced courtyards. The use of local materials (stone, wood, and mud plaster) and indigenous landscape elements (flagstone walks, vegetation, and rock outcroppings) links the structures harmoniously with the natural setting.

Access. There are two ways into Frijoles Canyon from the mesa development area. One is down the Frey Trail, a steep 1.5-mile footpath that goes from Juniper Campground to the headquarters area. Most visitors prefer to drive into the canyon on the two-lane road built by the Civilian Conservation Corps in 1933, their first construction project at the monument.

Parking. The main parking lot is in the canyon at the end of the entrance road. The lot consists of a central island with parking on two sides, additional parking along the outer edge on all four sides, and buildings along three sides of the lot. The island parking spaces and the oversized vehicle space on the eastern edge are not part of the original design.

During the busy summer season the staff car pool, hike, and bicycle from the mesa to the canyon and park at the stable. Additional visitor cars are squeezed into parking spaces in the picnic area. Long-term parking for backcountry users is provided in the backpackers' parking lot on the south side of the creek. There are 120 canyon parking spaces available, including the spaces in the backpackers' parking lot.

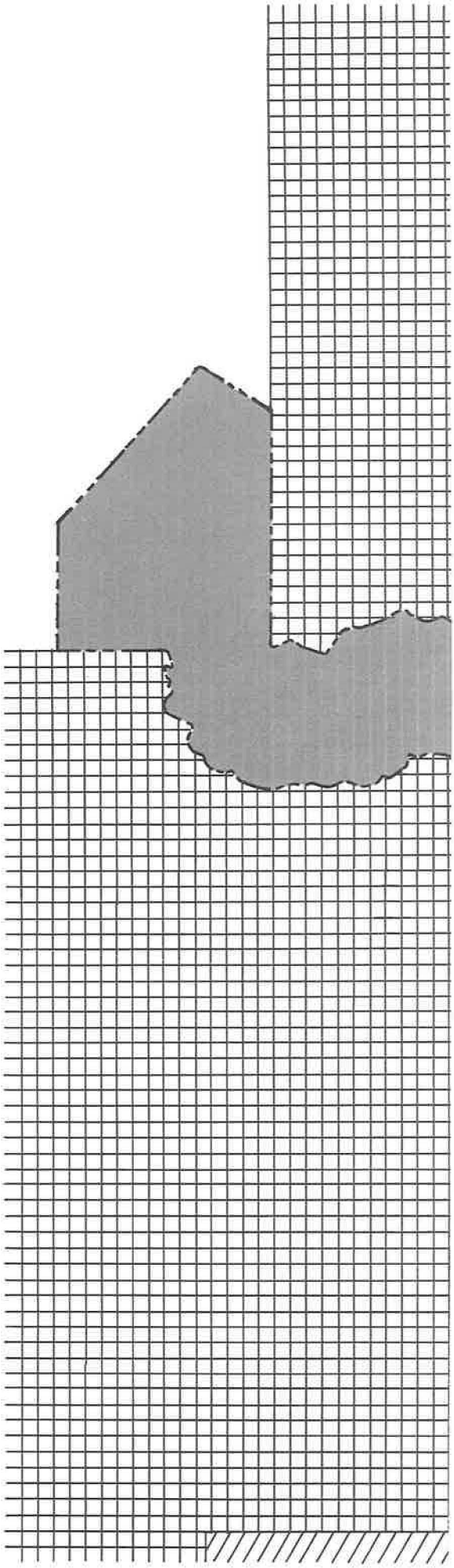
Visitor Center. Interpretive functions are in the visitor center (building no. 2). This CCC structure was built in three phases and consists of the original museum, the original administrative building, and the lobby between them (see Frijoles Canyon Existing Historic District Building Uses map). In the mid 1970s the museum was expanded to provide an additional exhibit room. Insect pests, environmental control problems, and a lack of security threaten the artifacts displayed. Inadequate space hampers all the visitor center functions — sales, information and reception, exhibits, audiovisual presentations, and staff offices.

Administration. The administrative offices are in the former dining room, kitchen, and lunchroom of the former Frijoles Canyon Lodge (no. 15). The kitchen and lunchroom were partitioned into offices after the equipment was removed. An employee dormitory, just behind the lodge dining room (no. 16), was connected to this structure in 1968 by building a winterized roof over the dining terrace. Later a terrace at the rear of the dormitory was enclosed to provide additional office space. Even with that expansion and the conversion of the lodge operator's house (no. 18) and three of the lodge cabin groups (nos. 23, 24, and 27) into offices, space for monument administrative functions is still not adequate.

On the southeast side of the administration building is the former service area for the former Frijoles Canyon Lodge — a walled compound containing three buildings. Two of the buildings, the carpentry building (no. 12) and oil and gas house (no. 14), are now being used for storage. Building 12 is also used as a library. The third, a garage (no. 13), has been adapted as an employee recreation center.

Concessions. All food service and gift sales are in the former lobby and sales room of the former Frijoles Canyon Lodge

VICINITY



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STATE-OWNED LANDS

INDIAN LANDS

SANTA FE NATIONAL FOREST

TOWNS, PRIVATELY OWNED LANDS, OTHER LANDS

0 5000 10000 FEET

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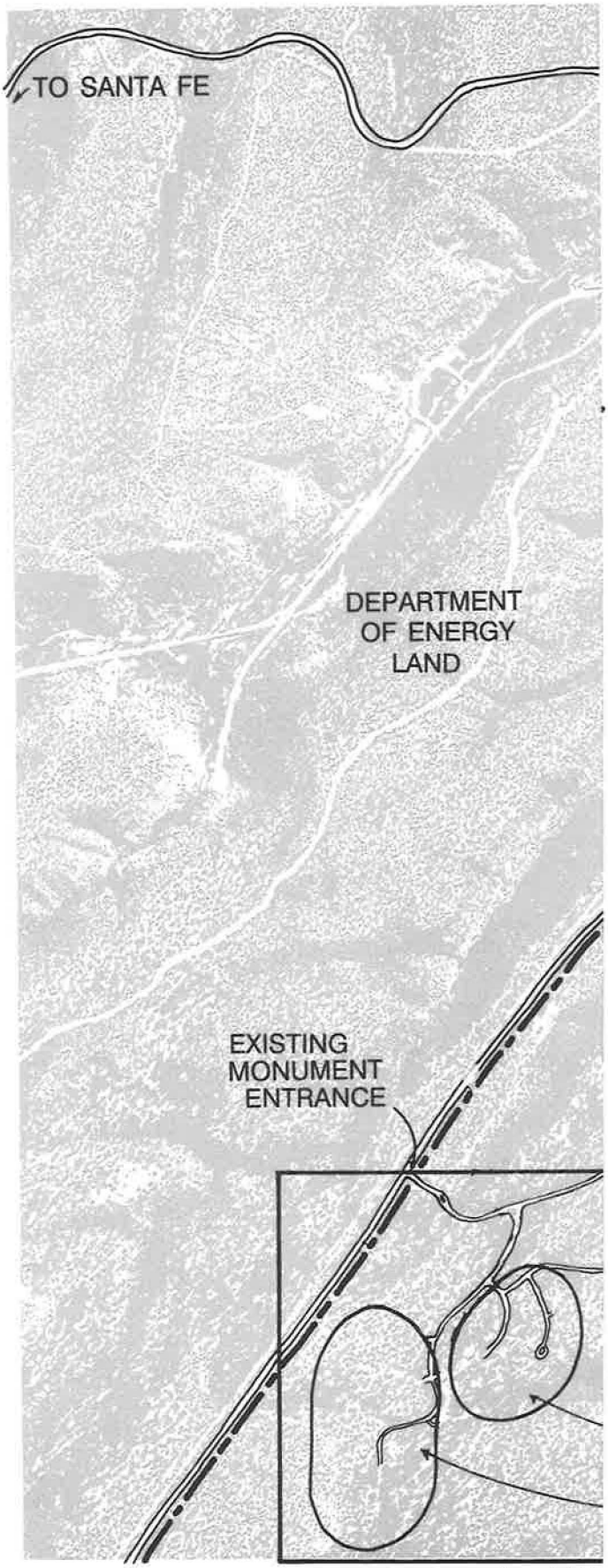
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FRIJOLES CANYON / MESA

EXISTING CONDITIONS



AREA SHOWN ON MESA-TOP VI
CONTACT STATION, HEADQUAR
AND MAINTENANCE FACILITY SI
PLAN MAP

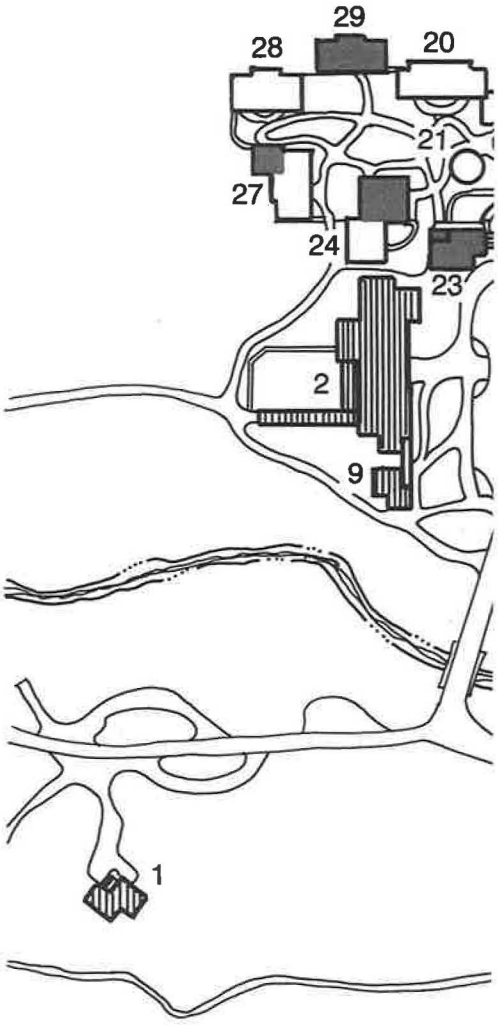
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FRIJOLES CANYON

EXISTING HISTORIC DISTRICT BUILDING USES



VISITOR FACILITY

CONCESSION FACILITY

ADMINISTRATIVE FACILITY

1 RESTROOM
2 VISITOR CENTER
3 MAINTENANCE WAREHOUSE/ OFFICE
4 MAINTENANCE WORK AREA AND CARPENTRY SHOP
5 GAS AND OIL HOUSE
6 EQUIPMENT SHED
7 RESIDENCE
8 RESIDENCE
9 RESTROOM
10 RESIDENCE AND GARAGE (RANGER DORMITORY)
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(no. 17). The food and gift shop functions occupy two separate floor levels. Access is from the main courtyard into the snack shop, and from there by stairs to the connected gift shop sales area. The gift shop can also be entered from a more private walled courtyard that leads to the staff housing area. Neither entrance is accessible for the mobility impaired. The sales space is adequate, but crowded displays obscure the architectural features of this room, which is one of the original public rooms in the canyon. The snack bar, which includes a lunch grill, is undersized and inefficiently arranged to meet the needs of monument visitors during busy periods.

Public Restroom. Building 9, at the south end of the visitor center, is the only public restroom on the northeast side of the creek. It is too small for the number of visitors, and it is not accessible to the mobility impaired.

Housing. Staff housing in the Frijoles Canyon historic district includes four stone residences (nos. 7, 8, 11, and 32), a ranger dormitory (no. 10), and three historic lodge cabins (nos. 19, 20, and 28). A small round building known as the kiva (no. 21), originally a restroom and linen storage building for the cabins, is now used as a laundry room, storage area for residents, and monument herbarium. Although four of the former lodge cabin groups now serve as seasonal employee housing, more seasonal employee housing is needed.

The White Rock staff housing area, south of the historic district, supplements the CCC cabin housing in the canyon. This area includes a combination of nonpermanent mobile homes, modular structures, and manufactured housing. The area and buildings are in poor condition, are not visually appealing, and are not historically significant. Monument managers have long intended to remove the White Rock housing facilities and restore the site.

Maintenance. The walled maintenance compound contains four buildings. Building 3, built in 1939, is a warehouse converted to offices. The carpentry shop (no. 4) and the gas and oil house (no. 5) retain their historic uses. The equipment shed (no. 6) was originally a garage and is now a storage building for lumber, search and rescue, and fire management equipment. The maintenance facility is adjacent to the visitor use area and is too small, making operations difficult there. Another structure, the powerhouse (no. 22), is just outside the maintenance area. This building originally housed a generator for the monument's electricity, but it now encloses a transformer because the monument is on commercial electric service.

Other Visitor Facilities. Southwest of Frijoles Creek is a picnic area that also serves as an overflow parking area for about 24 cars during peak-use periods. To the east is a 36-car parking lot, which serves backpackers and visitors during peak-use periods. The area occupied by the picnic grounds and the backpackers' parking lot was originally built as a campground. The creation of the backpackers' parking lot obliterated 12 campsites.

There are restrooms (no. 1) in the picnic area. This building was the first permanent building constructed by the Civilian Conservation Corps in the canyon. The structure is partially banked into the hillside and contains the elements of architectural style that were adopted in constructing the other CCC buildings, such as battered stone walls, flat roofs surrounded by parapets, vigas and latias, heavy timber lintels, and the interplay of masses and voids.

Horse Stable and Corral. The stable (no. 25) shelters the horses used in monument

operations. These structures are considered adequate for monument use.

Frijoles Mesa

Entrance Station. The entrance station (no. 26), one of the original CCC buildings, is on the monument's two-lane entrance road, 300 feet from NM 4. A ranger is stationed there during peak periods to collect entrance fees and control traffic. During the busy summer season the canyon parking fills quickly, and additional vehicles must wait until space becomes available in the canyon. A few of the waiting cars are accommodated on the entrance road in the canyon and at the entrance station. Only about eight cars can wait at the entrance station at one time; during extremely busy periods, additional cars must line up on NM 4, creating a safety hazard.

Campground/Amphitheater. Juniper Campground is on the mesa near the entrance station and has 94 campsites, including tables, fireplaces, a dump station, toilets, and water taps. The 250-seat outdoor amphitheater was built in 1974 on the site of a former CCC quarry.

Staff Housing Area. Staff housing is on the mesa near the campground and the Frey Trail and in the canyon historic district. The mesa housing units are permanent structures of mixed architectural styles and are not compatible with the architectural style of the monument. The houses are not visible to the public from the main road, but they can be seen from the Frey Trail and the campground.

Fire Lookout. The fire lookout station with its attached quarters (no. 30) was an early part of the CCC development. In 1956 a small concrete block addition was built containing a kitchen and a bathroom. This building also houses the monument's major communication systems.

Tsankawi

Few visitor facilities are available at Tsankawi. There is a small dirt parking lot (little more than a pulloff) for about 20 cars within the right-of-way of NM 4 at East Jemez Road. When staffed, a small building with a covered patio and a small office serves as the visitor contact point. Behind the visitor contact building there is a trailer pad for a temporary volunteer residence and portable toilets that flush to a septic tank.

VISITOR USE

Current Visitor Use

During 1991 Bandelier National Monument averaged nearly 950 recreation visits (an entry by one person for any part of a day for recreation) per day. January had the lowest use, with approximately 200 recreation visits per day, and July had the highest use, averaging almost 1,590 recreation visits per day. Nearly all visitors use the canyon visitor center and restroom, which results in a very crowded visitor center on busy days.

Parking is currently the critical factor limiting visitor use. On an average day 340 vehicles enter the monument, with an average of 2.8 persons in each vehicle. The 120-space parking capacity is often exceeded during the summer and other peak seasons. When the canyon parking lots are full, visitor vehicles must wait at the head of the canyon parking lot and at the entrance on top of the mesa. As one vehicle exits, another is allowed into the monument. The average length of stay for monument visitors is two hours and 45 minutes, which means that the daily

optimum turnover rate for parking spaces is 3.6 times.

During the last decade the staffing level has been insufficient to meet visitation demands, forcing interpretive services and other monument programs to rely heavily on volunteers.

Future Visitor Use

Current projections indicate that visitor use will average between 1,325 to 1,600 recreational visits per day during the year 2003 — an increase of 325 to 600 per day. At that rate, average daily visitation during the peak months of summer could range between 1,950 to 2,250 recreational visits per day. This assumes no variations in visitor use levels throughout the week. However, typically weekends have higher levels of visitation than weekdays. By the year 2003, visitation could double.

The resource capacities of Frijoles Canyon and Tsankawi are unknown. It is necessary to determine the optimum sustainable visitation levels of the resources to protect them from the detrimental impacts of overuse.

More information about future visitor use projections is in the "Visitor Use" section of the "Affected Environment."

THE ALTERNATIVES FOR FRIJOLES CANYON

Several alternatives were considered for Frijoles Canyon. Through discussion and the planning review process, the alternatives were pared down to only two distinct and feasible options. Alternative 1 is the preferred alternative. It would institute a mandatory shuttle bus during the peak season, leave interpretation in the canyon, and relocate administration and maintenance to two sites on the mesa top. Juniper Campground would be reduced by about 10 campsites. Alternative 2 is a no-action alternative in which existing conditions would continue with all NPS facilities and functions remaining in the canyon.

No changes would occur to either the amphitheater or the boneyard on the mesa.

ALTERNATIVE 1 — PREFERRED ALTERNATIVE — MESA-TOP, VISITOR HEADQUARTERS, AND MAINTENANCE FACILITIES

Summary

This alternative addresses vehicular congestion, visitor center crowding, inadequate administrative and maintenance space, and the undesirable mixing of operational and visitor activities. A visitor shuttle would be in operation during the peak season (currently April through October). No new construction would occur in the canyon except for handicap-accessible restrooms. The CCC buildings in the canyon would be used for interpretation, and the visitor contact station on the mesa top would provide orientation, information, and other visitor services. A segment of the Frey Trail would be relocated to link with the new visitor contact station, and a new pedestrian trail would connect Juniper Campground loops with the visitor contact station.

Most maintenance and administrative services would be removed from the canyon and placed on the mesa top. Minimal maintenance, law enforcement, and security services would remain in the canyon, along with some staff offices and some housing.

General Development

Shuttle and Visitor Parking. A universally accessible, concessioner-operated shuttle service (including lifts) would be mandatory during the peak visitation season (currently April through October). At other times visitors would be able to drive into the canyon and park there. Some fees would be charged to cover entrance and/or use. Commercial tour buses would not be allowed in the canyon but would park on the mesa. Tour bus visitors would take the shuttle to the canyon. As future demand dictates, the operational period of the shuttle, and therefore of the visitor parking lot on the mesa (described below), could vary to relieve congestion in the canyon and allow for regulation of visitation. Visitors would board the shuttle at the visitor contact station, which would be near the intersection of the main entrance road and the campground/employee housing access road.

Shuttle buses would use clean-burning fuels such as propane, natural gas, or electric power. No diesel engine vehicles would be allowed in the canyon except for deliveries, garbage pickup, and maintenance activities. At night the shuttle buses would be parked at the monument maintenance facility.

The 9-acre visitor parking area would be constructed northwest of the entrance road, set back 100 feet from NM 4 and adjacent monument roads and 250 feet from Juniper Campground loop A. These setbacks would reduce visual and noise impacts for campers, administrative office personnel, and visitors. The 9-acre site would allow a low-density parking design, further reducing the visual impact of the parking lot pavement. Large parking lot islands would retain many existing ponderosa and pinon pines to provide shade and screening. The low-density parking design would visually break up the large pavement area and allow grade changes to be made in the islands rather than in parking areas. A new exit-only road, about 700 feet northwest of the entrance road on NM 4, would be constructed for visitor use during the peak season and year-round use by those visiting the headquarters.

The parking lot design would include stormwater retention basins or other structures designed to capture the initial stormwater runoff from the parking areas, which might contain high concentrations of contaminants (gasoline, oil, and antifreeze).

The visitor parking area could ultimately accommodate 260 visitor cars, RVs, and buses. The visitor parking area construction would be phased and would not exceed 160 spaces until a visitor experience/resource protection study is completed and it is demonstrated that the monument could accommodate a higher visitation level. Headquarters parking would include another 10 visitor spaces and 25 staff spaces.

Entrance Station. The existing entrance road and entrance station would be maintained. During the peak season, monument entry fees would be collected at the contact station/shuttle bus pay point. During nonpeak periods, fees would be collected at the entrance station.

Camping. Juniper Campground would be reduced by about 10 campsites to reduce the number of campers (density) and improve the camping experience. The campsites would be removed near where campground loops A and B come together.

Visitor Contact Station. A new, combined visitor contact station and shuttle bus station would be constructed near the intersection of the main entrance road and the campground/employee housing access road, at the southwest corner of the new visitor parking lot on the mesa (see Frijoles Canyon, Preferred Alternative — Mesa-top Visitor Contact Station, Headquarters, and Maintenance Facility Site Plan). During the peak season, all visitors would park their cars in the mesa parking lot and be directed to the visitor contact station where they would pay the entrance fee, get information and orientation, see the monument's audiovisual programs, and board the shuttle, walk to the canyon, or take the Tyuonyi overlook trail.

The contact station staff would suggest ways to structure visits to fulfill the desired visitor experience, including information about Tsankawi. Exhibits would help provide this information, and displays would explain the shuttle system and the purpose for using it. A theater with a sloped floor and fixed seating for 75 to 100 visitors would be part of this facility, along with accessible restrooms. Various programs could be shown in the theater, but it would primarily be for the introductory audiovisual show.

The visitor contact station would also serve as the trailhead for the Frey Trail, Tyuonyi overlook trail, and a new trail/walkway along the existing campground access road, which would provide pedestrian access between the campgrounds, the

Tyuonyi overlook trail, and the visitor contact station.

An existing segment of the Frey Trail, from the new maintenance site to the oversized vehicle parking lot, would be relocated to connect the trail to the visitor contact station. The relocated segment would go from the visitor contact station to the southeast and would pass east of the housing and maintenance areas. Existing topography and vegetation would screen the trail from the housing, maintenance, and lagoon areas. The existing segment of the trail would no longer be necessary and would be obliterated and revegetated with native species.

Interpretation. All interpretive facilities except the theater would be in the CCC historic district facilities. Interpretation would be extended into buildings 12, 13, 14, 15, 16, and 17 plus the existing visitor center (building no. 2). The interpretive program would be expanded to present in detail the stories of the area's occupation by the ancestral Puebloans of the Rio Grande, their survival and evolution into today's local Pueblo communities, and the Pueblos' continuing relationships with Bandelier.

New exhibits would describe the natural forces that created the landscape and how natural processes and human activities have interacted there, how the site evolved into a national monument, the story of the CCC historic district facilities, and monument management activities. Interpretation staff offices and workspace and the cooperating association sales area would also be provided in the CCC buildings.

A visitor experience sequence would be developed for the canyon — to identify the best location for the shuttle bus dropoff, satisfy visitors' needs for basic information, prevent visitor confusion, and disperse visitors throughout the monument (to avoid congestion and degradation of the visitor experience and the resources).

Concessions. The food and gift shop concessions would be removed from the monument; these services would be provided nearby in Los Alamos and White Rock. This proposal is consistent with the 1965 Concessions Policy Act (16 USC 20 et seq.), which provides legislative direction with respect to NPS management of the concessions program.

Food, lodging, gasoline, gift shops, and other services are available locally, on the major routes to the monument. The gift and food concessions at Bandelier offer products and services already available nearby or at local Pueblos. Visitors can use those services either before or after their monument experience.

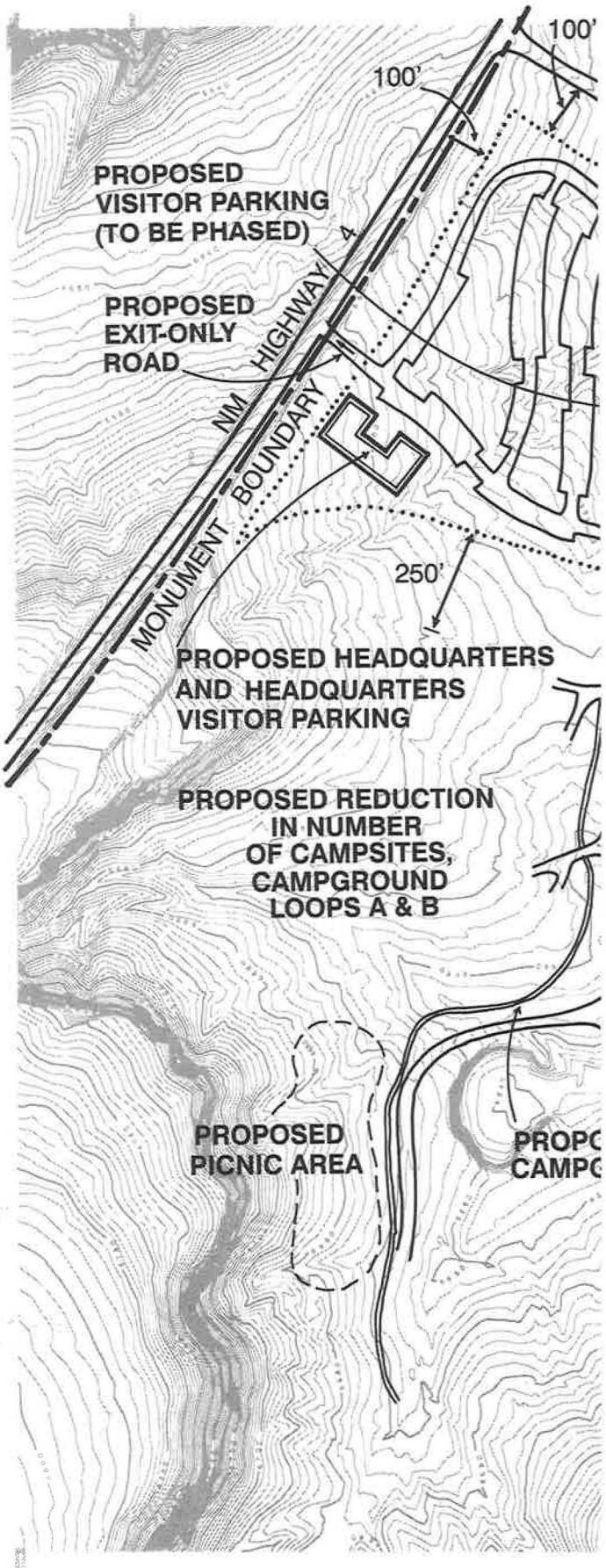
Headquarters and Maintenance. A new monument headquarters building would be constructed on the northwest side of the shuttle parking area and about 200 feet from the nearest point of campground loop A. This facility would include offices for all monument divisions including resource management. Some small satellite offices would also be provided in the canyon and the new maintenance area for greater efficiency of those operations. The headquarters building would be about 15,000 square feet. Ten parking spaces would be provided in front of the new headquarters building for those doing business there.

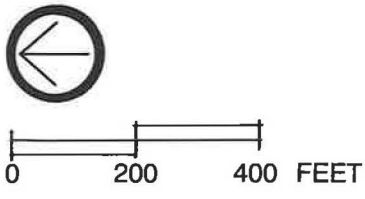
A maintenance facility, including all maintenance divisions, emergency vehicle facilities, some small offices, and the storage boneyard, would be on the mesa northwest of the sewage lagoons and southeast of the mesa staff housing. The buildings would be designed to reduce or mitigate wilderness viewshed impacts by using such measures as dispersing the various buildings within the development

FRIJOLES CANYON

PREFERRED ALTERNATIVE:

MESA-TOP VISITOR CONTACT STATION, HEADQUARTERS, AND MAINTENANCE FACILITY SITE PLAN





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area to visually reduce their mass, siting them in a low area, setting the floor elevation as low as possible, building them into the slope to the greatest extent possible, orienting windows away from the wilderness area to reduce reflections there, using building materials and colors that are compatible with the development area, planting vegetative screening, and minimizing tree removals.

Wastewater Treatment. Bandelier has two independent sewage lagoon systems. The mesa system, south of the mesa housing area, is currently operating at its capacity. This lagoon system is surrounded by archeological sites, and the general area around the lagoons is the only site available for the new maintenance facility described in this preferred alternative.

