FOIA Number: 2013-0661-F (3)

FOIA MARKER

This is not a textual record. This is used as an administrative marker by the William J. Clinton Presidential Library Staff.

Collection/Record Group: Clinton Presidential Records

Subgroup/Office of Origin: Americorps

Series/Staff Member: General Files

Subseries:

OA/ID Number: 24237

FolderID:

Folder Title:
[Americorps/USDA - Natural Resources Conservation Servive] [4]

Stack:	Row:	Section:	Shelf:	Position:
S	66	1	1	2

EVALUATION OF WATERSHED CONDITIONS AND HAZARDS

and

RECOMMENDATIONS FOR ADDITIONAL PROTECTIVE MEASURES

for the

LAGUNA FIRE AREA

Orange County, California

January, 1995

Prepared for and in cooperation with

GOVERNOR'S OFFICE OF EMERGENCY SERVICES, STATE OF CALIFORNIA

Prepared by:
USDA, Natural Resources Conservation Service
and
Americorps National Service
Lancaster, California

APPENDIX B

MAPS OF INITIAL FLOOD, EROSION AND SEDIMENT CONTROL MEASURES

LIST OF PREPARERS

Principal contributors leading to the publication of this report were:

USDA, NATURAL RESOURCES CONSERVATION SERVICE

Urban and Community Assistance Team

Patti J. Novak, Ecologist
Laura K. Lundin, Civil Engineer
David W. Lundin, Civil Engineer

Americorps National Service

Sandy A. Haynes, Field Technician
Phillip D. Sam, Field Technician
April D. Jurgen, Field Technician

Lancaster Field Office

L. Robert Dean, District Conservationist

Salinas Area Office

Douglas W. Toews, Area Engineer

ACKNOWLEDGEMENTS

The following are acknowledged for their participation and/or technical contributions:

OFFICE OF EMERGENCY SERVICES, STATE OF CALIFORNIA

David Sabaroff, Manager
Michael Sheeran, GIS Computer Specialist

CITY OF LAGUNA BEACH MUNICIPAL SERVICES

Terry Brandt, Director
Kevin Retmier, Field Staff

CITY OF LAGUNA BEACH FIRE DEPARTMENT

Chris Kent, Fire Prevention Specialist

COUNTY OF ORANGE - ENVIRONMENTAL MANAGEMENT AGENCY

Bill Reiter, Manager-Public Works Operations
Dale Dillon, Manager-Field Operations, Public Works

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Purpose of Study

This report is prepared for the Governor's Office of Emergency Services (OES) and provides an evaluation of the conditions of the Laguna Fire area. The report also discusses the condition of the initial erosion control measures implemented, identifies potential post-fire flood, erosion, and sedimentation hazards, and provides recommendations for additional protection measures.

Other agencies and organizations requesting this report include: City of Laguna Beach Fire Department, City of Laguna Beach Municipal Services, County of Orange Public Works, Laguna Fire Relief Coalition, and Laguna Beach Coalition of Neighborhood Associations.

1.2 Background

On Wednesday, October 27, 1993 a fire began in the southern San Joaquin Hills in the area south of Interstate 5 and west of State Route 133. An estimated 17,000 acres burned, extending from Turtle Rock in the north to the City of Laguna Beach (City) in the south (Appendix A). Approximately 380 homes burned in the residential areas of El Moro Trailer Park, Emerald Bay, North Laguna Beach, Laguna Canyon, Canyon Acres, and Top of the World. The burned wildland areas included Crystal Cove State Park, Laguna Coast Wilderness Park, and Irvine Company Open Space Reserve, unincorporated land owned by the City of Laguna Beach, and the Laguna Laural Ecological Reserve.

In November 1993, the City and the County of Orange (County) requested assistance through the Emergency Watershed Protection Program (EWP) administered through the USDA Soil Conservation Service, now called the Natural Resources Conservation Service (NRCS), under provisions of Section 403, Agricultural Credit Act of 1978. The purpose of the EWP Program is to assist in relieving imminent hazards to life and property from watersheds impaired by natural occurrences. Staff from the NRCS conducted site reviews and prepared Damage Survey Reports for the burned area. These reports identified damages, potential flooding, erosion, and sedimentation hazards, and recommended protective measures. Several of the measures were constructed by the County, however, many of the recommended treatments within City jurisdiction were not implemented. Also, several requests for technical assistance were received from individual landowners regarding erosion and sediment control on their property and appropriate recommendations were provided.

Also in November, the City retained Woodward-Clyde Consultants to assess the erosion and sedimentation hazards within City jurisdiction and to develop a plan addressing those hazards. The plan titled "Phase I Erosion and Stabilization Plan Laguna Beach Fire" (WCC Plan) lists several short-term erosion and sedimentation control alternatives. Several of these measures were immediately implemented by the City and primarily

addressed erosion and sedimentation problems resulting from mild to moderate storms.

The watersheds within the burned areas are large enough to produce significant effects on downstream structures and property value. Laguna Beach has a history of flooding which has resulted in significant structural damage (FEMA 1985). Immediately following the fire, a lack of vegetative cover and the presence of water repellent soils indicated a significant potential for flooding and damage to downstream structures. Prior to implementation of protective measures the area received approximately 0.5 inches of rain, which left mud and debris in residences and on the streets in portions of Laguna Beach (EWPP 1993).

2.0 STUDY AREA

2.1 Scope of Study

The focus of this study is primarily on flood potential and the measures which may be implemented to reduce the damages from flooding. Although erosion and sedimentation will certainly occur and should be addressed, only their contribution to flooding is included in the recommendations of this study.

A map of the study area is provided in Appendix A and includes the following burned areas: Laguna Canyon Road, Canyon Acres, Mystic Hills/Skyline Drive, Park Avenue, Park Avenue/Browncroft, Crystal Cove/Los Trancos, El Moro, Irvine Cove, Emerald Bay, High Street area between Boat Canyon and Laguna Canyon, and Lookout Drive. Orange County Environmental Management Agency (OCEMA) and the OES provided the WCC Plan. Maps displaying the locations and types of initial protective measures were prepared using the OES Geographical Information System (Appendix B).

Field reconnaissance of the burned areas was conducted on November 18, 29, 30, and December 6, 1994, and on January 18, 1995, by staff from the Urban and Community Assistance Team of NRCS and by AmeriCorps members.

2.2 Environmental Setting

2.2.1 Climate

The climate of the study area is typical of the Southern California Coastal Region, with mildly warm, dry summers and moderately cool, rainy winters. The mean annual temperature is approximately 67 degrees F. Average temperatures range from 52 degrees F in the winter to 68 degrees F in the summer (FEMA 1985; USDA 1978). Mean annual rainfall is approximately 12 inches with a minimum of 4 inches and a maximum of 29 inches, for the past 68-year record (OCEMA 1994). Most precipitation occurs during the

winter between November and April. Summer tropical storms are infrequent but tend to have larger rainfall totals (FEMA 1985; USDA 1978).

2.2.2 Soils

The soils of the study area are predominantly derived from sandstone or shale. Soils of the coastal terraces are of the Myford association. Myford soils are moderately well drained sandy loams that have a strongly developed subsoil. They are formed in sandy sediments and occur on marine terraces, older alluvial fans, and terrace remnants in the foothills (USDA 1978).

Soils of the coastal foothills are of the Cieneba-Anaheim-Soper and the Alo-Bosanko associations. These soils formed in weathered sandstone, calcareous shale or weakly consolidated sediments (USDA 1978).

