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Site selection for a mountain biking facility

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SITE SELECTION FOR A MOUNTAIN BIKING FACILITY

A Thesis

Presented to

The Faculty of the Department of Geography

San Jose State University

In Partial Fulfillment

of the Requirements for the Degree

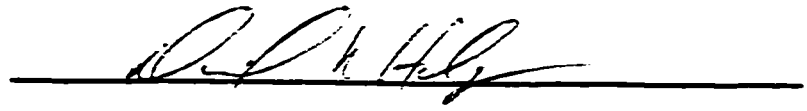
Master of Arts

by

Steven M. Jones

December 1999

APPROVED FOR THE DEPARTMENT OFGEOGRAPHY



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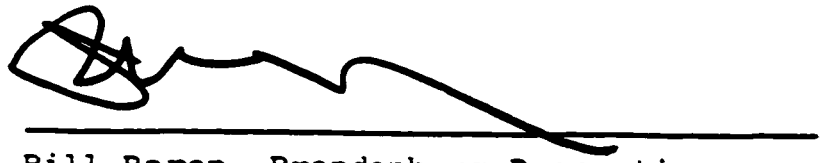

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ABSTRACT

SITE SELECTION FOR A MOUNTAIN BIKING FACILITY

by Steven M. Jones

This thesis reports on a site selection process for a 2,500 acre mountain biking facility in northern California. It develops the design elements or "ingredients" that are required for development of such a facility. Simultaneously, ideal landscape criteria for a mountain biking facility are defined and located as a foundation for the design elements. This site selection is the process of finding the best location to place the design elements.

The best sites were selected by analyzing transparent overlays of computer generated maps, each displaying one of the eleven landscape criteria. The site selection process revealed one best site in each of the two regions examined. The site in Cedar Mountain region was compared to the site in the Tassajara region. The Tassajara site was selected as the best place to locate a mountain biking facility. Tassajara encompasses nearly all of the best landscape criteria required while the Cedar Mountain site fails on the vegetation criterion and on the road access criterion.

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INTRODUCTION

Mountain biking provides an opportunity to experience the outdoors with the exhilaration of riding a bicycle on trails that hug the terrain. Trails concentrate mountain bikers to narrow corridors through natural environments, leaving the rest of the landscape undeveloped and supporting of wildlife (International Mountain Biking Association, 1995). This relatively new sport was developed in the 1970's (Breeze, 1998). It combines an excellent form of exercise with the thrill of exploring vast open spaces.

Conversion of rural lands to urban uses, particularly in California, has increased the pressure to provide more public recreational opportunities on the remaining rural open spaces. As a result, public agencies are experiencing increased demands for services while they are also challenged with fiscal uncertainty (East Bay Regional Park District, 1997). Simultaneously, the sport of mountain biking has grown tremendously. For example, commercial mountain bikes did not exist before 1978 (Breeze, 1998). As of 1995 there were forty-six mountain bike trail advocacy groups in California alone (International Mountain Biking Association, 1995)! In 1996 mountain biking was featured in the Summer Olympics for the first time (Breeze, 1998).

The sport of mountain biking benefits from preserved open space. Revenue from the mountain biking facility proposed here would be used to manage and preserve surrounding open spaces. A mountain biking facility with these amenities would provide a safe, yet exhilarating atmosphere with year round trail maintenance and guaranteed open trails.

Use of trails by multiple users creates a challenging situation. Today mountain bikers often have to share trails with equestrians and hikers. Working to improve the relationship among multiple users on public trails is important. However, this project offers mountain bikers one alternative to the current situation on public trails. Equestrians and hikers have always had alternatives to sharing the trails. Equestrians have riding centers and ranches; hikers have single track (narrow trails) and exclusive "hiking only" trails. This project should not be viewed as a threat to public trails, but as a new idea offering an exciting alternative for mountain bikers.

To envision this development, imagine a biking facility paralleling the atmosphere at a world class alpine sport resort (Jensen, 1996). A ski resort would have incredible terrain for downhill skiing combined with modern

amenities located in a building that architecturally creates a sense of place in alpine surroundings. This mountain biking facility emulates that concept in a mild climate with little or no alteration to the existing landscape. Such a mountain biking project would be unique compared to "summer only" mountain biking in the remote Sierra Nevada. This project will be in a mild climate closer to a major urban area.

Thesis Goal

The goal of this thesis is to select the most suitable site for a mountain biking development within the East Bay region of northern California. A mountain biking development consists of sufficiently large acreage with loop trails and amenities complimentary to mountain bikers. Pleasanton Ridge and Briones regional parks are two examples of East Bay parks with loop trails and sufficient acreage for mountain biking. However, there are no parks in the Bay Area that currently offer modern amenities on site such as a lodge, restaurant, large outdoor deck, activities for children, bike rental, first aid service and lessons. Hopefully this document is the first step leading to development of a business plan for such a facility.

This thesis concentrates on a search for land that best suits the criteria for a mountain biking facility. The site selection process is meant to be a broad search for ideal sites, performed objectively prior to consideration of land value, land availability and land use zoning. Two sites were selected simultaneously from two areas within the East Bay. The two areas were researched for site selection followed by a comparison of the two final sites selected. From the two sites, the site that best suited the criteria was selected. The first major component of the site selection process was to define the elements necessary to design the development. The second major component was to define and locate the landscape criteria required to fulfill the design (See Table 1). Each landscape criteria was then evaluated in a series of map overlays to select the best site for the facility.

TABLE 1.

DESIGN ELEMENTS

1) Single Track Trails and Fire Road Trails

2) Overnight Accommodations/Lodge

3) Trail Staging Areas

4) On Site Utilities

5) New Access Road(s)

LANDSCAPE CRITERIA

1) Facility Area

2) Weather and Climate

3) Landforms

4) Buffer Zone

5) A Convenient Location

6) Ridgelines

7) Vegetation

8) Trail Soil Quality

9) Access by Car or Bus

10) Natural Water Features

11) Drinking Water

THE STUDY AREA

The East Bay in northern California is a region that satisfies the special requirements for an innovative mountain biking facility. The region has a mild climate for riding throughout the year and a large mountain biking population. Mountain biking was born in the Bay Area in the 1970's. The birthplace of the sport is Mount Tamalpais in the North Bay (Breeze, 1998). The East Bay, specifically eastern Alameda County, southeastern Contra Costa County and southwestern San Joaquin County, lies in the Coast Range and is easily accessible from San Jose, Oakland and San Francisco. This part of the Coast Range has an ideal climate for outdoor recreation. The region receives much less rainfall and fog than the immediate coast and the shores of San Francisco Bay, yet is much milder than the Sierra Nevada.

Preliminary investigation using general landscape criteria narrowed the research area to two regions in the East Bay, southeastern Contra Costa County and southeastern Alameda County near San Joaquin County. The general landscape criteria from Table 1 were: **2)** weather and climate **3)** landforms **4)** buffer zone **5)** convenient location. Criteria 2,3 and 4 were investigated using visits

to the field and quick appraisals of topographic maps. Criteria 5 was investigated with the help of an e-mail survey which included a question on desirable driving distance to a mountain biking facility (See Table 3). Results narrowed the study to two manageable regions. A 7.5-minute quadrangle was selected as the "unit" for research to streamline data collection and analysis. Specifically, the "Tassajara Quadrangle" at 37 degrees, 50 minutes north and 121 degrees, 50 minutes west. Also, the "Cedar Mountain Quadrangle" at 37 degrees, 35 minutes north and 121 degrees, 35 minutes west.

THE TASSAJARA REGION

This region satisfies the preliminary criteria for the site selection of a mountain biking facility. Tassajara is a sparsely populated region dominated by the terrain of the Diablo Range. The region is southeast of Mount Diablo and lies approximately five miles east of Danville, California, five miles north of Livermore, California and seven miles south of Clayton, California.

The entire quadrangle lies within the Sunset Climate Zone fourteen except for the few highest peaks above 2,000

feet (Sunset, 1987, 15). Analyzing a topographic map shows the local relief to be 2,000 feet.

The Bay Area has a large mountain biking population because it is the birthplace of mountain biking. To evaluate accessibility, mountain bikers in the Bay Area wee surveyed for their opinions. A majority of those surveyed are willing to travel approximately fifty miles for a day of mountain biking (see Table 3). The Tassajara quadrangle is within approximately twenty miles of the major population centers of the Bay Area. Narrowing the research area to the Tassajara quadrangle is justified by the above preliminary findings.

THE CEDAR MOUNTAIN REGION

This region also satisfies the preliminary criteria for the site selection of a mountain biking facility. Cedar Mountain is a sparsely populated region dominated by the Diablo Range. The region is in southeast Alameda County and lies approximately thirteen miles southeast of Livermore, California. The majority of the quadrangle lies within ideal climate zones for mountain biking (Sunset, 1987, 15). Analyzing topographic maps shows the local relief to be 2,800 feet. The Cedar Mountain quadrangle is twenty to

thirty miles from major population centers of the Bay Area. Continued research of the Tassajara and Cedar Mountain 7.5-minute quadrangles is justified by the preliminary findings above.

DESIGN ELEMENTS FOR THE FACILITY

The first component of this site selection process is listing and describing the elements or "ingredients" for the design of a mountain biking facility. For example, the elements for a neighborhood park design would include seating, pedestrian access, playground, tables, turf fields, restrooms, irrigation and drainage. The elements for a mountain biking facility are trails, overnight accommodations, staging areas, utilities, and access roads. The site selection process is essentially the process of finding the best area to locate the design elements.

1) Single Track Trails and Fire Road Trails

The site needs optimal conditions for trails. The landscape criteria section below lists optimal landscape conditions. This site selection project is broad and does not detail the actual construction of trails, i.e., culverts, tree pruning, berms, etc. However, potential

negative impacts of trail construction/use are minimized by selecting a site with optimal landscape conditions.

After this site selection project, during future phases of design, trails would be sited to create different levels of difficulty for mountain bikers. "Single track" is a trail description that refers to the width of a trail that allows one user in one direction at a time, i.e. three feet (narrow trails 2-3',wide trails 3-8', and fire roads 8'+) (International Mountain Biking Association, 1995). Single-track trails are located on more challenging terrain. Construction of single track or narrow trails has less impact on the landscape and allows for a better "connection" with nature. However, mountain bikes are often not permitted on single-track trails. A world class mountain biking facility would need to provide access to several single-track trails.

A trail along a fire road allows multiple users to easily pass travelling in opposite directions. Fire roads are less challenging than single track trails because they cover more gentle terrain. Existing fire roads on public lands generally allow access to mountain bikers. Constructing new fire roads would have more environmental impact than the construction of single-track trails. Using

any existing trails would minimize impacts of the proposed facility.

2) Overnight Accommodations/Lodge

The lodge will be the focal point of this facility. A lodge will make this facility unique among all other areas for mountain biking. It will provide both day-use opportunities and overnight accommodations for riders from all over the world. Riders will be able to interact at the lodge before and after a ride. All revenue for the facility will be generated through the lodge. The ideal architectural design will evoke a "spirit of place" which captures the outdoor beauty and history of rural Alameda and/or Contra Costa County. Hopefully the overnight accommodations will be "affordable" without compromising the character and unique feel of the surrounding landscape.

A marketing study following this site selection phase, will identify the level of quality required for the accommodations and activities. Should the lodge host wedding receptions and business retreats? Amenities within the lodge would include but not be limited to, environmental interpretive center, restaurant(s), bike

shop, first aid station, large outdoor patio/deck area, swimming pool, hot tub, restrooms and administration space.

3) Trail Staging Areas

Trail staging areas are the spaces at major trail nodes to accommodate kiosks, parking, drinking water, and first aid. Signage with rules and safety regulations will be posted here. Staging areas that are not adjacent to the lodge will be created with minimal impact to the existing landscape.

4) On Site Utilities (water, power, sewer easements)

Utilities will be limited to the lodge area and the few staging areas. Areas requiring new utilities would be placed as close to existing utilities as possible. All utilities would be placed underground where possible.

5) New Access Road(s)

Paved access for automobiles and public transit to the lodge and or staging areas will be needed if existing roads are unsuitable or absent. A marketing study will be needed to calculate the number of users required to support the

business. From this, traffic projections and the need for new access roads could be developed.

LANDSCAPE CRITERIA FOR THE FACILITY

The first component of this report was to define the elements or "ingredients" of this mountain biking facility. The second and most detailed component of this report was identifying and locating the landscape criteria for the mountain biking facility.

The landscape criteria (See Table 1) were derived from field observations of existing East Bay open spaces and from a United States Forest Service list of "features" for trail locations. Some ideal features from the United States Forest list are: ridges, open timber, access to water, natural drainage, well-drained soils, and access to other transportation modes (International Mountain Biking Association, 1995). The following landscape criteria are described in their order of application for the site selection process.

1) Facility Area

Briones Regional Park near Lafayette, and Sunol Wilderness are two of the most popular parks for mountain biking in the East Bay according to Steve Fiala, trails specialist for the East Bay Regional Park District (Fiala, 1997). Both parks are approximately 5,000 acres, basically square in shape and allow multiple uses on the trails. Both parks have ideal landforms, ridgelines, diverse vegetation, and are easily accessible by car (Wildflower, 1997). However, neither park has a lodge. It is estimated that, if each park were split in half, each half would still retain ample acreage for enjoyable riding on loop trails. For example, an average rider could ride within Briones Regional Park for two hours and only traverse half the acreage. Of course, a 2,500 acre requirement is only a minimum, the more open space available the more opportunities there are.

A loop trail within the facility area is more desirable than a single "out and back" trail. The shape and topography of the proposed property will determine the feasibility of loop trails. A loop trail allows for maximum variation during the riding experience, permitting vistas and open space in the middle of the loop. A loop trail also

provides even dispersion of the users along the circuit rather than bottlenecks at distinct end points of the trail. A minimum 2,500 acre park will permit ample space for loop trails and excellent riding, based on Briones and Sunol Wilderness as examples.

2) Weather and Climate

The ideal weather for year round mountain biking would have limited rainfall, few periods of freezing temperatures, limited periods of temperatures above 90 degrees Fahrenheit, and limited summer or winter fog. Summer coastal fog in California can greatly reduce temperatures and reduce the hours of daily sunshine. Winter fog in the Central Valley of California regularly reduces visibility and can prevent sunny days for weeks or months at a time.

These general conditions in northern California are found in "Sunset Climate Zones", 7,13,14,15, and 16, using the *Sunset Western Garden Book* system (Sunset, 1987). For example, Sunset zone 14 is found in areas with the moderating effect of marine air on land that would otherwise be colder in winter and hotter in summer. Each of the five ideal zones experience annual rainfall of

approximately 15 inches concentrated in winter and early spring. Average daily high temperatures range annually from 50 to 80 degrees Fahrenheit (U.S. Department of Agriculture, 1977). One could mountain bike comfortably all year except for one factor, mud. During the winter and early spring the soil becomes intermittently saturated, creating conditions encouraging soil erosion and difficult riding. The facility may need a budget to mitigate muddy trail conditions.

3) Landforms

A good mountain biking experience provides excellent exercise, thrilling downhill descents, safe travel and challenging climbs. A thousand feet of relief on a property of 2,500-5,000 acres ensures enough variation in slopes to provide an excellent riding experience. Five hundred feet in elevation can be ascended on an enjoyable 8% slope in 10 to 15 minutes (International Mountain Biking Association, 1995).