The lower lagoon system, south of the entrance road, was expanded onto neighboring DOE land in 1993. That expansion used all the available land in that area. This system treats the wastewater from Frijoles Canyon and currently has an excess capacity. Most wastewater treatment demand now originates in Frijoles Canyon. However, implementing the preferred alternative would require all visitors to stop at the proposed visitor contact station on the mesa before entering the canyon, transferring most of the wastewater treatment demand on the smaller mesa system.

The preliminary engineering analysis of wastewater treatment systems considered an existing and a high visitation scenario. The existing scenario is predicated on the current 422,000 annual visitors. The high visitation scenario assumes 500,000 annual visitors (the projected visitation for the year 2000; see the "Visitor Use" section in the "Affected Environment"). In both scenarios all variables except the number of visitors remained the same, including employee housing location and monumentwide water conservation measures. (The park staff and planning team consider 500,000 annual visitors to exceed the capabilities of the staff, facilities, and resources to serve the public without sustaining significant damage to the resources and degrading the visitor experience.)

The analysis found that the existing demand level (422,000 annual visitors) will exceed the capability of the mesa lagoon system if the preferred alternative is implemented. It also confirmed that the lower lagoon system has excess capacity, and that the capacity of the lower system and the mesa system combined would be more than adequate to treat the wastewater generated from the existing level of visitation. The same finding was reached for the high visitation scenario with 500,000 annual visitors.

The monument staff should identify the desirable visitation level to preserve the resources and the visitor experience. Because this visitation level has not been determined, the National Park Service should assume the high visitation scenario and increase the mesa lagoon system capacity to serve 500,000 visitors.

Three options for increasing the capacity of the mesa lagoon system follow.

1. A new lagoon could be constructed to increase capacity, but this would create a new visual intrusion and would impact other development and archeological sites. Development would have to be done at a third site. None of these outcomes is favored by the staff at the monument or the NPS regional office.

   Resources potentially affected: A new lagoon would create a new visual intrusion and would disturb about 1.3 acres of vegetation and soil, potentially impacting development and

archeological sites as well as threatened and endangered species.

2. An evapotranspiration bed could be constructed instead of a lagoon and would have to be built at a third treatment site. It would provide treatment equal to or better than a lagoon.

   Resources potentially affected: This system would be less visually obtrusive than the lagoon option because it would be covered with wetland vegetation instead of being an open water surface. This system would disturb about 1.8 acres of native vegetation and soil. It would potentially impact archeological sites and could potentially introduce exotic emergent plants into the semiarid piñon-juniper environment of the monument.

3. Connecting the two existing lagoon systems by piping would combine their capacities, effectively enlarging the mesa system and still having the capacity to treat all the wastewater generated under the high visitation scenario.

   Resources potentially affected: Piping location would use the existing roadway disturbed area for about 7,200 linear feet, but new disturbance to vegetation and soil would be required for about 2,600 linear feet (about 1.8 acres) of pipeline outside the roadway (see previous Frijoles Canyon/Mesa Existing Conditions map). Archeological sites and threatened and endangered species could also be affected.

An intense conservation program should be implemented to reduce water consumption regardless of the option chosen. The installation of water-conserving toilets already underway would continue and would include the installation of low-flow fixtures of all kinds, not just toilets. Composting toilets could be installed where possible, as well as a gray water reuse system.

Any of the above options would treat and dispose of wastewater generated in the monument. Additional options that would provide satisfactory treatment are also possible. Because the overall effect on the monument environment is such a strong consideration, a value analysis should be undertaken by the park, region, and Denver Service Center to determine the most appropriate alternative. Value analysis is a method applied by a diverse group of participants to identify functional alterative solutions to a problem. The alternatives are then compared and ranked according to selected criteria (e.g., resource impact, routine maintenance required, and life-cycle costs), which are then weighted by the group in terms of their importance to the specific project.

Because the most appropriate alternative cannot be determined until the design phase value analysis is completed, consultation with appropriate agencies (the state historic preservation office, the U.S. Fish and Wildlife Service, etc.) would be conducted to determine what mitigation is required for impacts from the wastewater system to cultural and natural resources.

Until the value analysis is completed and the design concept is determined, this plan will assume option 3 above solely for the purpose of estimating development costs. This option includes a lift station, piping, trenching, and roadway patching. The cost estimate could change when the actual design concept is determined.

Water. Domestic water is supplied to the park by the Department of Energy (DOE) at Los Alamos. There is no capacity problem for this supply.

Electricity. Monument electricity is supplied by the Department of Energy at Los Alamos. There is no capacity problem for this supply.

Natural Gas. Natural gas is supplied to the monument by the Department of Energy at Los Alamos. There is no capacity problem for this supply.

Telephone. Monument telephone service is provided mainly by U.S. West. Only the FTS-2000 service is supplied by AT&T. The existing 41-line telephone system is now full and has no expansion room.

New telephone service will be required to provide the 60 office and 33 residential telephones the monument estimates are needed. U.S. West Communications service to the Department of Energy and the monument is carried on poles (aerial lines) from White Rock. The new service would be carried on those same poles to a feeder box, requiring no new easement, ground disturbance, or poles. From the feeder box, telephone service would be extended along existing roadways to the canyon and mesa facilities.

Picnic Facilities. A universally accessible picnic area would be provided on previously undisturbed land on the mesa north of the campground access road between campground loops B and C. The existing Cottonwood picnic area in the canyon would be retained, but the density of picnic sites would be significantly reduced. Designated picnic sites would be delineated and hardened, while the rest of the former picnic area would be restored to a natural condition. Streambank stabilization would be required through much of the former picnic area, and there would be provision for limited stream access from designated picnic sites on hardened trails.

Housing. Staff housing on the mesa would remain unchanged.

Restrooms. The existing canyon restrooms in buildings 1 and 9 cannot be easily modified to make them accessible for visitors with disabilities. Accessible restroom facilities would be added between buildings 9 and 2, and they would be elevated about 2 feet to remove them from the 100- and 500-year floodplains. Another accessible restroom would be constructed adjacent to building 15 on the south. Accessible restrooms would also be provided at the new mesa visitor contact station.

Stable and Corral. The existing stable is a historic building and would continue to function as a stable. The existing large corral is not a historic use and has recently been reduced to one-third of its original size; the area no longer in use was revegetated. The corral would remain as it is.

Proposed Uses of the Historic District Buildings. Building 1 would continue to be used as restrooms that are not accessible to visitors with disabilities (see Frijoles Canyon, Preferred Alternative — Proposed Historic District Building Uses map). To make it accessible would require alterations to the structure and site, which would degrade its historic integrity (see appendix A).

Building 2 would be made universally accessible and would continue in its current use as the visitor center for the monument. Some interpretive and resource functions might be relocated to other CCC structures. The theater function would be provided in the new visitor contact station on the mesa.

Building 3 would be converted from its current use as a maintenance warehouse/office to a first aid station and offices for the protection/law enforcement and

emergency medical treatment staff assigned to the canyon.

Building 4 would continue as a maintenance work area and carpentry shop. However, it would no longer be the monument's primary maintenance facility.

Building 5, the gas and oil house, would be converted to a maintenance or law enforcement function, probably as storage.

Building 6 would remain as a storage facility for maintenance materials, fire cache, and search and rescue equipment.

Buildings 7, 8, 10, 11, and 32 would retain their current use as staff residences.

Building 9 would retain its current use and condition as restrooms. Restrooms that are accessible to visitors with disabilities would be added on the northwest side of the building.

Building 12 would be made universally accessible and would be converted from library/storage to an interpretive facility.

Building 13 would be made universally accessible and would be converted from training room to an interpretive facility.

Building 14, currently used for storage, would be converted to an interpretive use.

Building 15 would be made universally accessible and would be converted from its current use as monument headquarters to an interpretive use, presenting one of several facets of the expanded interpretation program.

Building 16 would be converted from administrative offices to interpretive offices and workspace. With its several level changes (up eight steps) and historic configuration of small separate rooms, it would not be accessible to staff or visitors with disabilities.

Building 17 would be made universally accessible and would be converted from a concession facility to an interpretive use such as cooperating association sales area or CCC interpretation area.

Building 18 would continue as interpretive offices; it would also be used as a conference workroom. Because access is primarily through building 16, it would not be made universally accessible.

Buildings 19, 20, 28, the west half of 24, and the south two units of 27 would continue to be used as housing facilities. Any curatorial or other storage functions they fulfill would be relocated to the new headquarters building on the mesa.

Building 21 would continue to be a storage facility, laundry, and utility distribution point for the cabin housing area. The herbarium would be relocated to the new headquarters building.

Building 22 would continue as the powerhouse, housing transformers for monument electrical power.

Building 23 and the east half of 24 would be converted from their current office uses to housing.

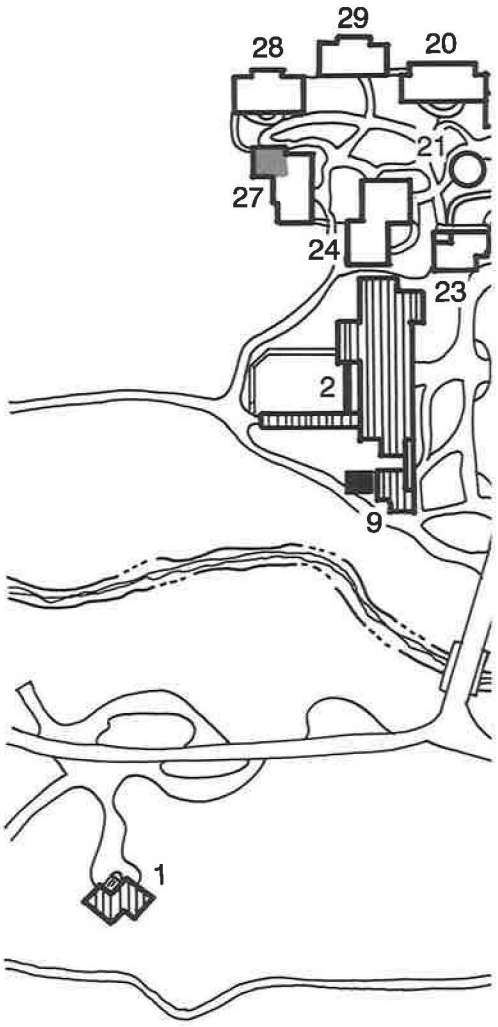
Building 25 would continue to be the stable and tack room. The adjoining small corral area and the large turn-out corral south of it would remain as they are.

Building 26 would be made universally accessible and would remain as the entrance station.

The north unit of building 27 would be converted to storage use only.

FRIJOLES CANYON

PREFERRED ALTERNATIVE: PROPOSED HISTORIC DISTRICT BUILDING USES



VISITOR FACILITY

CONCESSION FACILITY

ADMINISTRATIVE FACILITY

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Building 29, the curatorial storage area/resource management office, would be converted to housing. Building 30 would remain as a fire lookout.

CCC historic district courtyards include the small patio area northwest of the museum, the small courtyards on either side of building 18 (the Frey apartment), the courtyard northwest of building 17 (the gift shop), and the main courtyard between buildings 15 (headquarters) and 17 (food service concession). Interior open spaces include the lawn area behind building 2 (visitor center), the central open area surrounded by the lodge cabins, and the paved enclosed areas southeast of building 15 (headquarters) and between buildings 3, 4, 5, and 6 (the canyon maintenance complex).

All the courtyards and interior open spaces in the CCC historic district would maintain their current uses except for the main courtyard between buildings 15 and 17 and the paved enclosed area southeast of building 15. The main courtyard is now an outdoor lunchroom. Under the preferred alternative it would be made universally accessible and used as a place for relaxation and socialization, as originally designed. The paved enclosed area southeast of building 15 would be made universally accessible and become an interpretive demonstration area, displaying Native American arts and crafts.

Accessibility. Provisions would be made to accommodate the needs of special populations who visit the monument (see appendix A). Special populations include those with sight, hearing, and mobility impairments as well as the elderly, children, and non-English-speaking populations.

Visitor facilities and administrative areas would be designed or rehabilitated for appropriate access to comply with Public Law 90-480, the Architectural Barriers Act, and the Americans with Disabilities Act of 1990. Sufficient access to visitor facilities would be provided to ensure that visitors with disabilities have the same information and experiences for safe and meaningful visits to the monument.

The historic structures would require special treatment, and any proposals for modifications must be done by a qualified historic architect with appropriate 106 consultation.

Lighting. For implementation, this alternative would require security and safety lighting for many of the new facilities. At night excess light is as much a viewshed intrusion as a large structure is in the daytime. Where exterior lighting is necessary, it should be designed to minimize excess light and confine the light to the area requiring illumination. This can be accomplished by using lower wattages and light shields, among other treatments. Also, existing lighting needs should be reviewed regarding the potential for retrofitting them to reduce light pollution.

Revegetation. Revegetation would be accomplished with plants from the monument's existing gene pool. Preparations for revegetation operations, including plant propagation, seed collection, and the salvage of native soil and plants from construction sites, should begin three or more years before construction. Formal landscaping would not be done in development areas. Naturalized plantings would be used in these areas.

Resource Protection

Existing resource management policies and measures would continue.

Boundary Adjustments and Land Protection

No boundary adjustments would be needed to implement this alternative.

Plan Implementation

Legislative Actions Required to Permit the Action to Occur. No legislative actions would be required to implement this alternative.

Additional Studies Required. A *highway access safety study* should be completed before any development or construction to determine the degree of risk to visitors as they enter and leave the monument.

A *visitor experience/resource protection study* (VERP) is needed to assess the impact of implementing this alternative on the visitor experience and the cultural and natural resources. The General Authorities Act of 1978 (PL 95-625) and NPS *Management Policies* require that general management plans address the issue of visitor carrying capacity. The current VERP study team's working definition defines carrying capacity as the type and level of visitor use that can be accommodated while sustaining the desired resource and social conditions that complement the purposes of the park system units and their management objectives. Every effort would be made to conduct the VERP study before the obligation of construction money.

Because Bandelier National Monument hosts more than 360,000 visitors a year and 95% of this use occurs in and around Frijoles Canyon, there is high potential for visitor use to damage monument resources. Also, many visitors using the site at one time affects visitors' experiences at the monument. It is therefore important to explore the concept of carrying capacity in planning monument infrastructure and visitor management programs.

A *sewage treatment system study* is recommended to verify expected demand and determine the needed treatment capacity.

Staffing. The projected increases in visitation would require additional staff for maintenance, wastewater treatment, visitor and resource protection, and interpretation. Fewer staff would be dedicated to parking and traffic control.

Action Plan. Monument staff and the regional safety officer would prepare an emergency action plan for structures in the 100-year and 500-year floodplains, which would identify actions to be taken to limit risks to people and property.

TABLE 1. FRIJOLES CANYON, PREFERRED ALTERNATIVE 1, DEVELOPMENT COST ESTIMATES

ITEM DESCRIPTION	QUANTITY AND UNIT	GROSS CONSTRUCTION COSTS	ADVANCE & PROJECT PLANNING COSTS	TOTAL PROJECT COSTS
Studies Required				
Visitor experience/resource protection study	LS	$100,000	-	$100,000
Highway access safety study	LS	12,500	-	12,500
Mesa Visitor Facilities				
Shuttle buses	5	450,000	-	450,000

TABLE 1. FRIJOLES CANYON PREFERRED ALTERNATIVE 1, DEVELOPMENT COST ESTIMATES (CONT.)

ITEM DESCRIPTION	QUANTITY AND UNIT	GROSS CONSTRUCTION COSTS	ADVANCE & PROJECT PLANNING COSTS	TOTAL PROJECT COSTS
Mesa Visitor Facilities (cont.)				
Visitor contact/shuttle station:				
building with theater	4,500 SF	1,768,500	337,500	2,106,000
concrete patio waiting area	1,000 SF	6,600	1,200	7,800
wood shade structure	1,200 SF	47,200	9,000	56,200
Shuttle access road (asphalt)	1,350 SY	84,900	16,200	101,100
Visitor parking lot (asphalt) with petro-trap catch basin	14,000 SY	917,000	175,000	1,092,000
Sidewalks (concrete)	4,300 SF	28,200	5,400	33,600
New Frey Trail link (stabilized earth)	12,500 SF	212,900	40,600	253,500
New campground access trail	9,600 SF	163,500	31,200	194,700
Mesa picnic area:				
accessible picnic sites w/tables	25	55,700	10,600	66,300
trash receptacles	5	2,600	500	3,100
recycle bins	3	1,600	300	1,900
Mesa Headquarters/Maintenance Facilities				
Headquarters building	15,700 SF	2,776,500	529,900	3,306,400
Headquarters staff and visitor parking	2,300 SY	150,700	28,800	179,500
Maintenance building	10,100 SF	1,653,900	315,600	1,969,500
Maintenance truck garage addition	3,500 SF	68,800	13,100	81,900
Equipment shed	5,100 SF	253,900	48,500	302,400
Paint storage building	360 SF	43,200	10,800	54,000
Gravel maintenance yard	16,400 SY	601,600	114,800	716,400
Loading dock	1	39,300	7,500	46,800
Security fence around maintenance complex	2,100 LF	99,000	18,900	117,900
Underground utility extensions:				
water	2,000 LF	83,800	16,000	99,800
electric	3,200 LF	150,900	28,800	179,700
telephone				
main feeder line	LS	125,000	-	125,000
service extensions	19,400 LF	44,000	-	44,000
trenching (rock)	19,400 LF	152,500	29,100	181,600
natural gas	2,850 LF	74,700	14,300	89,000
wastewater treatment:				
lift stations	1	190,000	36,300	226,300
sewer lines (includes trench and road repair)	9,800 LF	487,800	93,100	580,900
Frijoles Canyon Area				
Convert CCC cabins to staff housing:				
Building 23	950 SF	62,200	11,900	74,100
Building 24, east half	1,000 SF	65,500	12,500	78,000
Building 29	1,,300 SF	85,200	16,300	101,500

TABLE 1. FRIJOLES CANYON PREFERRED ALTERNATIVE 1, DEVELOPMENT COST ESTIMATES (CONT.)

ITEM DESCRIPTION	QUANTITY AND UNIT	GROSS CONSTRUCTION COSTS	ADVANCE & PROJECT PLANNING COSTS	TOTAL PROJECT COSTS
Frijoles Canyon Area (cont.)				
Accessible Restrooms				
Building 15	400 SF	15,700	3,000	18,700
Building 9	270 SF	10,600	2,000	12,600
Rehabilitate structures for interpretation:				
Library building 12	800 SF	225,300	43,000	268,300
Training building 13	1,300 SF	366,100	69,900	436,000
Administration building 15	4,400 SF	1,239,300	236,500	1,475,800
Concession building 17	2,000 SF	563,300	107,500	670,800
Visitor center building 2	5,000 SF	1,408,300	268,800	1,677,100
Rehabilitate structures for administration:				
Maintenance warehouse building 3	1,400 SF	91,700	17,500	109,200
Administration offices building 16	2,700 SF	176,900	33,800	210,700
Administration offices building 18	1,400 SF	91,700	17,500	109,200
Removals				
Remove 10 campsite pads (asphalt)	530 SY	9,000	1,700	10,700
Remove White Rock housing area				
Asphalt pavement	2,400 SY	40,900	7,800	48,700
6 modular buildings and 3 storage sheds	3,600 SF	12,700	2,400	15,100
4 carports	1,100 SF	3,900	700	4,600
Canyon picnic area pavement (asphalt)	1,350 SY	23,000	4,400	27,400
Backpackers' parking lot pavement	1,200 SY	20,400	3,900	24,300
Site Work				
Revegetate mesa-top segment of Frey Trail	11,700 SY	76,600	14,600	91,200
Revegetate backpackers' parking area	7,700 SY	50,400	9,600	60,000
Revegetate White Rock housing area	13,400 SY	87,800	16,800	104,600
Revegetate mesa visitor facilities	13,300 SY	87,100	16,600	103,700
Revegetate headquarters and maintenance facilities	5,700 SY	37,300	7,100	44,400
Revegetate canyon picnic area	1,350 SY	8,800	1,700	10,500
TOTAL ALTERNATIVE COSTS		**$15,706,500**	**$2,860,500**	**$18,567,000**

LF = linear feet; LS = lump sum; SF = square feet; SY = square yards

NOTE: Total costs presented are gross figures, which include advance planning, design, construction drawing preparation, construction supervision, and facilitating administrative services. Estimates are class C, meaning they are derived from average costs for similar facilities in other NPS areas.

ALTERNATIVE 2 — NO ACTION

Summary

This alternative proposes no significant change in the monument management. There would be no new developments and no major changes in management direction. Tour buses would still enter the canyon throughout the year and operate as they now do. Diesel-powered vehicles (buses) would still bring passengers into the canyon and return to the mesa to park, as they now must do.

General Development

This alternative would result in no new development. Historic structures would still house administrative and maintenance functions. The *Final Master Plan* and *Interpretive Prospectus* would continue to be in effect, and existing resource protection plans and measures would continue.

Resource Protection

Existing resource management policies and measures would continue.

Boundary Adjustments and Land Protection

No boundary adjustments would be required.

Plan Implementation

No legislative actions, additional studies, or staffing changes would be needed to implement this alternative.

ALTERNATIVES CONSIDERED BUT REJECTED

Other alternatives considered for Frijoles Canyon differed only in development location. The development sites considered were within or adjacent to the monument or in the town of White Rock.

The Town of White Rock

White Rock was considered as a location for a new headquarters and administrative building, maintenance facility, and visitor center/shuttle station under the mandatory shuttle alternative. Law enforcement and interpretive rangers would comprise most of the staff remaining at the monument. The monument housing and campground facilities would remain unchanged.

To locate NPS facilities at White Rock would fragment monument operations (maintenance and headquarters) and significantly increase travel costs for staff and equipment to travel to and from the monument. A visitor contact and shuttle bus station at White Rock would relieve congestion in the monument but increase shuttle operating costs and double the travel time for a round-trip. Highway 4 also has sharp curves and steep grades, requiring reduced speeds.

Being 8 miles from the monument entrance, the White Rock site would confuse people about where they should enter the monument. Visitors might drive past White Rock to the monument entrance only to be sent back to board a shuttle, or they could come to the monument by a route that does not pass through White Rock, missing the visitor contact/shuttle station entirely. The White Rock site was rejected due to its distance from the monument, which would increase operating costs, create operational inefficiencies, and be inconvenient for visitors.

Department of Energy Sites

Two sites outside the monument on Department of Energy (DOE) land, both about 1.5 miles north of the monument entrance, were considered for the new maintenance and administrative facilities and staff parking. These sites would have required access and parking development and utility extensions.

Computer viewshed analysis determined that the two DOE sites had greater impact on the views from the wilderness areas than two nearly identical development sites across the road to the west, which are already in the monument. The DOE sites had several other disadvantages: they would require negotiation to obtain; their hazardous materials status was unknown; and their development would increase distance and travel time to the developed monument areas and reduce staff efficiency. For these reasons the two DOE sites were rejected before being incorporated into any fully developed alternative.

Ponderosa Campground

Ponderosa Campground was considered for the development of maintenance and corral facilities. The site had adequate development space and appeared well suited for the corral function. It would also reduce the travel time (on horseback) for the backcountry trails maintenance and archeological crews, saving about half a day over the Frijoles Canyon facility.

An interim plan to reduce the negative impacts of the canyon horse corral was implemented while this campground option was being examined, and it was decided to table any further corral relocation options until the success of the current solution was assessed. The solution appears to be working well, and there is no longer a need to relocate the corral facility. The site was not efficient for a maintenance facility due to its distance from other monument operations and developed areas, which require the most maintenance. This site was rejected because of its distance from the main visitor area, the reduced need to relocate the corral, the fragmentation of the operations at the monument, and the potential for maintenance and corral development to conflict with the existing group camping use.

Mandatory Shuttle, Visitor Facilities at Juniper Campground, and Maintenance at Satellite Site

An alternative to develop separate visitor and administration/maintenance facilities on the mesa was developed and analyzed. The visitor facilities included a visitor contact station and shuttle terminal, a 260-car parking lot, RV and tour bus parking, and picnicking on the mesa. The Juniper Campground and several of the existing access roads there would be removed, and camping would no longer be provided except for the group camping at Ponderosa Campground. The complete interpretive program would be presented in the historic CCC structures in the canyon.

Under this alternative, it would be mandatory year-round for all visitors to ride a shuttle bus to the canyon to relieve parking congestion there. With no need for canyon visitor parking (120 cars), the picnic area parking and the backpackers' parking lot there would be removed and only the historic central parking lot would be retained. Administration and maintenance would be relocated to new facilities at a site 1.25 miles north of the monument entrance where there would be ample space for those activities and their operational activities would not intrude on visitors or degrade the visitor experience.

This alternative required removing Juniper Campground and losing that service to the public unless non-NPS organizations developed campgrounds locally. The distance to the new administration and maintenance facility would be less efficient, fragment staff, decrease staff efficiency, and cause unnecessary costs in staff travel time and fuel consumption. The new maintenance facility could be seen from the wilderness area and would disturb a previously undeveloped area of the monument. For these reasons, this alternative was rejected.

Mandatory Shuttle and All Development Southeast of the Entrance Station Site

An alternative was developed and analyzed to consolidate visitor, administrative, and maintenance facilities in a linear strip along NM 4 immediately southeast of the monument entrance station and access road on the mesa. Visitor facilities included a visitor contact station, a shuttle terminal, and parking for visitors, tour buses, and RVs. Food service and gift shop concessions would be removed from the monument. It would be mandatory year-round for visitors to ride the shuttle to the canyon.

The full interpretive program would be presented in the canyon CCC buildings. Administrative offices would be southeast of the visitor parking, followed by staff parking and the new maintenance facility. Maintenance and administrative staff would share one staff parking lot. The Juniper Campground would not be disturbed in this alternative. The backpackers' parking lot and picnic area parking in the canyon would be removed.

This alternative would have made it difficult to screen parking and maintenance facilities from the monument entrance and the highway, and space constrictions dictated a long, linear layout of facilities. This would create traffic safety hazards for staff and visitors entering and leaving the monument on NM 4. Another reason for rejecting this alternative was its proximity to sensitive species habitat.

Mandatory Shuttle and All Development at Juniper Campground Site

An alternative was developed and analyzed that consolidated visitor, administrative, and maintenance facilities at the Juniper Campground site on the mesa. Visitor facilities included a visitor contact station, a shuttle terminal, a picnic area, and parking for visitors, tour buses, and RVs. Food service and gift shop concessions would be removed from the monument. It would be mandatory year-round for visitors to ride the shuttle to the canyon.

The full interpretive program would be presented in the canyon CCC buildings. Administrative offices and staff parking would be east of the visitor parking. The new maintenance facility would be northeast of the visitor parking and north of the administrative offices. Maintenance and administration staff would share parking. The Juniper Campground would be removed in this alternative, as would the backpackers' parking lot and picnic area parking in the canyon.

This alternative was rejected because it required removing the campground, which is a use the Park Service desires to maintain at the monument.

Mandatory Shuttle and All Development at DOE Site TA-33

An alternative was developed and analyzed that consolidated visitor, administrative, and maintenance facilities at DOE

site TA-33, on NM 4 adjacent to the monument on the south. This alternative required all visitors to ride a shuttle bus to the canyon. Visitor facilities included a visitor contact station, a shuttle terminal, a picnic area, and parking for visitors, tour buses, and RVs. Food service and gift shop concessions would be removed from the monument and would not be provided at the new visitor contact station.

A new access road would be needed to provide safe access and egress to this site, and several existing buildings belonging to the Department of Energy would need to be removed. The full interpretive program would be presented in the canyon CCC buildings. The administrative offices, staff parking, and maintenance facility would be several hundred feet south of the visitor parking. Maintenance and administration staff would share parking. The Juniper Campground would be undisturbed in this alternative. The backpackers' parking lot and picnic area parking in the canyon would be removed.

This alternative was rejected for a variety of reasons. There is a high probability the site is contaminated with nuclear material, precluding NPS acquisition until it has been cleaned up by the Department of Energy. Waiting for this cleanup operation would postpone solving several urgent problems at the monument. Even after the cleanup, the site would remain under DOE jurisdiction and be jointly occupied by the Department of Energy and the National Park Service due to ongoing DOE scientific operations that would remain there. This would relegate NPS development to less suitable areas of TA-33.