Cieneba soils occur on steep to very steep hillsides, are somewhat excessively drained, and are formed in weathered sandstone. If the soil is bare, runoff is rapid and the erosion hazard is high. Anaheim soils are well drained and are formed in weathered soft sandstone or shale. They occur on moderately steep to very steep north-facing slopes. Soper soils are well drained and occur on 15 to 75 percent slopes (USDA 1978).

The Alo-Bosanko association occurs on strongly sloping to steep coastal foothills. The Alo and Bosanko soils are well drained clays occurring on slopes of 9 to 50 percent (USDA 1978).

2.2.3 Vegetation

The natural vegetation of the study area is mixed chaparral, coastal sage scrub - a phase of the southern coastal scrub, and riparian woodland. The coastal sage scrub occurs on relatively dry sites, usually on the lower slopes of the foothills facing the ocean. Mixed chaparral usually occurs at higher elevations on more mesic, moist, sites. Riparian woodland occurs along perennial stream channels (Barbour and Major 1988).

The coastal sage scrub is a moderately dense community of deciduous shrubs. Characteristic species include California sagebrush (*Artemisia californica*), sage (*Salvia* spp.), California buckwheat (*Eriogonum fasciculatum*), and California encelia (*Encelia californica*). The mixed chaparral is a dense community of needle-leaved and broad-leaved evergreen shrubs. Dominant woody genera include species of ceanothus (*Ceanothus*), chamise (*Adenostoma*), and sumac (*Rhus*). The riparian communities include western sycamore (*Platanus racemosa*), coast live oak (*Quercus agrifolia*) and willow (*Salix* spp.) (Barbour and Major 1988; Hickman 1993).

Ephemeral annuals and short-lived perennials will dominate intershrub spaces for a few years after fire. Many of the shrub species in both communities will crown-sprout the first year, however, seedling reproduction usually occurs only after these sprouts have flowered and set seed. (Westman 1981).

2.3 Initial Flood, Erosion, and Sedimentation Control Measures

Immediately following the fire, EWP Program assistance was made available by the NRCS. Through this program, interdisciplinary teams of technical experts began evaluating watershed conditions and recommending protective measures to protect life and property from flooding and debris flows. This information was compiled in Damage Survey Reports, which were used to secure 75% of the funding for the projects through federal funds, with the sponsor contributing the remaining 25%.

The County cooperated with the NRCS to sponsor many of the proposed projects. These projects included several pipe debris barriers, or trash racks, pipe and wire debris fences, rock gabion check dams, a timber debris/sediment barrier, and a sediment detention basin. All of these structures are designed to reduce the probability of flooding by removing medium to large debris and some sediment from the storm water, preventing the blockage of downstream culverts and waterways. These structures are designed to continue their effectiveness, with maintenance, until the hydrologic condition of the watersheds has recovered. Hydromulching was also applied on some critical hillsides to provide a mulch cover and to supplement the natural revegetation.

Several DSR's were completed for areas within the City of Laguna Beach. The City sponsored the construction of pipe debris barriers and a perforated pipe inlet to help protect the Irvine Bowl from flood damage and several acres were hydromulched.

In November 1993, Woodward-Clyde also evaluated the condition of the burned areas, watershed factors, surviving structures, and drainage facilities. With this information, their erosion and stabilization plan was developed. Several short-term erosion and sediment control measures were identified and installed. The primary measures implemented were: hydromulching, silt fencing, gravel bag check dams, straw bale check dams, and concrete traffic barriers or K-rails (WCC 1993).

Hydromulching was primarily applied to the lower slopes of Laguna Canyon and selected slopes in residential areas of Emerald Bay, Park Avenue, Irvine Cove, and High Street. Gravel bag barriers were placed throughout residential areas and along main roadways. Barriers were also installed around homes that were burned and around storm drain inlets to collect debris and sediment. Silt fencing was used in channels as sediment retention structures and also on burned slopes in residential areas to retain debris. Straw bale and gravel bag check dams were used as sediment retention structures and installed in ephemeral stream channels, gullies, and other drainage ways. The K-rails were used in conjunction with gravel bag barriers in areas of potential mud or debris flow to direct the material away from structures or roadways (WCC 1993).

Maps were prepared delineating locations and selected protective measures for the burned area (Appendix B).

3.0 FINDINGS AND RECOMMENDATIONS

3.1 Condition of Burned Areas and Initial Flood, Erosion, and Sedimentation Control Measures

On November 18, 29, 30, and December 6, 1994, and January 17, 1995 staff of NRCS and AmeriCorps conducted field surveys of the burned areas described in Section 1.2. Observations were made of watershed and vegetative conditions, stream channels and other drainage ways, conditions of erosion control structures, storm drain systems, inlet/outlet structures, revegetation efforts, and construction in residential areas.

Precipitation from July 1993 to June 1994 was 9.82 inches with most occurring from January through April (OCEMA, 1994). Although rainfall was below normal, it was enough to produce substantial cover of post-fire annual and perennial herbs and grasses on all burned areas. Crown-sprouting of chaparral and coastal sage scrub was also common, as 50 percent or more of the shrub species of each plant community have crown-sprouting ability (Westman 1981). However, perennial vegetative cover was less than 20% in most burned areas observed. On Irvine Company Open Space Reserve land, the majority of the burned stems and branches of shrubs and trees have been removed.

In early January, 1995, tropical storms separated by days of clear weather have encouraged the growth of annual grasses in many of the areas. Many of the watersheds are now in better hydrologic condition and, after this year, may not require extreme protective measures.

Stream channels with permanent or intermittent flow have largely revegetated with native, woody riparian species. Ephemeral channels have little to no regrowth.

The majority of the gravel or sand bag barriers, straw bales, and straw bale/sand bag check dams have been removed within the jurisdiction of the City. Remaining sand bags were in poor condition. Straw bale/sand bag check dams were still in place in areas under County jurisdiction. Most of these were loose and unstable, and the bales, bags, and anchoring stakes were in various stages of deterioration. Locations of the barriers and dams will be discussed in Section 3.3. of this report.

Certain natural channels and storm drain systems do not have adequate capacity to transport large flows and/or excessive sediment and debris loads. The Laguna Canyon channel has been designed for the 4% (25-year) flood and is inadequate for larger floods (FEMA 1985). Hydrologic analysis indicates that drainage systems in Canyon Acres, Park Avenue, and Irvine Cove have capacity to only carry runoff from the 50% (2-year) storm events (WCC 1993). The downtown area has culverts that are also undersized and historically cause flooding in the business area.

3.2 Discussion of Potential Erosion/Flood Risks

Twelve major watersheds were affected by the fire; five within the study area. The size of the five watersheds is significant - the area east of Laguna Canyon Road has an estimated 700 acres and the area west of Laguna Canyon Road has over 1500 acres.

Fire intensity, soil characteristics, presence of water repellent soils, steepness and length of slope, and duration and intensity of rainfall all affect the amount of erosion after a fire. A good vegetative cover can greatly offset the effect of climate, soil, and topography on erosion, although revegetation may take several years. The amount of erosion also depends on the time elapsed since the fire. Post-fire erosion may be significantly greater than on a well-vegetated watershed.

Increased peak flows created by fire-denuded slopes are responsible for accelerated erosion and flood damage. Scouring out of stream channels and overland flow contribute the greatest sediment yields (Radtke 1983).