For example, if a mountain bike ride takes one to two hours, then a thousand feet of relief will permit three to four climbs and descents during the ride. A trail with appropriate slopes and cross slopes will have good runoff,

minimize soil erosion, and provide safe sight distance to hazards.

The International Mountain Biking Association (IMBA) has included the following information in their manual. However, rating of trails remains controversial and is somewhat subjective.

TABLE 2.

U.S. Forest Service Off-Road Bicycling Trail Guidelines.

GRADE "pitch" = slope	Easiest	More Difficult	Most Difficult
Maximum pitch	10%	30%	+30%
Max. sustained pitch	10%	10%	15%
Length of max. pitch	100'	300'	500'

4) Buffer Zone

A buffer of empty land between urban development and the facility serves two purposes. First, users of the facility will have a better open space experience the further away they are from urbanization. Second, a buffer will minimize or eliminate sound and visual impacts on existing neighborhoods.

The facility will include a "lodge" which may occasionally host racing and entertainment events. Proper site selection will allow all mountain biking related activities to take place without disturbing adjacent land

uses. To select a single distance that would mitigate potential sound and visual impacts is difficult when designing in steep and complex terrain. For example, visual and sound impacts on flat terrain would need to be farther from urban development compared to impacts hidden behind hills.

5) Convenient Location

There are many parallels between the site selection of a golf course development and the site selection process of a mountain biking facility. Both land uses require specific soil, ample acreage, access to water, and more. Several golf course developers have argued that adjacency to the golfer (the user) is a primary requirement when selecting a site. The National Golf Foundation provides demographic data to developers to help them decide how far a golfer might travel to play a round of golf (Fuller, 1997). Parallel information is not available for the mountain biking population. From personal experience, a drive less than sixty miles or one hour is appropriate for a day of mountain biking. However, with overnight accommodations people may be willing to travel further. A rural lodge adjacent to a mountain biking facility in the East Bay

region would be unique. Overnight accommodations would provide an attraction for riders from further away while being conveniently located for local riders.

6) Ridgelines

A "ridgeline" is the top and spine of a hill. On a ridgeline, a mountain biker can only go downward or continue along the spine. Ridgelines provide three functions that enhance the mountain biking experience. First, reaching them is a goal. Second, they generally allow for a gently sloping trail along the spine of a ridge while riders reap the psychological benefits of "being at the top". And third, ridgelines generally provide excellent views. An enjoyable loop trail begins along a flat valley, ascends up a challenging hill, continues along a flat ridgeline and ends with an exhilarating downhill.

Slopes below ridgelines may face all possible directions and aspects. No one aspect for mountain biking in considered ideal, variety is best. A southwest aspect in the East Bay will be drier, have fewer trees and allow more riding in sunlight. A northeast aspect in the East Bay will generally have more shade, more trees, and allow riding in

cooler temperatures. Diverse ridgelines on the property will ensure a variety of aspects, views and slope angles.

7) Vegetation

This mountain biking facility in the East Bay will be located amongst native oak woodlands, thus eliminating widespread grasslands from consideration as potential sites. Trees provide shade in the summer and mitigate wind. Trees also add aesthetic value to the mountain biking experience. The proposed facility could become an economic means to preserving native oaks.

Areas south of Mount Diablo are under pressure for residential development, according to Contra Costa County supervisors (Danville, 1998). This area, in addition to other undeveloped lands of the East Bay, is dominated by grassland and oak woodlands. A mountain biking development in this case will generate revenue to preserve oak woodlands on the land used for the facility. The goal to preserve the site's oak woodlands will help in the development approval process. The plants and animals associated with California native oak woodlands will positively contribute to the character and overall success of the project.

8) Soils of Mountain Biking Trails

The type of riding surface is crucial in determining the quality of a mountain bike ride. Clay soils with little or no gravel, drain poorly and become extremely sticky after rain. As a result, trails with muddy surfaces erode quickly, creating difficult riding conditions. One example is the soil one-half mile North of Sycamore Creek in Danville. The "soil association" description of this area is "Altamont-Diablo-Fontana association" (U.S. Department of Agriculture, 1977, 6):

> Strongly sloping to very steep, well-drained clay and silty clay loams that formed in material weathered from soft, fine-grained sandstone and shale on uplands.

Mountain biking immediately after rainfall is nearly impossible due to the thickness and sticky texture of this soil. Although this particular soil association is said to be "well drained", the clay content and parent material lack larger rocky particles found in less muddy soils.

The ideal soil for average mountain biking is a shallow well-drained rocky loam (International Mountain Biking Association, 1995). Gravel or small rocks allow for good drainage during wet weather. Gravel and small rocks

control dust and keep the riding surface firm in the summer.

One example of an ideal mountain biking soil is found in the Black Hills southeast of Mount Diablo. The soil association description of this soil is the "Rock outcrop-Xerorthent association" (U.S. Department of Agriculture, 1977, 6):

> Steep to very steep areas of rock outcrop and excessively drained, very shallow, loamy soils that formed in material weathered from sedimentary rock and basic igneous rock on uplands.

This soil has been observed under a variety of different weather conditions. Mountain biking is possible immediately after rainfall because this soil is not sticky, the trails erode little and they do not become beat-up by excessive use. Although the description above says "steep to very steep", trails would be constructed on low angle ridgelines as well as hillsides perpendicular to slopes.

Soil conditions at the extreme ends of the local soil types may be desired for certain levels of riding. For example, some riders enjoy wet, sticky challenging surfaces at different times of the year. However, soil conditions

that satisfy the average rider must take priority in a site selection.

9) Access by Car or Bus

The facility must be located in proximity to an existing well maintained paved road. Road construction is expensive. The estimated cost of a new road in an area with hills is approximately $500,000 per mile (Fuller, 1997). While construction is generally an economic benefit to a community, potential negative impacts of construction must be considered as well. For example, a paved road along with any corresponding fencing can be a barrier to wildlife. Therefore, alignment of a new road must take wildlife corridors into consideration.

10) Natural Water Features

Natural water features add aesthetic value to all outdoor recreation. Rivers, creeks, lakes, and ponds are visually pleasing as well as important wildlife habitats. In addition, natural water features are the best method of draining rainfall from a trail system (International Mountain Biking Association, 1995). Landslides, erosion, and loss of wildlife can be avoided by reducing the

alteration of natural water features. The existence of natural water features would benefit any mountain biking facility.

11) Drinking Water

All recreation developments need drinking water. A primary concern for this proposed facility is access to drinking and irrigation water. Knowledge of water district boundaries and local government jurisdiction is necessary to plan for accessibility to water. It would be advantageous to locate the lodge within an existing water district service area because of the additional costs involved with drilling a well or expanding a water district service area.

METHODOLOGY ALTERNATIVES

What is the most efficient method for the project investigation? Creating paper maps for each landscape criterion would be time consuming and difficult to edit. Locating or creating necessary rural digital data for a geographic information system (GIS) would require more resources than available here.

The chosen methodology was a combination of paper maps and computer technology. Computer graphics of mapped data were analyzed much like a stack of paper maps, but with the efficiency of a computer. The maps do not have tables of information or attributes linked to the cartographic data. GIS was simply used as a graphics tool to edit the digital maps. Digital maps of Tassajara and Cedar Mountain were obtained from a CD-ROM, "*TOPO,* San Francisco Bay Area" (Wildflower, 1997).

Both Cedar Mountain and Tassajara quadrangles were investigated for the existence of the ideal landscape criteria. Each landscape criterion is a single layer of information created on the computer. Each layer of information was displayed on a single transparent paper map for use in an overlay process. The overlay process here allows each layer of information to be investigated simultaneously. The map overlays were analyzed by looking for areas, which encompassed high priority criteria versus low priority criteria. This project searched for a 2,500 acre site within each quadrangle that meets most of the landscape criteria. Individual 2,500 acres square "windows" were overlaid onto the complete stack of overlays. One square area with the highest number of desired criteria

from Tassajara was compared to the square area with the highest number of desired criteria from Cedar Mountain. The two 2,500 acre areas were analyzed and a final site was selected.

Today, GIS is an efficient tool for investigating separate layers of landscape data in a digital format. The original intent of this project was to use digital data in a GIS format. However, a pure GIS analysis was not chosen for this project. Currently, rural areas such as Tassajara and Cedar Mountain have too little digital landscape data available for a formal GIS format.

Where is digital landscape data available for use in a more limited GIS? The Internet is an excellent source for inexpensive digital, spatial data. One example is the United States Geological Survey (USGS) web site, www.cr.usgs.gov. Unfortunately, all layers of digital data are not available for every part of the country. If more rural information becomes available from the USGS, it would be in the format of a Digital Line Graph (DLG).

A DLG is a vector representation of cartographic information (Environmental Systems Research Institute, 1990). DLG's display information which can be graphically depicted as a line such as: political boundaries,

hydrography, public land survey, transportation data, man-made structures, hypsography, vegetative surface cover, non-vegetative surface cover and survey control markers. For example, much of the landscape criteria required for a mountain biking development could be depicted as lines such as a "roads" layer map. The digital landscape data could be created by collecting and digitizing field data. However, this would require more resources than available here.

LANDSCAPE CRITERIA ANALYSIS

1) Facility Area Methodology and Findings

Area criteria in this project were determined using the draw tool in ArcView. Polygons were drawn representing approximately 2,500 acres on the Tassajara 7.5-minute quadrangle and the Cedar Mountain 7.5-minute quadrangle (Wildflower, 1997).

A polygon representing 2,500 acres was created and overlaid onto many of the data layers (See figure 1). The polygon became a "window" to be moved around on the data layers. Analysis was via "looking through the window" searching for certain characteristics of each data layer. In the end, the window displaying the best criteria became the site selected for a development proposal.

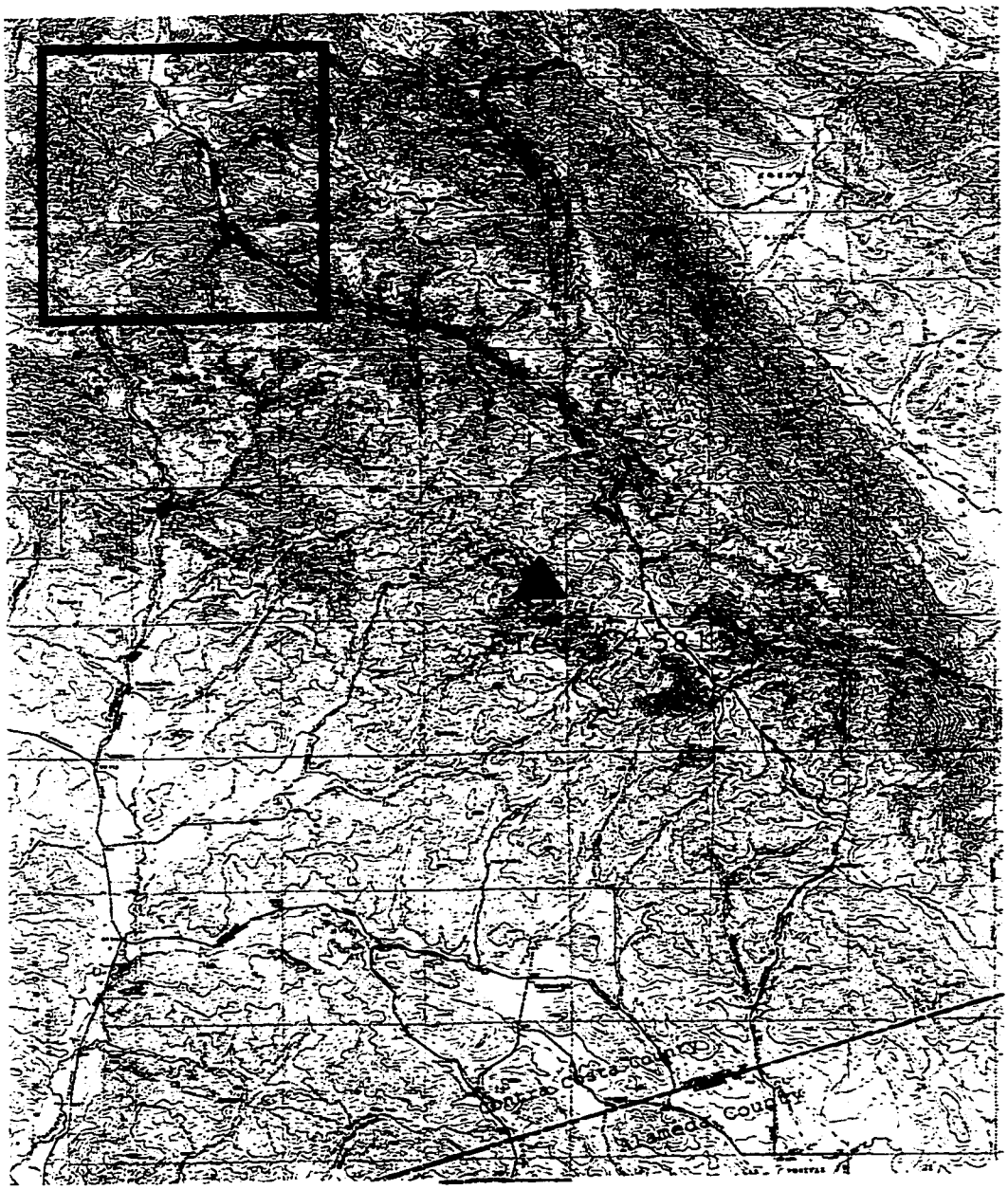

Figure 1.Tassajara.
Sample 2,500 acre polygon.

Scale 1:24,000

N

2) Weather and Climate Methodology and Findings

Descriptions of the optimum climate zones were found in the *Sunset Western Garden Book.* These climate zones were transferred onto a view of the Tassajara and Cedar Mountain 7.5-minute quadrangle maps using a computer draw tool. The quadrangle maps were copied into the graphics program from a CD-ROM "Topo!" (Wildflower, 1997). Areas outside the optimal climate zones were not considered for site selection.

Each study area lies entirely within the acceptable climate zones (7,13 through 16). Therefore, there are no climate zone boundaries to be delineated. The climate data layer for the overlay process was not needed.

3) Landforms Methodology and Findings

To evaluate landforms in this project, the Tassajara and Cedar Mountain 7.5-minute quadrangles were copied from the "Topo!" CD-ROM into Microsoft Paint (copyright '81-'96, Microsoft corporation). The areas with more than 1,000' of local relief were highlighted after looking for the highest and lowest elevations in each quadrangle. For example, the highest point in the Cedar Mountain region was 3,675' and the lowest was approximately 800'. Thus, the simplest

1,000' contour intervals to display were 1,000', 2,000', and 3,000'. A chloropleth map was created to display zones of 1000' and lower, 1000' to 2,000', 2,000' to 3,000 and 3,000' and above. A chloropleth map using the same relief ranges was created for the Cedar Mountain quadrangle (See figure 2).

A 1,000' range of elevation was found within portions of each of the two study areas. A 2,500 acre square with three 1000' elevation zones, was needed to guarantee at least 1000' of relief on each of the maps.