Current vehicular access to TA-33 is not safe, and a new access road would be required. The site also includes critical peregrine falcon habitat (an endangered species), which must not be disturbed.

Visitor Services and Interpretation on the Mesa

An alternative was developed to provide visitor facilities at Juniper Campground and resources management offices and maintenance facilities at a satellite site 1.25 miles north of the monument entrance along NM 4 on the mesa. This is similar to another rejected alternative except that the visitor facilities included a visitor center to present the full interpretive message on the mesa instead of in the canyon, there would be no mandatory shuttle for visitors, several administrative offices would remain in the historic CCC buildings in the canyon, and only half of Juniper Campground was removed. Mesa visitor facilities also would include a picnic area and parking for visitors, tour buses, and RVs.

Visitor parking capacity on the mesa would total 200 cars plus RV and tour bus parking. The backpackers' and picnic area parking in the canyon would be removed, leaving only the 60 spaces in the historic central parking lot. Food service and gift shop concessions would be removed from the monument. All visitors would be directed to the visitor center, where they would receive the interpretive messages while they waited for a parking space to open up in the canyon. Only when a space became open would they be allowed to take their vehicle to the canyon, and canyon congestion would be controlled by allowing only 60 cars there at one time. The new maintenance facility and resource management offices would be 1.25 miles north of the monument entrance.

This alternative would remove half of the Juniper Campground facilities, which the Park Service desires to maintain, and make it more difficult for visitors to experience the canyon and the primary resources. Resource management offices and maintenance would be developed in a previously

undisturbed area. It also required visitors to wait at the mesa visitor center parking lot for a parking space to open in the canyon or hike to the canyon on the Frey Trail.

The waiting required under this alternative would create frustration for visitors and increase the potential for visitors to leave without seeing the resources. The new resource management offices and maintenance facility would be less efficient, fragment staff, decrease staff efficiency, and cause unnecessary costs in staff travel time and fuel consumption. These facilities could also be seen from the wilderness and thus would be a visual impact, and they would disturb a previously undeveloped area of the monument. For these reasons, the alternative was rejected.

Minimum Change

An alternative was developed that reduced canyon parking, provided overflow parking on the mesa and developed administration and maintenance facilities at a satellite site 1.25 miles north of the monument entrance. It differed from other alternatives because it maintained all the existing parking in the canyon and provided only overflow or "waiting" parking on the mesa. As space became available in the canyon, staff would allow the appropriate number of vehicles into the canyon. The entire interpretive function would be maintained in the canyon by expanding interpretation into the historic canyon structures vacated by administration and maintenance. No interpretation would have been offered on the mesa.

This alternative required additional staff to regulate the flow of visitors from the mesa to the canyon. The wait would be inconvenient and frustrating to visitors, especially during times of heavy monument use. This alternative also required removing a portion of Juniper Campground for parking and disturbing a previously undisturbed area for administration and maintenance. For these reasons, the alternative was rejected.

THE ALTERNATIVES FOR TSANKAWI

Four alternatives were originally considered for Tsankawi. Of these, two were rejected. The two remaining alternatives represent the full range of development that can be feasibly recommended at Tsankawi. Alternative A is the preferred alternative. There is no true no-action alternative for Tsankawi. All the alternatives involve action of some kind because the existing parking lot at Tsankawi will be removed by a state highway widening project, regardless of whether the Park Service undertakes any development action there or not. This parking area must be replaced, so there will be some action under any alternative.

ALTERNATIVE A — PREFERRED ALTERNATIVE — MAXIMUM PROTECTION/MODERATE USE

Summary

Under this alternative Tsankawi would remain open. A new visitor contact station and a new 30-car parking lot would be constructed. Two full-time rangers would be stationed at the site, and a staff residence would be constructed there. Management emphasis would be on interpretation and protection.

General Development

Both natural and cultural resources at Tsankawi are fragile and particularly vulnerable to human activity. Sensitive areas cover nearly the entire site, including both large mesas, the valley between them, Duchess Castle, and the valley south of the south mesa. To protect the resources, there would be no development in those areas. There are two limited development sites: the current parking and entrance area and the area about 700 feet south of the intersection of NM 4 and East Jemez Road (see Tsankawi, Alternative A — Preferred Alternative — Site Plan).

Resource protection would be stressed, and only a moderate level of visitor use would be allowed. The goal at Tsankawi would be to minimize any development footprint and locate modern facilities as unobtrusively as possible. This would require sensitive site planning and the application of sustainable design principles. Given the nature of the topography, the location of resources, the viewshed of the site, and acceptable vehicle access points, there would be no NPS development on the highly visible north and south sides of Tsankawi, on the south mesa where the major resources are, or at the Duchess Castle. All development would be on the southwest corner of the Tsankawi site. Due to the terrain, full site accessibility cannot be achieved without compromising the resources. Wherever possible the resources and facilities would be made accessible.

A visitor experience/resource capacity (VERP) study for this site should be completed before facility design. An access study is strongly recommended to verify the safety assumptions made for vehicular access points.

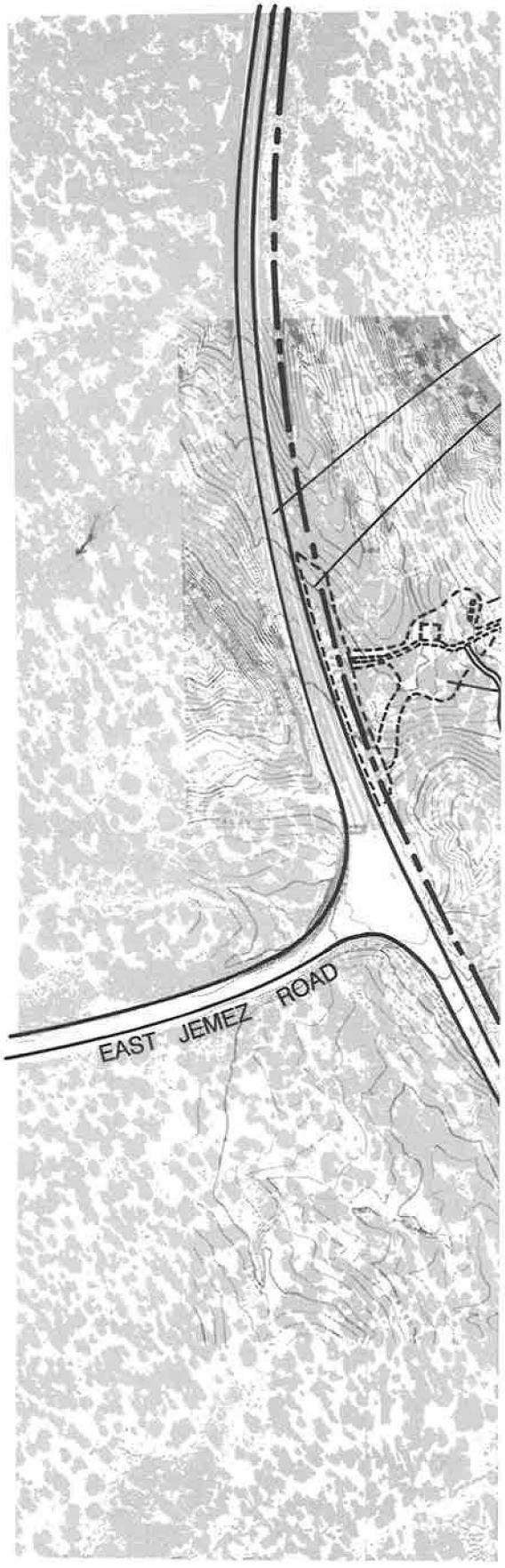
At this time the state is planning to improve the portion of NM 4 that abuts Tsankawi on the west. The highway will be widened, eliminating the existing parking and pedestrian access along the western edge of Tsankawi. The current parking area, within the NM 4 right-of-way, is not on NPS property.

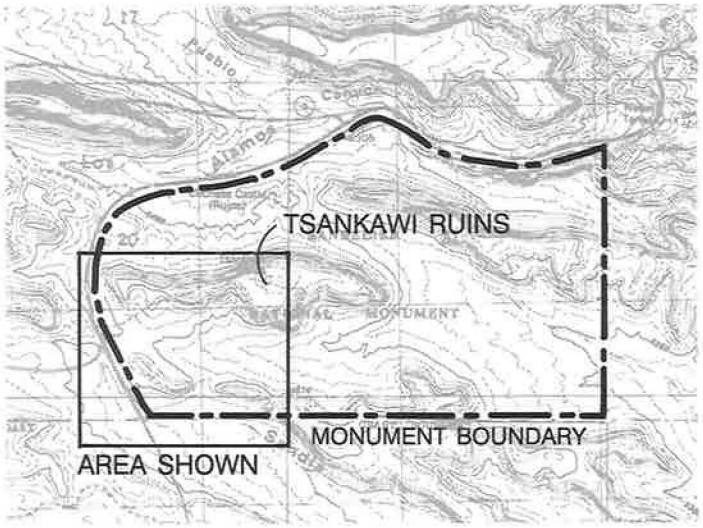
Access and Parking. Access would be from NM 4 at a point about 700 feet south

TSANKAWI

ALTERNATIVE A

PREFERRED ALTERNATIVE: SITE PLAN





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of its intersection with East Jemez Road. This location is a safe distance from East Jemez Road, has good sight distance, impacts the least existing vegetation, and minimizes ground disturbance by most closely matching grades with NM 4. Visual inspection of other possible access points showed that any other new entrance point would incur considerable costs for grading and revegetation. The proposed location has the added advantage of being hidden behind a small mesa, outside the viewshed of the south mesa but still adjacent to NM 4 and easily seen by visitors.

A 30-car, gravel parking lot would be provided at Tsankawi, just east of NM 4 at the site described above. The capacity of the parking lot would ensure that only the desired number of visitors would use the facility at one time, protecting the resources from overuse and the visitors from overcrowding.

Visitor Contact Station. A new universally accessible visitor contact station would be provided adjacent to the parking lot. It would be about the size of the existing contact station and would include a ranger work area, information/fee collection counter, interpretation/orientation area, visitor rest area, universally accessible restrooms, and vending machine services. Provisions would be made to ensure that visitors with disabilities have the same information and experiences for safe and meaningful visits to the monument.

Trails. A new trail would be constructed from the parking lot to the existing contact station area where it would connect with the existing trail system, causing a small net increase in trails. The new trail surface would be hardened for wear resistance in a manner that is compatible with the site's resources. Mitigation measures would also be developed to preserve the historic and prehistoric trails at Tsankawi.

Interpretation. Expanded interpretation is not necessarily desirable at Tsankawi. The tranquil setting provides a unique visitor experience, and the absence of development protects the site and resources from overuse. In this alternative there would be two full-time rangers stationed at Tsankawi. All visitor information would be supplied at the visitor contact station where one ranger would be based. The other ranger would be a roving interpreter whose presence would aid resource protection by deterring vandalism. There would be no increase in interpretive signs along the trails.

Housing. A duplex residence would be provided near the visitor contact station to allow a full-time onsite NPS presence. The residence would be 2,500 square feet, including a 1,200-square-foot staff residence, a 900-square-foot seasonal residence, and a double garage between them.

Removals. The existing parking area, entrance gate, access trail, visitor contact station, restrooms, and brochure boxes would be removed. The area would be restored to a natural state.

Revegetation. Revegetation would be accomplished with plants from the monument's existing gene pool. Preparations for revegetation operations, including plant propagation, seed collection, and the salvage of native soil and plants from construction sites, should begin three or more years before construction. Formal landscaping would not be done in development areas. Naturalized plantings would be used in these areas.

Resource Protection

Two full-time staff would be assigned to Tsankawi during normal open hours. Also, the proposed residence units would allow

for a round-the-clock NPS presence at Tsankawi.

Boundary Adjustments and Land Protection

No boundary adjustments would be necessary.

Plan Implementation

Additional Studies Required. A visitor experience/resource protection study and a highway access safety study should be completed before any development or construction. These studies will determine the degree of risk to the visitor experience and the resources and the risk to visitor safety from implementing this alternative.

Staffing. This alternative requires two additional full-time rangers stationed at the site. At least one ranger would reside on the site, providing a full-time NPS presence there.

TABLE 2. TSANKAWI PREFERRED ALTERNATIVE A, DEVELOPMENT COST ESTIMATES

ITEM DESCRIPTION	QUANTITY AND UNIT	GROSS CONSTRUCTION COSTS	ADVANCE & PROJECT PLANNING COSTS	TOTAL PROJECT COSTS
Studies Required				
Visitor experience/resource protection study	LS	$100,000	-	100,000
Highway access safety study	LS	12,500	-	12,500
Visitor Facilities				
Access road and turn lanes (asphalt)	1,100 SY	72,100	13,800	85,900
Parking lot (gravel)	1,111 SY	40,800	7,800	48,600
Sidewalks (concrete)	2,175 SF	14,200	2,700	16,900
Visitor contact station w/accessible restrooms	600 SF	90,400	17,300	107,700
Patio rest area:				
Concrete patio	500 SF	3,300	600	3,900
Wood shade structure	500 SF	19,700	3,800	23,500
Access trail (asphalt)	5,400 SF	18,100	3,500	21,600
Relocate brochure box	LS	100	-	100
Underground utility extensions:				
Water	200 LF	8,400	1,600	10,000
Electric	200 LF	9,400	1,800	11,200
Telephone	200 LF	3,900	800	4,700
Septic system service extensions	500 LF	23,600	4,500	28,100

TABLE 2. TSANKAWI PREFERRED ALTERNATIVE A, DEVELOPMENT COST ESTIMATES (CONT.)

ITEM DESCRIPTION	QUANTITY AND UNIT	GROSS CONSTRUCTION COSTS	ADVANCE & PROJECT PLANNING COSTS	TOTAL PROJECT COSTS
Monument Operations Facilities				
Duplex residence: (1200 SF staff; 900 SF seasonal; 400 SF garage)	2,500 SF	262,000	50,000	312,000
Residential access road (gravel)	1,050 SY	38,500	7,400	45,900
Underground utility extensions:				
Water	700 LF	29,300	5,600	34,900
Electric	700 LF	33,000	6,300	39,300
Telephone	700 LF	13,800	2,600	16,400
Septic System:				
Tanks and lateral field	1	26,200	5,000	31,200
Service extensions	400 LF	18,900	3,600	22,500
Removals				
Remove existing gate and replace with fence	10 LF	400	100	500
Remove existing toilets	3 each	3,000	600	3,600
Remove existing visitor contact station	1,050 SF	3,700	700	4,400
Remove existing access trail	2,400 SF	4,600	900	5,500
Site Work				
Revegetate around operations facilities	4,500 SY	29,500	5,600	35,100
Revegetate disturbed areas	4,000 SY	26,200	5,000	31,200
Revegetate around visitor facilities	6,000 SY	39,400	7,500	46,900
TOTAL ALTERNATIVE COSTS		**$945,000**	**$159,100**	**$1,104,100**

LF = linear feet; LS = lump sum; SF = square feet; SY = square yards

NOTE: Total costs presented are gross figures, which include advance planning, design, construction drawing preparation, construction supervision, and facilitating administrative services. Estimates are class C, meaning they are derived from average costs for similar facilities in other NPS areas.

ALTERNATIVE B — CONTINUE CURRENT MANAGEMENT AND USE

Summary

Existing parking and vehicular and pedestrian access would be removed by the state highway department's widening of NM 4. There would be no significant change in monument management under this alternative (see Tsankawi, Alternative B — Site Plan).

General Development

Access and Parking. The Park Service would build a new access point and parking lot 700 feet south of East Jemez Road on NM 4, preserving the status quo but not providing any additional facilities. The new parking lot and access point would be developed as described in alternative A.

Trails. The trail from the existing parking lot to the visitor contact station would be removed. A new trail would extend southward from the visitor contact station to the new parking lot.

Visitor Contact Station. Visitor contact and orientation would continue in the existing visitor contact station. Orientation would be provided mainly through printed information.

Interpretation. Summer interpretive walks and talks would continue in the Tsankawi unit. The existing *Final Master Plan* and *Interpretive Prospectus* would continue to be in effect.

Housing. No employee housing would be added at Tsankawi.

Accessibility. Accessibility for visitors with disabilities would remain limited beyond the contact station.

Removals. The existing parking lot will be removed by the state. The gate, brochure box, and trail would be removed by the Park Service. The fence along NM 4 would be made continuous, and the brochure box would be relocated to the new trail between the new parking lot and the visitor contact station. Facilities would be replaced only to preserve the status quo and not to increase or decrease use at the site.

Revegetation. Revegetation would be accomplished with plants from the monument's existing gene pool. Preparations for revegetation operations, including plant propagation, seed collection, and the salvage of native soil and plants from construction sites, should begin three or more years before construction. Formal landscaping would not be done in development areas. Naturalized plantings would be used in these areas.

Resource Protection

Tsankawi would continue to have a minimal NPS presence, with no full-time NPS personnel residing or stationed there. Existing resource protection plans and measures would continue.

Boundary Adjustments and Land Protection

No boundary adjustments would be necessary.

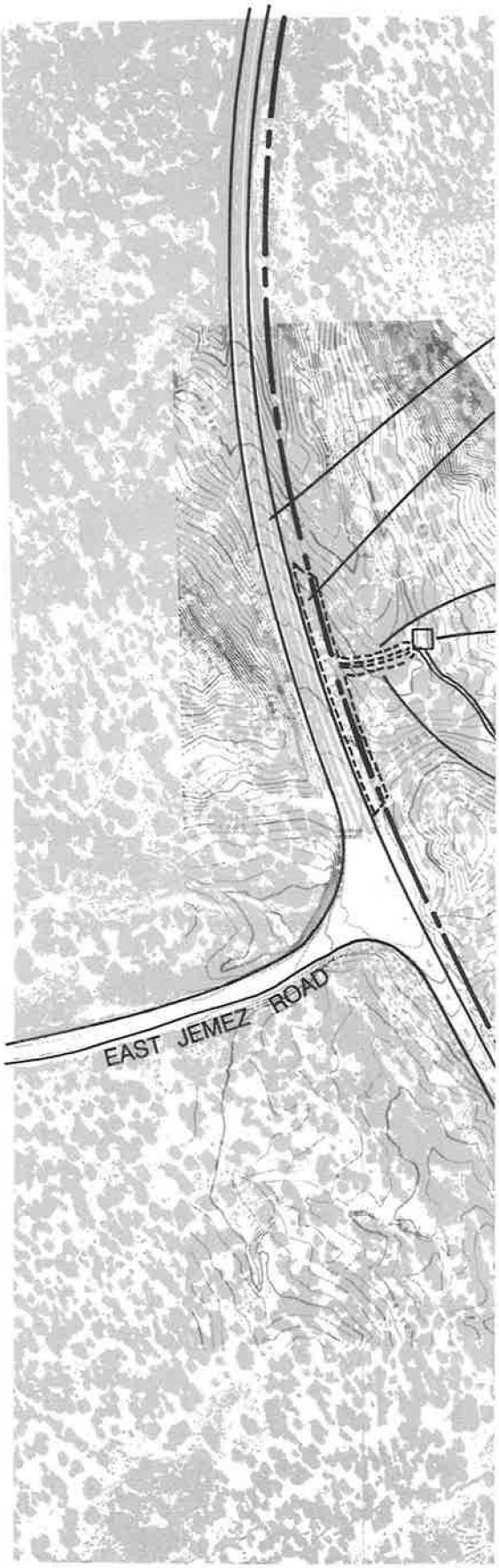
Plan Implementation

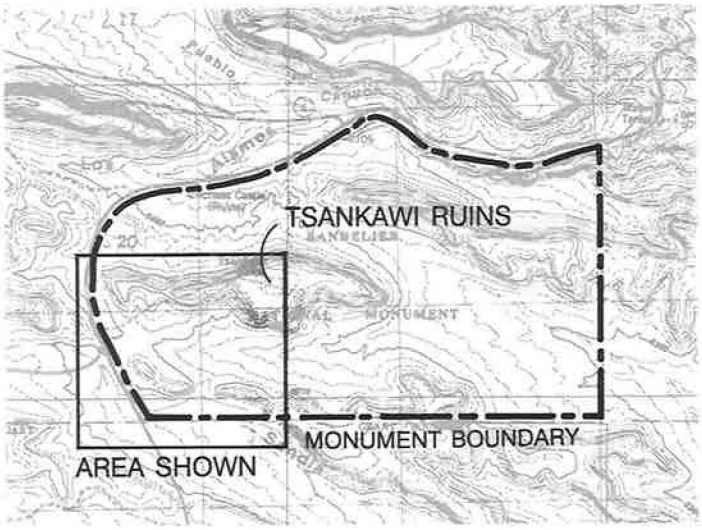
Additional Studies Required. A visitor experience/resource protection study should be completed before any development or construction to determine the degree of risk for the resources and visitor experiences. A highway access safety study should be completed before any development or construction to assess visitor safety concerns.

Staffing. No additional staff would be required.

TSANKAWI

ALTERNATIVE B
SITE PLAN





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TABLE 3. TSANKAWI ALTERNATIVE B, DEVELOPMENT COST ESTIMATES

ITEM DESCRIPTION	QUANTITY AND UNIT	GROSS CONSTRUCTION COSTS	ADVANCE & PROJECT PLANNING COSTS	TOTAL PROJECT COSTS
Studies Required				
Visitor experience/resource protection study	LS	$100,000	-	$100,000
Highway access safety study	LS	12,500	-	12,500
Visitor Facilities				
Access road and turn lanes (asphalt)	1,100 SY	72,100	13,800	85,900
Parking lot (gravel)	1,111 SY	40,800	7,800	48,600
Access trail (asphalt)	5,400 SF	18,100	3,500	21,600
Relocate brochure box	1 Each	100	-	100
Removals				
Remove existing gate and replace with fence	10 LF	400	100	500
Remove existing access trail	900 SF	1,700	300	2,000
Site Work				
Revegetate around visitor facilities	5,100 SY	33,400	6,400	39,800
Revegetate disturbed areas	500 SY	3,300	600	3,900
TOTAL ALTERNATIVE COSTS		**$282,400**	**$32,500**	**$314,900**

LF = linear feet; LS = lump sum; SF = square feet; SY = square yards

NOTE: Total costs presented are gross figures, which include advance planning, design, construction drawing preparation, construction supervision, and facilitating administrative services. Estimates are class C, meaning they are derived from average costs for similar facilities in other NPS areas.

ALTERNATIVES CONSIDERED BUT REJECTED

Two other alternatives were considered for Tsankawi, but they were rejected as unfeasible.

Maximum Use/Moderate Protection

An alternative to accommodate the greatest number of visitors to Tsankawi and protect the resources to the greatest degree possible was considered. The thrust of this alternative was to maximize visitation. It had the same interpretive goals as alternative A but required more development at the site, including a larger visitor contact station, more staff, more structured interpretation (e.g., videos, new trail guide brochure, guided tours, etc.), more new parking spaces, and a new access and interpretive trail. Accessibility would have received more emphasis, requiring special structures to be built, which would be detrimental to the site's scenic, natural, and cultural resources and the historic scene. This alternative was rejected because the Park Service believes that increased visitation would seriously

impact the delicate natural and cultural resources at Tsankawi.

Close the Facility to Visitor Use

An alternative was developed to close Tsankawi to the public except for scheduled, ranger-guided tours. There would be no development at Tsankawi, and all existing facilities and entrance points would be removed. This alternative was an attempt to protect the Tsankawi resources by removing them from public access and view. This alternative was rejected because it was felt that there is greater resource protection benefit by having visitors on the site and that there was no realistic way to keep people out without a full-time NPS presence. Would-be vandals and relic hunters would more likely be deterred by the possibility of having witnesses to their acts than by signs prohibiting access. Removing the total closure concept made this alternative essentially the same as another alternative presented; therefore it was dropped from consideration.

CULTURAL RESOURCES

Archeological Resources

Frijoles Canyon and Tsankawi are part of an extensive area once inhabited by ancestral Pueblo Indians. Bandelier National Monument, however, is only a small component of the story. Most archeological sites are in the backcountry of the monument. The Pajarito Plateau probably contains more than 7,000 archeological sites, including cavates, lithic and ceramic scatters dating from ca. A.D. 1150 to ca. 1600, with a density in some areas approaching 50 to 60 per square mile. Associated with these sites is an excellent assemblage of Middle Rio Grande glazewares.

The ancestral Puebloans had no metals, so they made tools from locally available materials. They used basalt to shape building blocks and enlarge caves in the softer tuff cliffs. They also used basalt, andesite, welded tuff, and quartzite to make manos and metates (stones for grinding corn). Many arrowheads, knives, and scrapers were made of obsidian (volcanic glass) from the Jemez volcano, but basalt and Pedernal chert were also used.

The ancestral Puebloans were primarily farmers, but they also gathered wild, edible plants. They grew corn, beans, and squash in the rich soils of the canyon floor, but raised most crops on the mesa tops where there was more space. Farming was difficult because long drought periods were common, and they controlled and conserved their water and practiced soil conservation techniques to make their land more productive.

Archeologists believe that the Pueblo people first settled the Pajarito Plateau in present-day Bandelier National Monument between A.D. 1150 and 1325. Increased population in Bandelier between A.D. 1290 and 1300 coincided with the abandonment of the Kayenta and Mesa Verde settlement areas of the Four Corners area. Some or all of Bandelier's new occupants may have come from this area. At Bandelier the ancestral Puebloans experienced a cultural rebirth, called the Classic Period (ca. A.D. 1325-1600). Population had decreased substantially by A.D. 1525, and the remaining people left before A.D. 1600, possibly during one of the droughts late in the century.

During the Classic Period, people were concentrated into large Pueblo villages. The ground plans varied, but the general pattern of multistory pueblos with hundreds of rooms and circular kivas surrounding courts and plazas was consistent throughout the general geographic area.

The ancestral Puebloans from the Rio Grande area settled the Tsankawi Mesa and canyon country during the late 1100s. This early settlement consisted of many small pueblos and cliff dwellings that contained from 6 to 30 rooms. Around 1300 these people started moving into fewer but larger pueblos. Tsankawi Pueblo was begun sometime in the late 1300s with building continuing into the 1400s. Archeologists believe that it was inhabited until the late 1500s.

The earliest site documentation in the region occurred during the 1880s. Adolph Bandelier visited the area several times during this decade. He measured caves and sites, collected artifacts, and noted details of construction, concentrating his

efforts on the valley of the El Rito de los Frijoles. Charles Lummis, who often accompanied Bandelier, took the earliest photographs of this region.

Formal archeology began with Edgar L. Hewett's work in the summer of 1896. He carried out an extensive reconnaissance of the area from Santa Clara to El Rito de los Frijoles, although he relied extensively on Bandelier's reports for some of his publications. Hewett worked sporadically until the summer 1908 when he became involved in the excavation of Tyuonyi. By 1909 he had participated in unearthing three kivas, some burials beyond Tyuonyi, 35 rooms in a pueblo at the south rim of the canyon wall, and some additional rooms at Yapashi (Pueblo of the Stone Lions). This early work failed to completely excavate or stabilize these archeological sites.

Digging at archeological sites stopped after 1911 and did not resume until 1933 when the Civil Works Administration sponsored additional stabilization at Tyuonyi, at the long house, and began work at Tsankawi. In 1937-38 the National Park Service used CCC labor to continue excavating and stabilizing the archeological sites. CCC accomplishments were substantial — they finished excavating and stabilizing the great kiva, reconstructed the kiva at the Ceremonial Cave, and stabilized Tyuonyi.

Additional archeological work took place in the late 1940s. The excavation at the Rainbow House began then and continued through fall 1950. At this time archeologists from Adams State College in Alamosa, Colorado, excavated the remaining kiva and 28 additional pueblo rooms. Finally, in the 1960s, plans for constructing Cochiti Dam resulted in a survey to identify sites that would be directly affected by the reservoir. This work encouraged several scientists to more systematically examine the resources outside Frijoles Canyon. Numerous reports ensued. In the 1980s archeologists from the NPS Southwest Regional Office conducted a survey of 43% of the surface area of the monument. This work continues and will provide abundant data needed to manage and interpret the monument's archeological resources.