The total volume of rainfall and rainfall intensity are both important when considering potential for flooding. In small watersheds such as those in the Laguna Beach fire area, a storm event which produces a large volume of rainfall in a short period of time will likely cause a higher peak runoff rate than a storm which produces the same volume of rainfall over a long period of time.

If the soil in a watershed is saturated by previous storm events, additional rainfall will runoff immediately rather than being infiltrated. This saturated condition increases the total volume of direct runoff and may increase the potential for erosion and debris flows.

A low percentage of vegetative cover will effect flooding by increasing the amount of direct runoff. A lack of vegetative cover on the hillsides also exposes a greater area of soil which is unprotected from erosion, thus increasing the sediment load in the storm flow runoff.

As sediment is added to the direct runoff, through sheet, rill, and gully erosion, as well as streambank and streambed erosion, the total volume of runoff increases, or is bulked. Debris such as rocks, limbs and foreign matter (furniture, shopping carts, etc.) also bulk the storm flow volume. These additions to the storm flow will increase the volume the direct runoff, often overtaxing the storm drain system.

Restrictions in the flowpath such as brushy areas, debris, and undersized culverts and storm drain entrances, reduce the rate at which the storm flow can travel, sometimes completely blocking the flowpath. With the channel restricted, the flow often overtops its banks and floods the surrounding areas. When the restriction suddenly gives way, the surge of storm flow can move very rapidly and with great force, and may cause severe damage downstream.

These five factors, singularly and in combinations, can create the potential for localized and widespread flooding.

All of the study areas exhibit a high potential for localized flooding. Those areas which are expected to experience significant flooding and have the highest potential for damage, include Laguna Canyon Road, Canyon Acres, and Park Avenue/Browncroft. Although significant flooding is also expected in the Emerald Canyon area of Emerald Bay, damage would be minimal.

3.3 Recommended Protective Measures

The following recommendations are based upon a field reconnaissance of the burned area conditions and initial protective measures, review of Damage Survey Reports and the WCC Plan, and discussions with City and County representatives and NRCS personnel initially involved with the EWP program. Protective measures are recommended on an area-wide basis and a site-specific basis for individual burned areas.

For all areas, it is recommended that sandbags are installed to prevent sediment from leaving burned lots that are vacant, unvegetated, or currently under construction. Sandbags should be installed around the lot perimeters and loose piles of soil should be covered and surrounded with sandbags. Loose fill material and other debris can contribute to the sediment load in channels carrying storm runoff.

Many of the straw bales, used last year for debris barriers, are unstable and may move during a storm event. The bales that are loose should be removed and may be spread for mulch on site rather than being hauled off site and disposed.

Recommended protective measures and additional field observations for individual burned areas are as follows:

Laguna Canyon Road Burned Area - Maps 1-6, 12

* General recommendations:

The preferred alternative is to improve and expand the existing drainage system. Drainage should be provided from the north side to the south side of road and continue through the existing businesses and residences in a safe manner. The existing channel on the south side of the road should be extended and expanded to carry larger storm event volumes. This could possibly be done by increasing channel capacity while keeping the stream in as natural a state as possible, but further investigation would need to be completed. This alternative may not be economically feasible for the City and County to accomplish, but would provide the best flood control for the area which has historically experienced flood events during non-burn years.

If the drainage system is not improved, structures located along the south side of the road could be protected by pipe and plywood deflector walls and sandbags. These measures are needed to direct flow between buildings and into the existing flood channel and prevent flow from damaging the structures.

Straw bales and silt fences located along the north side of the road should be removed. The stakes that secured the bales in place have rotted and the

bales have the potential to move during a storm event. The loose bales, if they enter the drainage system, may plug culverts and cause flooding. The hydrologic condition of this area has greatly improved in recent months and the soil has been stabilized by vegetation.

* Specific areas:

Toll Road Construction Site - This site is contributing sediment to the stream channel. Complete construction site erosion control measures should be implemented and maintained during the duration of construction.

Sun Valley (Map 2) - This area was flooded during the storms of January 4th and 10th, 1995, and many of the homes were damaged by flood waters. The channel through this area is undersized and should be expanded to carry a larger flood event. If this is not feasible, the circular metal pipe culvert at the upstream end of the area is undersized and should be replaced with a box culvert or bridge with greater capacity. Homes located adjacent to the stream channel should be well protected with sandbags and pipe and plywood deflector walls.

Art Institute (Map 4) - The east side of the Art Institute should have a permanent drainage system installed to convey flows out to the existing drainage system. This could be located along the north-east edge of the property, diverting flow from the canyon that now floods the parking lot. Structures should be sandbagged to prevent water damage. As a temporary measure, an optional alternative is to install "K-rails" across the north end of the parking lot, creating a temporary storage area for sediment and debris. The rails would provide better protection than existing measures but would need to be cleaned out after every storm event. If nothing else is done, the existing straw bales and sandbags should be repaired or replaced as necessary. Many of the bales are loose and rotted and need to be replaced with new bales. The west side of the Art Institute should have a row of sand bags, 2 wide and 2 high, installed along the existing line of concrete rubble. The area behind this line should be regularly cleaned out to provide maximum protection. Buildings should be sandbagged to prevent damage.

Southern California Edison Morro Substation (Map 6) - K-rails and sandbags have been installed around three sides of the substation, providing a good degree of protection. Damaged sandbags should be replaced as necessary. The silt and chainlink fencing should be removed from the drainage channel. The fencing may fail, plugging downstream culverts and causing flooding.

Act 5 Parking Lot (Map 6)- Silt and chainlink fences should be removed from the channel. All of the fences have failed, allowing water around the sides and causing severe erosion to the channel side slopes. The fences may come loose, plugging downstream culverts and causing flooding. The apron on the gabion structure is being undercut and needs replacing. Future flow will increase the amount of undercutting and could cause structural failure. The trash rack, upstream of the culvert inlet, is in good condition.

Irvine Bowl - The grouted rock apron below the upper trash rack washed out during the January 4th and 10th storm events. The apron should be replaced with large, (24" or greater), loose rock installed in the area the apron was lost. Installation of the rock is crucial to prevent further damage

to the structure. Both racks need to be cleaned out on a regular basis to maintain the maximum storage volume.

Canyon Acres Burned Area - Maps 6 & 7

* General recommendations:

The existing channels in the area should be expanded to increase capacity. All of the channels and culverts are undersized and could flood in a relatively small storm event. Sandbags used as protection for residences last year should be replaced as necessary. Sandbags should also be installed around lots under construction to prevent debris runoff from entering the drainage system. Sandbags placed in any channels should be removed. Many of the sandbag check dams failed in the January storm events, adding material to the debris flows. Remaining bags should be removed to prevent additional debris in future flows.

* Specific areas:

Canyon Acres - A grade control structure should be installed at the upstream end of Canyon Acres to reduce downcutting in the channel bottom. This structure could incorporate a grade drop, small sediment storage basin and a road crossing for access to homes and roads on the north side of the channel. This structure would need to be maintained on a regular basis.

Milligan Avenue - The preferred, long term alternative would be widening the channel to increase capacity and replacing the existing sandbags with K-rails. An optional alternative would be to replace sandbags as needed, though this would not provide the protection channel expansion would.

Canyon Acres Drive and Lewellyn Drive - Remaining black plastic should be removed from the hillsides. The plastic prevents revegetation on the slope and increases runoff by preventing the soil from absorbing and storing the water.