Example: **Zone One, 0' to 1000'**

Zone Two, 1001' to 2000'

Zone three, 2001' to 3000'

For example, if only one elevation zone on the map is found within the site boundary, it could be a flat part of that zone. If only two 1000' elevation zones are found it could be the highest part of one zone and the lowest part of the other, thus having a minimal elevation change from 999' to 1001'. However if three 1000' zones are found within the site boundary, the site would have a minimum 1000' elevation relief i.e., 999' to 2001'. This presents

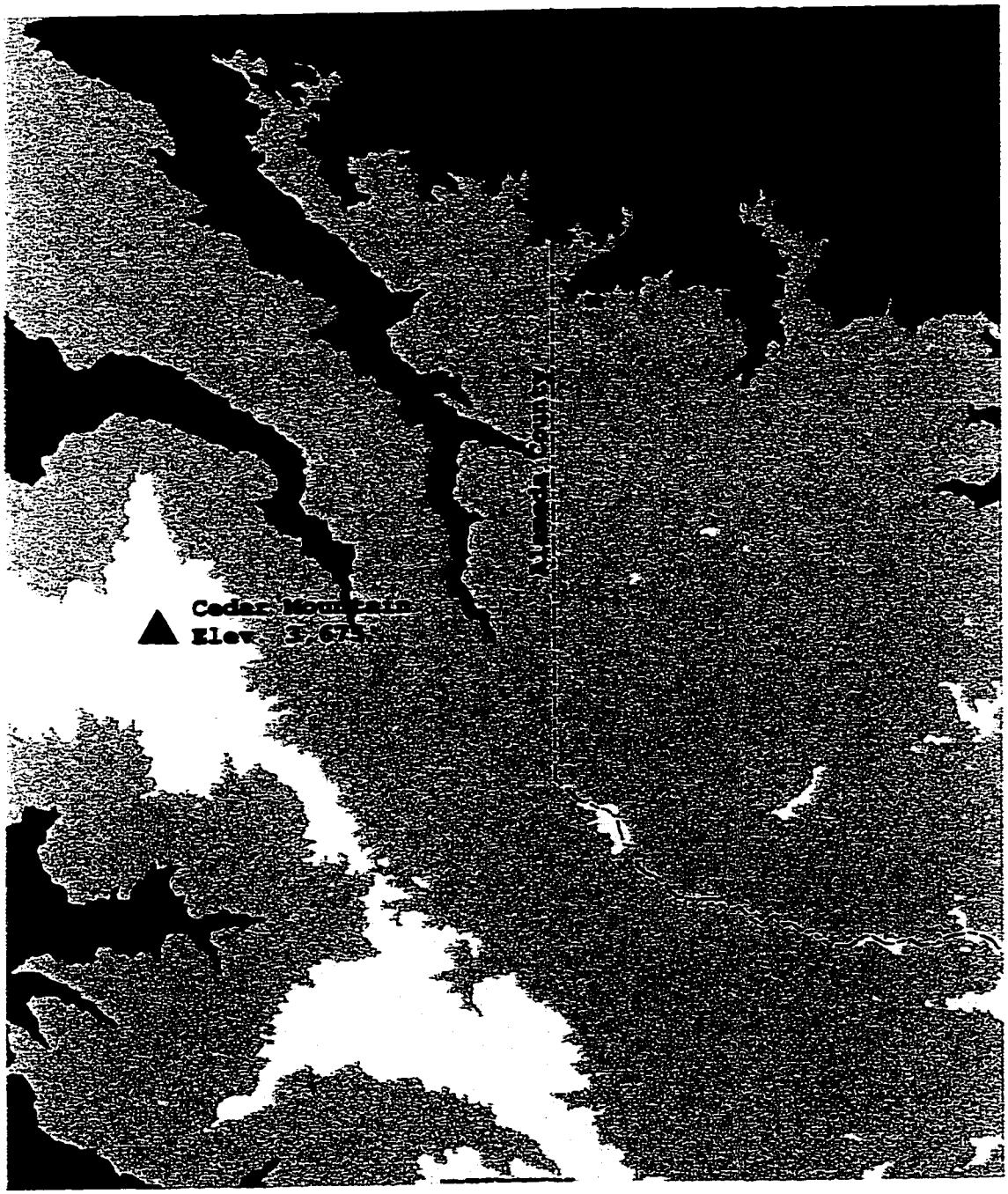

Figure 2.Cedar Mountain Elevation Zones

Scale 1:24,000

Legend

- Less than 1,000'
- 1,000' to 2,000'
- 2,000' to 3,000'
- 3,000' plus

N

the opportunity to locate the mountain biking facility in terrain that will provide the relief for excellent riding.

The relief data layer was analyzed for the 2,500-acre area that best represents ideal mountain biking landforms on both quadrangles (See figs.3, 4). A 2,500-acre area with only one elevation range was given low priority and assigned a value of 1 in the overlay process. A 2,500-acre area encompassing two elevation ranges was also given low priority and assigned a value of 1. An area encompassing three elevation ranges was given the highest priority and assigned a value of 2 in the overlay process.

4) Buffer Zone Methodology and Findings

Establishment of a buffer around the facility was analyzed here by searching the Tassajara and Cedar Mountain 7.5 minute quadrangles for existing urban development or infrastructure. Costly sound and view shed studies may be avoided if an outstanding site was found with a one mile or more buffer from urban development. Microsoft Paint was to be used to trace and highlight the edges of development onto a view of the Tassajara and Cedar Mountain 7.5-minute quadrangle maps. A "buffer" view was to be created in ArcView. Using the measure tool in ArcView, a one-mile

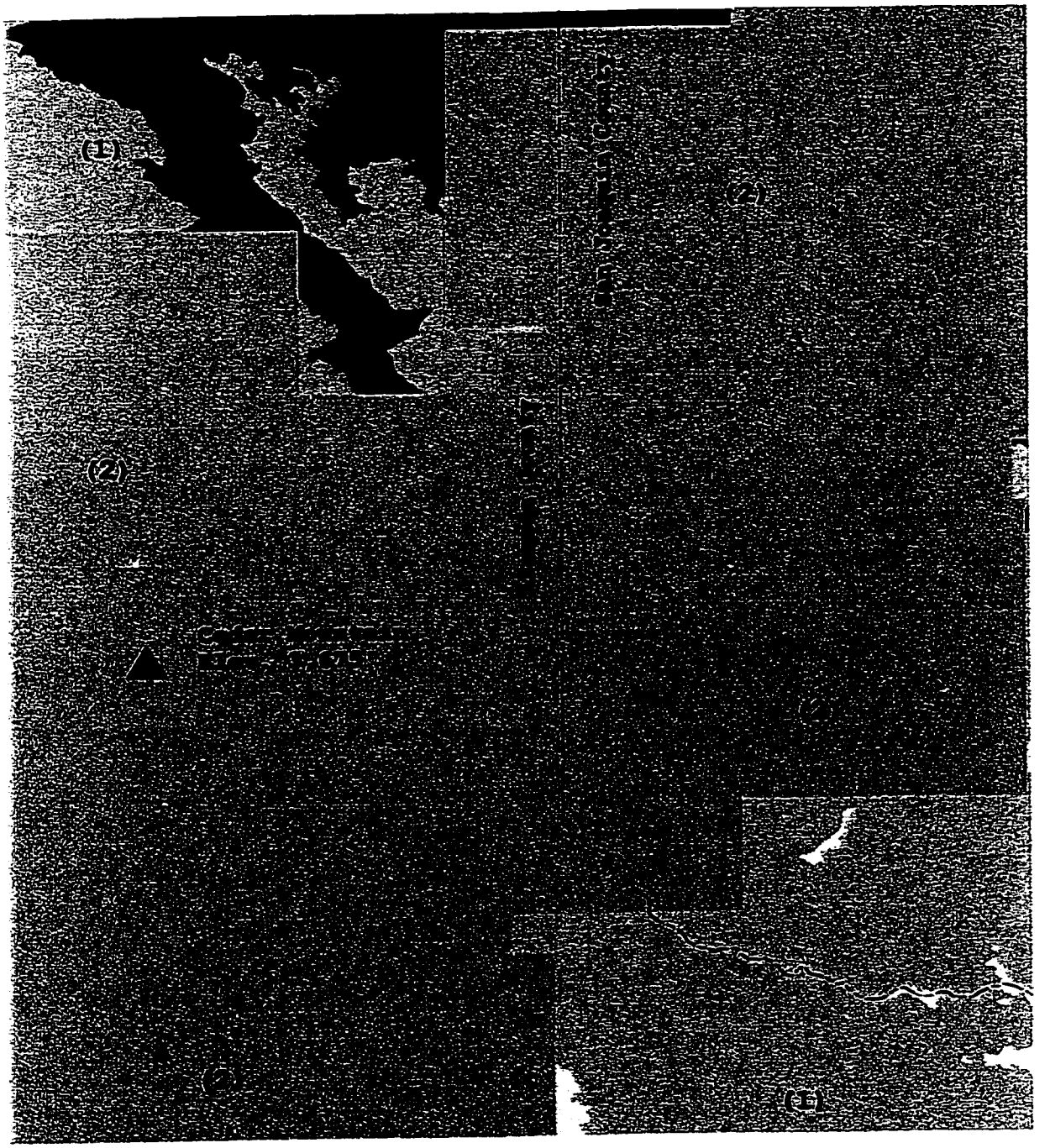

Figure 3. Cedar Mountain
Range of Elevation Site Selection Priorities

Legend

(2) **High priority. >1,000' Range of Elevation. Series of 2,500 acre square pacels.**

(1) **Low Priority.All other colors </= 1,000' Range of Elevation**

Scale 1:24,000

N

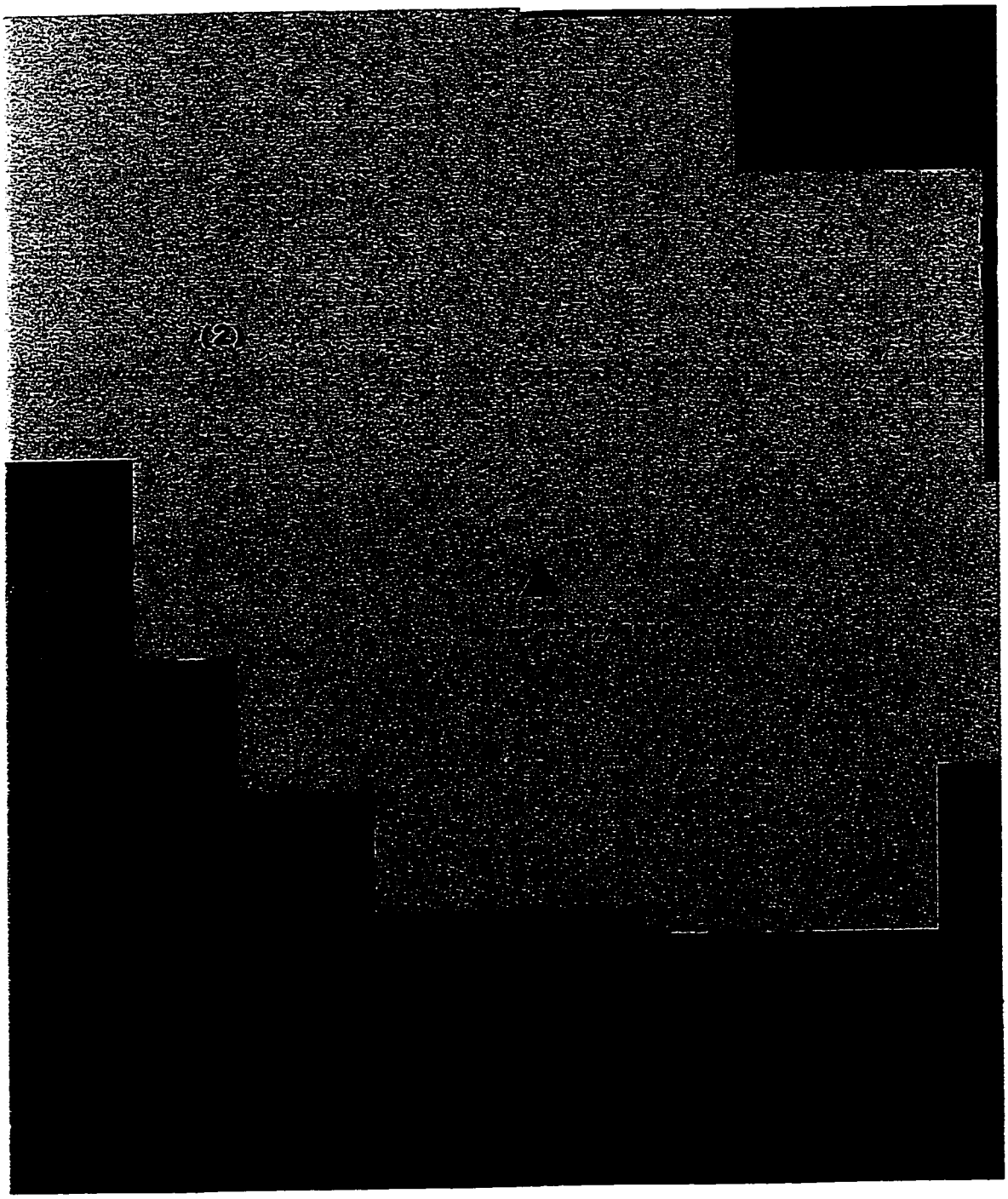

**Figure 4. Tassajara. Range of Elevation.
Site Selection Priorities.**

Scale 1:24,000

N

Legend

(2) High priority.
> 1,000' Range of Elevation.
Series of 2,500 acre square pacels.

(1) Low Priority. Mixed colors.
</= 1,000' Range of Elevation

buffer was to be delineated around existing urban areas.

No dense urban development currently exists in the Tassajara or Cedar Mountain areas. Therefore, there was no data to delineate within the 7.5-minute quadrangles. No adjacent urban development currently exists beyond the boundaries of the Cedar Mountain quadrangle. Urban development off Tassajara Road is present one mile east of the Tassajara Quadrangle border. A "buffer zone" data layer was not created here because both study areas are rural.

5) Location Convenience Methodology and Findings

Members of the Bicycle Trails Council of the East Bay (BTCEB) were surveyed via e-mail to analyze the convenience of facility location. The BTCEB is an off road trails advocacy group concentrating on keeping East Bay trails open for mountain bikers. Hundreds of similar organizations exist throughout the country.

The hypothesis of the survey was that mountain bikers would be willing to travel approximately 60 miles for a day of riding. They would also be interested in utilizing on-site overnight accommodations. This hypothesis was the initial inspiration to write this report and to select Tassajara and Cedar Mountain as research areas.

Table 3. Bicycle Trails Council of the East Bay Survey Results, 4/19/98

1) "How far are you willing to travel for a day of mountain biking?"

2) "Would the existence of on site amenities (food, shop, first aid, etc.) increase or decrease your desire to ride in a particular park?"

3) "Would you utilize overnight accommodations located adjacent to thousands of acres of mountain biking trails?"

	Question #1 Results (in Miles)	Question #2 Results	Question #3 Results
Response #1	60	decrease	yes
Response #2	100	increase	yes
Response #3	50	decrease	yes camp
Response #4	60	decrease	yes
Response #5	75	increase	yes
Response #6	60	increase	yes camp
Response #7	50	decrease	yes
Response #8	60	increase	no
Response #9	60	increase	yes
Response #10	60	increase	yes
Response #11	30	decrease	yes
Response #12	50	decrease	yes
Response #13	90	neutral	yes
Response #14	45	decrease	no
Response #15	90	neutral	yes
Response #16	90	neutral	yes camp
Response #17	60	decrease	yes camp
Response #18	0	decrease	yes
Response #19	30	decrease	no
Response #20	90	increase	yes
Response #21	0	decrease	yes
Results	58 Avg.miles	11 decrease 7 increase 3 neutral	18 yes 3 no

The respondents were asked how far they were willing to travel for a day of mountain biking. The average distance for the 21 respondents was 58 miles. Several commented that, if overnight accommodations were available they would be willing to travel farther than 60 miles. Both proposed sites are less than 58 miles from Oakland and San Jose, a convenient location for mountain bikers from these two major cities (See figs. 5 & 6). No data layer was created for this criterion. It was used to justify the preliminary selection of the two research quadrangles.