Bandelier's *Final Environmental Statement and Proposed Master Plan* (NPS 1976a) includes a detailed description of the principal unexcavated and excavated and stabilized archeological sites. Other significant archeological features associated with the monument are prehistoric trails, petroglyphs, and pictographs.

Ethnographic Resources

The Cochiti, Santo Domingo, Santa Clara, Jemez, and San Ildefonso Pueblos are nearby and claim cultural affiliation to the monument. Other Pueblos in the area are Sandia, Isleta, Laguna, Santa Ana, San Felipe, Santo Domingo, Zia, San Juan, Nambe, Taos, and Tesuque.

All the Pueblos have associations with Bandelier, and it is known that many archeological sites and other resources are considered culturally significant. A comprehensive ethnographic resources study has not been conducted.

History and Historic Resources

The Pueblo Indians left the Pajarito Plateau in the late 1500s and moved to new homes along the Rio Grande, but they continue to use the area for traditional purposes. The paintings in the Painted Cave depict Spanish soldiers and missionaries on horseback. They also portray a mission, complete with cross and bell.

Spaniards were the first non-Indians to visit the area, and in the 1740s Pedro Sánchez was granted title to the land that is today part of the monument. In the early 1800s Frijoles Canyon became a retreat for various robber bands and other questionable characters. Apparently the problem was severe enough that in 1811 Spanish authorities in Santa Fe ordered that the canyon be vacated.

Adolph F. Bandelier, the distinguished Swiss-American scholar, was the first Anglo to visit Frijoles Canyon. He completed the first extensive survey of prehistoric sites in this region and an ethnographic study of the Pueblo Indians around Santa Fe between 1880 and 1886. He set the scene of his ethnohistorical novel, *The Delight Makers*, in the canyon as he pictured it in prehistoric times.

Edgar L. Hewett spearheaded the movement to make Bandelier a national park — Cliff Cities National Park. After a protracted dispute with land and cattle interests, Hewett helped draft the Antiquities Act, which became law in 1906 and empowered the president to create national monuments to preserve archeological sites and other areas of interest. The work of Hewett and Jesse Nusbaum, another famous early Southwestern archeologist, was primarily responsible for establishing Bandelier National Monument as part of the Santa Fe National Forest in 1916.

Frijoles Canyon European occupancy has been documented since 1907 when Judge A. J. Abbott and his wife Ada Patton built a summer home directly across the creek from Tyuonyi (approximately 0.25 mile upstream from the current visitor center). The Abbotts also built a ditch and some cabins in the vicinity. They had a large vegetable garden, an orchard, cultivated fields, and a chicken coop, and they raised cattle on the mesa. The only access to their property was by wagon road that paralleled Frijoles Creek.

Abbott, who was Hewett's friend, served briefly as informal custodian of the monument. He led visitors on tours of the archeological sites and even provided a campground until the Santa Fe National Forest appointed an official custodian of the monument.

Between 1916, when the monument was created, and 1925, the U. S. Forest Service built a ranger station about 0.25 mile west of the Abbott's homestead. As well as the ranger's office/residence, the complex included a cabin, garage, and two parking areas.

In 1925 the Abbotts sold the ranch to Mr. and Mrs. George Frey. The Freys turned the property into a guest ranch, which provided the only available accommodations to canyon visitors until Frijoles Canyon Lodge was built. The Freys improved the hotel and expanded the cabins and tent sites. They also constructed a tram that brought in supplies, luggage, and linen.

The Freys had multiple occupations — running the lodge in the tourist season and raising chickens, ducks, horses, mules, and cattle. They had an extensive orchard and garden, which they irrigated with water from a ditch the Abbotts had dug.

In February 1932 the National Park Service assumed control of Bandelier National Monument, and soon thereafter plans for constructing the CCC complex became a reality.

The remains of the Duchess Castle (actually a school) are near Tsankawi. The ruin is significant for various reasons. First, Duchess Castle was built on top of an existing archeological site and used some of the original materials in its construction. Madame Vera von

Blumenthal and Rose Dugan built the "castle" in 1918, relying on Indian craftsmen from nearby Pueblos for its construction. Its purpose was to stimulate improvement of Pueblo pottery production and decoration. Between 1918 and 1929 von Blumenthal and Dugan did a great deal to revive and improve the quality of pottery made in some of the nearby Indian Pueblos, especially San Ildefonso.

Bandelier National Monument Civilian Conservation Corps Historic District

The Civilian Conservation Corps built a series of 31 stone buildings, with courtyards and interior open spaces, which was designated a historic district in 1987. The Frijoles Canyon CCC historic district contains the largest collection of CCC buildings in a national park system unit (and possibly in the entire country) that have not been altered by adding new buildings. The buildings include their original CCC-constructed furnishings.

All 31 buildings are clustered at the bottom of Frijoles Canyon except the entrance station and fire tower on top of the mesa. The district includes the entrance road that descends 600 feet into Frijoles Canyon, the entrance station, the fire tower, and the parking island and the original campground, which has served as a picnic area and overflow parking lot since the early 1960s. The district, which retains a great deal of design integrity, is a significant, distinctive, and exceptional example of Pueblo Revival (or Spanish Pueblo) architecture. The collection of matching handcrafted furniture and tin fixtures is also a historic resource.

Cultural Landscape

The following is a summary of a cultural landscape assessment that addresses only those elements in the areas considered in these development concept plans that were not examined in the 1988 *Historic Structures Report*, i.e., the district as a whole, circulation, the major parking area and central island, the backpackers' parking lot/picnic grounds, the courtyards and other outdoor spaces, and the entrance road. A full cultural landscape report is needed to evaluate the whole monument and not just the national historic district.

Although it includes much more than the historic district, the monument's cultural landscape is inseparable from the historic district just described. The CCC buildings, clustered at the bottom of the canyon, northeast of the creek and between opposing cliff faces, are arranged around three sides of a central plaza, with the individual structures clustered around smaller courtyards, giving the complex an inward-directed feeling of community. Frijoles Canyon buildings were restricted to 1,500 square feet, which caused the development to be divided into individual projects and resulted in a series of clusters that came to serve distinct monument functions. For example, there is a maintenance cluster, a visitor center/administration cluster, a visitor accommodation cluster, and a monument-housing cluster.

The district has a cohesive visual quality. The predominant one-story design and the flow of attached buildings present strong horizontal lines, which contrast with the steep canyon walls. The district's main characteristics are the use of native materials and Pueblo Revival architectural style and the spatial qualities, such as the ratio of space to building mass. The color and siting of the building clusters contribute to this cohesiveness, which includes the entrance station, the fire tower, and the entrance road, a portion of which is edged by a retaining wall, guardrail, and stone gutter. These road features, although separate from the main

CCC structures, visually prepare visitors for what awaits them at Frijoles Canyon and complement the strong architectural sense of the main part of the district, the CCC complex at the canyon bottom. Even the entrance sign provides a thematic visual link to the structures of the historic district by mimicking the construction materials and finishes of the CCC buildings (including the wild turkey symbol).

In keeping with the philosophy of NPS rustic architecture, the CCC buildings were designed to blend with the monument's natural and cultural settings. Designers used native materials, such as stones, for constructing the buildings, road wall, sills, and parapets, and local timber for the vigas, lintels, picnic tables, and bridges. The relatively small, low (one-story), rectilinear masonry buildings are reminiscent of the architectural style of nearby Pueblos but include traditional Southwestern themes. A good sense of proportion is maintained between the stone work and the open window and door areas. The lintels overlap the windows and give the visual impression of T-shaped openings, which are also reminiscent of a prehistoric pueblo.

The appearance of the buildings and connecting walls reflects an accommodation to the sloping hillside, an intentional part of the rustic design in which buildings are subordinate to their natural setting. The stepped design of structures and the native stone used in the walls help to blend them into the surrounding hillside while imparting an Indian pueblo feeling to the complex.

Original access to the canyon bottom was on a wagon road that paralleled the creek bottom. After 1925 most visitors used Frey's trail to ride horses into the monument. Motor vehicles came into the canyon for the first time in 1933 when the Civilian Conservation Corps built the entrance road. Visitors were then able to drive through the *portal* between the headquarters (building 2) and the restrooms (building 9), cross Frijoles Creek on a log bridge northwest of the portal, and access the campground.

In 1950 the CCC-built log bridge was replaced with one of stone and steel and relocated further south. The new bridge forced a change in road alignment, which eased visitor access to the campground by allowing automobiles to turn into the campground directly from the parking lot rather than going through the narrow portal between the headquarters and the restrooms.

The original entrance sign portrayed the notion that visitors would be entering a natural and cultural resource area with its use of indigenous stone and a simple wooden emblem. The sign that replaced it also provides a thematic visual link to the structures of the historic district by mimicking the construction materials and finishes of the CCC buildings (including the wild turkey symbol); however, it also presents a more formal introduction to the site.

The entrance station is the first architectural element along the entrance road. On the mesa and at the edge of the historic district, the station has all of the character-defining features of the canyon CCC structures and visually prepares visitors for Frijoles Canyon. The stone curb that lines the road on both sides of the entrance station is also repeated on the roads and parking areas in the canyon. The fire tower, also along the entrance road, was not constructed to serve a visitor function but contributes to the cohesiveness of the district by its use of compatible building materials and construction methods.

The 3.1-mile entrance road has both historic and landscape architectural significance. It was the first accomplishment of the Civilian Conservation Corps at Bandelier and allowed the prompt completion of the rest of the district by providing relatively easy and quick access to the monument. The road's character-defining features — the retaining wall, the guardrail, and the stone gutter — are all present at the approach to the CCC complex, creating a visual theme and experience for visitors. These features retain a great deal of integrity. All three road features are made of indigenous stone that characterizes the historic district. Not only are they aesthetically appealing, but they visually connect the road with the rest of the development and local surroundings. Other character-defining features include the road width and alignment and travel speed.

The entrance road offers the best views of Frijoles Canyon, both up and downstream from the visitor complex. Descending toward the CCC complex, it is possible to see a succession of mesas and reddish canyons typical of the Pajarito Plateau. Climbing out of the canyon, one can look over the guardrail and see the Rio Grande in the distance as it flows past the mouth of the Rito de los Frijoles. The descent on the entrance road also offers dramatic viewshed changes — from broad and open vistas of a series of plateaus to the narrow, constricted view of Frijoles Canyon.

The parking area in the CCC historic district, originally having room for 27 parallel spaces, has expanded over time to accommodate increased visitation and improve visitor and staff safety (including moving the central island). Character-defining features include the island's vegetation, the stone curb that edges the island, and the location of the parking area, which acts as a central plaza for the entire CCC district.

The character-defining features of the current picnic grounds and overflow parking areas are the native vegetation, mostly riparian and ponderosa pine, the sound of the creek, and the large boulders that line the road and serve as bumpers for parking, site density, the mix of individual and double/group units, and the consistent use for vehicular access/recreation.

The original CCC design included 42 campsites, each one with a table and fireplace. A later plan indicates a reduction in numbers; two sites were combined and two were deleted on the north side of the road while one was added on the south side of the road. The campsites were designed with attention to the cohesiveness of the overall development as evidenced by the use of the indigenous stone to build small retaining walls.

By 1963 the area had changed from campground to picnic grounds. Around this time designers combined several of the original campground sites and converted most of the campsites east of the bridge to parking spaces.

An informal inventory conducted in August 1993 showed relatively minor modifications in the area. The southeastern half has changed most, becoming almost exclusively a series of parking areas that accommodates close to 45 cars. The northwestern half has partially retained its picnic ground functions, although it shows a series of parking spots designed to accommodate larger vehicles.

Frijoles Creek is a very distinctive attribute of this area. Although often out of sight, its sound lends a unique character to the historic campground and draws visitors' attention. In a way, the creek is the heart of the monument. It made both prehistoric and historic occupation possible. It

also acts as a physical connector, linking the various segments of the monument.

The tree canopy along the picnic grounds/ parking area offers shade to those hiking the canyon trail along the old road alignment. The canyon is fairly wide in this area, yet the tall trees, valley floor, and canyon walls provide a special sense of enclosure, typical of the Bandelier experience.

Courtyards and interior open spaces are other important elements of the historic district. The placement and restricted size of the CCC structures was a response to topography and budget limitations. This placement created interesting spaces between the buildings. The historic district courtyards and interior open spaces share the basic characteristics of all the structures in the complex — stone walls covered with stucco. Other features include wooden lintels, vigas, corbels, and *canales* (scuppers, roof drains), small parapets built of indigenous stone, flagstone pavement, wooden benches, *bancos* (benches built into walls made of stone or stucco), handcrafted fixtures, wooden columns supporting portal roofs, the ratio of space to building mass, and the degree of enclosure, circulation, and partition of space with vegetation or structural elements.

The most prominent courtyard is next to the old lodge lobby and exhibits almost all of the character-defining features. It was originally designed and used as a place to relax and socialize. Today it serves as an outdoor eating area for concessioner customers, which required adding picnic tables, garbage cans, and recycling bins that have dramatically affected the character of the courtyard.

One of the smallest courtyards is adjacent to the present interpretation offices. Originally the Frey's residence, this was Mrs. Frey's private space and she planted apple trees that still survive. This courtyard is not rich in architectural details, yet it is strongly linked to the development of the monument. Today it is seldom used, continuing its history as a private space.

Another open space deserves special attention — the large area in front of the lodge cabins. This fairly extensive space contains all of the character-defining features of the CCC buildings. In addition, a series of low walls and steps subdivides the courtyard into smaller, more intimate spaces. This courtyard, and the structures surrounding it, offer the best examples of building in response to the topography. This area was used by hotel guests until the lodge closed in 1963. Today most of the buildings are either offices or staff quarters. Summer vegetation is quite dense and almost totally obscures the buildings, but in the fall, winter, and early spring, building features are almost as visible as they were decades ago.

The open space between the large open area in front of the cabins and the existing concession also maintains its original features, including a fireplace.

Another public outdoor space that contributes to the overall character of the district is the enclosed yard behind the museum and the visitor center. It was constructed in 1940 to feature an ethno-botanical garden landscaped with native plants. Although the garden was never installed, this space still maintains a high degree of integrity and exhibits many elements typical of the CCC architectural design.

In 1974-75 an exhibit room was added to the museum. This created a small courtyard on the northeastern corner of the building, which illustrates character-defining features such as a banco, wooden

vigas, and lintels. The use of red bricks instead of flagstones for paving denotes its recent construction; however, this L-shaped area reflects the attempt to maintain the nature of the historic district.

The Bandelier National Monument CCC Historic District retains historic landscape integrity in the area of location, design, setting, materials, workmanship, feeling, and association.

NATURAL RESOURCES

Climate

The climate of Bandelier National Monument is semiarid continental, characterized by distinct seasons with wide daily and annual temperature ranges. Summer is hot, and a moderate amount of rain falls during thunderstorms. Winter is mild to cold, and precipitation falls as light showers and snow. Average precipitation is around 15 inches at the lower elevations and up to about 31 inches at the highest elevations. Because of high temperatures and low humidity, the evaporation rate is high. The daytime mean annual air temperature is near 50° F.

Topography

The topography within the monument is variable and composed of steep rocky escarpments, gentle to moderately sloping mesa tops, and narrow floodplains and terraces. The major topographic features are the northwest-southeast trending mesas that are separated by the deep and steep-sided canyons. At the major visitor use area of Frijoles Canyon, elevation relief from the mesa to the canyon bottom averages about 400 feet.

The detached 826.2-acre Tsankawi unit (11 miles northeast of Frijoles Canyon) is a mesa that varies in elevation from 6,680 feet to as low as 6,000 feet.

Geology

The monument is on the Pajarito Plateau in north-central New Mexico on the eastern flank of the Jemez Mountains. These mountains are mostly volcanic in origin, and the monument's geology is closely associated with the volcanic nature of the region. Exposed rock consists primarily of limited areas of Tertiary and Pleistocene sediments with extensive areas of rhyolite tuff and some basalt.

The oldest rocks are red sandstones and shales of the Galisteo formation and gravel and sandstones of the Santa Fe formation in the southwest portion of the monument. Thick, massive flows and domes of Tertiary sediments of coarse porphyritic dacite, rhyodacite, and quartz latite dominate the northwest part of the monument. Recent alluvium (stream-deposited sediments) occurs along the Rio Grande and streams throughout the area.

Fine-grained igneous basalt flows underlie most of the lower mesas. Overlying the basalt is the Bandelier rhyolite tuff, which is formed of compacted volcanic fragments. Patchy deposits of unconsolidated pumice, from a few inches to several feet thick, cover some areas of the rhyolite tuff. Most of the soil material is derived from the erosion and break-down of this rhyolite tuff and pumice.

Soils

Monument soils are blanket-thin on mesa tops, shallow to deep in indented areas, moderately deep and deep in pumice deposits, and shallow to deep in the talus and stream canyon bottoms. Ongoing severe soil erosion is occurring but not

fully evaluated. Soil determination and makeup is incomplete, but 22 types of soil have been identified within the monument (see appendix B), seven of which are rock outcrop types. Bare rock, or rock outcrop, is a dominant feature of the monument area and occurs on mesa tops and along canyon walls. Soil characteristics of rock outcrops are of minor significance.

Vegetation

Approximately 720 species of flora have been identified within the monument, and the monument maintains a herbarium specimen collection. There are at least 32 families of flowers and small plants. Two basic plant communities cover the project areas.

Piñon-Juniper/Juniper Woodlands. Piñon pine, alligator juniper, one-seed juniper, Rocky Mountain juniper, saltbush, sagebrush and yucca comprise the dominant species. Piñon and juniper densities have increased due to historic grazing and fire suppression, although soil erosion is affecting this community and other natural and cultural resources. The mesa area north of Frijoles Canyon and the Tsankawi unit represent this community.

Riparian. This is the vegetation community in canyon bottoms near streams, creeks, and springs. The developed area in Frijoles Canyon consists of this community. Species of various trees and shrubs such as ponderosa pine, box elder, narrowleaf hoptree, oaks, cottonwoods, water birch, poison ivy, chokecherry, and gooseberry all exist in Frijoles Canyon.

More than 20% of the known 720 species in the monument are exotic or alien species. These species have displaced native plants and affected plant diversity.

Wildlife

The monument provides excellent natural habitat for many faunal species. Recent surveys indicate the presence of several species of amphibians, reptiles, mammals, and birds. At least 10 species from historical times are no longer present. Predators such as the grizzly bear and the gray wolf are no longer found in the area.

Mammals. There are 44 mammal species in the monument, including coyote, fox, black bear, weasel, skunk, raccoon, ringtail, mountain lion, badger, mule deer, three species of rabbit, and about 24 species of rodents all exist within the 32,737-acre monument. Distribution of these mammals is variable and depends on vegetational zones as well as elevation.

Twelve bat species have been recorded, and a maternal colony of about 20,000 Mexican free-tailed bats is in Frijoles Canyon.

Elk were successfully reintroduced in the area after being extirpated. The winter population in the monument is estimated at between 1,000 and 2,000. The state is studying the possibility of reintroducing bighorn sheep in the Bandelier area.

Amphibians and Reptiles. Seven amphibian species have been recorded. Two salamander species, three toad species, and four frog species are found in the monument.

Fifteen species of snakes, 10 species of lizards, and two species of turtles have been recorded. Lizards and snakes, including three species of venomous rattlesnakes, are found in most areas of the monument.

Birds. Approximately 160 bird species have been identified and recorded within the monument. Most of these species

reside in the area either as permanent or summer residents; about 115 are breeding species. Nearly 25% are spring or fall migrants. A roosting colony of about 50 turkey vultures use trees along Frijoles Creek near the developed area in Frijoles Canyon.

Other Wildlife. There are about 90 species of ants and roughly 1,000 arthropod species in the monument, including 10 that are likely new to science.

Rainbow, brook, and brown trout live in some of the monument streams as a result of an introduction program initiated before 1956.

Threatened and Endangered Species. Federal and state-listed threatened and endangered species will be addressed in a separate biological assessment document prepared by monument staff and submitted to the U.S. Fish and Wildlife Service.

Water Resources

The principal surface waters within the monument are canyon bottom creeks and several springs. Five canyons dissect the plateau in a northwest to southeast alignment. These five canyons support base flows originating from springs and seeps along the base of the mountains. Only Frijoles Canyon has permanent water flow along the entire reach to the Rio Grande.

Known impacts on the water quality of Frijoles Creek result from its proximity to the NPS headquarters, visitor center, NPS housing, stable operation, maintenance facility, and visitor parking. Past use of chemicals and pesticides, including DDT in the 1950s to early 1960s, have left residues in the creek and are a continuing source of contamination.

An increasing number of day and overnight backcountry visitors create an additional potential for impacts on water quality. Both the giardia and campylobacter organisms may occur in surface water streams.

Surface waters in the monument have been extensively monitored since 1977 at permanent sampling points. A permanent gauging station exists on Frijoles Creek. Sampling parameters include Ph, conductivity, water temperature, dissolved oxygen, turbidity, carbon dioxide, total hardness, and chloride. Intermittent fecal coliform samples are taken, mostly from Frijoles Creek.

Floodplains and Wetlands

The national wetlands inventory of the U.S. Fish and Wildlife Service has identified both riverine and palustrine wetlands in isolated places throughout Bandelier.

The canyon bottom of Frijoles Canyon, from the upper canyon to the confluence with the Rio Grande, has been identified as a permanently flooded, unconsolidated bottom, upper perennial, riverine wetland. Side canyons into Frijoles Canyon have been identified as intermittent, riverine wetlands that are intermittently flooded.

A temporarily flooded, deciduous forested, palustrine wetland dominates the area along Frijoles Creek near the Frijoles Canyon developed area.

Both a temporarily flooded, intermittent, streambed riverine wetland and a temporarily flooded, deciduous scrub-shrub palustrine wetland are along the northeast boundary of the Tsankawi unit in the bottom of Los Alamos Canyon.

There are no floodplains on the mesa tops. The only floodplain in the areas considered for these concept plans is along Frijoles Creek. The floodplain delineation is currently being prepared and finalized by the NPS Water Resources Division.

Preliminary indications are that a small portion of the developed area near Frijoles Creek is within the 100- and 500-year floodplains. In general, a 100- or 500-year flood will present little, if any, threat to monument facilities and resources.

The lower parking lot and the comfort station (no. 9) are within the 100-year floodplain. The base of the visitor center/ museum (no. 2) is less than 1 foot below the 500-year floodplain. The base of the comfort station is about 2 feet below the maximum depth of a 500-year flood. The entire parking area, along with the previous described units, are within the flash flood zone.

The administrative complex and the Tyuonyi site are within the probable maximum flood, which would cause major damage to several structures, including the Tyuonyi site. Estimated warning time for the probable maximum flood is about nine hours. Flash flood size is estimated to be about half the magnitude of the probable maximum flood, and the warning time is calculated to be about 40 minutes.

Air Quality

The Bandelier Wilderness is designated a class I air quality area. Air quality monitoring within the monument includes an automated 35mm camera and a transmissometer for measuring visibility. A national atmospheric deposition program site has been operated since 1982 to monitor acid deposition. Acid precipitation has not been identified in the monument, but potential exists in the near future. The Interagency Monitoring of Protected Visual Environments (IMPROVE) was installed in 1987 and is currently collecting fine particle samples, including $S0_2$; PM10 mass; organic and elemental carbon, nitrate, and chloride ions; and numerous additional particulate elements.

The Park Service has initiated a radon monitoring program in the monument, and results do not indicate a serious problem. The state Air Quality Division has purchased and plans to install an automated teleradiometer in the monument in the near future.

Regional haze has increased over much of the Four Corners region. Accelerated development and urban activity in Albuquerque and Santa Fe has caused views across the valley to become periodically obscured.

Wilderness

The designated wilderness at Bandelier includes more than 23,000 acres (71%) of the total acreage of the monument), consisting mostly of canyons and mesas connected by steep canyon walls 400–600 feet high. Elevations in the monument vary from about 5,300 feet to 9,000 feet, so viewsheds can be either very short or quite extensive, depending on where one stands in the monument and the type and amount of vegetation there. There has been no development within the wilderness since its designation in 1976, but several development areas inside and outside the monument are visible from the wilderness. Nearly all of these wilderness viewshed intrusions predate the wilderness designation. Among the intrusions are NPS developments for staff housing, campgrounds, and sewage treatment lagoons.

Development on several adjacent DOE sites (especially TA-33's water tower and huge dish antenna) and distant features such as highways, power lines, bridges, and towns (as nearby as White Rock, Los Alamos, and Espanola, or as distant as Santa Fe) also intrude on the views from the wilderness.

COLLECTIONS

The NPS collection at Bandelier National Monument comprises about 20,000 catalogued entries, totaling 250,000 items. About three-fourths of these are prehistoric artifacts ranging in time from the Paleo-Indian period (ca. 10,000 B.C.) through the Archaic and Rio Grande Puebloan eras. The remaining artifacts are ethnographic objects — mainly Pueblo arts and crafts from the 1930s and 1940s, historic objects (both Spanish and Anglo), and natural history collections such as mammal skins, a herbarium, and an insect collection.

VISITOR USE

Recreational visits (the entries of persons onto lands or waters administered by the Park Service for recreational purposes) to Bandelier National Monument have grown nearly 74% since 1982 (see table 4 and figure 1). Visitation fluctuates annually, but there is a steady pattern of growth. Record high levels of use occurred in each of the last three years, and the popularity of the monument is expected to remain high. Frijoles Canyon is only 5% of the monument's total area, but because it is accessible by car, recreational use is concentrated there. Archeological sites are the main attraction and within easy walking distance. Visitor services are also in Frijoles Canyon.

Visitation may level off due to congestion caused by concentrating uses in the canyon. Limited space in the canyon causes parking lots to fill quickly in the summer. Vehicles are then held at the entrance and allowed to enter only when another vehicle exits. Canyon parking capacity will continue to limit use during peak demand times.

Nonrecreational use of the monument has been relatively minor. Nonrecreational visits include persons going to and from inholdings, commuter and other through traffic, tradespeople working in the monument, any civilian activities related to the pursuit of a gainful occupation (e.g. guides), government personnel (not NPS employees) with business in the monument, citizens using NPS buildings for civic or local government business or public meetings, and outside research activities independent of NPS legislated interests (e.g., meteorological research). In 1990 nonrecreational use was estimated to be a constant 70 visits per month.

An overnight stay is defined as one visitor spending one night in the monument. Table 5 and figure 2 show that overnight use (including campground and backcountry use) is a minor part of the total monument recreational use. In 1993 such use made up only about 15% of the total overnight stays, a small percentage of total recreational use. Furthermore, it has not changed substantially during the last decade. Tent and recreational vehicle camping are provided at Ponderosa and Juniper Campgrounds. Ponderosa campground is used for group camping.

The monument is open all year (see table 6 and figure 3). At one time, Bandelier had relatively little visitation during the winter, but now the slack season is relatively short.

Some monument facilities close seasonally depending on the weather. Juniper Campground is closed between December

TABLE 4. BANDELIER — ANNUAL VISITATION 1982-93

YEAR	RECREATIONAL VISITS	NONRECREATIONAL VISITS	TOTAL VISITS
1993	366,638	840	367,478
1992	360,204	840	361,044
1991	345,725	840	346,565
1990*	327,918	810	328,728
1989	322,273	780	323,053
1988	249,561	780	250,341
1987	261,527	780	262,307
1986	237,977	780	238,757
1985	238,434	720	239,154
1984	215,500	901	216,401
1983	199,775	800	200,575
1982	210,850	830	211,680

SOURCE: National Park Service, Washington Office, Socioeconomic Studies Division

* Monument counting and reporting procedures were audited and verified. Since April 1990, the monument has reported a constant 70 nonrecreational visits per month.