Arroyo Street - All straw bales that are loose and unstable on the hillside above the homes should be removed. These bales may fall down the slope, causing injury, or may plug culverts and induce flooding. Replace or repair sandbags behind houses (along wooden fences) adjacent to the flood control channel to prevent overflow from the channel causing damage.

Mystic Hills/Skyline Drive Burned Area - Map 8

* General recommendations:

Approximately 80% of homes that burned last year are now under construction. Erosion control measures should be implemented during construction, as loose sediment and fill material could be a large contributor to the drainage system during heavy rains. Any lots that are under construction, vacant, or unvegetated should have protection measures installed.

* Specific areas:

Skyline Drive and Samoa Way - Sandbags have deteriorated and are unstable, and should be removed from the hillside below the roadways. They may fall down the hillside, enter the storm drain system, and cause plugging.

Skyline Drive - Sandbags are no longer needed along the road and should not be replaced. Many of the lots, which had been left bare after the wildfire, are now being rebuilt. Bagging along the roads is unnecessary if construction site erosion control measures are installed to control runoff from these lots.

Park Avenue/Browncroft Burned Area - Maps A, 8, & 9

The small watersheds within this burned area have experienced very rapid vegetative recovery and the hydrologic condition has greatly improved.

* Specific areas:

Park Avenue - All straw bales and silt fences adjacent to the roadway should be removed. These are unstable and may move from their present locations. The bales behind the K-rails may fall into the area behind the rails, decreasing storage that may otherwise be used for sediment storage.

Coral Drive and Park Avenue - Remove all sandbags on slope between these roads. Sandbags are unstable and may cause a hazard to motorists.

Griffith Way - This street should have a permanent drainage system installed to direct and control flows that now travel along the roadway. All residential sandbags should be maintained or replaced with pipe and plywood deflector walls along the edge of the roadway. A two foot tall headwall should be installed behind 605 and 610 Griffith Way. An inlet structure located behind these homes is set at an elevation only slightly lower than that of the homes and may plug and cause flooding.

945 Park Avenue - Masonry or pipe and plywood deflector walls should be placed behind the residence on Park Avenue and the doorway should be sandbagged for additional protection. The flow path from the Park Avenue overflow is only three inches below the lower story glass doorway, and water flowing through may cause damage to the home.

Hidden Valley Canyon - All loose and unstable straw bales on the hillside should be removed, as they are a hazard to the residents below. Straw bales may be opened and the straw spread for mulch on site.

High Street Area between Boat Canyon and Laguna Canyon - Map 12

* Specific areas:

Unnamed canyon - Three debris fences that were installed have collected sediment and should be cleaned out. Several straw bale/sandbag/silt fence

check dams were also installed in the canyon. These need to be periodically monitored and maintained. The Irvine Company recently installed sandbags for those that were undermined.

High and Locust Streets - Replace residential sandbags along the roadways to protect homes from flows.

Lookout Drive Burned Area - Map 12

Sandbags and silt fences have been removed by the Fire Department and are no longer necessary.

Emerald Bay Burned Area - Maps 13 & 14

* Specific areas:

Emerald Canyon - The pipe and timber debris/sediment barrier installed in the Emerald Canyon drainage was damaged and buried in the January storms. The channel bottom has stabilized and there is no need for the structure to be repaired.

The chain link fence across the channel near the tennis courts should be removed. It has failed in the January storms and could plug a culvert located downstream. The fence was protecting the culvert that, if it plugs, would cause little damage that would be limited to clean up. The fence could be replaced with a pipe trash rack.

Emerald Bay, North - Sandbags should be replaced at the following residences to provide protection from flood waters: 911 Shamrock, 1423 to 1425 Knockadoon (2 bags high/1 wide), 1005 Knockadoon (2 bags high across driveway, 1 high across curb).

Sandbags should be installed around any lots that are under construction or vacant to prevent runoff from contributing sediment and debris to the drainage system.

Windsor Drive - Residential sandbags should be replaced to prevent damage to the structures.

Pinecrest Drive - Residential sandbags should be replaced at the following addresses: 365 through 395, 401, and 407. Sandbags have been replaced by the Fire Department in the Open Space Reserve area.

Irvine Cove Burned Area - Map 14

* Specific areas:

The silt fence installed at the northeast boundary of the residential area is in good condition and may remain in place. The fence should be inspected regularly and maintained as needed.

Irvine Cove Crest Road - The sediment basin located east of the road should be cleaned out, enlarged to the east and a grouted rock inlet structure added. The sandbags placed across the outlet structure should be removed. They are causing the drop structure to plug and they could fail in the event of heavy debris flows. Sandbags should be installed across driveways and curbs at homes west of Pacific Coast Hwy., downstream of canyon (102 Irvine Cove Dr. and 2501 Monaco). The series of straw bale/sandbag check dams located in the channel above the sediment basin should be removed. Some of these dams have failed while others have deteriorated and headcutting has occurred, increasing the chances of failure of the remaining dams.

El Moro Burned Area - Map 15

* Specific areas:

The temporary trash rack, installed in El Moro Canyon on California State Park land, failed in the January storms. A headcut developed at the Pacific Coast Highway crossing, eroding upstream to the structure in a wedge shape. The cut was up to ten feet deep at the structure, undermining the rack, and causing failure. The State Park agency has requested that the County remove the remains of the structure. Grade stabilization structures may be installed to prevent future headcutting in the channel but a hydraulic and hydrologic study should be conducted before anything is installed in the channel.

Straw bales originally placed adjacent to the stream corridor have been removed and new mobile homes have been installed. Straw bales need not be replaced.

Sandbags at the north and east ends of the trailer park should be replaced, to divert water flow away from homes.