6) Ridgeline Methodology and Findings

Ridgelines were analyzed here by searching the Tassajara and Cedar Mountain 7.5-minute quadrangles for contour lines that connect prominent high points. Microsoft Paint was used to delineate and transfer ridgelines onto a view of the Tassajara and Cedar Mountain 7.5-minute quadrangle maps. A "ridgelines" view was created in ArcView (See figures 7,8). Areas with a high concentration of ridgelines were given priority in the site selection over areas not showing ridgelines.

Rolling and mountainous topography dominate both research areas. No prominent valley floors exist in the

Cedar Mountain area. Generally, the only areas without ridgelines are long continuous slopes covering one or more square miles. Within Tassajara are two valleys, Round Valley, which is approximately one square mile, and a portion of Tassajara Valley which is approximately two and a half square miles. Similarly, in Cedar Mountain there are valleys and long continuous slopes of one to two square miles without ridgelines.

The best data to highlight on the map layers were the few areas *without* ridgelines, because of the even distribution of ridgelines throughout both quadrangles (See figures 7 & 8). This data layer was analyzed for areas of approximately 2,500 acres (+/- 1,000 acres) with little or no ridgelines. The highlighted areas showing no ridgelines were given low priority and assigned a value of 1 in the overlay process. The remainder of the areas showing regular distribution of ridgelines were given high priority and assigned a value of 2 in the overlay process.

7) Vegetation Methodology and Findings

Vegetation was analyzed in this report by entering scanned infrared aerial photos of the Tassajara and Cedar Mountain 7.5-minute quadrangles into Microsoft Paint (NASA,

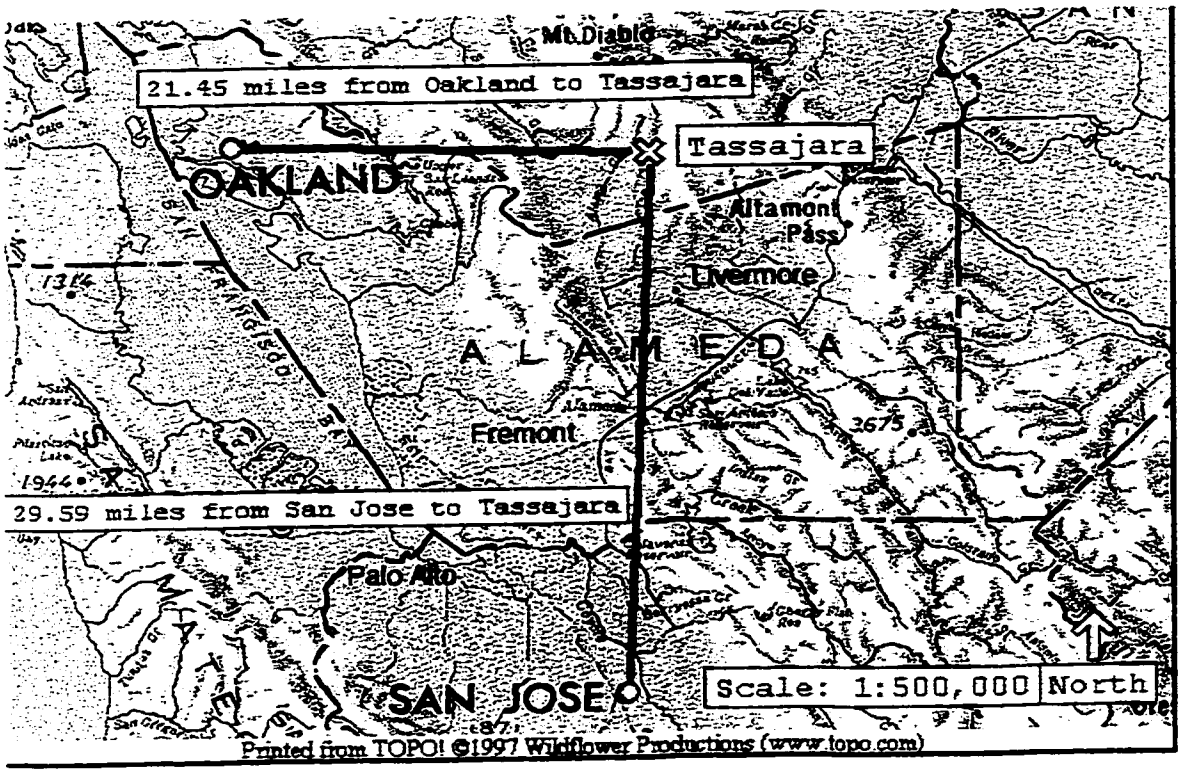

Figure 5. Distance to Tassajara

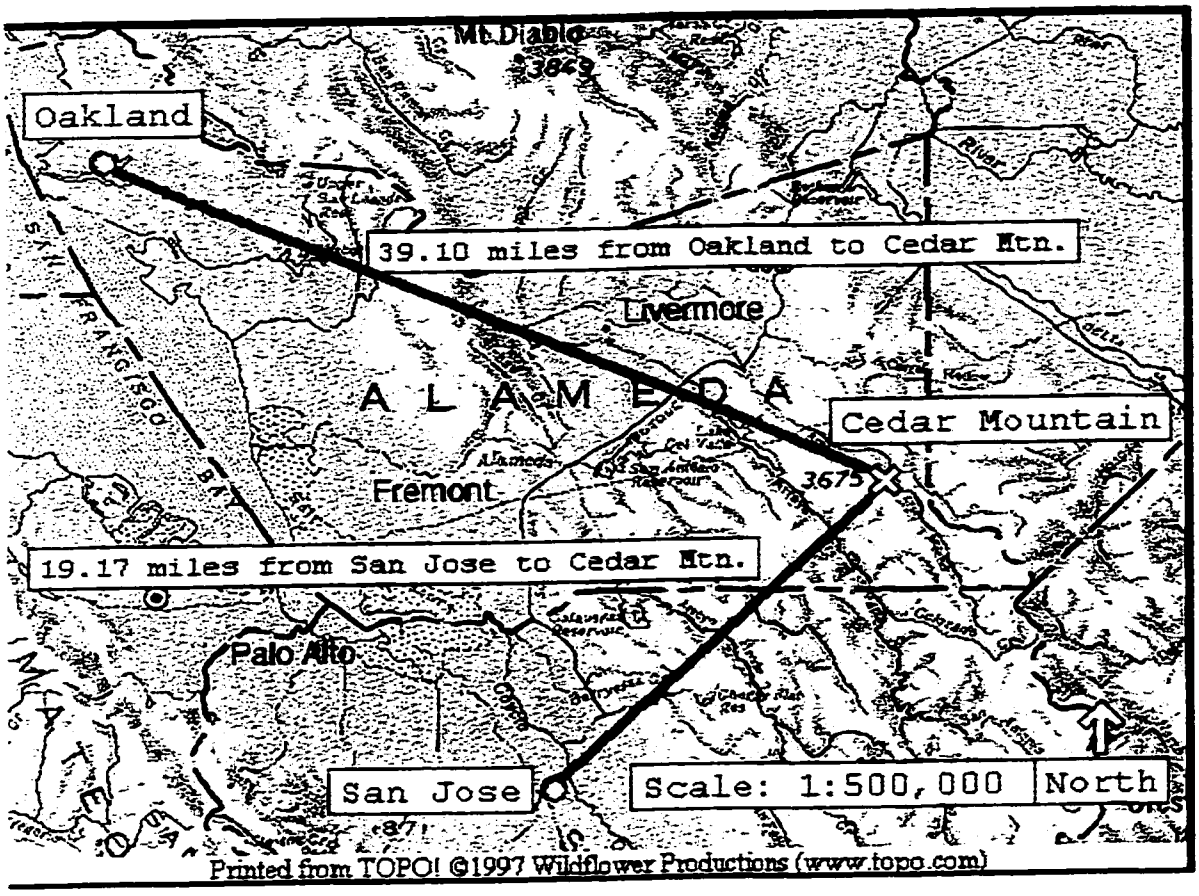

Figure 6. Distance to Cedar Mountain

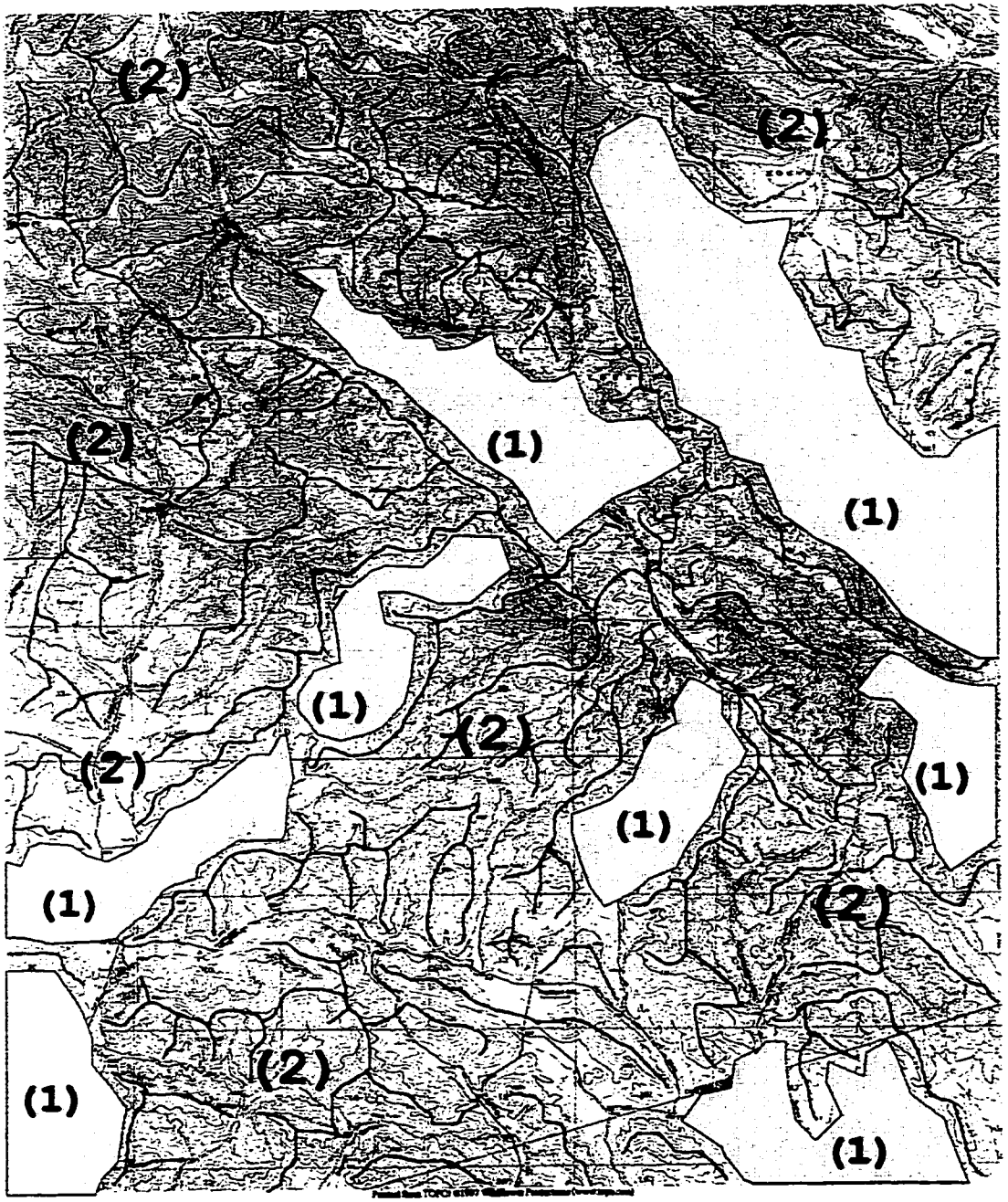

Figure 7. Tassajara Ridgelines

Legend

(1) Low priority. Largest continuous areas without ridgelines.

(2) High Priority. All non-yellow areas. Areas encompassing ridgelines.

Scale 1:24,000

Ridgeline

N

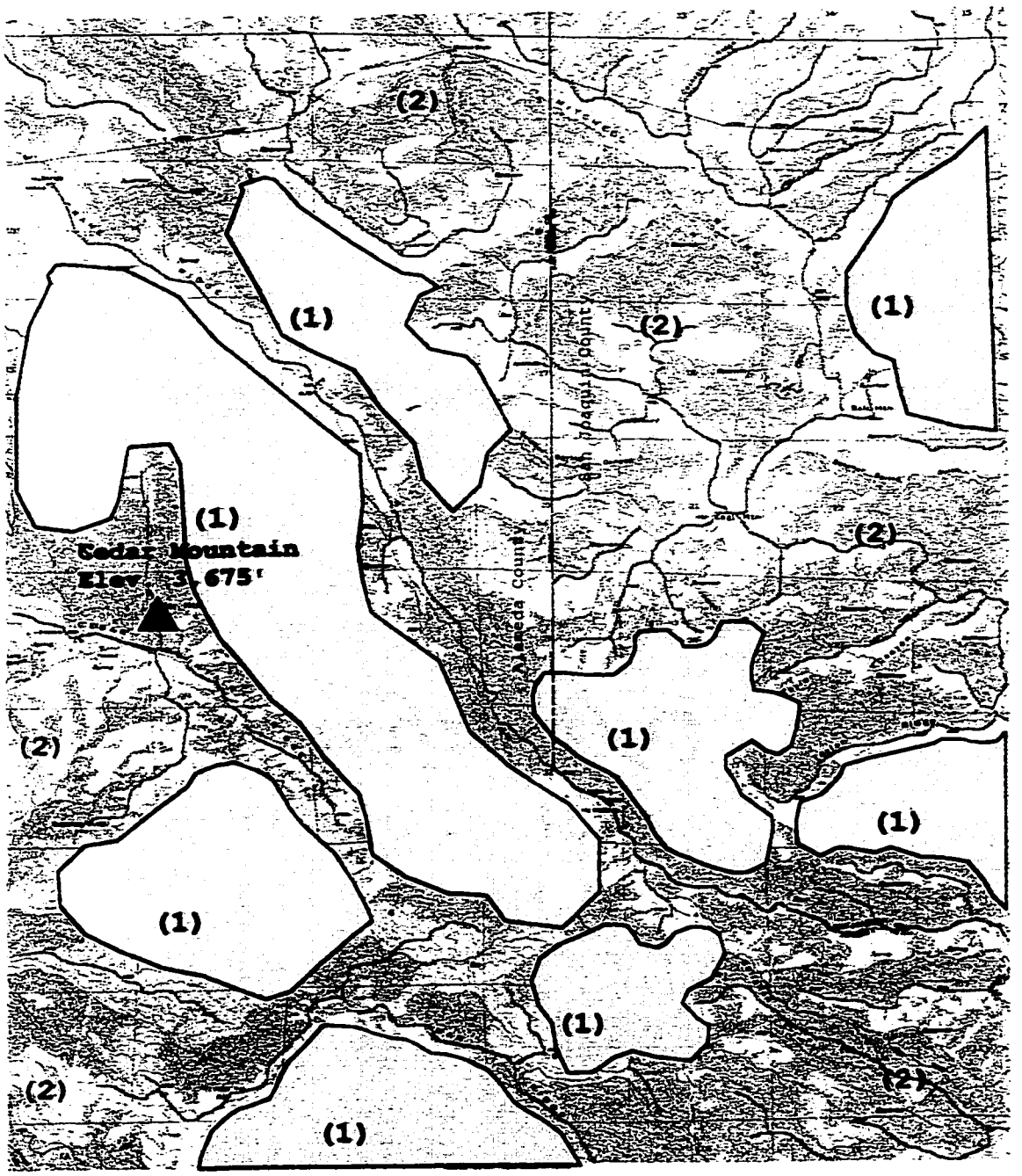

Figure 8. Cedar Mountain. Ridgelines.
Site Selection Priorities.