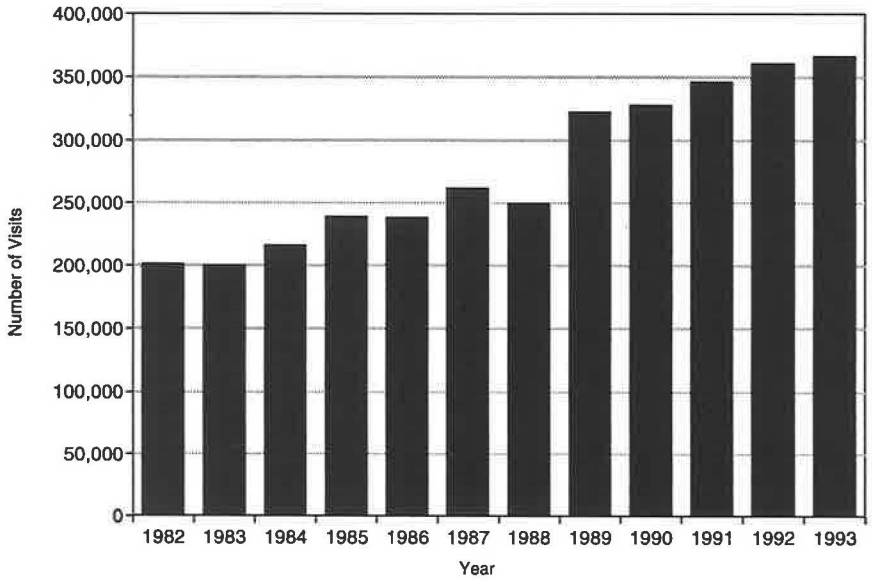


FIGURE 1. ANNUAL RECREATIONAL VISITS

TABLE 5. BANDELIER — OVERNIGHT STAYS 1982-93

YEAR	TENT CAMPING	RECREATIONAL VEHICLE CAMPING	BACK COUNTRY CAMPING	TOTAL OVERNIGHT STAYS
1993	13,135	7,416	4,062	27,088[a]
1992	12,458	7,369	3,937	25,666[b]
1991	10,952	7,861	3,747	22,559
1990[c]	10,836	7,677	5,382	23,895
1989	13,130	9,455	4,665	27,250
1988	12,904	8,241	4,437	25,582
1987	15,368	10,414	5,630	31,412
1986	11,287	8,037	4,116	23,440
1985	12,819	8,285	3,555	24,659
1984	10,858	7,053	3,891	21,802
1983	14,456	6,539	3,574	24,569
1982	13,790	7,508	4,044	25,342

SOURCE: National Park Service, Washington Office, Socioeconomic Studies Division

a. Includes 2,475 overnight stays at Ponderosa Campground (for groups).
b. Includes 1,902 overnight stays at Ponderosa Campground (for groups).
c. Monument counting and reporting procedures were audited and verified.

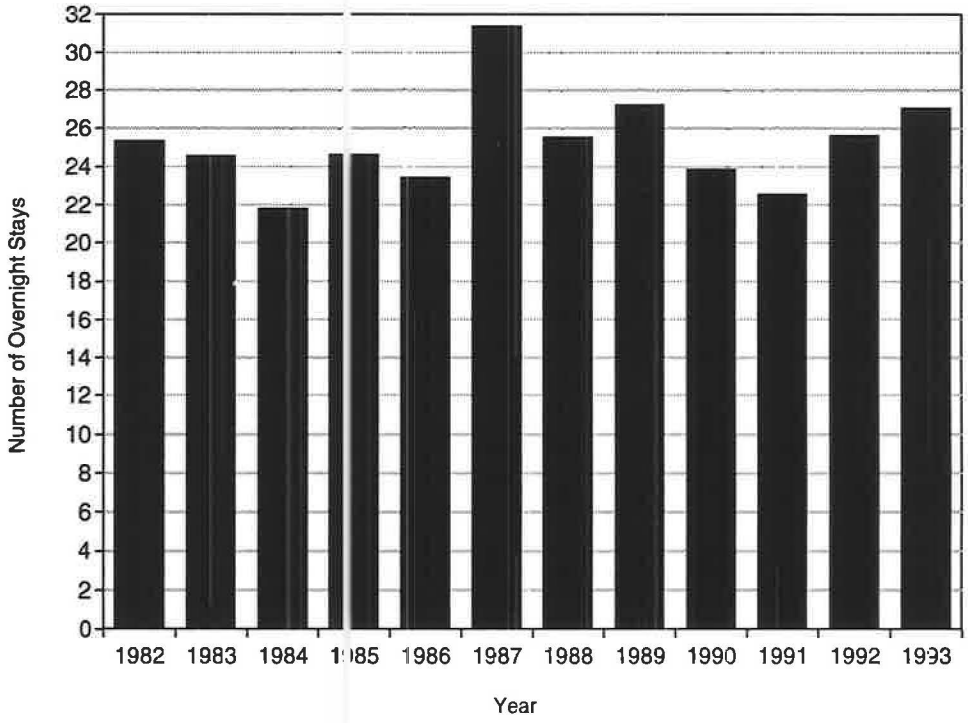


FIGURE 2. ANNUAL OVERNIGHT STAYS

TABLE 6. BANDELIER — 1993 VISITATION BY MONTH

MONTH	RECREATIONAL VISITS	NONRECREATIONAL VISITS	TOTAL VISITS
January	9,630	70	9,700
February	11,497	70	11,567
March	23,801	70	23,871
April	29,943	70	30,013
May	47,902	70	47,972
June	40,890	70	40,960
July	49,196	70	49,266
August	50,373	70	50,443
September	39,264	70	39,334
October	36,581	70	36,651
November	17,158	70	17,228
December	10,403	70	10,473
Total	366,638	840	367,478

SOURCE: National Park Service, Washington Office, Socioeconomic Studies Division

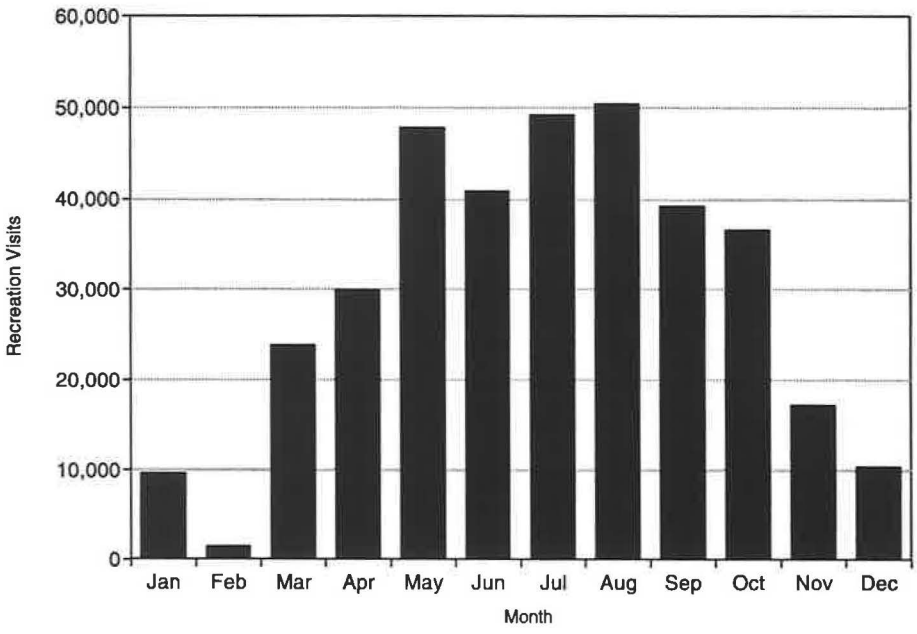


FIGURE 3. 1992 RECREATIONAL VISITS BY MONTH

and March, Ponderosa Campgrou ıd between November and April. So: ne trails are closed in winter due to ice an: l snow. In summer, the monument is bus: all week. The visitor center has had 1 ,300 visitors on a peak use day. In fall and spring, visitation is heavier on we ekends. The average visitor stays two and three-quarters hours. Since May 1990 o: ernight campers stay an average of 22.75 ıours.

The monument is known for its c ıltural, geologic, wilderness, and historic resources and offers a variety of recreationa l experiences. The visitor center in Frijoles Canyon provides orientation to th e monument, exhibits, audiovisual ›resenta-tions, and videotape programs. A snack bar and gift shop is in one of the historic buildings near the visitor center. In summer, demonstrations are freq ıently offered to show how local artisan s create pottery, embroider, make drums, or weave cloth. The monument staff condu :ts tours of the ancient villages and cliff si es in Frijoles Canyon. The monument's volunteers-in-parks program use: volunteers to help with the visito : center, tours, and other interpretive acti ities.

The monument's 75 miles of mai tained trails provide an unstructured re creational experience. About 90% of the mo ıument is designated wilderness, offering d ay hikers and backpackers solitude in a rel tively natural setting. Visitors can walk ancient trails to archeological sites that p edate European settlement. Cross-coun ry skiing is available seasonally in upper F rijoles Canyon.

Table 7 and figure 4 project recre ational visits for Bandelier based on data in table 6. Low, medium, and high levels of use are presented. The trend is for st ady increases in recreational use, with visitation rising by almost 170,00) visits by 2003, a 46% increase in 10 years.

Forecasting was achieved using a simple linear regression analysis based on limited time series data (12 data points). The high and low projections represent the approximate 90% forecast interval, i.e., there is a 0.90 probability that the actual values of the forecast variable will fall between the high and low projections.

Monument use is affected by a variety of factors. Due to time and resource constraints, forecasted use of this monument is based solely on past use, which is projected forward over time. This method implies that whatever factors influenced visitation in the past will continue to do so in the future and that the changes in those factors will follow the patterns of the past. Extrapolation of a historic trend forecasts trend patterns and does not consider the causes of the trend.

Forecasting in this manner is subject to a high probability of error because the method used is simplistic, relatively few data points are available, and there is no cause and effect relationship between past use and future use. Adding another year's visitation figures will affect the projections. For these reasons, a range of values were reported and caution is warranted when interpreting and using the results.

REGIONAL LAND USE AND REGIONAL VISITOR FACILITIES AND SERVICES

The Nature of Land Use on Adjacent Lands

Bandelier National Monument is bordered on the northeast by Los Alamos National Laboratory and other Department of Energy lands. The nature of the work that has been conducted on these lands makes them unsuitable for uncontrolled public access.

TABLE 7. BANDELIER — PROJECTED RECREATIONAL USE 1994-2003

YEAR	PROJECTED RECREATIONAL VISITS		
	LOW	MEDIUM	HIGH
1994	350,135	386,156	422,176
1995	365,513	402,790	440,067
1996	380,761	419,424	458,088
1997	395,893	436,059	476,225
1998	410,921	452,693	494,466
1999	425,857	469,328	512,799
2000	440,711	485,962	531,213
2001	455,493	502,597	549,700
2002	470,211	519,231	568,251
2003	484,871	535,865	586,860

SOURCE: National Park Service, Central Team, Branch of Planning

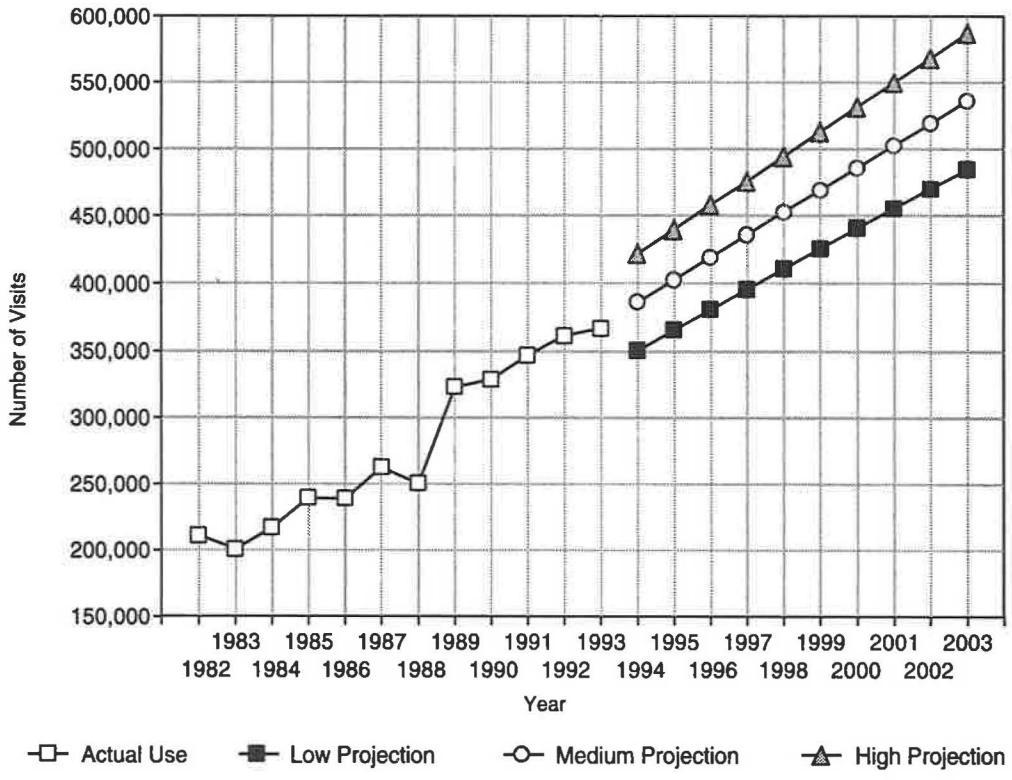


FIGURE 4. ACTUAL AND PROJECTED RECREATIONAL VISITS

The upper Frijoles Canyon area, in the extreme northwestern portion of the monument, is bounded by U.S. Forest Service lands and by private land known as Baca Location No. 1. The uses at Baca Location No. 1 include ranching, mining, logging, and trophy hunting. Most U.S. Forest Service land south of Baca Location No. 1 and adjacent to the monument on the west has been designated by Congress as the Jemez Mountains National Recreation Area. This designation will encourage greater recreational use and consequently more difficult control and maintenance of the monument's backcountry.

Other U.S. Forest Service lands border the monument on the north, west, and southeast. Directly south of the monument are Cañada de Cochiti Grant lands that are owned by the University of New Mexico.

The detached Tsankawi unit is bordered by Los Alamos National Laboratory on the north and west and by San Ildefonso Pueblo lands on the south and east.

Socioeconomic Environment

Los Alamos County Overview. Founded in 1943 as the base for the Manhattan Project, Los Alamos County was created out of Sandoval and Santa Fe counties. During World War II this site provided a secure location for developing the atomic bomb. Existence of the site was kept secret until 1945, and it was many years after that before Los Alamos appeared on any map.

Los Alamos County has an area of 109 square miles, 93% of which is owned by the federal government. It was 1962 before any properties within the county were sold to private owners. Until then the entire county was under federal control.

Los Alamos County is a consolidated city/county government, incorporated under a council-manager form of government. A full range of public services are provided in Los Alamos and White Rock, the only commercial and residential areas in the county.

Population — The county's population was projected to be 18,150 in 1991. In 1990, 11,830 people lived in Los Alamos and 6,285 in White Rock.

Economy — The economy of Los Alamos has developed around the Los Alamos National Laboratory and the research performed there. The laboratory is owned by the Department of Energy and operated by the University of California. The laboratory employs about 7,400 people, and an additional 3,000 individuals are employed there on a contract basis. An operating budget of approximately $900 million, nearly half of which goes toward salaries and benefits, makes the laboratory not only the economic base for the county, directly or indirectly employing most of the workforce in the county, but a major economic force in the state.

The laboratory continues to serve as a federal center for various research projects, primarily centered on the design, development, and certification of nuclear weapons technology. About half of the laboratory's efforts go to this type of research. Other areas of investigation include arms control and treaty verification, conventional defense, energy research and development, environmental technology, and health and biological research. The nature of the work at the laboratory accounts for the county having the highest average income, the highest level of education, and the lowest level of unemployment in New Mexico (1.6% in 1989). Employment by sectors is shown in table 8. In 1989 the lodging industry employed 130 people. That same year

eating and drinking establishments employed 592 people.

Transportation/Access — The monument is less than a one-hour drive north and west of Santa Fe and two hours from Albuquerque. Access to Bandelier National Monument is from NM 4. This route forms much of the monument's northern border. Frijoles Canyon, the hub of the monument's visitor activity, and Tsankawi are accessible from this route.

Much of the monument's backcountry is accessible from the west using U.S. Forest Service roads and trails. Access to the monument from these roads is uncontrolled.

Visitor Services — Los Alamos has a surprising variety of community services, recreational amenities, and cultural activities considering its size and relative isolation. Food, lodging, health services, etc., here also serve neighboring communities. Additional services are available in Santa Fe.

Regional Recreational Activities. The area surrounding Bandelier National Monument offers various recreational opportunities. Santa Fe National Forest offers outdoor recreation at both developed and undeveloped sites. Developed sites may have camping, drinking water, and/or picnic facilities. The Dome Wilderness Area and other parts of the forest offer opportunities for wilderness recreation. Opportunities also abound in Santa Fe National Forest for backpacking, day hiking, and hunting. The Puye Cliff Dwellings and several Pueblos are also nearby, offering various cultural and recreational opportunities to visitors. Santa Clara Canyon offers scenery, cliff dwellings, fishing, camping, and picnicking.

In Santa Fe one can find a full range of recreational and cultural opportunities, including many fine restaurants, shops, and museums. Santa Fe is known for its art and artists and is a leading center for commerce in art. There is also broad support for the performing arts including the renowned Santa Fe Opera.

TABLE 8. LOS ALAMOS COUNTY — 1989 EMPLOYMENT BY SECTORS

Sector	Number of Employees
Manufacturing	62
Construction	219
Transportation and Public Utilities	68
Wholesale and Retail Trade	1,319
Finance, Insurance and Real Estate	307
Services	3,796
Government	10,674
Total	16,445

SOURCE: Bureau of Business and Economic Research, University of New Mexico

ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This section provides an analytic basis for comparing the alternatives and the key environmental impacts that would result from implementing each of the alternatives. Information in this section is based on the scientific and analytic review of information collected by the Park Service and information provided by other agencies and contracted organizations.

Eliminating the current parking area (in the state highway right-of-way) and pedestrian access, caused by state plans to widen and realign NM 4, necessitates minimal development within the Tsankawi unit. Maintaining the status quo there will cause impacts; there is no true no-action alternative for the Tsankawi unit.

Duchess Castle, in the Tsankawi unit, would not be affected under any of the alternatives.

FRIJOLES CANYON — PREFERRED ACTION: ALTERNATIVE 1

Impacts on Cultural Resources

Archeological Resources. Overall, this alternative could have some impact on archeological resources. Based on existing survey information from a class II inventory, constructing the visitor contact station, the new Frey Trail extension, the parking area, administrative and resource management offices, and the new sewage and utility lines would possibly impact six previously affected sites and six previously unaffected sites. Some of the archeological sites that might be affected have architectural components, but it is likely that these components could be avoided during construction. Determinations of eligibility for all of these sites have not been done, so the significance of the impacts is unknown.

Although the project area has been surveyed, before any development could be initiated the National Park Service would conduct an additional project-specific inventory to ensure that the location, nature, and extent of the resources is thoroughly understood. Site significance would be evaluated, and a determination of eligibility for the national register would be made through consultation with the state historic preservation officer. If sites determined eligible for their potential to yield scientific information would be impacted by this alternative, a data recovery plan would be developed in consultation with the state historic preservation office and the Advisory Council on Historic Preservation. Data recovery would minimize impacts on archeological resources.

Civilian Conservation Corps Historic District. This alternative would help maintain the integrity of the CCC historic district because only changes in use are recommended (see Proposed Historic District Building Uses map). Using the buildings for interpretation would have a minor internal impacts. Visitor use of the CCC buildings, which are currently administrative offices, might accelerate the deterioration of those that would be used for interpretive purposes. Before modifying the interior of the historic structures, consultation with the state historic preservation office would be conducted.

The only new construction in the canyon would be handicap-accessible restrooms. Compatible architectural style and construction materials and appropriate

facility location would minimize their visual intrusion on the historic scene.

Cultural Landscape. Changes to the use and function of courtyards and interior open spaces would not impact character-defining elements. Removing concession services from the monument would positively impact the main courtyard (southeast of building 17) because it would lead to the removal of the picnic tables, garbage cans, and recycling bins that dramatically affect the character of this courtyard, as would restoring its historic use as an area devoted to relaxation and socialization.

Changes in the use of the interior open space between buildings 13 and 15 would have no negative impacts and would enhance the visitor experience by providing an interpretive and demonstration area and offering the public the opportunity to enjoy this space, which is currently used for parking NPS vehicles.

Constructing the pipeline between the two lagoon systems would require trenching within the entrance roadway. With special care, the structural characteristics of the road, such as the retaining wall, the stone guardrail, and the stone gutter, would not be affected. Subsurface resource finds would be possible.

Traditional use of the canyon picnic area would be discontinued, which would be a negative impact. Using the area for interpretive purposes could have a beneficial impact.

Ethnographic Resources. There would be no known impacts on area Indian communities who claim ancestry to the monument or on their traditional uses in the monument. Consultation with associated Pueblos has been initiated and would continue throughout the planning process to avoid impacts on other ethnographic resources (see "Consultation and Coordination" section).

Impacts on the Collections

The new resource management facilities would provide environmentally controlled museum storage areas, thus allowing for more adequate care of the extensive monument collections.

Impacts on Natural Resources

Soils. A total of approximately 7.22 acres on the mesa would be permanently compacted by new impervious structures and new asphalt for roads and parking areas. Temporary soil disturbance from construction activities would impact about 6.51 additional acres.

To mitigate these impacts all areas temporarily disturbed by construction activities would be revegetated with native plant species that are indigenous to the monument, including about 0.07 acre of soil exposed by removing asphalt at the canyon picnic area. The total area to be revegetated would be 6.58 acres. This includes areas disturbed for utility line burials, sewer lines, and constructing buildings, roads, trails, and parking.

Removing the pavement in the canyon picnic area, overflow parking area, and the backpackers' parking lot would also curb the continuing erosion of the Frijoles Creek bank that results from picnicking activities.

Vegetation. Native vegetation in the Southwest is fragile and difficult and costly to replace. A total of about 7.22 acres of undisturbed or minimally disturbed land would be permanently affected by the proposed action. The previously undisturbed land impacted by the proposal would constitute an unavoid-

able loss of a natural resource. Impacts would range from complete vegetation removal and light excavation, grading, and surfacing to selective tree cutting and brush removal for vista improvements and fuel reduction around structures and other public use areas.

About 0.44 acre of vegetation would be permanently displaced by new buildings, and about 1.47 acres of vegetation would be permanently displaced by asphalt for the parking area and shuttle stop. Nearly 2.32 acres of vegetation would be covered by asphalt for new access and circulation roads. About 4.42 acres of additional vegetation would be temporarily disturbed during construction activities.

The new trail link from the visitor contact station to the Frey Trail (east of the new maintenance area site) would permanently displace nearly 0.41 acre of vegetation. (No temporary vegetation displacement would occur for trail construction.)

Constructing facilities for the new mesa-top picnic area would permanently displace up to 0.18 acre of vegetation. Temporary disturbance for picnic area construction activities could occur on an additional maximum of 1.67 acres.

Constructing buildings and asphalt for the new maintenance/emergency vehicle facility would permanently disturb a maximum of 2.40 acres of vegetation. The temporary disturbance of vegetation due to construction activities for the maintenance facility would occur on about 0.42 acre of vegetation.

In summary, the total area of new development on the mesa would permanently displace about 7.22 acres of native vegetation and temporarily disturb about 6.51 acres of vegetation. About 0.07 acre of vegetation would be restored (with native species) after removing existing asphalt in the canyon.

Areas disturbed would be characterized as piñon-juniper woodland with some transitional ponderosa pine. To mitigate these impacts, all construction, where possible and feasible, would be planned to avoid mature, woody-stemmed plants, particularly mature ponderosa pine trees. To reduce the possibility of inadvertent loss of vegetation, clearing limits would be marked before clearing vegetation for construction activities. Underground utility extensions would be located in existing or proposed roadway corridors to the fullest extent possible. Vegetation on temporarily disturbed locations would be replaced with native plant species that are indigenous to the monument after completing construction operations.

Wildlife. Some wildlife in and adjacent to the development zone would be adversely affected because there would be an irretrievable loss of about 7 acres of habitat. An additional 6.5 acres would be temporarily lost due to construction disturbance.

Threatened and Endangered Species. Potential impacts on species listed as threatened or endangered on state and federal lists are being evaluated by the U.S. Fish and Wildlife Service. A biological assessment is being prepared, and consultation under the Endangered Species Act is being conducted. It is not anticipated that any federally listed species would be adversely impacted.

Floodplains and Wetlands. No alterations or affects on wetlands would occur. The new handicap-accessible restrooms between buildings 9 and 2 would be elevated at least 2 feet (or more if necessary) to remove them from the 500-year floodplain.

Water Resources. The quality of surface and groundwater would be generally unaffected under this alternative. Removing the White Rock housing units and visitor vehicles within the canyon would eliminate a small potential for degradation of water quality in Frijoles Creek.

Air Quality. The mandatory shuttle (replacing private vehicles in the canyon), which would use a clean-burning fuel (such as propane or electric) would significantly reduce emissions and slightly improve air quality in the canyon during the peak season (currently April through October).

To further mitigate these impacts, diesel and gasoline vehicles would be limited in their use to maintenance activities, private staff resident vehicles, garbage pickup, and delivery.

Impacts on Noise Levels

Localized and minor noise levels would temporarily increase during construction and revegetation activities. Permanent ambient noise levels would be slightly reduced. Impacts from aircraft overflights would continue.

The mandatory peak-season shuttle system would reduce noise levels significantly in the canyon if the shuttle does not feature a sound amplification system (NPS 1993b). Such a shuttle would also change the noise profile in the canyon — from a constant, high decibel noise level to an oscillating and lower noise level. Currently, private vehicles and buses operate randomly and at times constantly, producing a high ambient noise level. A peak-season shuttle (currently April through October) would provide a fluctuating noise level in the canyon, with a minimum ambient noise level when shuttle vehicles were not operating to a higher (but lower than current) noise level when shuttles were in the canyon. During nonpeak periods the noise levels would return to higher levels with many visitor vehicles coming into the canyon each hour.

To mitigate these impacts, buses and other large, louder vehicles would be limited in their use to maintenance activities, private staff resident vehicles, garbage pickup, and delivery.

Impacts on Views from the Wilderness

A geographic information system was used to determine the relative visibility of each development location from the wilderness. The site northwest of the entrance station, where visitor services and monument headquarters would be developed under this alternative, would be visible from about 1,270 acres within the monument. The maintenance site, south of staff housing, would be visible from about 3,625 acres in the monument.

Impacts on Visitor Use

Implementing this alternative would increase safety by providing expanded visitor parking on the mesa in the monument, thereby eliminating the current situation where visitors need to line up on NM 4 when Frijoles Canyon parking lots are full.

Implementing this alternative would eliminate the individual driving experience during the peak season when the shuttle buses would provide the only means of visitor access to Frijoles Canyon.

This alternative would end peak-season vehicular congestion in Frijoles Canyon but would relocate the traffic volume to the mesa. Peak-season traffic would

increase due to the addition of the shuttle buses, but traffic in the canyon would be reduced by removing visitors' vehicles.

Implementing alternative 1 would also allow the monument to regulate peak-season visitor density in Frijoles Canyon by controlling the frequency of the shuttle schedule. However, the number of visitors in Frijoles Canyon could potentially double if the shuttle trips are too frequent. This would cause higher visitor density, increased resource wear, increased demands on staff and utilities, and a less-than-desired visitor experience.

Alternative 1 would improve the visitor experience and monument efficiency by separating operations and maintenance from visitors to the greatest degree possible and by providing improved visitor orientation and education and universally accessible restrooms.

Expanding the interpretive program in the historic buildings of the canyon would ensure their continued use and maintenance and thus contribute to their preservation.

Removing concessions from the monument would (1) reduce the visitor length of stay in Frijoles Canyon and contribute to a reduction in canyon congestion, (2) improve the appearance of the canyon (because the courtyard that is currently used for the lunchroom would be restored to its historic use and ugly trash and recycling containers would be removed), and (3) reduce maintenance work in the canyon.

Removing the backpackers' parking area and the canyon picnic and overflow parking areas would reduce trash and maintenance work and release staff currently assigned to help with vehicle parking for other duties. It would also reduce the number of vehicles needed, canyon congestion, emissions, and noise and would enhance the scenery and the visitor experience.