Crystal Cove Burned Area - Map C

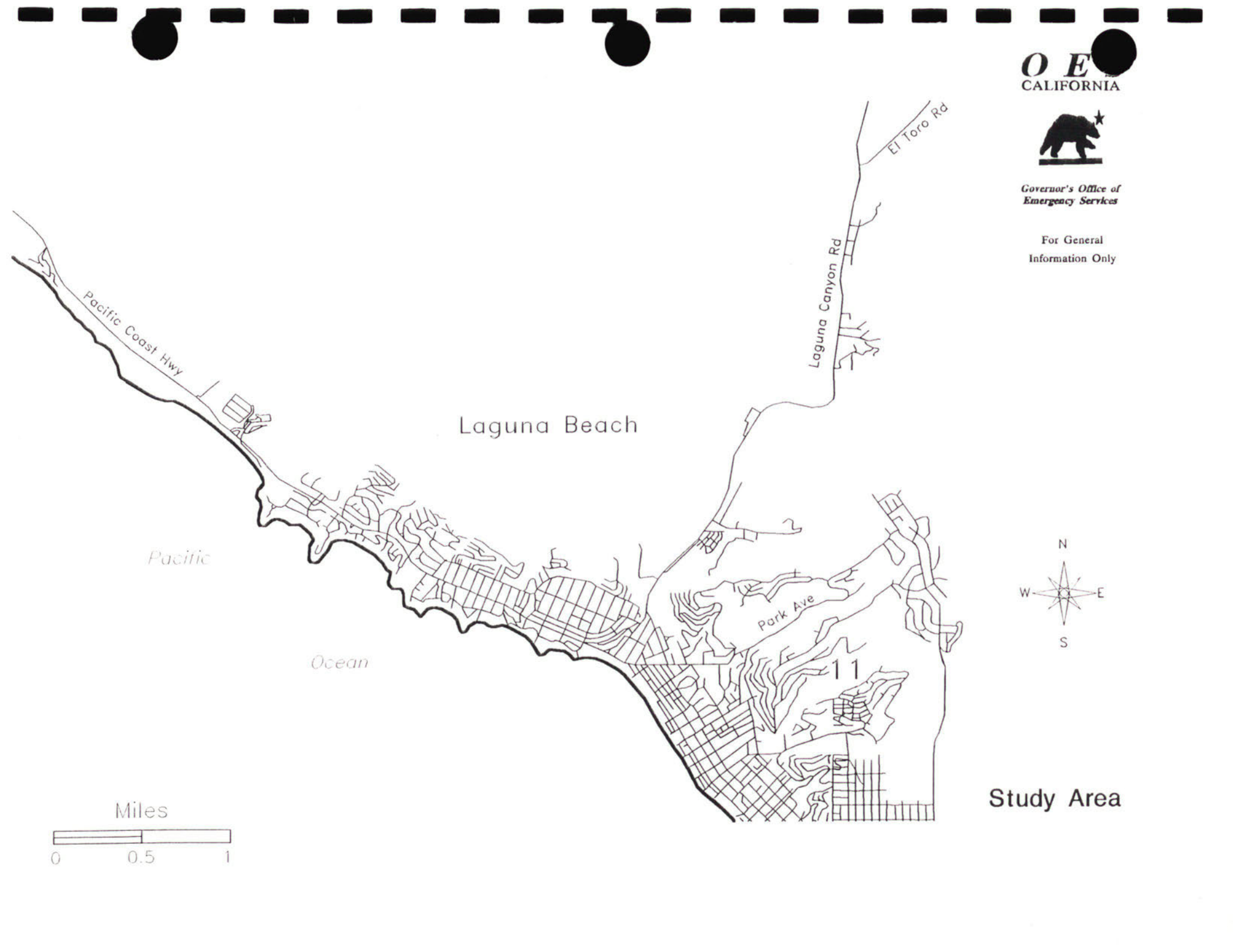
This area was heavily damaged by the January 1995 storms. Flows through the channel eroded the side slopes, undercutting five homes, washing out a foot bridge, and undermining the edge of the Pacific Coast Highway expansion. The vehicle bridge has also been undermined and may be in danger of failure from future storm events. Channel side slopes need to be stabilized and protected from future flows and both bridges need to be strengthened and protected. The California State Park agency is aware of the damage and is addressing the problem.

APPENDIX A

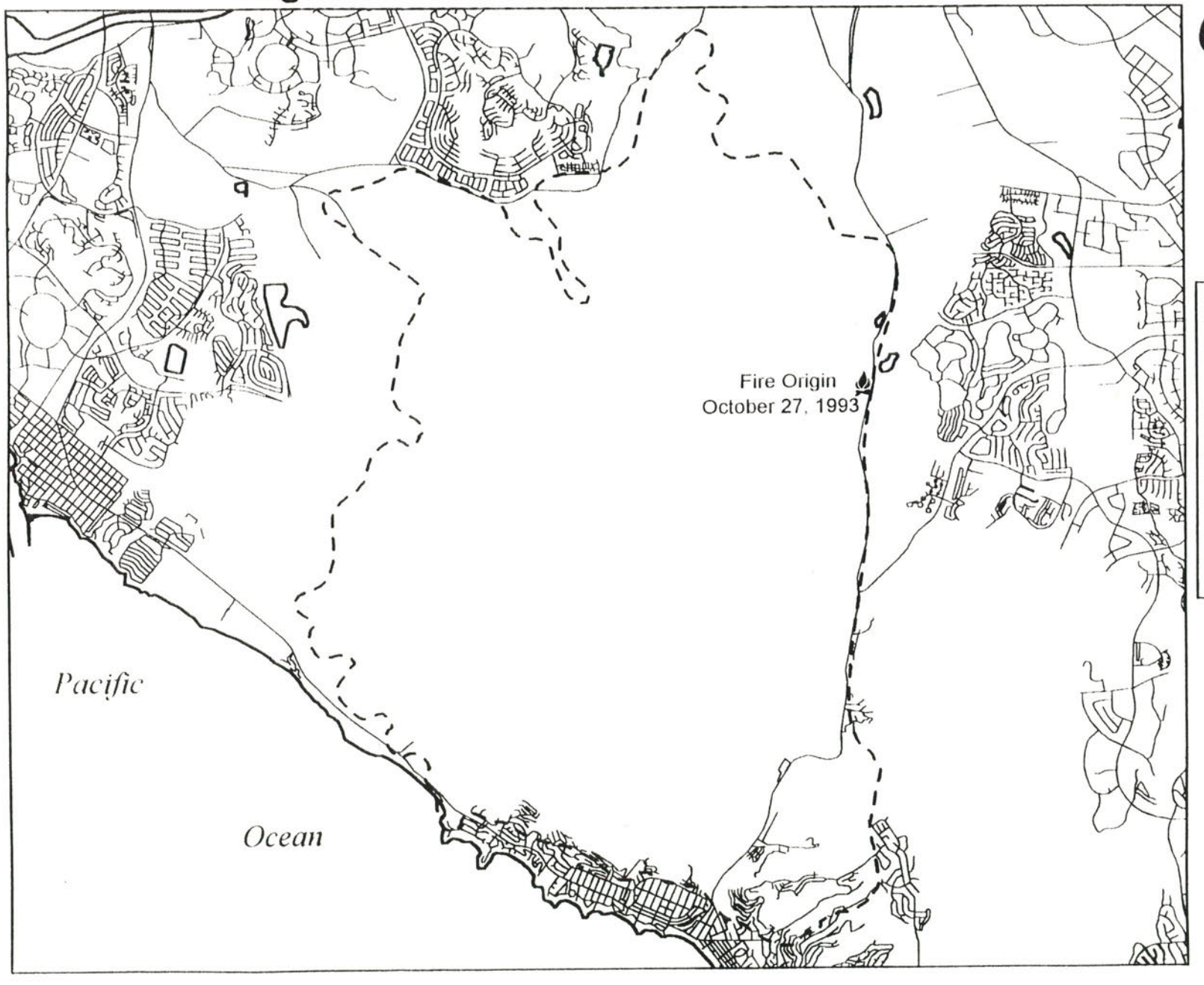
FIRE PERIMETER MAP

and

STUDY AREA MAP


O E
CALIFORNIA
Governor's Office of Emergency Services
For General Information Only
El Toro Rd
Laguna Canyon Rd
Pacific Coast Hwy
Laguna Beach
Pacific
Ocean
Park Ave
11
N
W
E
S
Miles
0
0.5
1
Study Area