Legend

(1) (1) Low priority.
Largest continuous areas
without ridgelines.

(2) (2) High Priority.
All non-yellow areas.
Areas encompassing ridgelines.

Scale 1:24,000

Ridgelines

N

1998)(See figure 9). Healthy, green vegetation shows up in shades of red on the infrared images. The deeper the red hue in the image, the more green and healthy the vegetation is in the field. The deepest shades of red in the image are usually trees. These red areas were highlighted in bright green to better graphically represent vegetation.

The vegetation cover in the NASA infrared photos was verified through site analyses to be primarily trees not grasses or shrubs. The photos were taken during the dry season of the year making the grasslands show up as shades of gray. The dominant vegetation on both sites is California native oak woodland. Cedar Mountain is home to a stand of a native cedars as well.

This vegetation data layer was analyzed for areas of approximately 2,500 acres (+/- 1,000 acres) with the greatest extent of tree coverage. The tree density was divided into three categories assigned a value of 1 or 2. Areas with a value of (1) had random or no tree coverage. Areas with a value of (2) had solid tree coverage (See figures 10, 11).

Unfortunately, the aerial photos did not cover the exact boundaries of the 7.5-minute quadrangles. Thus, the layers of vegetation data could not be fitted exactly to

the other landscape criteria maps. The location of the vegetation data was generalized when overlaid with the other landscape criteria layers.

8) Soils of Mountain Biking Trails Methodology and Findings

Soil quality on trails is analyzed here by digitizing soil association maps from United States Department of Agriculture Soil Conservation Service (U.S. Department of Agriculture, 1966). The polygons representing the soil associations were digitized onto digital views of the Tassajara and Cedar Mountain 7.5-minute quadrangles (Wildflower, 1997). A "soil association" is a single mapping unit displaying adjacent soils, which are too detailed to display as individual units. The soil associations were only compared to other associations within the individual 7.5-minute quadrangles due to the abundance of soil characteristics in other areas. For example, if only four associations were found within an individual quadrangle, they would be ranked best to worst one through four for that particular quadrangle. Clay or poorly drained soils are ranked worst while soils with well-drained rocky loam are ranked best.

The Cedar Mountain area only has one soil association, the "Vallecitos-Parrish association"; therefore no soil data layer map was created for Cedar Mountain (U.S. Department of Agriculture, 1966). The "Vallecitos-Parrish association" soil in the Cedar Mountain area is typically well drained, shallow gravelly loam with frequent rock outcroppings. This soil association is ideal based on the criteria for mountain biking. The Tassajara area has five soil associations; therefore a data layer was created to compare the best through worst soil associations in the quadrangle (See figure 12). The following are the Tassajara soil associations in order of best to worst:

1. **Rock outcrop-Xerothent association,** excessively drained shallow loamy soil formed in material weathered in sedimentary rock.
2. **Los Osos-Millsholm-Los Gatos association,** well drained clay loam formed in material weathered from interbedded sedimentary rock.
3. **Altamont-Diablo-Fontana association,** well-drained clay and silty clay formed in material weathered from soft, fine-grained sandstone.
4. **Brentwood-Rincon-Zamora association,** nearly level, well-drained clay on valley fill.
5. **Clear Lake-Cropley association,** poorly drained clays.

The top two soils were given the highest priority in the site selection process and assigned a value of 2 for the overlay process. The three lower quality soils were given the lowest priority and assigned a value of 1. This

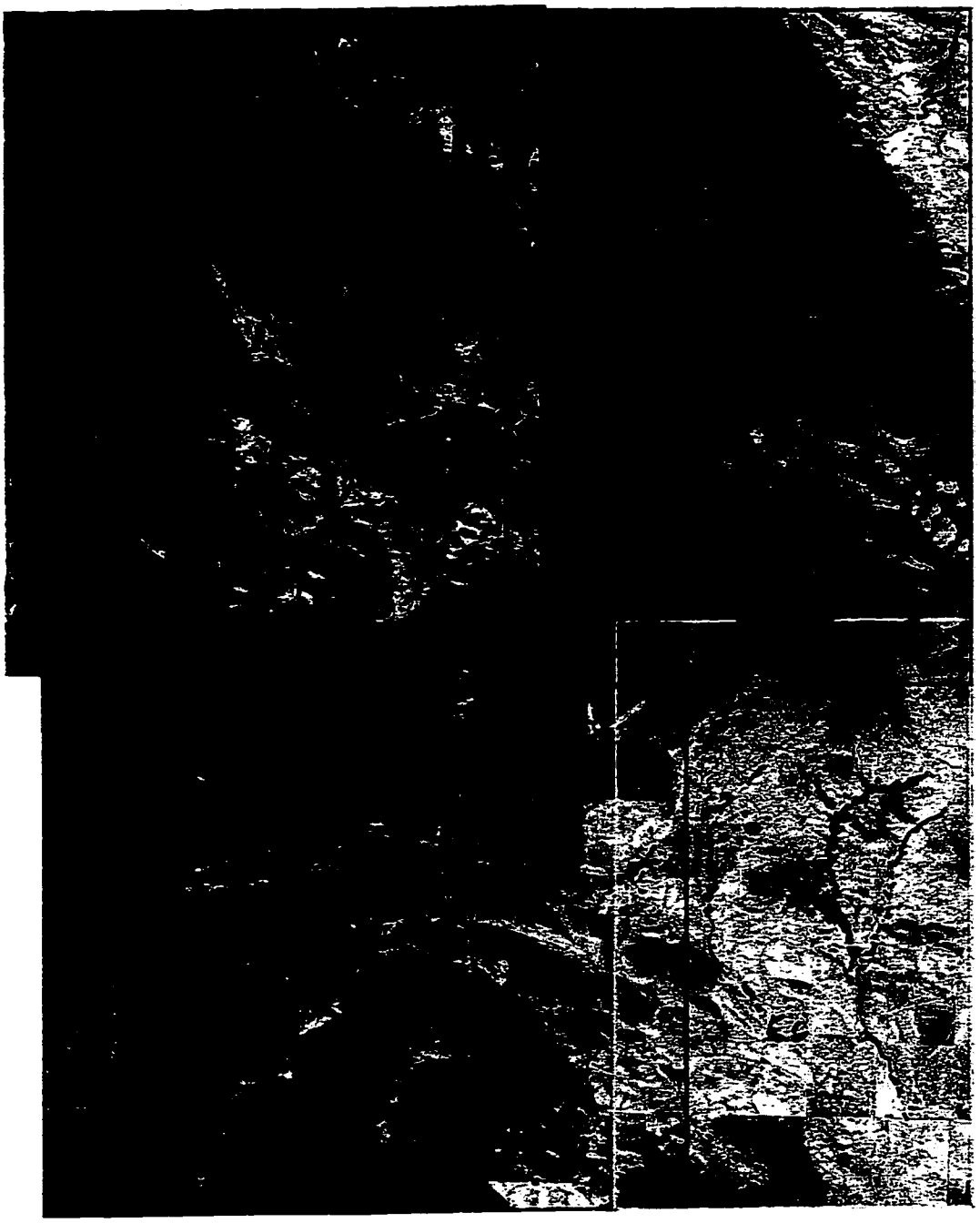

Figure 9. Tassajara Tree Coverage.
Aerial infrared image.

Not to scale

Legend

Highlighted healthy tree canopy.

N

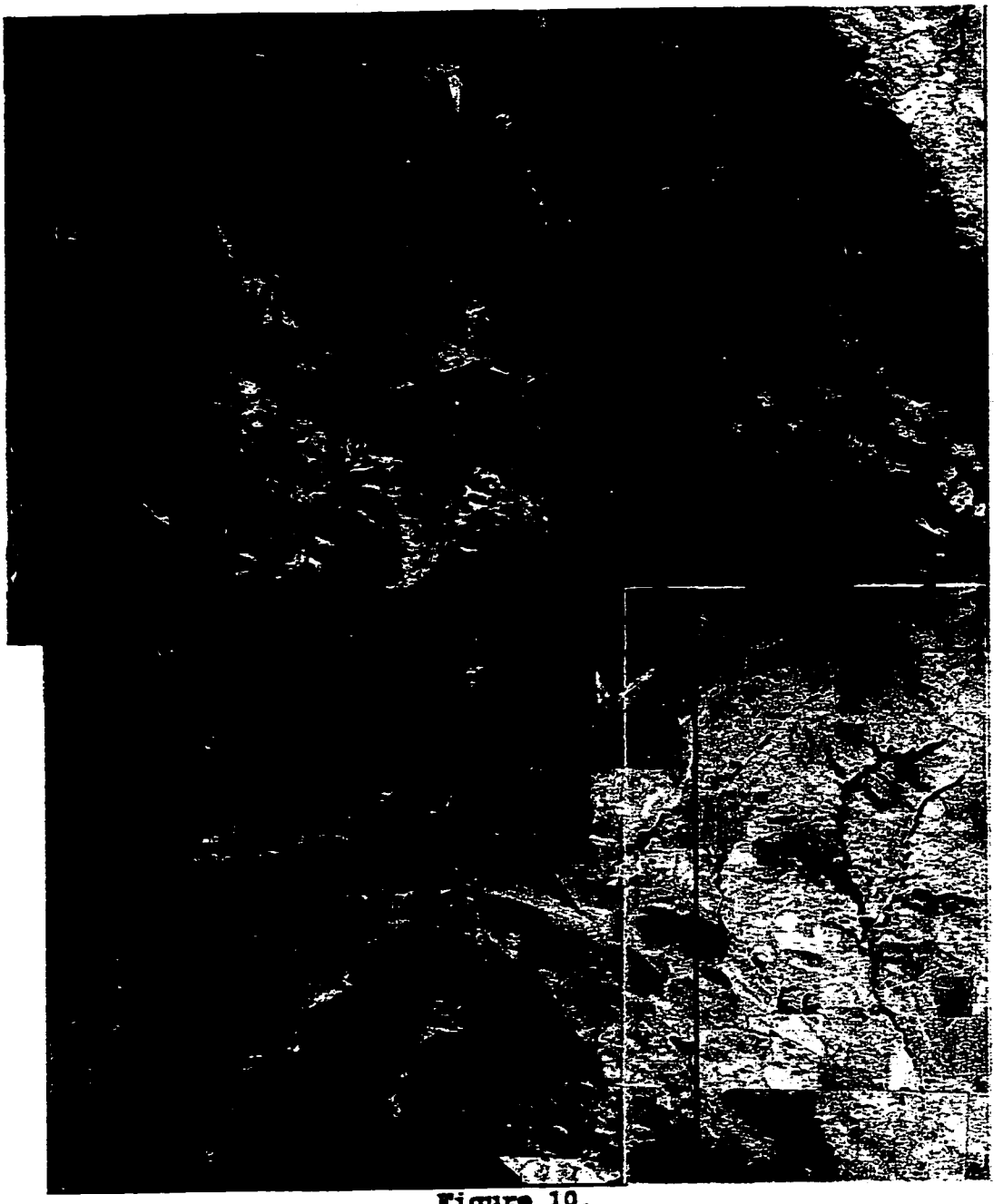

Figure 10.
Tassajara Tree Coverage.Aerial infrared image.Selection Priorities

Legend

(2) High priority.
Solid tree canopy coverage.

(1) Low Priority. All other colors.
Random or no tree coverage.

Not to scale

N

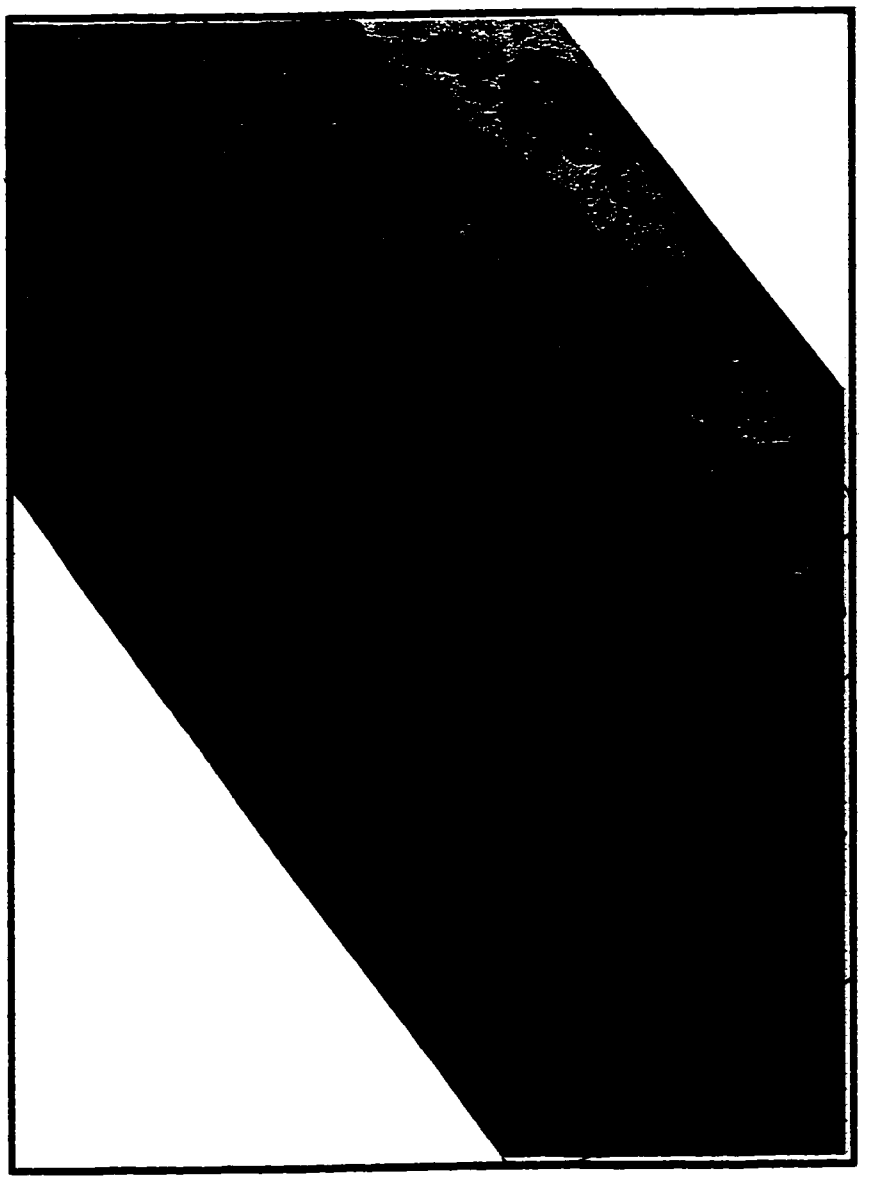

Figure 11.
Cedar Mountain Tree Coverage.Aerial infrared image.Selection Priorities

Legend

(2) High priority. Solid tree canopy coverage.