Removing the White Rock housing would enhance the monument's image by eliminating visually intrusive structures.

Socioeconomic Impacts

Short-term local economic benefits would be gained from construction-related expenditures. Monument construction activities would generate some temporary construction jobs and create additional local demands for goods and services.

Long-term benefits would include creating some seasonal jobs (driving buses). These positions would most likely benefit local residents.

Removing the concessions (gift shop and food service) would cause the loss of some jobs but could create others in Los Alamos, White Rock, or nearby communities.

This alternative would result in higher capital expenditures by the federal government and higher operations and maintenance costs for the monument because there would be more buildings to staff and maintain, more vehicles to purchase, operate, and maintain, and more interpretive programs to offer. The shuttle bus operation might have to be subsidized by the National Park Service to attract a concessioner and keep user fees reasonable. In such case, the cost of operating the bus service would not be completely covered by the fees charged to ride the shuttle.

Alternative 1 would provide adequate space for administration and maintenance staff to perform their tasks and improve their efficiency. At the same time, because monument functions would be dispersed

between two sites, staff travel time and fuel consumption would increase slightly.

Unavoidable Impacts

About 7 acres of undisturbed or minimally disturbed land and vegetation would be unavoidably affected by proposed development. These impacts are detailed under "Vegetation" and "Wildlife" above.

Irretrievable Commitment of Resources

Disturbing archeological sites, if such disturbance occurs, would result in an irretrievable loss of the archeological resources because disturbance would destroy the resource as data is recovered from the site.

Cumulative Impacts

The cumulative impacts of a mandatory peak-season shuttle and building a new visitor contact station and new mesa-top parking would benefit the visitor experiences and the natural, prehistoric, and historic resources in Frijoles Canyon by reducing noise and exhaust emission levels. Other impacts on the canyon resources from implementing a peak-season shuttle would depend on the frequency of the shuttle schedule, which would be controlled by monument managers. Potentially, the number of visitors in the canyon could increase over existing levels and canyon resources could be negatively impacted. Relocating administration and maintenance functions to the mesa top would also help limit the congestion in the CCC historic district.

Impacts on mesa-top resources resulting from construction activities would include both temporary and permanent soil and vegetation displacement. In this region, regenerating the lost vegetation can take decades.

FRIJOLES CANYON — ALTERNATIVE 2: NO ACTION

Impacts on Cultural Resources

There would be no new impacts on cultural resources or Indian communities who claim ancestry to the monument (including their traditional uses of monument resources). Based on visitation trends, existing negative impacts would continue. Consultation with associated Pueblos has been initiated and would continue throughout the planning process to avoid impacts (see "Consultation and Coordination" section).

Impacts on Collections

There would be no new impacts on the monument collections.

Impacts on Natural Resources

There would be no new impacts on natural resources. Based on visitation trends, existing negative impacts would continue.

Impacts on Noise Levels

High levels of ambient noise in Frijoles Canyon from vehicular traffic would remain unchanged. Impacts from aircraft overflights would continue.

Impacts on Views from the Wilderness

There would be no new impacts on the views from the wilderness.

Impacts on Visitor Use

Visitor safety would continue to be an issue. Projected increases in visitation would cause more frequent backups at the entrance road and down NM 4.

Visitor and vehicular congestion would continue and possibly increase in the canyon.

The number of visitors would increase even under the no-action alternative, and interpretive programs would not be adequate to serve the growing number of visitors. The museum, theater, and visitor facilities would be more crowded.

Even under this no-action alternative, monument managers would still have to comply with the provisions of the American's with Disabilities Act. The approved *Final Master Plan* would still be in effect, and the recently approved *Interpretive Prospectus* would still be implemented.

The courtyard lunch area would continue to be crowded and require maintenance, and the trash and recycle cans would remain visually intrusive. Keeping the concession in the canyon would continue to extend visitors' time in the canyon.

Vehicle noise levels would remain at least at existing levels without the peak-season shuttle.

Socioeconomic Impacts

Administration and maintenance staff would continue to have inadequate facilities.

This alternative would not require higher capital expenditure by the federal government.

Cumulative Impacts

The cumulative impact of implementing this alternative would be no resolution of the identified issues and continued degradation of monument resources and visitor experience because of the more intensive future uses of all monument resources.

TSANKAWI — PREFERRED ALTERNATIVE A: MAXIMUM PROTECTION / MODERATE USE

Impacts on Cultural Resources

Archeological Resources. Before any development could be initiated, the National Park Service would conduct an additional project-specific inventory to ensure that the location, nature, and extent of the resources is thoroughly understood. Site significance would be evaluated, and a determination of eligibility for the national register would be made through consultation with the state historic preservation officer. If sites determined eligible for their potential to yield scientific information would be impacted by this alternative, a data recovery plan would be developed in consultation with the state historic preservation office and the Advisory Council on Historic Preservation. Data recovery would minimize impacts on archeological resources.

A full-time NPS presence and improved visitor facilities would enhance resource protection.

Cultural Landscape. There would be minimal impacts on the cultural landscape because of the new facilities; however, these would be mitigated by designing them to blend in with the surrounding landscape and topography and locating them out of view of the resources and further from Tsankawi Mesa.

Ethnographic Resources. There would be no known impacts on area Indian communities who claim ancestry to the monument or on their traditional uses in the monument. Consultation with associated Pueblos has been initiated and would continue throughout the planning process to avoid impacts on other ethnographic resources (see "Consultation and Coordination" section).

Impacts on Collections

There would be no new impacts on the monument collections.

Impacts on Natural Resources

Soils. Permanent soil disturbance and compaction from impervious structures and asphalt would encompass about 0.88 acre. Up to 3.17 acres of soil would be temporarily disturbed by building, parking, and trail construction activities.

To mitigate these impacts, topsoil would be stripped and windrowed before construction activities and replaced during vegetation. All disturbed areas would be revegetated with native plant species that are indigenous to the monument.

Vegetation. Native vegetation in the Southwest is fragile and difficult and costly to replace. However, minimal native vegetation would be displaced by new structures and trails under this alternative. A total of about 0.88 acre of vegetation would be displaced by new buildings, trails, asphalt, and gravel fill. About 3.17 acres surrounding new pavement and structures would be disturbed by construction activities and would be revegetated with native plants upon completing construction activities. About 0.2 acre would be revegetated after removing existing structures and trails.

To reduce these impacts, all construction would avoid, where possible and feasible, mature, woody-stemmed plants. Construction limits would be clearly marked on the ground before construction.

Wildlife. Some wildlife (small mammals birds, insects, reptiles, and arthropods) in and adjacent to new development sites would be permanently displaced and thus would be adversely affected. There would be an irretrievable loss of about 1 acre of habitat; another 3 acres would be temporarily lost due to construction disturbance, but this land would be rehabilitated. Some wildlife species (deer, birds, etc.) would be temporarily displaced and disturbed during construction activities, but they would be expected to reoccupy the adjacent sites following construction.

Threatened and Endangered Species. Potential impacts on species listed as threatened or endangered on state and federal lists are being evaluated by the U.S. Fish and Wildlife Service. A biological assessment is being prepared, and consultation under the Endangered Species Act is being conducted. It is not anticipated that any federally listed species would be adversely impacted.

Impacts on Noise Levels

Permanent ambient noise levels would be unaffected. Localized noise levels would temporarily increase during construction activity.

Impacts on Views

The new visitor contact station and parking would be at least partially hidden and further from the resources on Tsankawi Mesa. Also, the existing visitor contact station, parking area, and visitor facilities would be removed from view.

Impacts on Visitor Use

Visitor safety would be improved by the full-time presence of NPS staff and because the new parking lot would improve the current short sight distances and avoid parking near heavy commuter traffic. The presence of two-full time rangers and the new facilities would also enhance the visitor experience and understanding of the site.

The size of the parking lot would regulate the number of visitors coming to see the unit.

Access for visitors with disabilities beyond the new contact station would not be possible without seriously compromising the resources. However, provisions would be made to ensure that visitors with disabilities would have the same information and experiences for safe and meaningful visits to the monument.

Socioeconomic Impacts

Short-term local economic benefits would result from construction-related expenditures; however, they would be minimal.

Additional NPS staff would be required to operate the contact station and serve as a roving interpreter.

Unavoidable Impacts

About 0.9 acre of undisturbed or minimally disturbed land and vegetation would be unavoidably affected by proposed development. These impacts are detailed above under "Impacts on Natural Resources."

TSANKAWI — ALTERNATIVE B: CONTINUING CURRENT MANAGEMENT AND USE

Impacts on Cultural Resources

Archeological Resources. Before any development could be initiated, the National Park Service would conduct an additional project-specific inventory to ensure that the location, nature, and extent of the resources is thoroughly understood. Site significance would be evaluated, and a determination of eligibility for the national register would be made through consultation with the state historic preservation officer. If sites determined eligible for their potential to yield scientific information would be impacted by this alternative, a data recovery plan would be developed in consultation with the state historic preservation office and the Advisory Council on Historic Preservation. Data recovery would minimize impacts on archeological resources.

Cultural Landscape. Because the new parking area would be further from Tsankawi Mesa and designed to blend in with the surrounding landscape and topography, the impacts on the cultural landscape would be minimal.

Ethnographic Resources. There would be no known impacts on area Indian communities who claim ancestry to the monument or on their traditional uses in the monument. Consultation with associated Pueblos has been initiated and would continue throughout the planning process to avoid impacts on other ethnographic resources (see "Consultation and Coordination" section).

Impacts on Collections

There would be no new impacts on the monument collection.

Impacts on Natural Resources

Soils. Approximately 0.6 acre of soils in the Tsankawi area would be compacted by the new gravel parking area, access road, and trail link.

Vegetation. Minimal native vegetation would be displaced by development under this alternative. Current maintenance and visitor activities would continue to have a minor impact on specific sites and locations. About 0.6 acre of vegetation would be permanently removed because of the new parking area, access road, and trail link.

Approximately 2.0 acres of temporary vegetation disturbance would occur because of construction activities. About 1.4 acres would be revegetated after completing construction activities and rehabilitating the old trail.

Wildlife. Because less than 1 acre of habitat would irretrievably be lost, permanent adverse impacts on wildlife would be minimal. About 2 acres of habitat would be temporarily lost due to construction disturbance, but these lands would be rehabilitated. Some wildlife species (deer, birds, etc.) would be temporarily displaced and disturbed during construction activities, but they would be expected to reoccupy adjacent sites following construction.

Threatened and Endangered Species. Potential impacts on species listed as threatened or endangered on state and federal lists are being evaluated by the U.S. Fish and Wildlife Service. A biological assessment is being prepared, and consultation under the Endangered Species Act is being conducted. It is not anticipated that any federally listed species would be adversely impacted.

Air Quality. Permanent area air quality would remain unaffected and unchanged. A temporary increase in localized dust would be expected in the immediate vicinity during construction activity.

Impacts on Noise Levels

Permanent ambient noise levels would be unaffected. Localized noise levels would temporarily increase during construction and reclamation activities.

Impacts on Views

Locating the new parking area behind the small mesa south of Tsankawi Mesa would diminish the impact on views from Tsankawi Mesa. The existing contact station and restrooms would still be visible from Tsankawi Mesa.

Impacts on Visitor Use

Visitor safety would be improved because the new parking lot would avoid the current short sight distances and heavy commuter traffic.

The size of the parking lot (the same as the existing area) would regulate the number of vehicles and thus the number of visitors at the site, making it possible that some visitors would not be able to see the site when they wish because the parking lot would be full.

Site accessibility for visitors with disabilities beyond the new contact station would not be possible without seriously compromising the resources. However, provisions would be made to ensure that visitors with disabilities would have the same information and experiences for safe and meaningful visits to the monument.

Socioeconomic Impacts

Short-term local economic benefits would result from construction-related expenditures; however, they would be minimal.

The Tsankawi site would be patrolled by staff stationed at Frijoles Canyon. This would require additional staff and increased fuel consumption.

Unavoidable Impacts

About 0.6 acre of undisturbed or minimally disturbed land and vegetation would be unavoidably affected by proposed development. These impacts are detailed above under "Impacts on Natural Resources."

COMPLIANCE

These draft development concept plans / environmental assessment provide public disclosure of the planning and decision-making process and the potential environmental consequences of actions and alternatives, as required by the National Environmental Policy Act. Following public review of this document the National Park Service will issue either a finding of no significant impact (FONSI) or a notice of intent to prepare an environmental impact statement.

Consultation with the U.S. Fish and Wildlife Service regarding protected threatened and endangered species was initiated in summer 1992. The monument staff has completed a biological assessment for impacts of the plans on federally listed threatened and endangered species, as well as a peregrine falcon site management plan. Consultation with the U.S. Fish and Wildlife Service will be completed by the NPS Southwest Regional Office to satisfy the requirements of section 7 of the Endangered Species Act.

All proposed actions will comply with section 106 of the 1966 National Historic Preservation Act as amended (16 USC 470 et seq.) and its implementing regulations and NPS-28, *Guidelines for Cultural Resources Management*. The identification of traditional cultural properties is also now required as part of section 106 of this act.

To comply with the American Indian Religious Freedom Act (42 USC 1966), which protects and preserves the right of American Indians to pursue traditional religious activities, monument managers would identify and consult with American Indian groups traditionally associated with monument lands and other resources.

There would be no known impacts on traditional users; consultation with these groups would continue.

All proposed development would include specifications that address the Native American Grave Protection and Repatriation Act (NAGPRA, Public Law 101-601, Nov. 16, 1990). Specifications will state that should human remains be discovered during construction, work will stop, the burial will be protected, and the Park Service will notify affected Indian groups of the inadvertent discovery.

Proposals in this plan will affect sites and areas that are on or may be eligible for listing on the National Register of Historic Places. To ensure that proposals that might affect these properties comply with provisions of section 106, the Advisory Council on Historic Preservation (ACHP) and the state historic preservation office (SHPO) were invited to participate in the planning process. The draft document will be sent to the preservation office and the advisory council for review, and their comments will be considered for incorporation into the final development concept plans.

Representatives of the state historic preservation office have been regular participants in core team planning. The NPS team also met with representatives of the Advisory Council to brief them on the project scope, issues, and general direction.

As elements of the plan are implemented, site-specific design and project descriptions will be submitted to these entities for their review and comment. These actions and their impacts are delineated in the text of this plan. This participation will satisfy the requirements of section 106 of the National Historic Preservation Act, as amended.

During the planning process, representatives from the Park Service and various Indian Pueblos met, and dialogue regarding the project is expected to continue in the future. Discussions have centered around facility development and

understanding Indian concerns. The following table lists specific plan actions and shows requirements that are needed for compliance purposes. The entire monument is on the National Register of Historic Places. The CCC historic district is also listed on the register.

TABLE 9. CULTURAL RESOURCE MANAGEMENT REQUIREMENTS FOR FRIJOLES CANYON, PREFERRED ALTERNATIVE 1

PROPOSED ACTION	AFFECTED RESOURCE/ NATURAL REGISTER STATUS	PROPOSED PROTECTIVE MEASURES	PROPOSED DETERMINATION OF EFFECT	FURTHER 106 COMPLIANCE REQUIREMENTS
Frijoles Canyon				
Construct new visitor facilities on the mesa (combined contact station/theater/shuttle bus station, parking with stormwater retention basins, new and relocated trails, picnic facilities, restrooms)	Eight archeological sites are in the project area or vicinity.	• Conduct site-specific archeological investigations. • Design facilities to avoid cultural sites or intrusion on cultural landscape. • Develop mitigation plan with SHPO if unable to avoid sites during construction. • Continue consultation with affiliated tribes. • Educate visitors about site protection.	No adverse effect	SHPO/ACHP consultation in preparing preliminary design and mitigation plans.
Construct new utilities, generally in previously disturbed roadbed.	• About 14 archeological sites, some with architectural components, are in the project area or vicinity.	Same as above.	No adverse effect.	Same as above.
Build stormwater lift station and sewer line to connect two existing lagoons.	About eight archeological sites, some with architectural components, are in the project area or vicinity.	Same as above.	No adverse effect.	Same as above.
Facility rehabilitation on mesa (remove about 10 campsites at Juniper Campground, renovate and revegetate area)	Two archeological sites, some with architectural components, are in the project vicinity.	Same as above plus archeological monitoring of facility removal where appropriate.	No adverse effect.	Same as above

Proposed Action	Affected Resource/ Natural Register Status	Proposed Protective Measures	Proposed Determination of Effect	Further 106 Compliance Requirements
Build new monument facilities on the mesa (administrative and resource management offices and parking).	One archeological site is in the project vicinity.	• Conduct site-specific archeological investigations. • Design facilities to avoid cultural sites or intrusion on cultural landscape. • Develop mitigation plan with SHPO if unable to avoid sites during construction. • Continue consultation with affiliated tribes. • Educate visitors about site protection.	No adverse effect.	Same as above.
Build new maintenance facility, storage boneyard.	Three archeological sites are in the project area or vicinity.	Same as above.	No adverse effect.	Same as above.
Discontinue historic use of the canyon picnic area, relocate use to new picnic area on the mesa, and rehabilitate and revegetate canyon picnic area.	Six archeological sites, some with architectural components, are in the project area or vicinity.	Same as above plus archeological monitoring of facility removal as appropriate.	No adverse effect.	Same as above.
Adaptively use historic structures. • Change the use of historic buildings 3, 5, 12, 13, 14, 15, 16, 17, 23, 24 (east half), 26, 27 (north unit), and 29. • Remove the concession from building 17 and main courtyard • Make buildings 2, 12, 13, 15, 17, 26, universally accessible. • Change use of eight CCC structures from administration to interpretation.	Buildings and landscape features are within CCC historic district, which is on the national register.	• Conduct appropriate site-specific archeological investigations if ground disturbance would occur. • Adaptation of buildings would follow secretary of the interior's standards and would be in keeping with cultural landscape. • Document structures and consult with SHPO before and during design.	• Action conforms to NHPA's section 110 and provides for a positive impact on the historic resources through continued maintenance and upkeep. • No adverse effect from change in function. • Because the danger of petroleum-related spills would disappear, the historic district would benefit.	Same as above.

PROPOSED ACTION	AFFECTED RESOURCE/ NATURAL REGISTER STATUS	PROPOSED PROTECTIVE MEASURES	PROPOSED DETERMINATION OF EFFECT	FURTHER 106 COMPLIANCE REQUIREMENTS
Return courtyards and interior open spaces (between buildings 15 and 17 and enclosed area southeast of building 15) to original function.	Same as above.	Same as above.	• Concession removal includes picnic tables, garbage cans, and recycling bins that negatively affect the courtyard character and the cultural landscape. • Positive effect on historic resources by restoring historic function.	Same as above.
Build a new trail link from the visitor contact station to the Frey Trail.	One archeological site that may have architectural components is in project area/ vicinity.	• Conduct site-specific archeological investigations. • Design facilities to avoid cultural sites or intrusion on cultural landscape. • Develop mitigation plan with SHPO if unable to avoid sites during construction. • Continue consultation with affiliated tribes. • Educate visitors about site protection.	No adverse effect.	Same as above.
Construct accessible restrooms in Frijoles Canyon.	• Area is part of cultural landscape. • Preliminary surveys indicate no archeological resources in area.	• Conduct appropriate site-specific archeological investigations. • Use of compatible architectural styles and materials, and proper facility siting would minimize visual intrusion on the historic scene. • Design facilities to avoid cultural sites. • Develop mitigation plan with SHPO if unable to avoid sites during construction. • Continue consultation with affiliated tribes.	No adverse effect.	Same as above.

TABLE 10. CULTURAL RESOURCE MANAGEMENT REQUIREMENTS FOR TSANKAWI, PREFERRED ALTERNATIVE A

PROPOSED ACTION	AFFECTED RESOURCE/ NATIONAL REGISTER STATUS	PROPOSED PROTECTIVE MEASURES	PROPOSED DETERMINATION OF EFFECT	FURTHER 106 COMPLIANCE REQUIREMENTS
Tsankawi				
• Build park access road, turn lanes, parking lot, sidewalks, new access trail. • Build new visitor contact station and patio area. • Relocate brochure box. • Build underground utility extensions, new septic system. • Build duplex staff residence, residential access road.	There are three archeological sites in the project area.	• Conduct site-specific archeological investigations. • Design facilities to avoid cultural sites or intrusion on landscape. • Develop mitigation plan with SHPO if unable to avoid sites during construction. • Continue consultation with affiliated tribes. • Educate visitors about site protection.	No adverse effect.	SHPO/ACHP consultation in preparing preliminary design and mitigation plans.
Remove existing gate and access trail, install fence	Same as above.	Same as above plus archeologically monitor facility removal as appropriate.	No adverse effect.	Same as above.

TABLE 11. CULTURAL RESOURCE MANAGEMENT REQUIREMENTS FOR TSANKAWI, ALTERNATIVE B

PROPOSED ACTION	AFFECTED RESOURCE/ NATIONAL REGISTER STATUS	PROPOSED PROTECTIVE MEASURES	PROPOSED DETERMINATION OF EFFECT	FURTHER 106 COMPLIANCE REQUIREMENTS
Tsankawi				
Build park access road and turn lanes, parking lot, new access trail.	There are three archeological sites in the project area.	• Conduct site-specific archeological investigations. • Design facilities to avoid cultural sites or intrusion on landscape. • Develop mitigation plan with SHPO if unable to avoid sites during construction. • Continue consultation with affiliated tribes. • Educate visitors about site protection.	No adverse effect.	• SHPO/ ACHP consultation in preparing preliminary design and mitigation plans.
Remove gate and access trail and relocate brochure box.	Same as above.	Same as above plus archeologically monitor facility removal as appropriate.	No adverse effect.	Same as above.

CONSULTATION AND COORDINATION

In April and August 1994 the *Draft Development Concept Plans / Environmental Assessment* were reviewed by the Bandelier National Monument staff and the NPS Southwest Regional Office. Changes required from these reviews were incorporated into the document. The document was circulated to the NPS Washington Office for policy review and to the New Mexico state historic preservation office and the Advisory Council on Historic Preservation in November 1994. Comments from the policy review will be addressed in late 1994, and the document will be revised as necessary and placed on public review in early 1995.

Public involvement activity began March 30, 1992, with a four-day scoping workshop at Los Alamos. Workshop participants included representatives from Bandelier National Monument, the NPS Southwest Regional Office, NPS Harpers Ferry Center, and the NPS Denver Service Center; San Ildefonso Pueblo; the New Mexico state historic preservation office; and the Department of Energy / Los Alamos National Laboratory.

In the interest of keeping the group from becoming too large, and because there were many different interests being represented at the scoping meetings, the Park Service felt that one representative from each of the non-NPS organizations was appropriate at this time. San Ildefonso Pueblo was selected because it has the closest ties with the areas in the monument that would be affected by implementing the plan.

Following the completion of the rough draft plan, the five neighboring Pueblos were contacted by letter (dated May 13, 1993) to arrange meetings with them to discuss the draft plan and receive their comments. A follow-up letter was sent to the same five neighboring Pueblos on June 1, 1993. Meetings were subsequently held with the Pueblos of Santa Clara (June 18, 1993), San Ildefonso (June 18, 1993), and Cochiti (June 24, 1993). The meetings were held at the governor's office of each Pueblo. In addition, Santa Clara Pueblo made an onsite visit with an inspection tour and discussion on September 2, 1993.

San Ildefonso responded to the Park Service's meeting with them by letter (dated July 15, 1993). In their letter they made certain proposals directly and indirectly related to the draft plan. Regional Director John Cook responded by letter dated September 23, 1993.

Following the meeting with the Santa Clara Pueblo at the Pueblo and the Santa Clara onsite visit, Santa Clara Pueblo Governor Walter Dasheno responded by letter dated September 9, 1993.

Copies of these letters are provided in appendix C.

In 1995 the Park Service will place the draft document on public review and invite comments at an informal open house. During this period monument representatives and planning staff will meet with the five neighboring Pueblo leaders at their Pueblos to discuss the draft plan and get comments. Comments and concerns will be solicited from the remaining 14 Pueblos by mail. All Pueblos will also be invited to attend the open house. Onsite tours and discussion will be offered to all Pueblos.

The agencies listed below have provided assistance and information in the preparation of this document.

Bureau of Business and Economic Research, University of New Mexico
Department of Energy / Los Alamos National Laboratory
Los Alamos County Chamber of Commerce
Los Alamos County Tourist Information Center
Museum of New Mexico
National Park Service
  Bandelier National Monument
  Southwest Regional Office
  Water Resources Division
New Mexico Division of State Records and Archives
New Mexico State Highway and Transportation Department
New Mexico Division of Wildlife
New Mexico State Historic Preservation Office
U.S. Department of Agriculture, Soil Conservation Service
U.S. Fish and Wildlife Service
U.S. West Communications, Santa Fe, New Mexico

APPENDIXES

APPENDIX A: SUMMARY OF ACCESSIBILITY RECOMMENDATIONS

Note: "Accessible" in this appendix refers to accessible to people with disabilities.

CONVERSION RATING	RECOMMENDATION
0 = ACCESSIBLE	RU = Remain Unaccessible
1 = EASY	MA = Make Accessible
2 = MODERATE	CA = Currently is Accessible
3 = DIFFICULT	

BUILDING NO.	BUILDING NAME	RATING	RECOMMENDATION
1	Comfort Station	3	RU
2	Visitor Center	2	MA
3	Warehouse	3	RU
4	Maint. Shops	1	CA
5	Gas & Oil House	2	RU
6	Storage Shed	0	CA
7	Residence	3	RU
8	Residence	3	RU
9	Comfort Station	3	RU*
10	Ranger Dorm	3	RU
11	Residence	3	RU
12	Library	1	MA
13	Training Room	2	MA
14	Gas & Oil House	3	RU
15	Admin. Office	2	MA
16	Admin. Office	3	RU
17	Snack & Curio Shop	2	MA
18	Admin. Office	3	RU
19	Cabin Group A	3	RU
20	Cabin Group B	3	RU
21	Kiva/Laundry	2	RU
22	Powerhouse	2	RU
23	Cabin Group D	3	RU
24	Cabin Group C	3	RU
25	Stable	2	RU
26	Entrance Station	1	MA
27	Cabin Group E-1	3	RU
28	Cabin Group E-2	3	RU
29	Cabin Group E-3	3	RU
30	Fire Lookout	3	RU
32	Residence	3	RU

* Additional accessible facilities are recommended at this location.

Building 1: Comfort Station

The path to the building is not currently accessible due to steep grades, and the restrooms are not accessible due to changes in grade, narrow door widths, and standard toilet partition sizes.

Recommendation: The trail could be made accessible, but not easily due to the elevation changes. Major modifications would be necessary to make the interior of this structure accessible. Because there are plans for accessible restrooms in the main building complex area, there seems to be no need to make this comfort station or the trail to it accessible.

Building 2: Visitor Center

The building does not currently meet accessibility standards. New exhibits to supplement the existing, or all new exhibits, are needed, which will probably alter the visitor use and flow. Although it is not possible to solve this difficult problem without also designing the new exhibit flow, some analysis of existing problems and suggested solutions will hopefully lead to an overall resolution.

Front Entrance. The ramp does not provide for a level entry at the door. A level landing area of 5 feet is required in front of each entrance. The screen doors have been removed, and the entrance doors have been modified to open out. However, the narrow 30-inch width of the doors does not allow access by opening only one leaf. Doorways with two independently operated door leaves must have at least one leaf with a clear opening minimum width of 32 inches.

Recommendation: The ramp configuration at the front doors will need to be revised to provide a 5-foot level landing at the door and a 4-foot minimum length. To make this entrance accessible without changing the door width, it will be necessary to make the doors either automatic or power assisted. An alternative would be to widen each door leaf to 2 feet 10 inches and reduce the size of the sidelights. A second alternative would be to use an adjacent single-leaf door to the left of this entry, which is now 36 inches wide. A possible drawback of this approach would be that the person entering would not directly arrive in the central lobby. This door could be added to the main entrance, which would give the building a visitor flow with a one-way routing.

Rear Entrance from Portico. This pair of new doors are the required size to be accessible. The stone floor of the portico has been ramped to eliminate the 3-inch elevation change at the door. Although the slope of the ramp is low, there is no level landing at the door.