Laguna Beach Fire Perimeter October 1993



OES
California

Governor's Office of Emergency Services

LEGEND

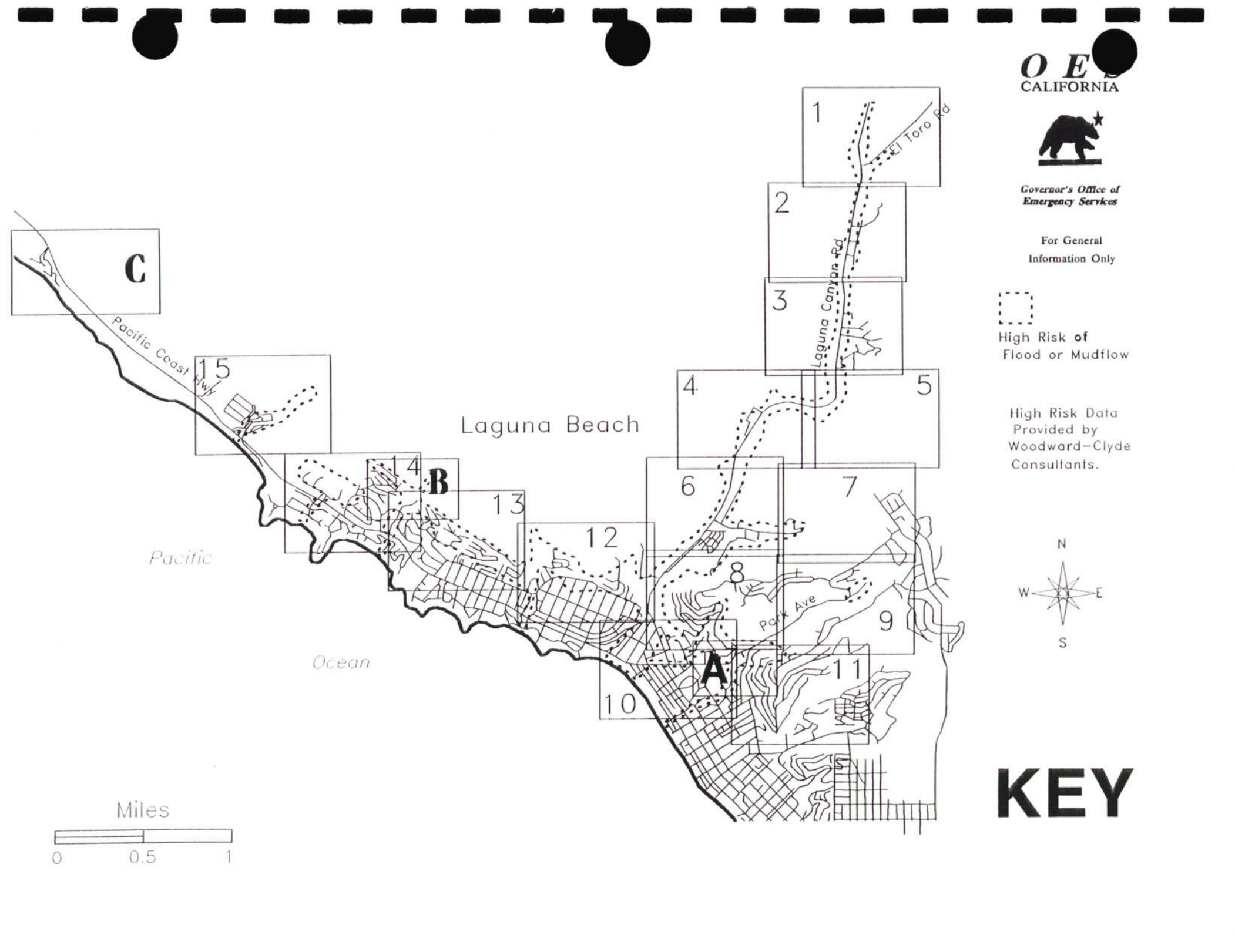
- Fire Perimeter
- Streets
- Shorelines

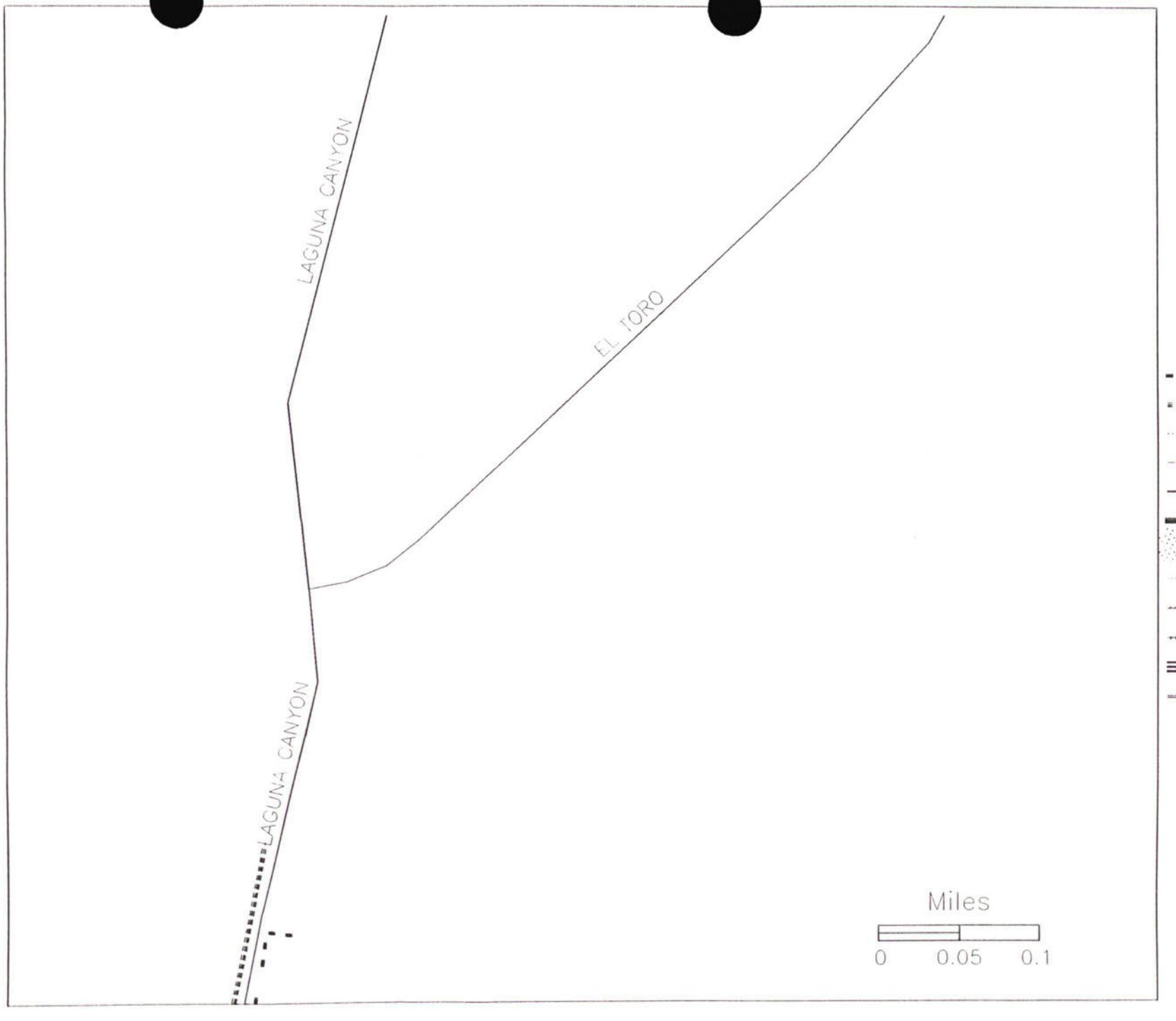
Miles

0 .5 1

Fire Perimeter From BLM
Overflight Nov. 5, 1993

N
W E
S


OES
CALIFORNIA
Governor's Office of Emergency Services
For General Information Only
High Risk of Flood or Mudflow
High Risk Data Provided by Woodward–Clyde Consultants.
N
W
E
S
KEY
Laguna Beach
Pacific
Ocean
Pacific Coast Hwy
El Toro Rd
Laguna Canyon Rd
Park Ave
A
B
C
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Miles
0
0.5
1