(1) (1) Low Priority. All other colors. Random to no tree coverage.

Not to scale

N

data layer was analyzed to seek areas of approximately 2,500 acres, which encompass either of the top two ideal soil associations. The 2,500 acre polygons depicting ideal soils were highlighted for display in the overlay process.

9) Access by Car or Bus Methodology and Findings

Access by car and bus was analyzed here by searching the Tassajara and Cedar Mountain 7.5-minute quadrangles for existing paved roads. Paved roads were delineated onto a view the Tassajara and Cedar Mountain 7.5 minute quadrangle maps using Microsoft Paint (See figure 13). A roads view was created in ArcView. A one-mile zone was delineated around the existing roads, using the measure tool in ArcView. This one-mile zone was used as a guide for measuring the distance an entry road might have to be built. Ideally, the facility would be sited within one-mile of existing roads.

Paved roads are located within each research area. Neither research area has local bus service. A one-mile buffer was drawn around the existing roads. There are actually sections within each quadrangle that are beyond one mile from any paved road. Areas beyond the one mile buffer were given low priority and were assigned a value of

1 for the overlay process. Areas within the one mile buffer became high priority and assigned a value of 2 for the overlay process (See figures 14 & 15).

10) Natural Water Features Methodology and Findings

The existence of natural water features was analyzed by searching the Tassajara and Cedar Mountain 7.5-minute quadrangles for graphics depicting water. Water features were delineated and entered onto a view of the two quadrangles. A "hydrology" layer was entered into ArcView. The layer was overlaid onto other maps in to ensure that natural water features exist on potential sites.

Creeks and intermittent streams are found in both research areas. Cedar Mountain is almost divided in half by Arroyo Mocho, a major stream in this part of the Diablo Range. Tassajara Creek and Marsh Creek are two major creeks that originate in the Tassajara area. It was found after visiting the site, that both creeks are generally dry in the summer. However, they all efficiently drain the frequent heavy, winter precipitation.

Water is distributed relatively evenly throughout the majority of both quadrangles; therefore, the best data to highlight on the map layer were the few areas *without*

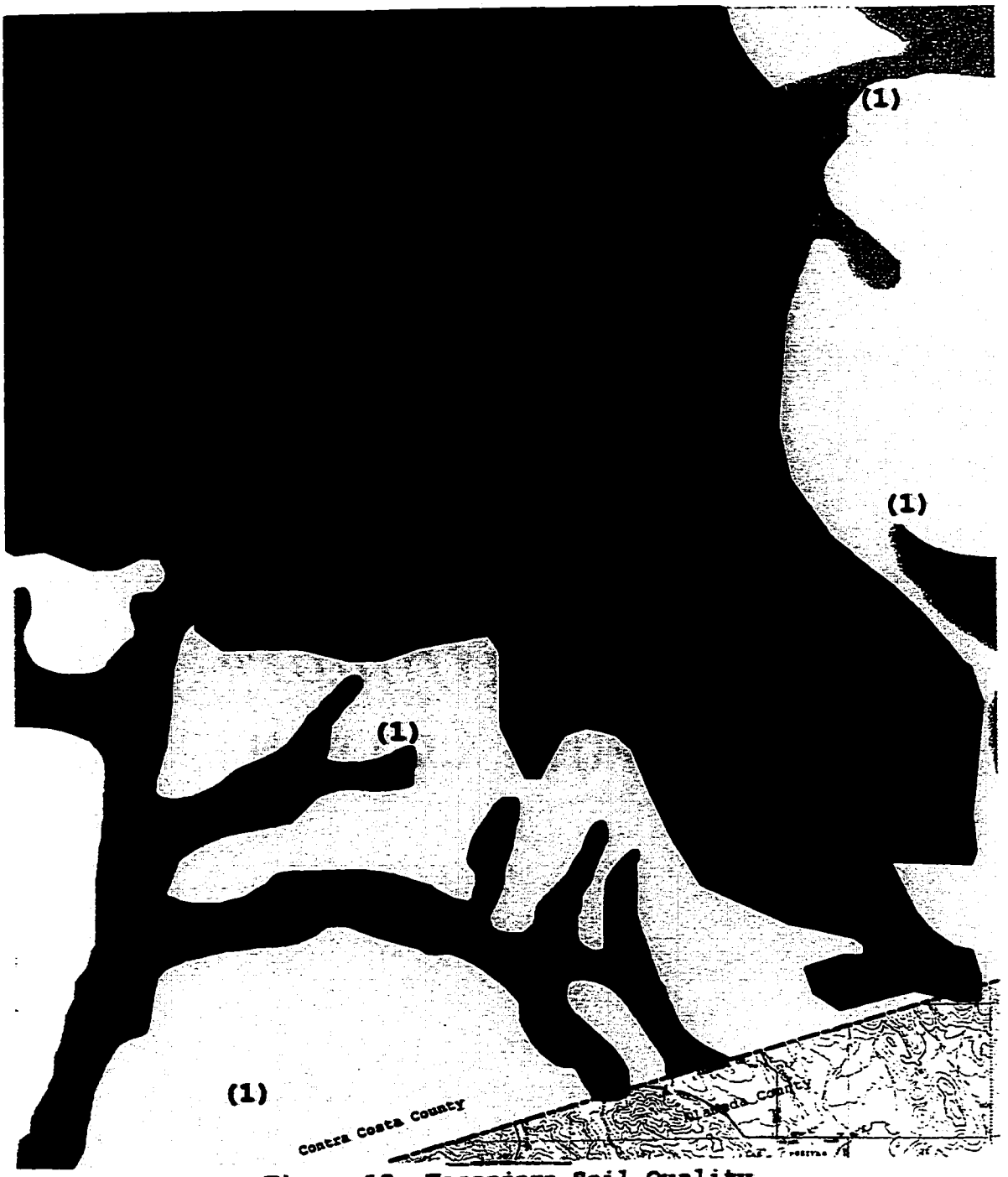

Figure 12. Tassajara Soil Quality.
Site Selection Priorities

Legend

(2) High priority. Best soil quality for mountain biking.

(1) Low Priority. All other colors.Moderate to poor soil quality for mountain biking.

Scale 1:24,000

N

natural water features. This data layer was analyzed for areas of approximately 2,500 acres (+/- 1,000 acres) with few or no natural water features. The highlighted areas without natural water features were given low priority and assigned a value of 1 in the overlay process. The areas not highlighted were given high priority and assigned a value of 2 for the overlay process (See figure 16). The Tassajara area does not have any continuous areas of 2,500 acres or more without a natural water feature. Therefore, no data layer was needed. Cedar Mountain has a few areas of approximately 2,500 acres or more without natural water features. Therefore, a natural water features data layer was created for the Cedar Mountain area.

11) Drinking Water Methodology and Findings

Local water districts were contacted to analyze accessibility to water service. Officials were asked if their district provided water for customers in the two research areas. Maps of existing service areas were analyzed. The boundaries could be mapped if service areas were found within the research areas. Areas within water district service boundaries would be given priority to reduce costs of the mountain biking facility.