Recommendation: Move the ramp so that a 5-foot level surface can be provided at the door.

Interior. The first floor of this building is on three different levels. One enters at the lobby level, then down 6 inches to the existing auditorium or up 13 inches to the existing museum/display area (and exit to rear portico and canyon trail). Access to the auditorium does not meet accessibility requirements. The clear opening width of the door is marginally adequate, but there is no level landing before the door at the bottom of the ramp. Access to the museum area from the main level is currently by a steep removable ramp, which requires an attendant.

Recommendation: Because it is planned to relocate the auditorium, the door at the bottom of the ramp could be removed. Another possible location for a ramp to the auditorium floor level would be at the front left corner of the lobby.

Access to the museum from the lobby could be attained by installing a scissor lift (3 feet x 4 feet) on the right side of the wide stair, which could be either user controlled or remotely controlled. An alternative access to the current exhibit area would be to alter the double doors at the rear of the

former auditorium (they are not historic) and install a ramp up to the portal floor level. This would put one on an accessible route to the exhibits via the portal or to the restroom (as discussed later).

Building 3: Warehouse

This building does not have an accessible entrance, and the toilet and most interior rooms are not accessible. To make the entrance accessible would require about an 18-foot ramp. The interior would require considerable modifications, such as widening doorways and moving wall partitions and plumbing fixtures. Due to the planned use of this building as a field office for patrol rangers and the fact that it is not in a public location, it probably does not need to be made accessible.

Building 4: Garage & Carpenter Shop

The carpenter shop has an accessible entry. The garage is only accessible through the sliding garage doors. The proposed future use of this building probably would not require additional accessibility.

Building 5: Gas & Oil

This building is not accessible, and the planned future use probably would not require accessibility.

Building 6: Garage (Materials Storage)

This building is accessible. Future plans are to retain the current function.

Buildings 7, 8, 10, and 11: Residences

None of these buildings are accessible. All have steps leading to the entrances, narrow doorways, and small interior rooms with tight hallways. Two of the residences have interior level changes from the main floor level to the living room. None of the bathrooms are accessible, and conversion would be difficult due to the existing configurations. The planned use of these structures is to continue to use them for housing.

Recommendation: To make these buildings accessible would require extensive modifications. Therefore, these buildings should remain unaltered.

Building 9: Comfort Station

The current restrooms adjacent to the visitor center are not accessible because the entrance doorways are too narrow and the toilets are in standard sized compartments. Modifications to these structures would be extensive in relation to the size of the building.

Recommendation: Construct new single-unit restrooms (one each for men and women) to the rear of the existing women's restroom. Access could be provided through a new gate in the nonhistoric wall between the women's restroom and the visitor center. Ramps at this location would allow access to the rear portal of the visitor center and to the visitor center itself.

Building 12: Library/Storage

The building is not accessible. There is a step up to the front door, and the leaves of the front door are more than 4 feet wide. The future plan s call for this building to be used as an interpretive facility. This would require an accessible entrance a nd interior, which will not be difficult to achieve. A grade ramp could be constructed to the front doo , and the door panel could be altered to reduce its width.

Building 13: Training Room

Future plans call for this building tc be used as an interpretive facility, which could require full interior accessibility. The entrance fr om the parking lot portal could be modified to provide an accessible entrance by ramping the pc rtal floor to eliminate the 12-inch change in grade at this entry and providing a level landing at the c oor.

Building 14: Gas & Oil House

It would be nearly impossible to make this structure accessible. Any future use would have to be such that nonaccessibility would not be a p roblem.

Building 15: Administrative Office

This building is not accessible. For th future proposed use as a visitor facility, the building must be accessible.

Entrance. The front portico is not ac essible from the side walk. Access is currently from the patio between buildings 15 and building 17, down a 6-foot ramp. The double front entry doors do not meet minimum clear opening width for a s ngle-leaf door, and they are not actuated.

> **Recommendation:** A ramp should be installed at the left side of the portal. To make the entrance doors accessible would require th em to be automatic or power-assisted so that both open simultaneously. An alternative wo ld be to use the adjacent 3-foot-wide door to the right of the current entrance doors.

Interior. The interior is on two level . The first, or main, level is entered either through the double front doors or the door to the right of them and was the original dining room, lunch room, and kitchen. Up 6 inches from this level o the rear was the original rear portal, an open area between buildings 15 and 16, which has since been enclosed.

It is planned to use the enclosed space between buildings 15 and 16 for public use, which will require an accessible route between the two l evels. There is an existing 4-foot-long ramp in the coffee room, but it does not meet accessibility requ rements. The slope is too steep. There are two existing exits out from this level that can potentially b e used for circulation or emergency egress. The door exiting toward the loading dock does not ha e enough distance between the latch side of the door and the wall to meet requirements for entry f om the loading dock. There is also a step at the exterior of the door.

> **Recommendation:** Installing a 6-fo t ramp would provide adequate accessibility between the two levels. The door from the office are a to the loading dock will be accessible when the walls in this area are removed as planned. If nee ded for circulation, the door from the upper level to the loading

dock could be moved over to provide adequate distance from the latch to the wall and the step could be ramped.

New Restrooms. The restrooms in the attached building 16 are not accessible. Facilities should be provided somewhere in the vicinity of this building because it is a long distance to the ones by the visitor center and those will not have the capacity for increased visitor use.

Recommendation: Accessible restrooms could be constructed in the space between buildings 12 and 16, with access from the existing loading dock for building 15. Access to the dock from the southeast courtyard is proposed to be via a chairlift.

Building 16: Administrative Office

Planned use for this building is for interpretive offices and workspace. Currently, this building is not accessible. There are eight separate floor levels within this small building. It is not feasible to make the modifications necessary to make it accessible, and it would require extensive modification.

Recommendations: Recommendations are to leave this building as is.

Building 17: Snack & Curio Shop

This building is not accessible. Plans are to convert this building to an interpretive use. This building will need to be made accessible.

Snackbar Entrance. There is a 7-inch difference in elevation from the southeast portal to the snack bar floor level. The opening width of the double doors is 4 feet, so each individual leaf is 2 feet, which is not accessible.

Recommendation: The accessible entrance is proposed to be from the southeast portal through the double doors. If the existing cooler is removed, the pavement could ramp up the necessary 7 inches± to the doors. There needs to be a level landing at the doors, and they need to be automated or power activated. An alternative to power activated doors would be to remove the double doors and replace them with a 3-foot-wide door and a fixed panel.

Interior. The existing snack bar is about 16.5 inches, three risers, below the existing gift shop. The existing restroom is not accessible and cannot be made so without extensive modifications, so it does not need to be.

Recommendation: To gain access between the two interior levels, a chairlift could be installed along the southwest wall.

Gift Shop Entrance. The gift shop patio is not currently accessible from either the parking lot sidewalk or the gift shop. The patio is about 11 inches above the sidewalk. There is a 1.5-inch threshold at the double entry doors from this patio to the gift shop, and the interior floor level is 7 inches lower than the threshold. A ramp is provided at the interior of this door, but it is steep (dropping 7 inches in 5–8 inches) and there is no level landing at the door. The double entrance doors are each 2.5 feet wide.

Recommendation: The entry/exit from the gift shop to the patio does not need to be accessible for general circulation flow, but it should remain in use for assisted exit in emergencies. For this use,

the existing ramp and narrow door should remain in place. Then the patio does not need to be accessible from the sidewalk.

Building 18: Administrative Office

This building would continue in its current use as offices for interpretive staff. The building is not on an accessible route, and neither entrance is accessible. The interior is on two different levels. It would require major modifications to make this building accessible.

Recommendation: The recommendation is to leave this building as is.

Building 19: Cabin Group A

This cabin group appears to meet exterior accessibility standards based on the slopes and surfaces of the walks. These units will remain as housing facilities. Unit A is not accessible because it is down two risers, and the bathroom could not be easily made accessible.

Unit B could be made accessible by eliminating the riser at the door, but the bath is shared with unit A and could not easily be made accessible.

Units C and D could be made accessible by raising the porch floor to cabin floor height. The shared bathroom is not accessible.

It would take major modifications to make any of these units accessible. Also, the flagstone surfaces at the entry porches may not meet standards.

Recommendation: The recommendation is not to alter this building.

Building 20: Cabin Group B

It is planned that this building remain in its current use as housing. See building 19 for accessible route. The site plan shows steps up to the cabins from the circulation path. To make the units accessible, the porch floors would need to be raised to cabin floor levels. The bathrooms are not currently accessible, and it would require major modification to alter them.

Recommendation: The recommendation is to retain this building as is.

Building 21: Kiva/Laundry

See building 19 for accessible route. The building is to retain its current as a storage facility, laundry, and utility distribution point. The basement and first floor are not accessible. It is not feasible to make the basement accessible. The main level could be made accessible by raising the outside approach to floor height and removing some interior walls; however, the entry door is too narrow.

Recommendation: The recommendation is not to alter this building for accessibility.

Building 22: Powerhouse

This building will continue to be used as a powerhouse. As long as the current function does not change, it does not need to be made accessible.

Building 23: Cabin Group D

It is planned to convert this building from office use to housing. See building 19 for accessible route. Unit A is not accessible because of several steps on the sidewalk approach route. The bathroom is not accessible. Unit B is not accessible due to the configuration of the front door swing, which does not provide enough access room between the door and wall). The porch is not accessible, but it could be made so by adjusting the slope on the sidewalk. The front door could be made accessible by reversing its swing.

Recommendation: To make the bathrooms accessible in both units would require extensive modifications. Therefore, this building should remain unaltered.

Building 24: Cabin Group C

This building will be converted to housing. This building is not currently on an accessible route due to steps on the sidewalk route. The entrances are not accessible due to differences in elevations, and the bathrooms are not accessible.

Recommendation: Due to the extensive modifications required to make this structure accessible, the recommendation is to leave this building in its existing state.

Building 25: Stables

This building is not on an accessible route due to steps, etc. The building does not need to be accessible because it is planned to continue in its existing use.

Recommendation: The recommendation is to leave this building as it is.

Building 26: Entrance Station

This building will remain as an entrance station. The building is not accessible due to the elevation difference between road surface and island surface. The stone surface on the island does not meet standards for width of joints. The interior of the building meets standards, and the doors are accessible.

Recommendation: It would not require much alteration to make the building accessible.

Building 27: Cabin Group E-1, Housing

This building will continue its current use as a housing facility. See building 19 for accessible route. This building is not accessible from the exterior due to elevation differences between the walkway, the porch, and the floor. Alterations to make the building accessible could easily be made. The bathrooms are not accessible and could not be easily converted.

Recommendation: The recommendation is to leave this building as is.

Building 28: Cabin Group E-2, Housing

See building 19 for accessible route. See building 27 for building accessibility.

Recommendation: The recommendation is not to alter this building for accessibility.

Building 29: Cabin Group E-3, Office & Curatorial

This building will be converted to housing. See building 19 for accessible route. This building is not on an accessible path due to the two sets of steps on the route. The bathrooms are not accessible.

Recommendation: The recommendation is not to alter this building for accessibility.

Building 30: Fire Lookout

This building will remain a fire lookout. It is not accessible due to stairs from grade to the second floor balcony. To make the tower accessible would require installing an elevator on the exterior, which would comprise the integrity of the historic scene.

Recommendation: The recommendation is not to alter this building for accessibility.

Building 32: Residence

This building will continue to be used as a residence. The building is not accessible due to steps leading up to the entrance patio. The living area is accessible. The kitchen is not accessible but could be fairly easily remodeled and made accessible. There are no toilet facilities on the living level, and one could not easily be installed. The sleeping areas and bathroom are up four risers and are not accessible; they could not be made accessible without major modifications.

Recommendation: The recommendation is not to alter this building for accessibility.

APPENDIX B: SOIL TYPES IDENTIFIED IN THE MONUMENT

This synopsis has been extracted from a soil survey of Bandelier National Monument (Earth Environmental Consultants, Inc. 1978).

☼ = Soil types identified in the Frijoles Canyon project area
● = Soil types identified in the Tsankawi unit project area

☼ **Rhyolite Tuff Rock Outcrop-Hackroy Complex.** This soil type is extensive, is on 3%-15% slopes of mesa tops, and has rather severe limitations for most uses. Accelerated soil erosion is a common feature.

☼ **Hackroy-Nyjack Complex.** Soil of moderate extent and occurs on 3%-15% slopes of mesa tops and on side slopes of ridges. Soil erosion is variable because removal varies from slight sheet erosion to severe accelerated erosion where V-shaped gullies occur. This soil type has few limitations for most engineering uses except for those in which the shallow to moderate depth to bedrock is detrimental.

☼ **Frijoles Gravelly Sandy Loam.** Soil of moderate extent and occurs primarily on 3%-15% slopes on mesas and talus slopes in canyons where pumice is the parent material. Accelerated erosion is a common feature, and V-shaped gullies frequently occur. Pumice deposits have few limitations for most engineering uses.

☼ **Rhyolite Tuff Rock Outcrop.** This soil represents large areas on mesa tops of 0%-15% slopes and where preexisting soils have eroded away. This type is extensive, leaves bare exposed rhyolite tuff bedrock, and has severe limitations for most engineering uses. Shallow loamy soil material exists only in pockets, cracks, and crevices.

☼ **Very Steep Rhyolite Tuff Rock Outcrop.** Soil is moderately extensive on slopes of 45%-120% slopes of steep canyon walls and cliffs. It is generally inaccessible to humans and most animals. This type has severe restrictions for engineering uses.

☼ **Typic Ustorthents.** Soil occurs on 15%-75% slopes of stony, cobbly colluvial (talus) materials at the foot of steep canyon walls. Large amounts of stone and cobble are typical of this soil type and limit most engineering uses.

☼ **Aquic Haplustolls.** Soil of moderate extent on 1%-3% slopes and occurs only in canyon bottoms along major drainageways. It is subject to seasonal flooding and stratified with stream-washed cobble and stones. Development potential is limited because it is in the floodplain.

Basalt Rock Outcrop-Prieta Complex. This soil has limited distribution and occurs only in the southeast part of the monument near the Rio Grande River. It occurs on high basaltic mesas above the river on 3%-15% slopes and has severe use limitations.

Sandstone Rock Outcrop. This soil also has limited distribution in the southwestern part of the monument near Red Rock Canyon. It occurs on steep hills of stratified sandstone and shale of 15%-75% slope. Erosion is severe and has severe limitations for most uses.

☼ **Nyjack Loam.** This soil is of moderate extent and occurs mainly in the north and northwestern part of the monument on mesas of 0%-15% gentle slopes. This soil type has few use limitations.

Unnamed Eutric Glossoboralfs. These soils are of moderate extent on mesas of 0%-15% slopes in the northwest part of the monument. Moderate slope is the only use limitation.

Eutric Glossoboralfs Complex. These soils are not extensively distributed and occur on 5%-10% slopes on mesas and side slopes of domes in the Baca Location. This soil complex has few use limitations.

Eutric Glossoboralfs Rock Outcrop Complex. This soil is moderately extensive on 20%-45% slopes and occurs on steep side slopes of domes and in canyons of the Baca Location. It is subject

to severe water erosion and has rather severe use limitations.

Cumulic Haploboroll-Eutric Glossoboralfs Complex. This soil has few use limitations and limited distribution of 0%-15% slopes occurring on gentle undulating to moderately sloping mesa tops on Sawyer Mesa and along St. Peters Dome Road.

Argic Cryoborolls-Rock Outcrop Complex. This soil has limited distribution on 5%-45% slopes and occurs on moderately sloping mountain tops, ridges, and steep mountain sides on Cerro Grande Mountain. The soil has severe use limitations.

Griegos Soils. This soil is on 40%-80% steep north- and east-facing slopes on high mountains. This soil is highly erodible and has severe limitations for most uses.

Basalt Rock Land. This soil is of slight distribution and occurs on 50%-90% slopes of very steep rock outcrop. Because of the very steep slopes, this soil has severe limitations for engineering uses.

Bluewing Gravelly Sandy Loam. This soil is of little extent on 0%-5% slopes and occurs on terraces formed in recent alluvium of mixed origin. This soil is subject to severe erosion and has moderate to severe use limitation.

Guaje Gravelly Sandy Loam. This soil is of moderate distribution on 10%-30% slopes and occurs on foot slopes and hills. Erosion is variable, from moderate sheet erosion to severe where V-shaped gullies occur and has severe limitations for most engineering uses.

Los Alamos-Silver Sandy Loam. This soil is of limited distribution on 0%-10% slopes and occurs on uplands and alluvial fans. Accelerated erosion is a common feature of this soil, and it has moderate to severe limitations for engineering uses.

● **Penistaja Fine Sandy Loam.** This soil is of moderate disbursement on 0%-5% slopes and occurs on alluvial fans formed in mixed water-laid and wind-laid material. This soil has a moderate erosion factor and few engineering limitations.

● **Tuff Rock Land.** This soil type has extensive distribution in the area and generally consists of bare rock as steep walls, cliffs, and mesa tops. This soil type is generally inaccessible to humans and has severe limitations for engineering uses and for most wildlife.

APPENDIX C: LETTERS OF CONSULTATION AND COORDINATION

Central Files

(505) 67203861

D18

February 26, 1992

Mr. Pete Martinez, Governor
Pueblo of San Ildefonso
Route #5, Box 315-A
Santa Fe, New Mexico 87501

Dear Honorable Governor Martinez:

The Bandelier National Monument staff will begin the 1st phase of the park's Development Concept Planning (DCP) scoping meetings on March 31st, April 1st and 2nd, in the Los Alamos Hill Top House conference rooms. The meetings begin at 9:00 AM. These meetings are working groups, as DCP teams assist in our efforts to identify problems and develop alternative approaches. We invite you or your tribal representative to attend these working sessions and assist us identify problems and develop alternatives.

The major issues the DCP team will address are: development and operation of the Tsankawi Unit of Bandelier National Monument; the problems of over crowding, congestion and lack of office space, housing and work space within Frijoles Canyon. We are considering relocating some support services outside the canyon and implementing a visitor shuttle bus/transportation system.

If you cannot attend the sessions, please send a tribal council member/representative to assist us on your behalf. If any major discussions or decisions are to be made a written authorization must accompany the representative.

We would appreciate your involvement and assistance.

Thank you.

Sincerely,

Roy W. Weaver
Superintendent

(505) 672-3861

D18

May 13, 1993

Honorable Governor
Pete Martinez
San Idlefonso Pueblo
Route 5, Box 315-A
Santa Fe, New Mexic 87501

Dear Governor Martinez:

Bandelier National Monument had begun long term planning for the eventual relocation of some activities from Frijoles Canyon to Frijoles Mesa. In addition, that same planning activity is addressing the future use of the Tsankawi unit of the park. We are soliciting your concerns and suggestions regarding both areas of Bandelier National Monument.

The Plan, called a Development Concept Plan (DCP) is being developed jointly by Bandelier National Monument staff, the National Park Services Southwest Regional Office, and the National Park Services' planning and design center located in Denver, Colorado. Participating in the initial scoping meetings were representatives from the San Ildefonso Pueblo, the New Mexico State Historic Preservation Office, and the Department of Energy.

We are in the process of developing the preliminary draft DCP. It has not had the benefit of review outside of the planning team. We feel that it is vital that we receive your thoughts on the issues. We would like to meet with you and the Tribal Council in order to receive your concerns and suggestions, to answer questions, and to discuss the DCP. In the meantime we will forward to you a copy of the preliminary draft DCP when it becomes available so that you can review it before hand. We will contact you to set up a meeting.

The DCP planning efforts were begun in response to serious overcrowding problems at Bandelier NM. This overcrowding is effecting the quality of the experience our visitors receive when they visit the park as well as making it very hard for our staff to accomplish their work.

The DCP is looking at various alternatives to minimize the overcrowding problems. Namely, to move those activities not directly related to visitor services out of Frijoles Canyon, thus providing more room for

services in the Canyon while providing ample space in other, less sensitive areas of the park, to accommodate our other park functions.

The plans for Tsankawi are responding to different types of problems; such as; How best to protect the special character of Tsankawi? To what level should it be developed? What is the best way to accommodate visitors while protecting Tsankawi?

As soon as we have a preliminary draft we will send a copy to you to aid in your considerations and thought process. Your efforts to help us identify and resolve these issues would be very much appreciated.

Thank you.

Sincerely,

Roy W. Weaver
Superintendent

Copies of this same letter were sent to:

Jemez Pueblo
Santa Domingo Pueblo
Cochiti Pueblo
Santa Clara Pueblo

a slightly different letter will be sent to the remaining 14 Pueblos and Hopi Governor.

United States Department of the Interior

NATIONAL PARK SERVICE
Bandelier National Monument
HRC 1, Box 1, Suite 15
Los Alamos, New Mexico 87544-9701

IN REPLY REFER TO:

(505) 672-3861

D18

June 1, 1993

Honorable Governor
Thomas Moquino
Santo Domingo Pueblo
Post Office Box 99
Santo Domingo Pueblo, New Mexico 87052

Dear Governor Moquino:

A Development Concept Plan (DCP) is being prepared to address congestion and space problems in Frijoles Canyon of Bandelier National Monument. We are seeking information, guidance, advice, and concerns from you on to this plan and the future of Frijoles Canyon.

It is important at this stage of our planning process where your input and concerns need to be heard directly. Our planning team from our Planning Office in Denver, Colorado will be in the area for DCP planning meetings the week of June 14th. Their schedule is tight since they are involved in several other planning projects as well. We should be able to have the background information to you a week before for your review prior to any meetings. We would like to meet with you and your Council members sometime during that week if you are able.

Please let me know at 672-3861 as soon as possible It is our intent to meet individually with each pueblo interested. Since we may be meeting with several pueblos, scheduling may be a problem. If scheduling is not a problem, we may be able to meet you at the Pueblo. We would prefer to meet you and your Council at your Pueblo community.

I am looking forward to hearing from you.

Sincerely,

Roy W. Weaver
Superintendent

Identical letters sent to the Governors of: Cochiti, Santa Clara San Ildefonso and Jemez Pueblos.

NATIONAL PARK SERVICE 75 1916 - 1991

Office of Governor
Pete Martinez

PUEBLO DE SAN ILDEFONSO
TEWA
NEW MEXICO 87

Telephone
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Route 5, Box 315-A
Santa Fe, New Mexico 87501

July 15, 1993

RECEIVED
JUL 15 1993
BANDELIER NM

Mr. Roy Weaver - Superintendent
Bandelier National Monument
HCR 1, Box 1 Suite 15
Los Alamos, NM 87544-9701

Honorable Superintendent Weaver,

As usual it was a pleasure to have had an opportunity to interact with the National Parks Services, on behalf of the Pueblo of San Ildefonso.

Again as I stated the Pueblo wants to be a part of the Parks Services solutions to it's problems now and in the future.

As suggested at the meeting of June 18th, 1993 - the Pueblo is willing to incorporate into it's future economic developmental plan - means by which we could become a minor part of the solution towards the Park's current problems. We suggest the following areas of joint co-operation initiatives:

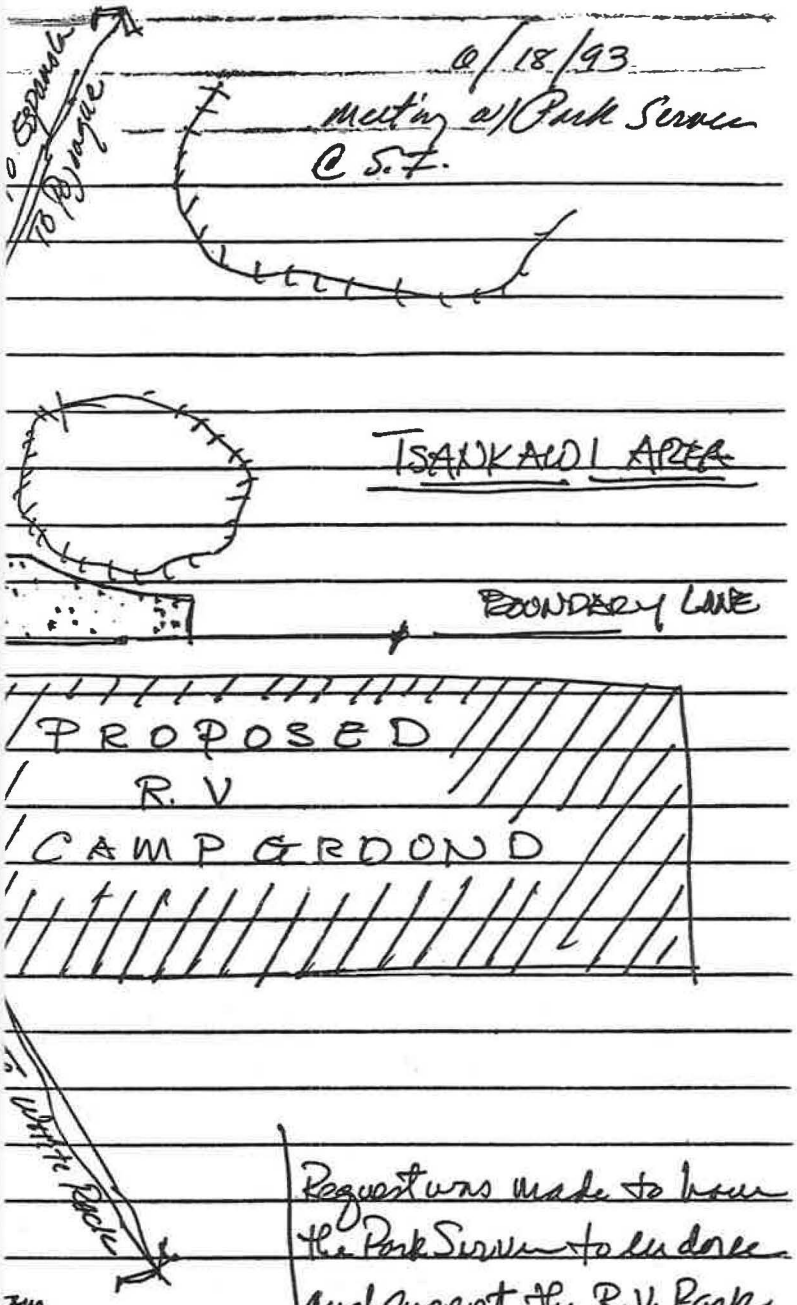
I. the Pueblo develop it's Cultural Center at the White Rock location
   - A. A possible shuttle service to compliment that the Park service is planning on developing.
   - B. Assist the Pueblo develop it's Archeological resources on the East side of State Road #4 (White Rock Area)
   - C. the Pueblo with assistance from the Park Service or through a joint powers Agreement would develop an R.V. park to the south of Tsankawi.
   - D. the Park service would endorse the Pueblo's efforts in developing hotel/motel possibilities to meet tourists demands at White Rock.

Again I thank you and the Park service for the opportunity, afforded the Pueblo to be a small part of the solutions - I certainly look forward to a continued dialogue now and in the future.

Sincerely,

PUEBLO OF SAN ILDEFONSO

Gilbert Sanchez, Lt. Governor



6/18/93
meeting w/ Park Service
C.S.F.

with the ending of State Road 4, parking area at Tsankawi would be eliminated.

NOTES:
Park Service is proposing there own shuttle system.

ISSUES
1. Distance to Bandelier from White Rock (cost estimate)
2. Shuttle service insurance.
3. Joint partnership on funding request for shuttle service or other development to resolve Bandelier's present problems in transportation, parking, trails, etc.

Requestions made to have the Park Service to endorse and support the R.V. Park and Cultural Center/Visitor Center.
Reviews in opportunity of the surrounding Concept.

D18(SWR-DP)

SEP 2 3 1993

SEP 2 5 1993

Honorable Gilbert Sanchez
Lieutenant Governor
Pueblo of San Ildefonso
Route 5, Box 315A
Santa Fe, New Mexico 87501

Honorable Gilbert Sanchez:

Thank you for your letter of July 15 to Superintendent Roy Weaver expressing your desire to work cooperatively with the National Park Service and outlining areas of possible joint cooperation. We appreciate your interest. Also, we are pleased to receive your thoughts about San Ildefonso Pueblo's future plans in conjunction with our planning efforts for Bandelier National Monument.