CALIFORNIA

Governor's Office of Emergency Services

For General Information Only

Legend

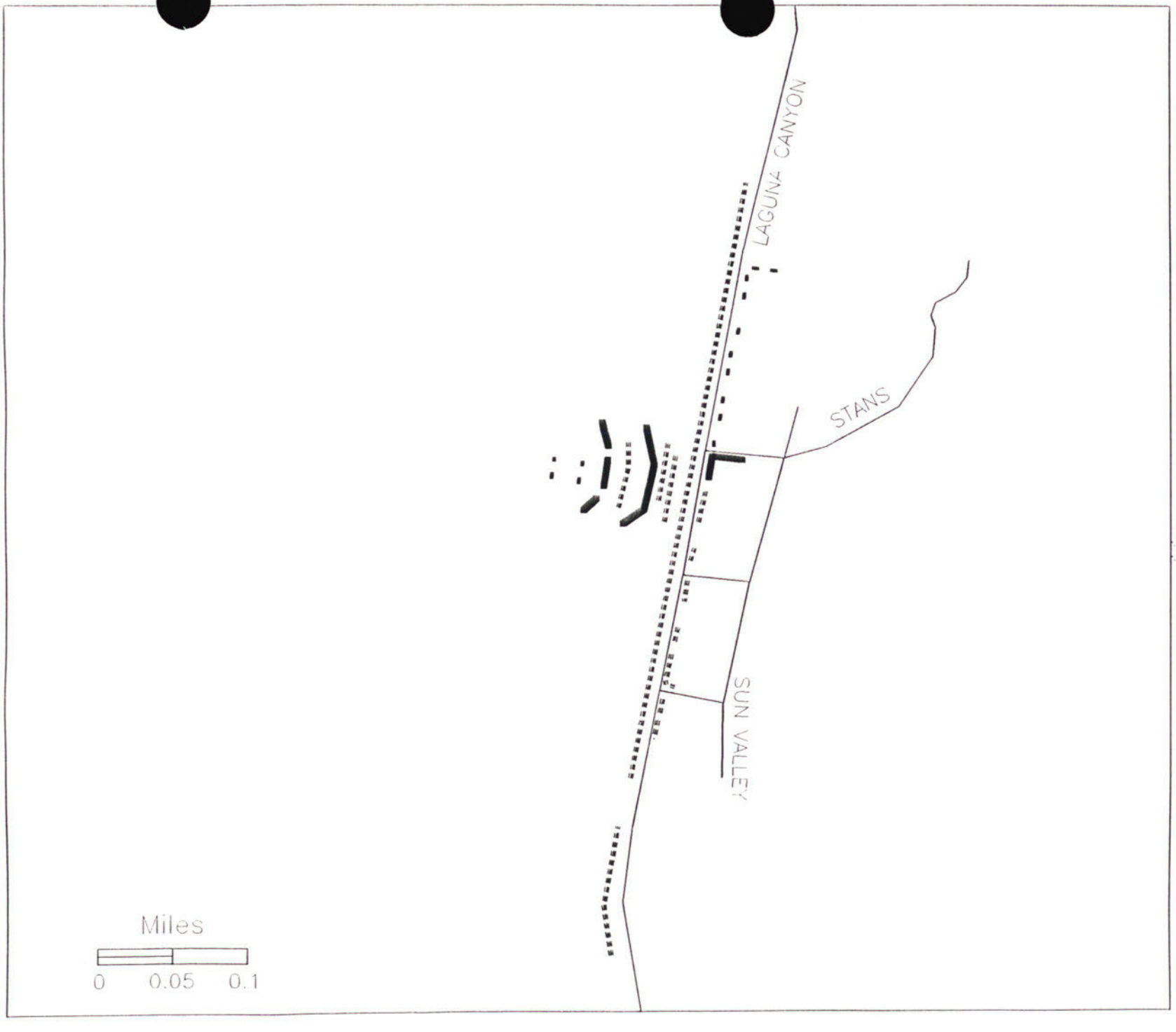
- Sandbags
- Haybales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- K – Rail
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Trash Rack
- Other