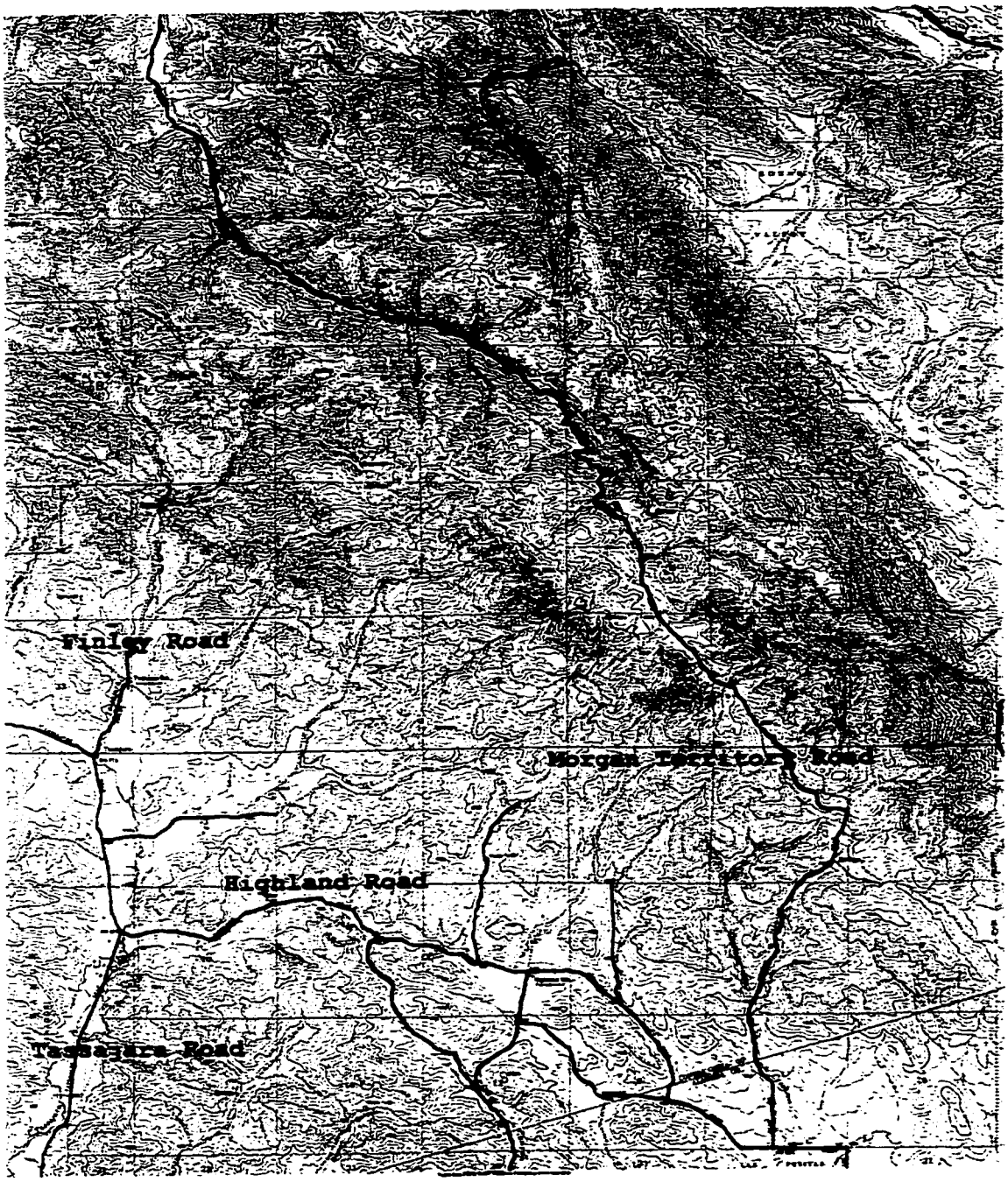

Figure 13. Tassajara. Existing Paved Roads

Scale 1:24,000

N

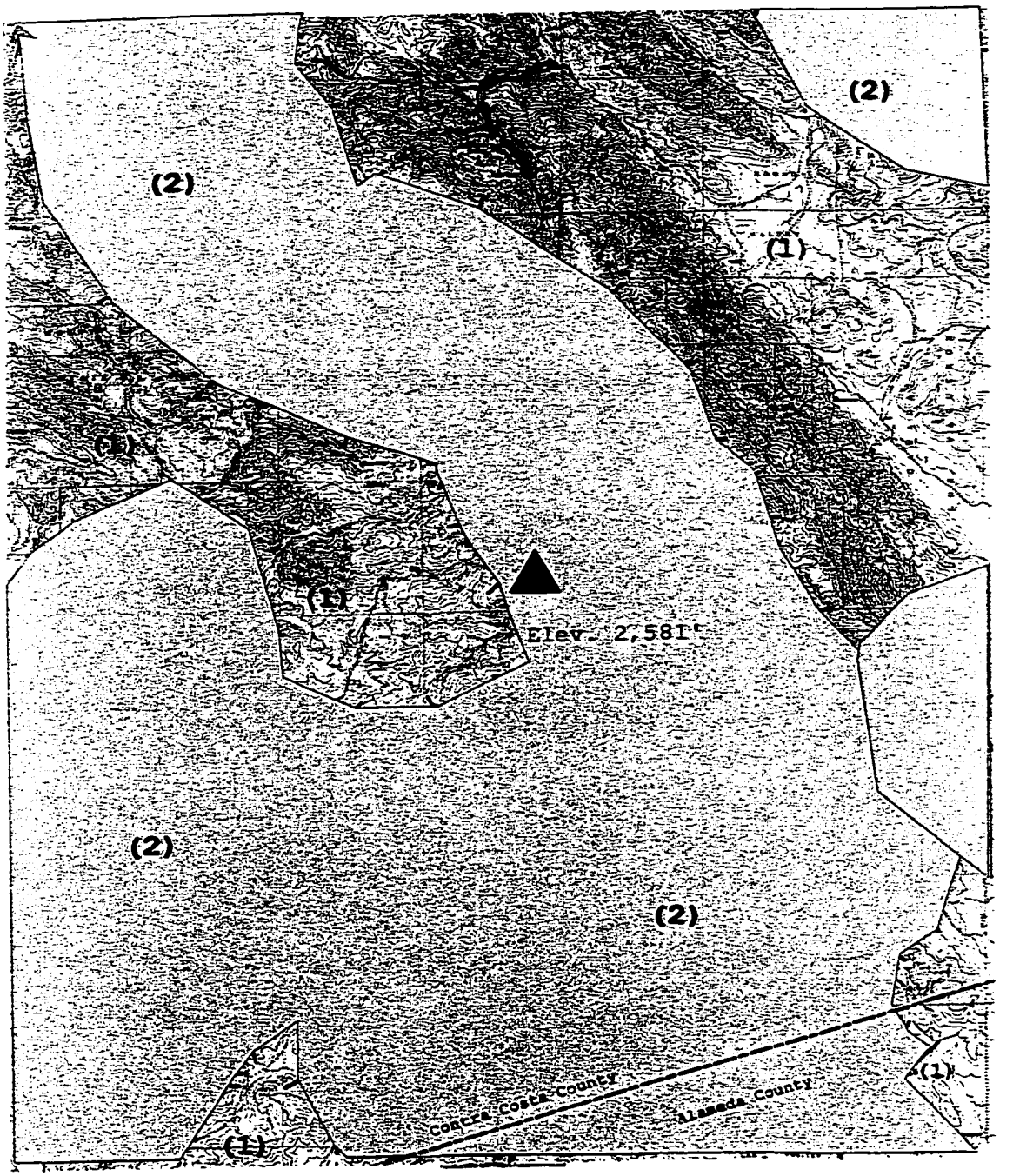

Figure 14.Tassajara.Proximity to Existing Roads.Site Selection Priorities

Legend

(2) **(2) High priority.Areas one mile from existing roads.**

(1) **(1) Low Priority.Areas beyond one mile from existing roads.**

Scale 1:24,000

N

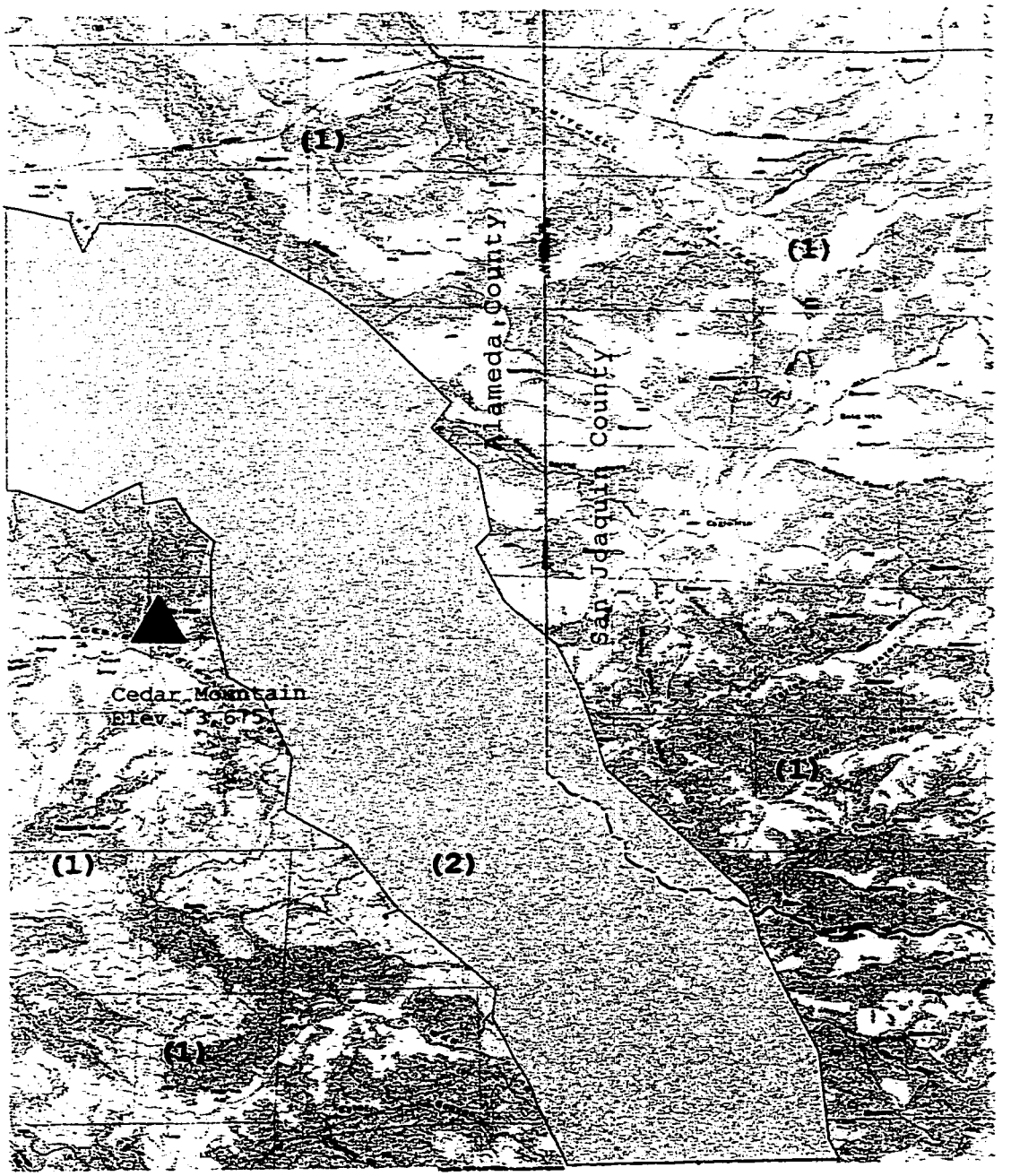

Figure 15. Cedar Mountain.
Proximity to Existing Roads. Site Selection Priorities.

Legend

(2) **(2) High priority. Areas one mile from existing roads.**

(1) **(1) Low Priority. All other colors.Areas beyond one mile from existing roads.**

Scale 1:24,000

N

Both study areas lie outside of any water district. According to Randy Werner of California Water Services Company, Livermore district, lands south of Tesla road on the north side of the Cedar Mountain area do not now receive water service from a municipal water district (Werner, 1998). Access to potable water would need to come from the construction of a well. According to Ed Novi of the Contra Costa Water District (CCWD), lands in the Tassajara quadrangle do not currently lie within district service area (Novi, 1998). According to Tom Bonigut of the East Bay Municipal Utility District (EBMUD), lands east of the town of Danville do not lie within the district service area (Bonigut, 1998). Access to potable water would need to come from the construction of a well on this site too. A comparison between areas within water district service boundaries and areas in need of a well cannot be made. Therefore, an "access to drinking water" data layer was not created as a criterion in the site selection process.

Drinking water is still a vital component to a successful project. Access to water is a highly political issue in California as seen in the delays of the Dougherty Valley and Tassajara Valley residential development projects in Contra Costa County (Danville, 1998). Politics,

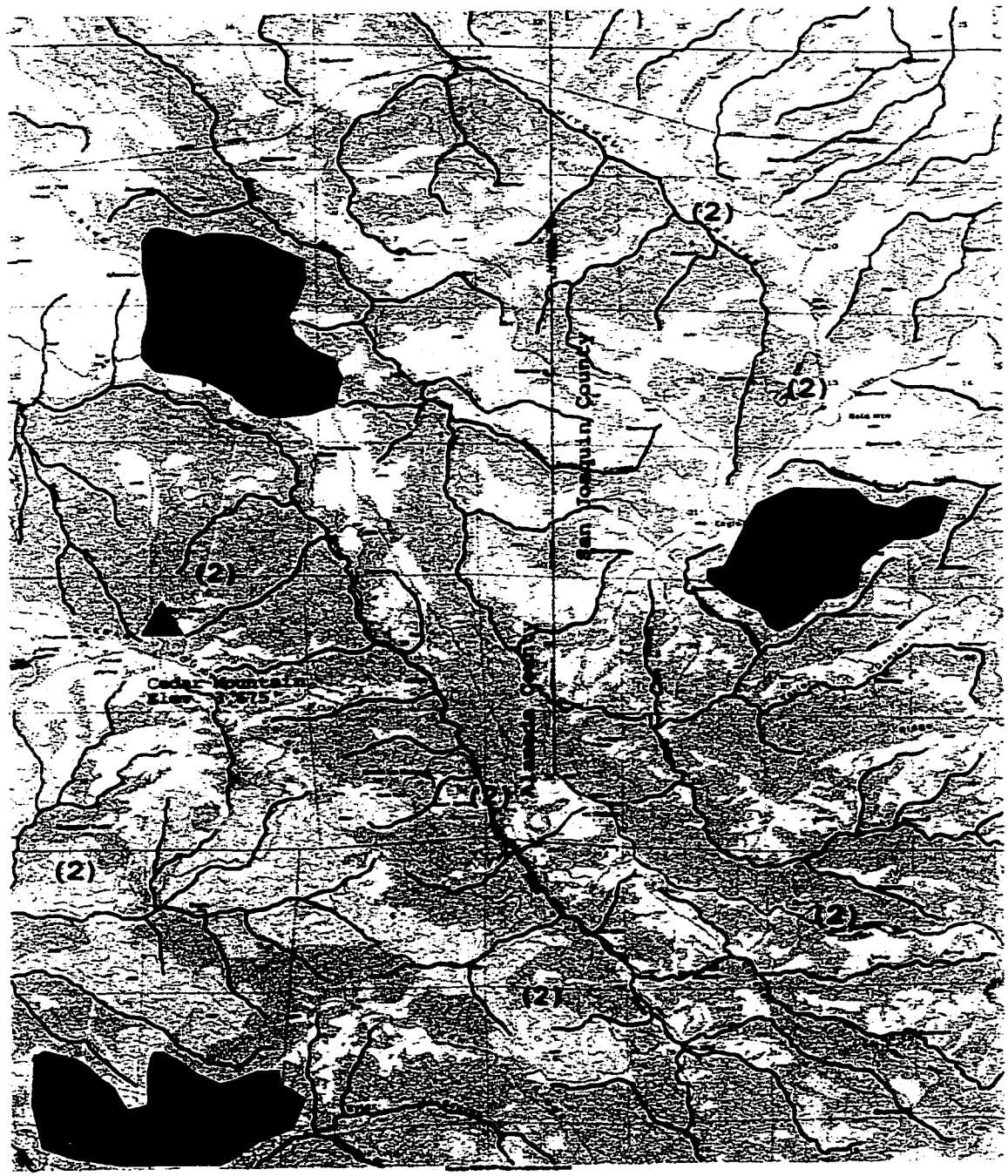

Figure 16. Cedar Mountain. Natual Water Features.

Legend ——— Natural Water Feature

Scale 1:24,000

(1) Low priority. Largest continuous areas without natural water features.

(2) (2) High Priority. All non-purple areas. Areas encompassing natural water features.

N

not location, would determine access to water even if this project were adjacent to a water service district.

SUMMARY OF RESULTS

Overlays were not created for all eleven landscape criteria. Overlays were created for seven landscape criteria. All of the seven landscape criteria within the two study areas were analyzed simultaneously in the overlay process for the final site selections. The remaining four criteria were found throughout the entire quadrangles. Therefore, certain layers were excluded because there was no variation of data to analyze. They were: "Weather and Climate", "Buffer Zone", "Convenient Location" and "Drinking Water" (See Table 4).

Using any of the excluded criteria would have no effect on the overlay results. No soil layer map was created for the Cedar Mountain area because the area has only one soil category. The one soil association happens to be an acceptable soil for mountain biking. No natural water feature map was created for the Tassajara area because natural water features are distributed throughout the entire quadrangle.

TABLE 4. OVERLAYS CREATED PER QUADRANGLE

Landscape Criteria	Cedar Mountain	Tassajara
Facility Area	yes	yes
Weather and Climate	no	no
Landforms	yes	yes
Buffer Zone	no	no
A Convenient Location	no	no
Ridgelines	yes	yes
Vegetation	yes	yes
Trail Soil Quality	no	yes
Access by Car or Bus	yes	yes
Natural Water Features	yes	no
Drinking Water	no	no

Tassajara Results

Square "windows" of 2,500 acres were moved over each digital map searching for the highest number of desired landscape criteria. It was discovered that only the Tassajara quadrangle has potential 2,500 sites that include all of the mapped landscape criteria. In Tassajara there are two areas of approximately 2,500 acres or more which include ten of the eleven high priority landscape criteria. One site is in the northwest corner of the Tassajara quadrangle (See figure 17). The other site is in the center of the Tassajara quadrangle (See figure 18).

The northwest Tassajara site has a larger continuous area of high priority criteria than the site in the middle of Tassajara. In fact, the northwest site is entirely covered by ten of the eleven criteria (See figure 17).

Unfortunately, this site is not located within a water services district. The northwest corner was selected for the site of the mountain biking facility because of the large continuous area of high priority landscape criteria.

Cedar Mountain Results

In Cedar Mountain there are no areas of approximately 2,500 acres which encompass each of the high priority landscape criteria. One alternative is in the middle of the quadrangle and includes the majority of the high priority criteria (See figure 19). The missing criteria in this site are "easy access to drinking water" and "dense vegetation coverage". The western edge of this middle site meets the edge of the road buffer criterion. All other criteria are found within the 2,500-acre window.

Another possible site at Cedar Mountain is found in the middle of the western edge of the quadrangle (See figure 20). Essentially the same criteria are found at this site as were found in the "middle site". However, there are at least two factors which set the two sites apart. First, the western site borders the edge of the "one mile road buffer", although the terrain connecting the existing road to the site is very steep. Second, the western site is

found directly on the summit of Cedar Mountain. The summit site has only limited relief. Therefore, the site in the middle of the Cedar Mountain quadrangle is considered best due to better road access and more variety in relief.

COMPARING CEDAR MOUNTAIN TO TASSAJARA

Both the Cedar Mountain and Tassajara sites would be excellent for development of a mountain biking facility. Both areas are accessible to mountain bikers, have excellent landforms, have pleasant climates and are somewhat remote from urban development. Both areas have excellent ridgelines, natural water features, and sections of good soil quality. Native oak woodlands dominate both areas but neither is entirely covered by trees.

The Tassajara site has ten high priority landscape criteria throughout the entire 2,500 acre window. Only "access to drinking water" is a problem. A well would need to provide drinking and minimal irrigation water to the facility. Not only are ten of the eleven criteria found within the Tassajara alternative but each of the ten criteria covers the entire 2,500-acre square.

The best Cedar Mountain site is not entirely covered by the high priority landscape criteria. The missing

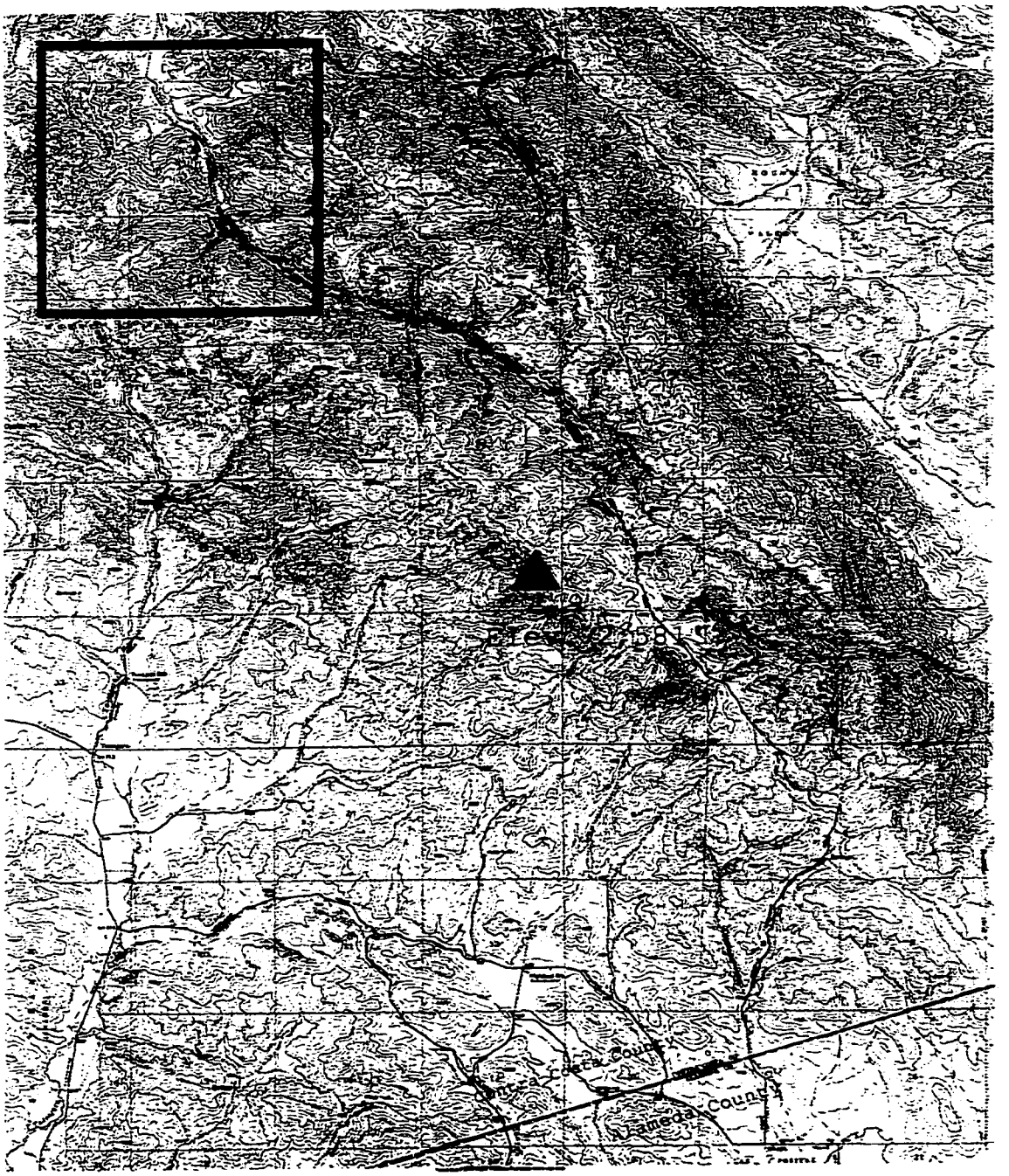

Figure 17. Tassajara Site Selection
2,500 acre Mountain Biking Facility

This site encompasses all of the high priority landscape criteria for a mountain biking facility.