In response to the four items that you mentioned in your letter:

1. We support the Pueblos efforts in developing a cultural center in the vicinity of the White Rock community, and providing a shuttle service from your center to Bandelier would be an added service for visitors. Although the National Park Service does not have a need for a shuttle service from White Rock to Bandelier, we are open to discussion on the possibility of a cooperative effort.

2. We are open to discussion on the possibility of technical assistance to the Pueblo in connection with developing Pueblo archeological resources to the east of White Rock and potentially other projects. We would need to have a more detailed understanding of your objectives and needs to discuss this possibility further.

3. We have been working closely with the New Mexico State Highway Department and others over the years to preserve Tsankawi resources and to maintain the quality of the visitor experience at Tsankawi by minimizing impacts from neighboring areas such as visual or aural intrusions. A recreational vehicle development of the scale suggested by your sketch map would constitute a considerable impact to Tsankawi, and we need to request that you consider an alternative location for this development. Perhaps a site closer to White Rock, more closely associated with your cultural center, would be a possibility.

There are two possibilities for the location of National Park Service facilities (visitor contact and parking) at Tsankawi, Option A - locating inside the National Park Service boundary in the southwest corner; or Option B - locating on Pueblo land outside the National Park Service boundary, just to the south of the National Park Service boundary. We are open to discussion with you concerning Option B if a location that is not visible from Tsankawi Mesa could be found.

4. I heartily support Superintendent Weaver in his endorsement of your efforts to develop a cultural center and tourist facility in the White Rock area.

Again, thank you for your letter. Please continue working directly with Superintendent Weaver, who looks forward to hearing from you with regard to the points discussed above, and to continuing your constructive dialog into the future.

Sincerely,

/s/ John E. Cook

Regional Director,
Southwest Region

cc:
Superintendent, Bandelier National Monument

DCP-file

SANTA CLARA
POST OFFICE BOX 580
(505) 753-7326
(505) 753-7330

September 9, 1993



INDIAN PUEBLO
ESPANOLA, NEW MEXICO
87532

OFFICE OF GOVERNOR

SEP 13 1993

U.S. Dept. of the Interior
National Park Service
Bandelier National Monument
HRC 1, Box 1, Suite 15
Los Alamos, N.M. 87544-9701
ATTN: Roy W. Weaver, Superintendent

Dear Mr. Weaver:

Thank you for meeting with Mr. Mel Tafoya and I, last Thursday. Mr. Gary Roybal explained to us the expansion plans further after our meeting. Mr. Roybal showed us the upper campgrounds and the potential area for development of the area east of the main entrance.

The Bandelier situation is similar in nature to ours, except on a larger scale. We feel the meeting was very productive and gives us some ideas also. We would like to recommend that the upper campgrounds remain in their present location. The area which is currently a gravel pit and storage area should be noted as a potential possibility.

We are requesting a meeting on September 24, 1993 at 9:30 a.m. at Puye Cliffs. We would like to invite Mr. Gary Roybal, Virginia Salazar, Mr. Ed Natay of the Santa Fe office, and anyone else who might provide us some assistance and ideas in our area of development.

We have not had a chance to look for reference items which you have previously sent to us.

If you have questions please feel free to contact our office.

Sincerely,

Walter Dasheno
Governor

xc: file; Mel Tafoya; Francis Tafoya; Lt. Governor; Gloria Naranjo, Tourism Dept.

DIR

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U.S. Forest Service
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As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

NPS D-66, May 1995

3420
R3-03-03

Tree Survival and Insect Activity in Partially Scorched Ponderosa Pine in the Cerro Grande Wildfire, New Mexico

David A. Conklin
Forest Pathologist

and

Terrence J. Rogers
Forest Entomologist

USDA Forest Service, Southwestern Region
Forestry and Forest Health
333 Broadway Blvd., SE
Albuquerque, New Mexico

Abstract

Four rectangular plots containing a sample of 232 ponderosa pine were installed a few weeks after the May 2000 Cerro Grande (Los Alamos) wildfire in an area that burned at low to moderate intensity. Sample trees had an average crown (needle) scorch of about 80 percent and most had moderate to heavy bole char. Seventy-six percent were alive in May 2003, three years after the fire. Survival varied greatly by plot, with 95 percent of the mortality occurring on two of the four plots. About 75 percent of the trees that died had some sign of bark beetle attack. Nearly all of the bark beetle activity occurred in year two and three after the fire, a period of extreme drought. About 1/3 of the live trees on these plots became infested with wood borers; on one plot, a borer/woodpecker complex increased tree mortality. Over half the trees that received 100 percent crown scorch survived the three year period.

Introduction

The Cerro Grande Wildfire burned over about 43,000 acres near Los Alamos, New Mexico in early May 2000. About 15,000 acres burned as a high intensity crown fire, while the remainder generally burned at low to moderate intensity. In late June, about six weeks after the fire, we installed a set of plots to monitor bark beetle activity in fire-damaged trees in an area burned at low to moderate intensity.

Some studies conducted in the northern Rockies have indicated that fire-damaged conifers, especially Douglas-fir, are prone to bark beetle attack (Weatherby et. al. 1994, Ryan and Amman 1996, Rasmussen, et. al. 1996, USDA Forest Service 2000). Relatively little information has been available on bark beetle activity in fire-damaged ponderosa pine in the Southwest. Large outbreaks of bark beetles have generally not been observed following recent fires in New Mexico, although at least some bark beetle activity probably does occur after most sizable fires—both prescribed fires and wildfires--in the Southwest (Conklin and Armstrong 2001, McHugh and Kolb 2003).

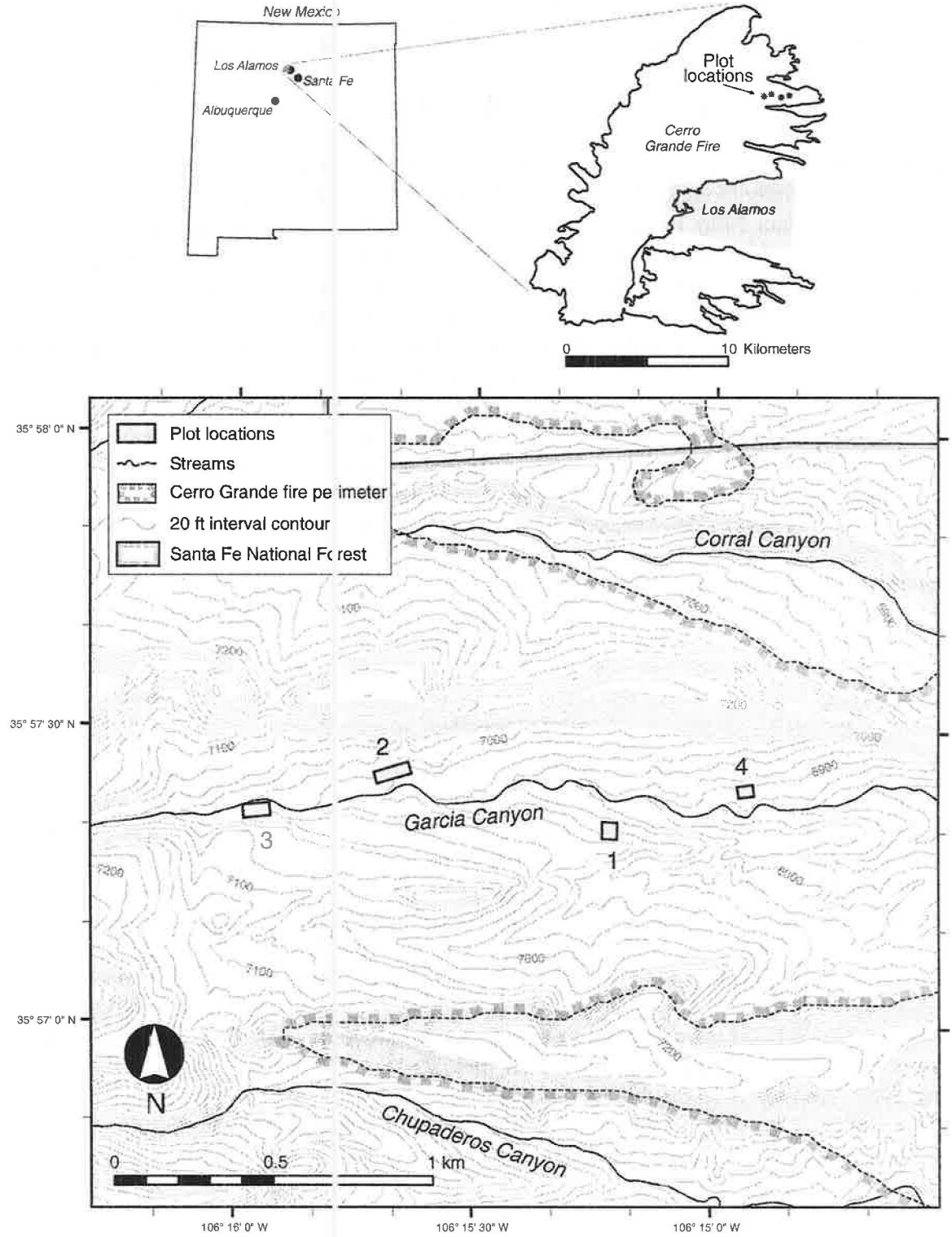
Trees killed directly by fire do not provide suitable habitat for bark beetle development. Such trees are usually easily recognized soon after a fire by a complete or nearly complete consumption of needles, a result of the fire "crowning." Extreme cambial damage usually makes these trees unattractive to, and unsuitable for, bark beetles. Trees experiencing less intense fire often survive, at least initially, and can provide suitable bark beetle habitat. It has long been known that dead and dying trees are often entered by wood-boring insects, especially roundheaded and flatheaded beetles.

Study Area

Our plots are located in Garcia canyon, in the northern portion of the Cerro Grande fire area, about four miles northeast of Los Alamos (Figure 1). The low-elevation stringer of ponderosa pine in Garcia canyon burned at varying intensities during this large wildfire, resulting in a mosaic of partially to completely scorched areas. An intermittent stream (usually dry) lies in the bottom of Garcia Canyon. Forest Road 445 (not shown) parallels this drainage and provides access to the study area.

The forest on the south side of Garcia Canyon had been thinned in 1994 in a Forest Pest Management-funded "bark beetle prevention project." This 137 acre treatment was a low thinning which removed one-half to two-thirds of the trees in most areas, reducing basal areas from about 120 to around 70 ft^2/acre, on average. Most of the down material was promptly removed from the site by fuelwood gatherers, while a few of the larger stems were sold as vigas. Because of its proximity to archeological sites along the canyon walls, the forest on the north side of the canyon was left unthinned. Both areas were broadcast burned in 1995.

Figure 1. Cerro Grande Fire Monitoring Plots



In addition to the treatment within Garcia canyon itself, several hundred additional acres of ponderosa pine forest in nearby canyons and mesas were thinned and prescribed burned from 1994 to 1999 in what was known collectively as the Garcia Canyon Ecosystem Restoration Project. This "landscape-scale" treatment may well have moderated fire behavior within the northern portions of the Cerro Grande wildfire.

Methods

Four rectangular plots containing roughly equal sample sizes (50 to 65 trees each) were installed in easily accessible areas, about 6 weeks after the fire. The plots were intentionally located in areas having moderate to high levels of crown (needle) scorch but little to no actual crown consumption. (Areas where significant "crowning" occurred--consuming the foliage and killing the buds--would have provided little opportunity for either tree survival or bark beetle activity). Essentially all the crown scorch within our selected plot locations was a result of heat rather than direct combustion. Two plots (Plots 1 and 3) were installed in the thinned portion of Garcia Canyon, and two others (Plots 2 and 4) in the unthinned portion (Figure 1).

All ponderosa pines over 4" dbh were tagged, measured for dbh, and rated for both crown scorch and bole char. Crown scorch ratings were estimates, to the nearest 10 percent, of the proportion (length) of the live crown in which the needles were scorched. Trees were observed from several angles when estimating crown scorch. New growth from surviving buds—which was starting to become visible when these scorch ratings were made in late June--was ignored. The distribution of sample trees by scorch class is displayed in Figure 2. All of the sample trees had some crown scorch, and nearly two-third of them had ratings of 80 percent or higher.

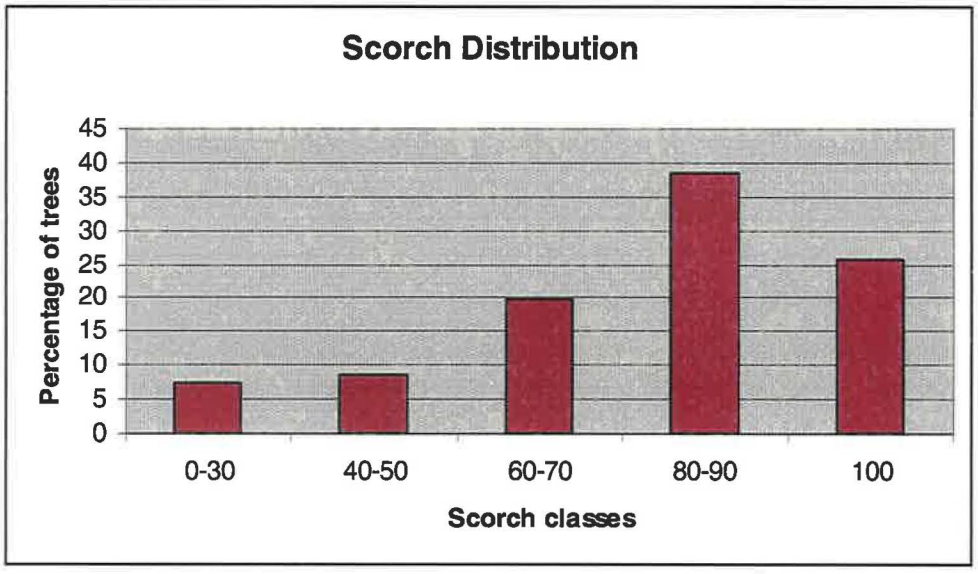


Figure 2. Proportion of sample trees, by scorch class group.

Bole char was rated simply as "light," "moderate," or "heavy." Bole char was relatively uniform on our plots; most trees (86 percent) had heavily-blackened bark completely encircling the trunk and extending several feet high, and were rated "heavy." No attempt was made to determine actual damage to the cambium, which itself would have damaged the tree and possibly even attracted bark beetles.

Initial plot attributes are summarized in Table 1 below. Most trees on these plots were about 80 years old at the time of the wildfire. Several of the larger trees on Plot 2 were 100 to 120 years old.

	Size (acres)	# Trees	Avg. dbh	BA (ft^2/ac.)	Average crown scorch	% of trees with heavy bole char
Plot 1	0.60	58	10.5	59	76%	91%
Plot 2	1.02	51	18.1	98	61%	63%
Plot 3	0.94	58	14.6	74	87%	100%
Plot 4	0.48	65	12.7	131	82%	86%

Table 1. Plots at time of establishment.

The plots were revisited to assess insect activity and tree survival in November 2000 (six months after the fire), and in May 2001, 2002, and 2003 (one, two, and three years after the fire). We based our assessments of insect activity on external signs (boring dust, pitch tubes, etc.) until the tree was clearly dead, in order to avoid further damaging sample trees and possibly influencing our results.

Results and Discussion

Seventy-six percent (176 of the 232 sample trees) were alive in May 2003, three years after the fire. Survival varied greatly by plot, with most (95 percent) of the mortality occurring on Plots 1 and 4 (Table 2). Survival generally decreased with increasing crown scorch (Figure 3), although there was no difference in survival within the range of 40 to 90 percent scorch due to complicating factors of insect activity, tree size, and site differences. Sixty-three percent of the sample trees with 100 percent crown scorch survived. Seventy-one percent of trees with heavy bole char survived, while 100 percent (33 trees) of those with light or moderate bole char survived.

Year	Plot 1	Plot 2	Plot 3	Plot 4	Total
One	6	1	0	1	8
Two	14	0	0	6	20
Three	9	1	1	17	28
Total	29 (50%)	2 (4%)	1 (2%)	24 (37%)	56 (24%)

Table 2. Number of trees that died on each plot, by year, with percent mortality over three -year period in ( ).

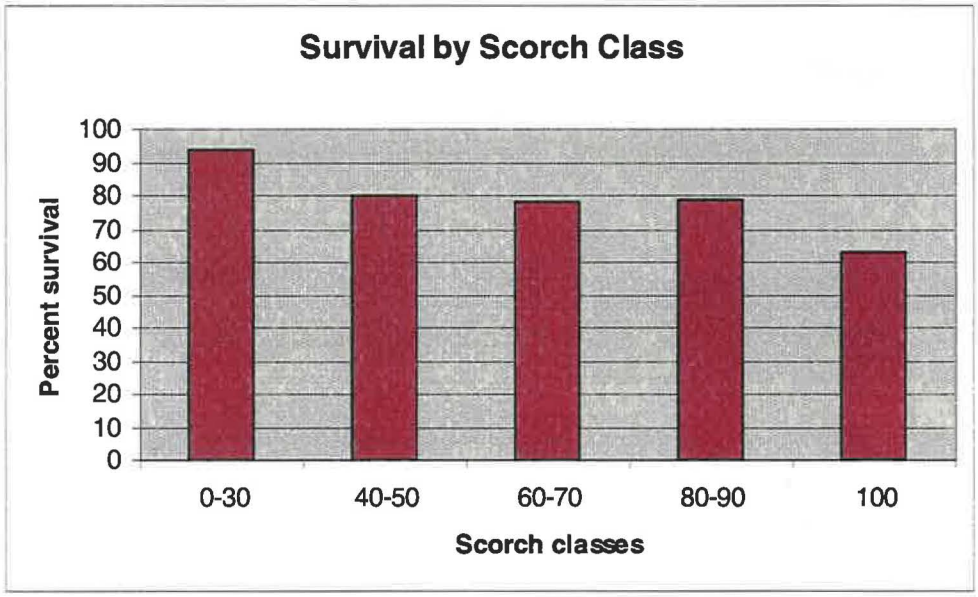


Figure 3. Proportion of sample trees surviving, by scorch class group.

Somewhat surprisingly, only eight sample trees died in the first year after the fire. Twenty trees died in year two, and 28 in year three. Most of the mortality the first two years after the fire was on Plot 1, while in year three the greatest proportion occurred on on Plot 4 (Table 2).

Insect activity

About 75 percent of the trees that died in the three years following the fire had some sign of bark beetle attack—either *Ips* sp. and/or Western pine beetle (*Dendroctonus brevicomis*). The remaining mortality was attributed to either fire damage alone or woodpeckering (see next paragraph). Nearly all of this bark beetle activity occurred in years two and three (2001 and 2002) following the fire, with about two-thirds of it in year three (Cover Photo). Several trees were attacked by red turpentine beetle the first year

after the fire; however, these survived, except for three that were heavily damaged by woodpeckering.

Surprising to us, about one-third of the live trees on these plots became infested with wood borers (Cerambicid and/or Buprestid beetles). Borer activity was most pronounced on Plot 1, where at least 32 trees (55 percent) became infested and were subsequently damaged by woodpeckers feeding on these insects.[1] This "peckering" (holes and bark sloughing) (Figure 4) appeared to have increased mortality significantly on this plot, as only 11 of these 32 trees survived. Several of the peckered trees were subsequently attacked by bark beetles, helping to assure their death. (The condition of the bark on a few of these trees made it difficult to determine whether or not they had been attacked by bark beetles). Most of the borer-infested trees on the other plots survived the three-year period; the extent of damage to the wood in these living trees is unknown. Additional borer activity has undoubtedly occurred in dead trees—those killed by bark beetles or by the fire itself—but we have not quantified this activity. Wood borer activity in surviving, fire-damaged trees has been little documented and may warrant further study.

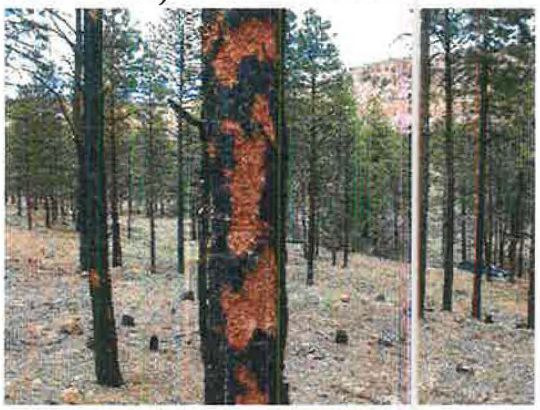


Figure 4. "Peckering"on scorched trees.

The relatively high level of bark beetle activity that occurred the third year after the fire seemed more a result of the extreme drought in 2002 than fire damage. Under more favorable moisture conditions, it is very likely that many of the trees that died in year three would have survived. Mortality of scorched ponderosa pine has usually declined considerably in the third year after fires (Conklin and Armstrong 2001, McHugh and Kolb 2003). Nevertheless, there are indications that fire damage was a still significant factor in year three of the current study. All of the trees that were attacked by bark beetles in year three had heavy bole char, while no trees with light or moderate bole char ratings were attacked.

Precipitation records for nearby Los Alamos (http://www.wrcc.dri.edu) indicate significant deficits each year of the three year period, with the greatest deficit in 2002. On a percentage basis, the annual deficits are as follows: 2000: -25%, 2001: -21%, 2002: -36%. These deficit figures are based on averages since 1942. Note that in 2000, the year of the fire, the bulk of the deficit occurred prior to the May fire; the period after the fire was actually close to normal.

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[1] Some wood borer activity was detected when the plots were initially set up, six weeks after the fire. At that time we had observed some fine-textured, reddish dust in bark crevasses on five trees, all on Plot 1. We initially assumed that these trees had been attacked by *Ips* bark beetles, thinking that their weakened condition had precluded the formation of pitch tubes. By November 2000 (six months after the fire), many more trees had this reddish dust, and several of them had been "peckered." Additional peckering was evident by May 2001. By then, given that most of these trees were still green, and with the lack of pitch tubes, we realized that the reddish dust was a result of borer larvae rather than *Ips*.

Other factors affecting tree survival

Overall, there was little difference in bark beetle activity and tree mortality between the thinned areas (sampled on Plots 1 and 3) and the unthinned area (sampled on Plots 2 and 4). However, the largest seasonal outbreak did occur on unthinned Plot 4, which had the highest basal area (>130 ft^2).

Survival within this study area generally increased with increasing tree size. Plots 1 and 4, where most of the mortality occurred, had smaller average dbh's than the other two plots (Tables 1 and 2). Moreover, on both Plot 1 and Plot 4, the trees that survived averaged about one inch larger in diameter than those that died. These results are consistent with Reinhardt and Ryan (1989), who estimate mortality of fire-damaged trees based on crown scorch and bark thickness (as computed from dbh). Simply stated, larger trees usually have thicker bark than smaller trees, providing greater fire resistance.

In addition to crown scorch, bole char, and tree size, it appears that site differences—elevation, aspect, and location relative to the canyon bottom (water table) greatly influenced survival rates on the four plots. Our results illustrate the complexities inherent in predicting the survival of partially scorched trees and the variation that may occur across a landscape. Some of the variation among these four plots--in order of increasing mortality--is discussed below:

Plot 3. Despite having the greatest average crown scorch (87%) and all trees having heavy bole char, this plot had the lowest mortality rate—only one tree died, a result of bark beetle attack in year three. The location of this plot in the canyon bottom, close to the water table, undoubtedly influenced survival. Fifteen of 16 trees with 100% crown scorch survived.

Plot 2. The low mortality rate (two trees) on this plot can be attributed to less severe scorch than on the other plots and the larger average tree size (> 18" dbh). Its location on a bench several feet above the water table is probably not as favorable as Plot 3; nevertheless, 10 of 11 trees with 100% crown scorch survived. Our initial speculation that the relatively large, fire-damaged trees on this plot might be attractive to western pine beetle did not materialize.

The fact that Plots 2 and 3 are located further up the canyon and at slightly higher elevation than Plots 1 and 4 is another factor that cannot be discounted. The higher elevation plots probably received somewhat more precipitation over the three-year period than the lower elevation plots.

Plot 4. As of May 2002, two years after the fire, mortality was fairly low on this plot: only 7 of 65 trees (11 percent). However, at that time, the entire plot--located on a south-facing slope--appeared off-color and severely stressed. Seventeen trees were attacked and killed by bark beetles over the next twelve months (Cover Photo). Nine of 16 trees with 100% crown scorch survived the three-year period.

Plot 1. The overall impression is that this plot suffered high mortality (50 percent) because the smaller, relatively thin-barked trees were more severely damaged by bole char, and possibly root damage. Cambial damage most likely lead to the wood borer/woodpecker complex which contributed to much of the mortality. Moderate levels of bark beetle activity in years two and three helped "finish off" several of these damaged trees. The location of this plot-- relatively high on the slope, where soils were thinner—probably contributed to the high mortality rate. Four of 17 trees with 100% crown scorch survived.

Survival of severely scorched trees

Other studies have reported remarkable recovery of heavily scorched ponderosa pine (Dieterich 1979, Harrington 1987). In this study, the survival rate among trees with 100% crown scorch ratings--63 percent-- was higher than we have reported in several prescribe-burned areas, where it has usually ranged from 15 to 30 percent (Conklin and Armstrong 2001; our unpublished data). Several factors account for this difference. One is that on most of our prescribed fire plots (but not the Garcia Canyon plots), some trees with 100% scorch ratings experienced *crown consumption* and were killed directly by fire. Another factor is that our prescribed fire plots were in dwarf mistletoe-infected stands, while this disease is absent in Garcia Canyon. Dwarf mistletoe infection can increase the mortality rate among heavily scorched trees (Harrington and Hawksworth 1990, Conklin and Armstrong 2001). An additional factor, discussed previously, is that the location of several sample trees in the canyon bottom contributed to the overall high survival rate on the Garcia Canyon plots.

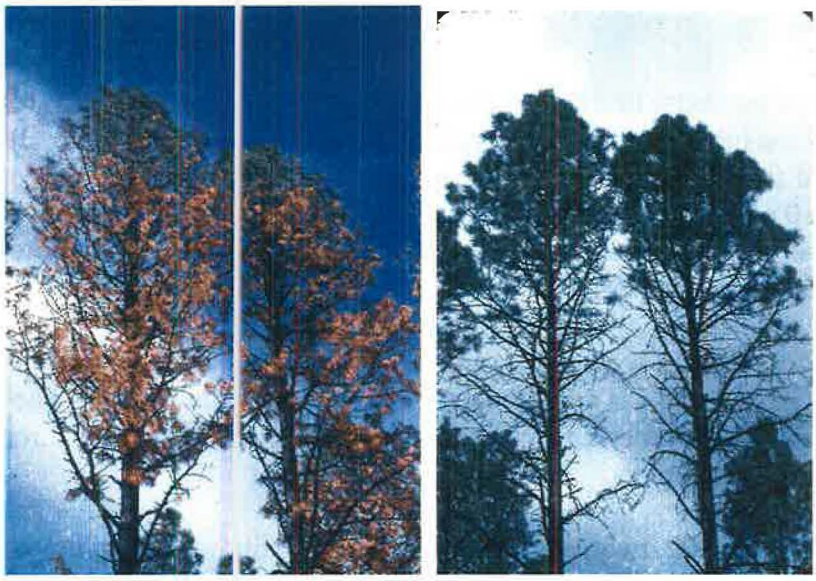


Figure 5. Recovery of trees with 100% crown scorch. Left: Photo taken November 2000, six month after fire, after flush of new growth. Right: Photo taken May 2003, three years after fire. (Note that angle of photos is slightly different.)

Conclusions

The overall high survival rate (76 percent) among these (mostly) heavily scorched trees is all the more notable, given the prolonged drought during this period. However, if the drought continues, as it has through the first half of 2003, additional bark beetle activity and tree mortality is likely on these plots. The Los Alamos area experienced some of the highest levels of bark beetle activity in ponderosa pine in New Mexico in 2002. Results from these plots indicate that although drought has been the overriding factor in this outbreak, the partially-scorched trees from the Cerro Grande wildfire have at least contributed toward the build-up in beetle populations. The magnitude and duration of this outbreak will largely be determined by the extent and severity of the drought.

Acknowledgements

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