Scale 1:24,000

N

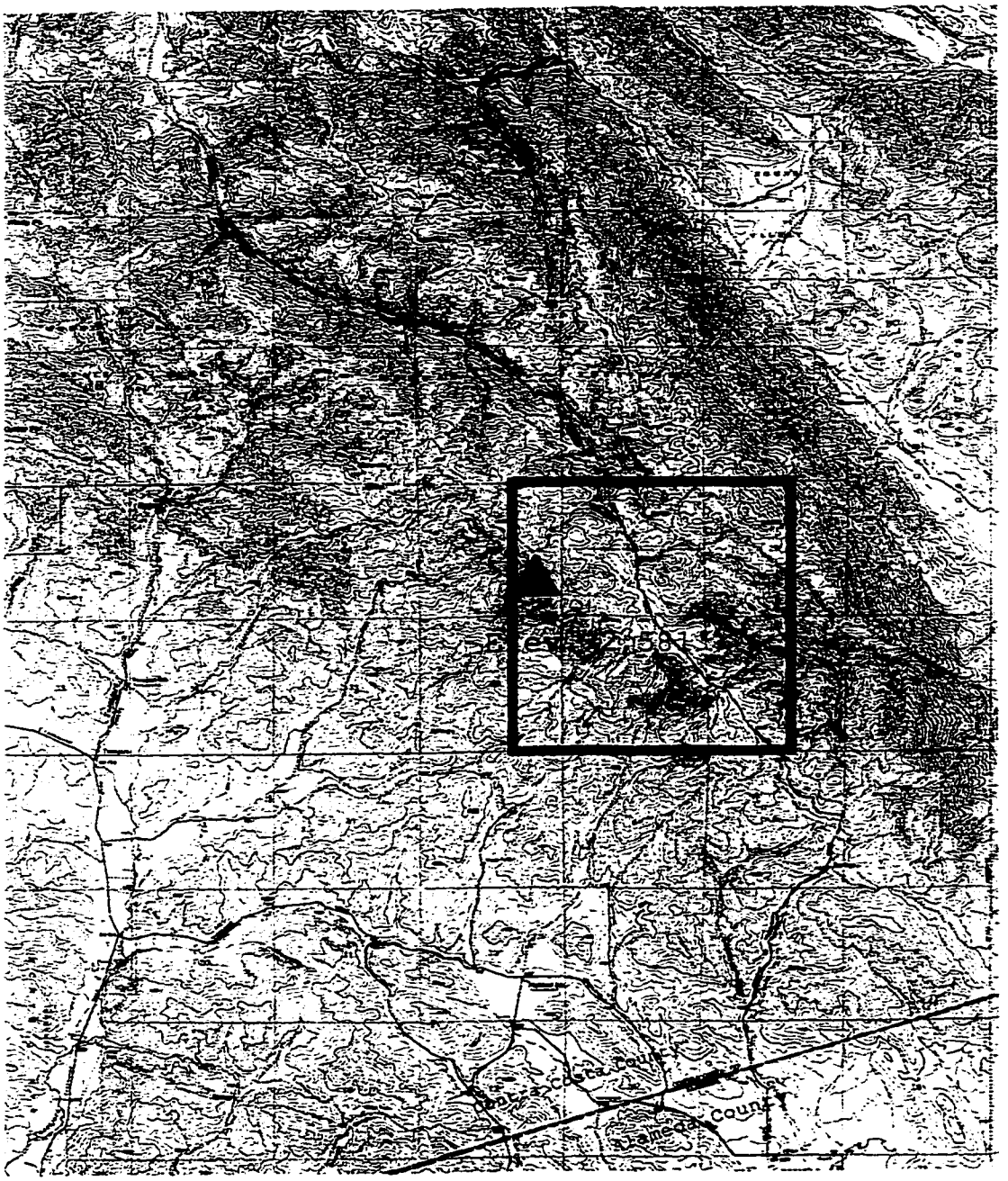

Figure 18. Tassajara Site Alternative 2,500 acre Mountain Biking Facility

This site nearly has all of the high priority landscape criteria for a mountain biking facility.

Scale 1:24,000

N

criteria at the Cedar Mountain site are access to drinking water and dense vegetation. However, stands of trees are present. Trees and the existence of more paved roads give Tassajara the edge over Cedar Mountain in site selection. All in all the Tassajara site is better than the Cedar Mountain site.

CONCLUSION

This report develops a methodology to locate the best site for a mountain biking facility in the East Bay. The site selection process offers a broad search strategy for ideal sites, performed objectively prior to consideration of land value, land availability and land use zoning. The first major component of the site selection process was to define the elements necessary to design the development. The elements were trails, overnight accommodations, staging areas, utilities, and access roads. The second major component was to define and locate the necessary landscape criteria. The landscape criteria were: facility area, weather and climate, landforms, buffer zone, convenient location, ridgelines, vegetation, soil, access by car or bus, natural water, and drinking water. The site selection

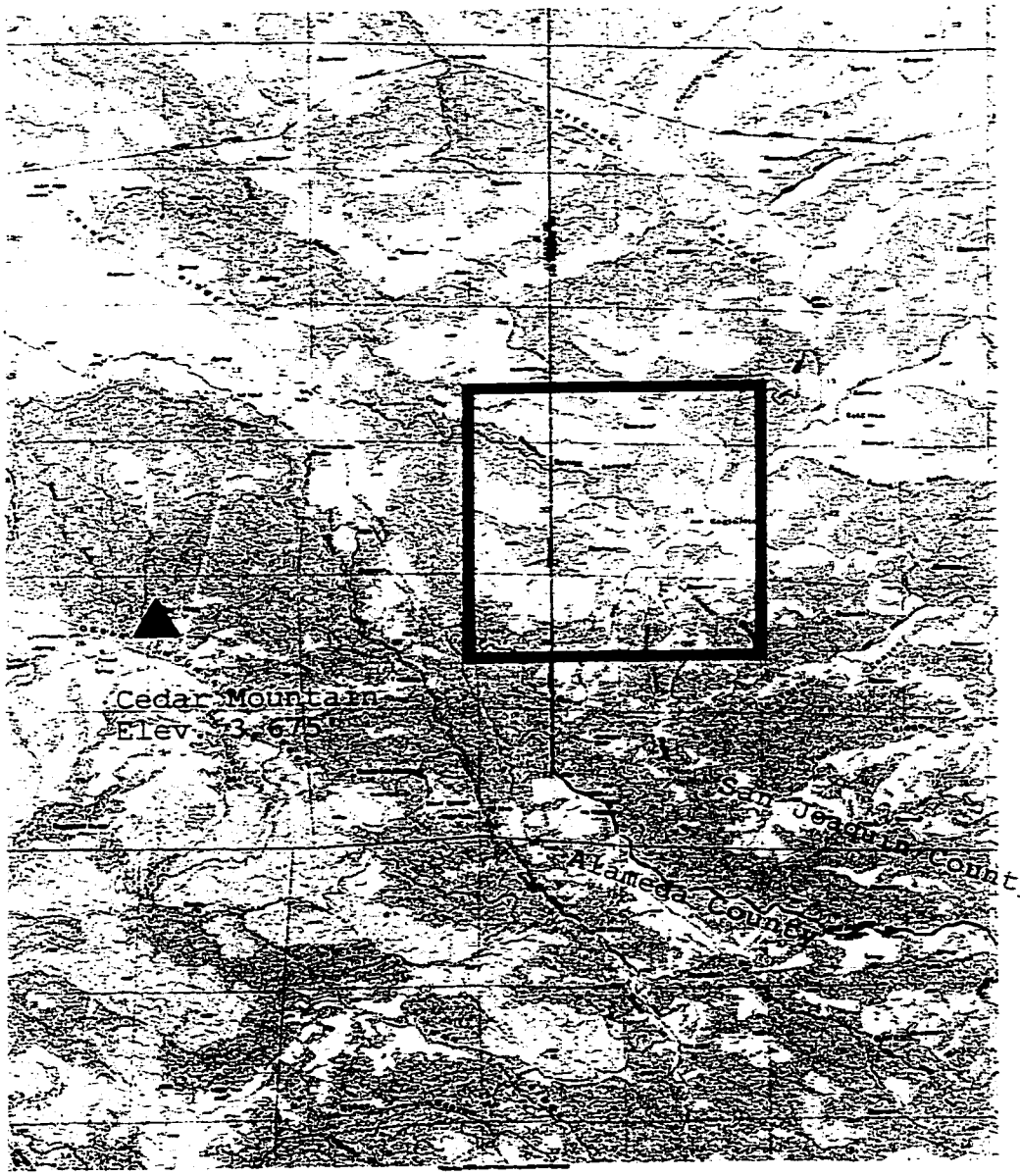

**Figure 19. Cedar Mountain Site Selection.
2,500 acre Mountain Biking Facility.**

Scale 1:24,000

N

This site encompasses all of the high priority landscape criteria for a mountain biking facility except the vegetation priority. Randomly distributed vegetation coverage does exist in this area.

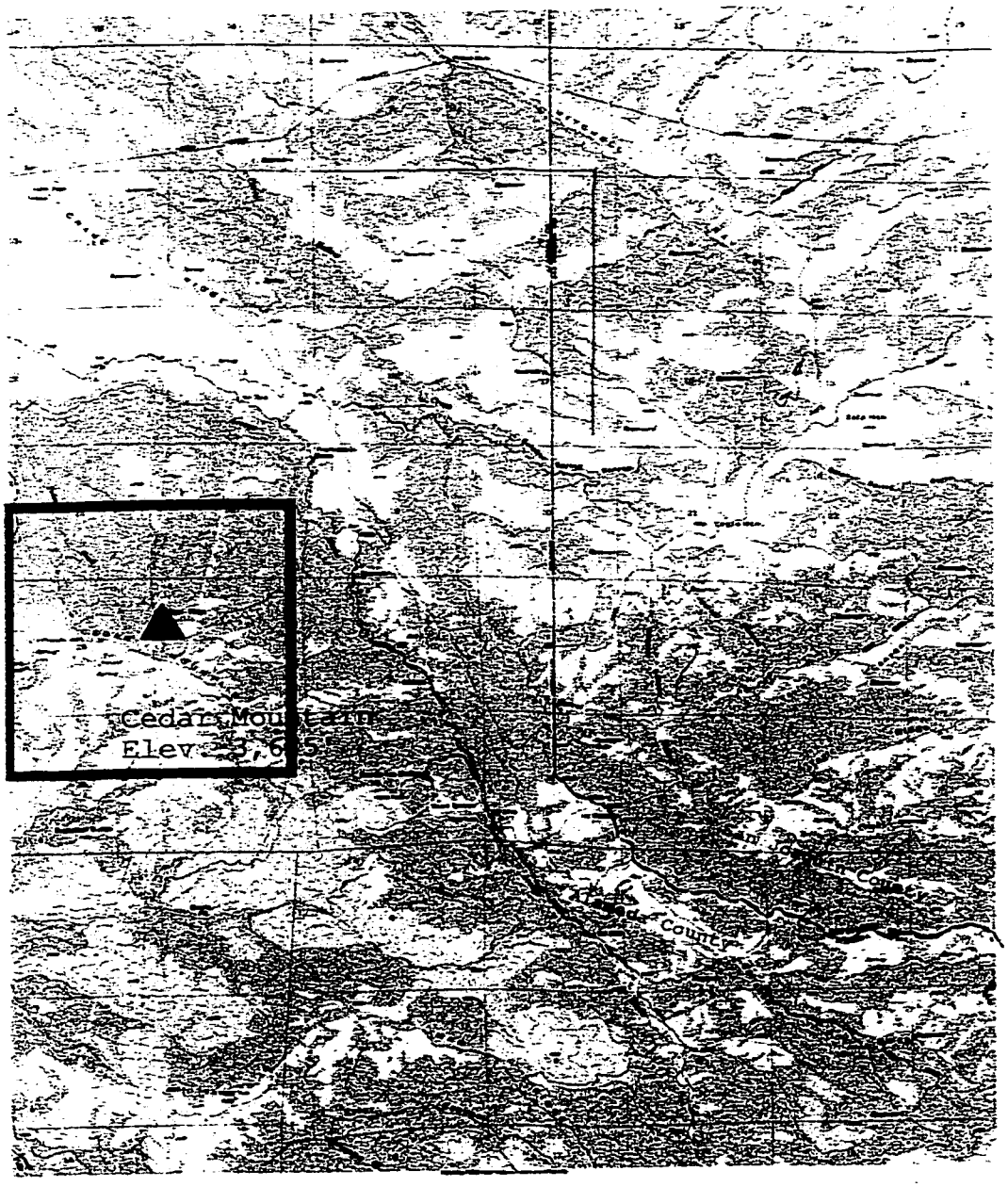

**Figure 20. Cedar Mountain Site Alternative.
2,500 acre Mountain Biking Facility.**

Scale 1:24,000

N

This site nearly has all of the high priority landscape criteria for a mountain biking facility.

process is essentially the process of locating the best site to place the design elements.

This report tests this locational model for the Tassajara and Cedar Mountain quadrangles and selects a 2,500-acre mountain biking facility. Finding and locating the final site alternatives was determined using the transparent overlay maps. Analyzing the overlays determined the best 2,500-acre site to be in the northwest portion of the Tassajara 7.5-minute quadrangle. The final site was tested against the entire remainder of the Tassajara quadrangle and the entire Cedar Mountain quadrangle.

The final site is a location where excellent riding conditions are found due to high priority landscape features at the site. The selected site is accessible, has excellent landforms, pleasant climate, native oak woodlands and is somewhat remote from urban development. The site is adjacent to Mt. Diablo State Park and Morgan Territory Regional Park. The adjacent parks create a greenbelt for additional riding. This facility can be used year round, compared to "summer only" biking at remote Sierra Nevada locations, because of the site's mild climate and proximity to large population centers.

Final Thoughts

This report can be viewed as a low cost stepping stone in seeking financial resources and public approval for development of the project. The development process for rural open space can be very expensive due to environmental review and potential public opposition. A "politicized" strategy may be necessary when attempting to develop rural open spaces. This project benefits from the fact that mountain biking *requires* natural landscapes. The sport and revenue generated from a lodge could be used as a means of preserving land that the public and politicians are concerned about losing to other development. Thus, the data in this report minimizes the up-front expenses that would normally be required to complete a rural development project.

This report justifies the need for further analyses to develop a mountain biking facility. Future reports would need to study economic feasibility, local planning and zoning ordinances, parcel maps, land acquisition, real estate costs and availability of desirable properties. Other analyses would include, but not be limited to, the following topics: flood control, seismic activity, wetlands, wildlife, sound and visual mitigation, and

cultural resources. A planned mountain biking facility is a new idea for open spaces in the Bay Area and an exciting alternative for mountain bikers.

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