N

W E

S

1



OES
CALIFORNIA

Governor's Office of Emergency Services

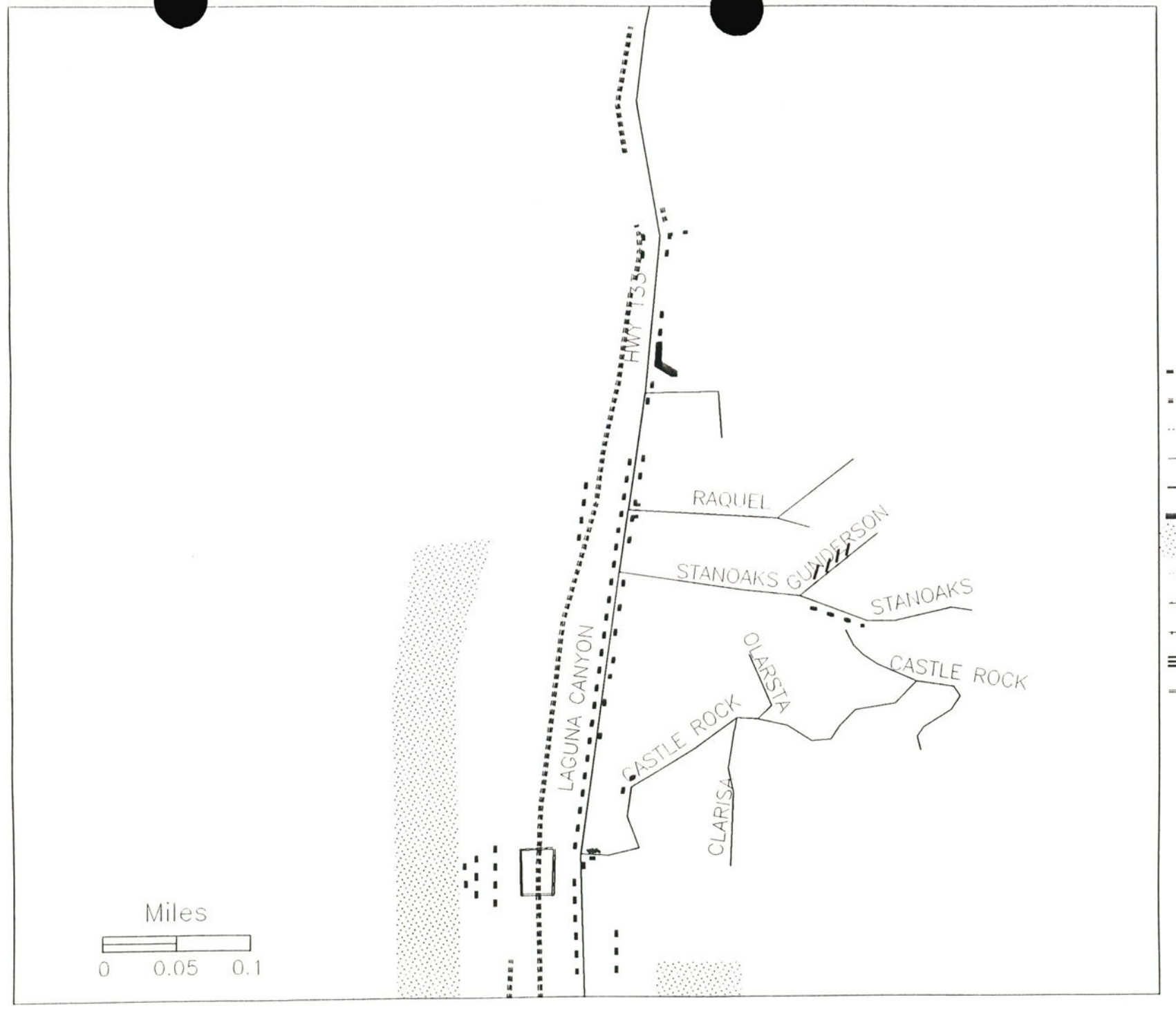
For General Information Only

Legend

- Sandbags
- Haybales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- K - Rail
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Trash Rack
- Other

N
W E
S

2



OES CALIFORNIA

Governor's Office of Emergency Services

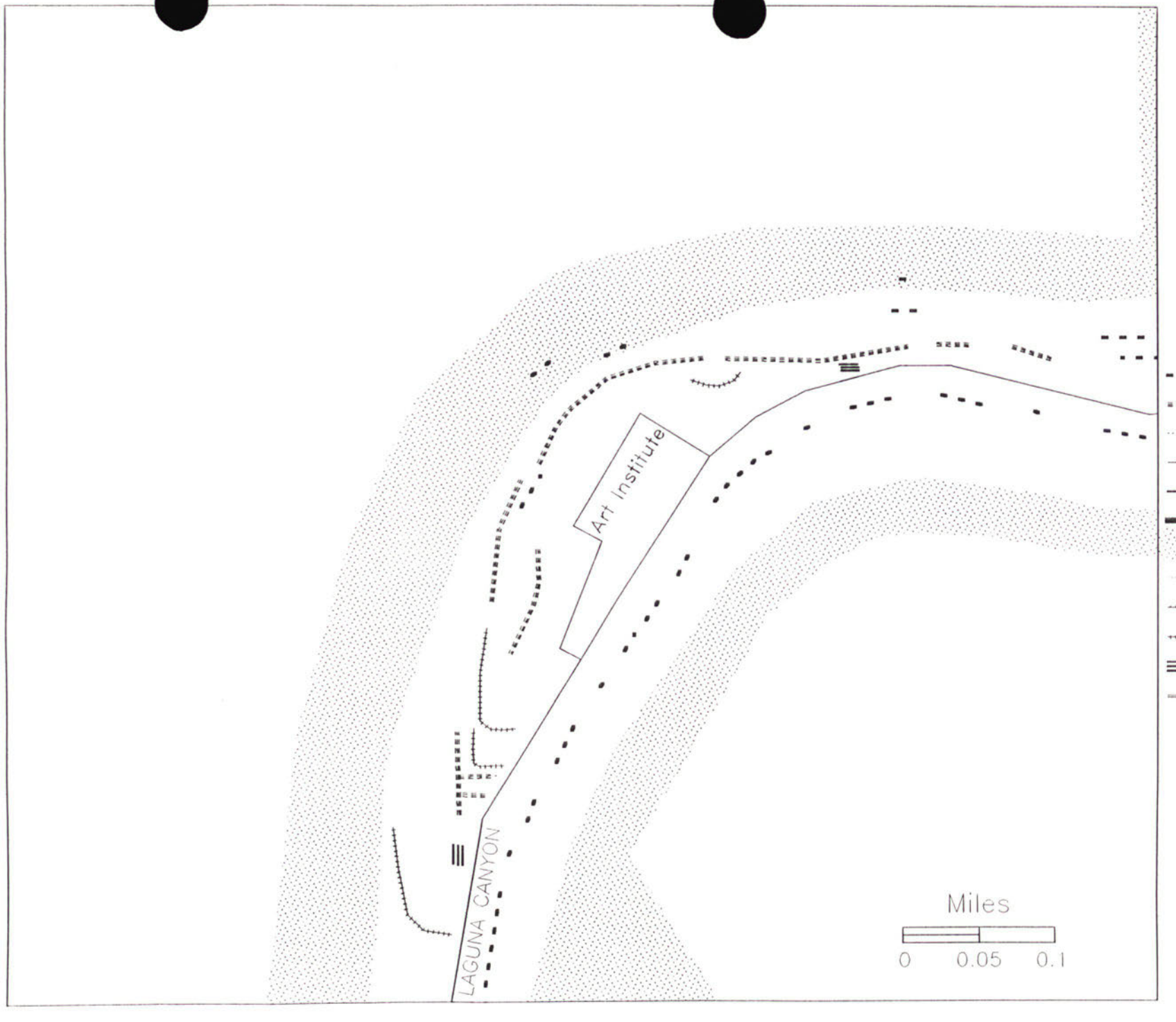
For General Information Only

Legend

- Sandbags
- Haybales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- K - Rail
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Trash Rack
- Other

N
W E
S

3



OES
CALIFORNIA

Governor's Office of Emergency Services

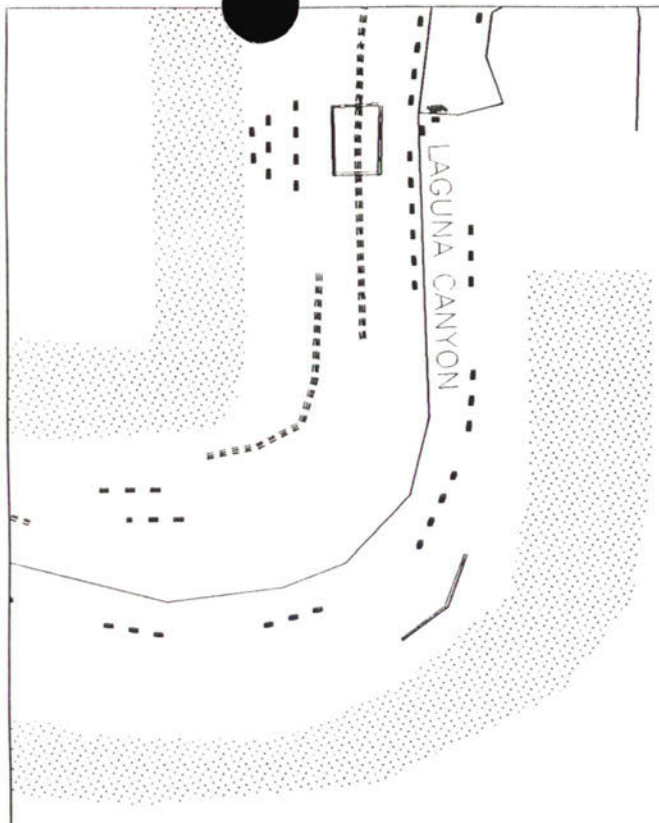
For General Information Only

Legend

- Sandbags
- Haybales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- K - Rail
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Trash Rack
- Other

N
W E
S

4



Miles

0 0.05 0.1

OES
CALIFORNIA

Governor's Office of Emergency Services

For General Information Only

Legend

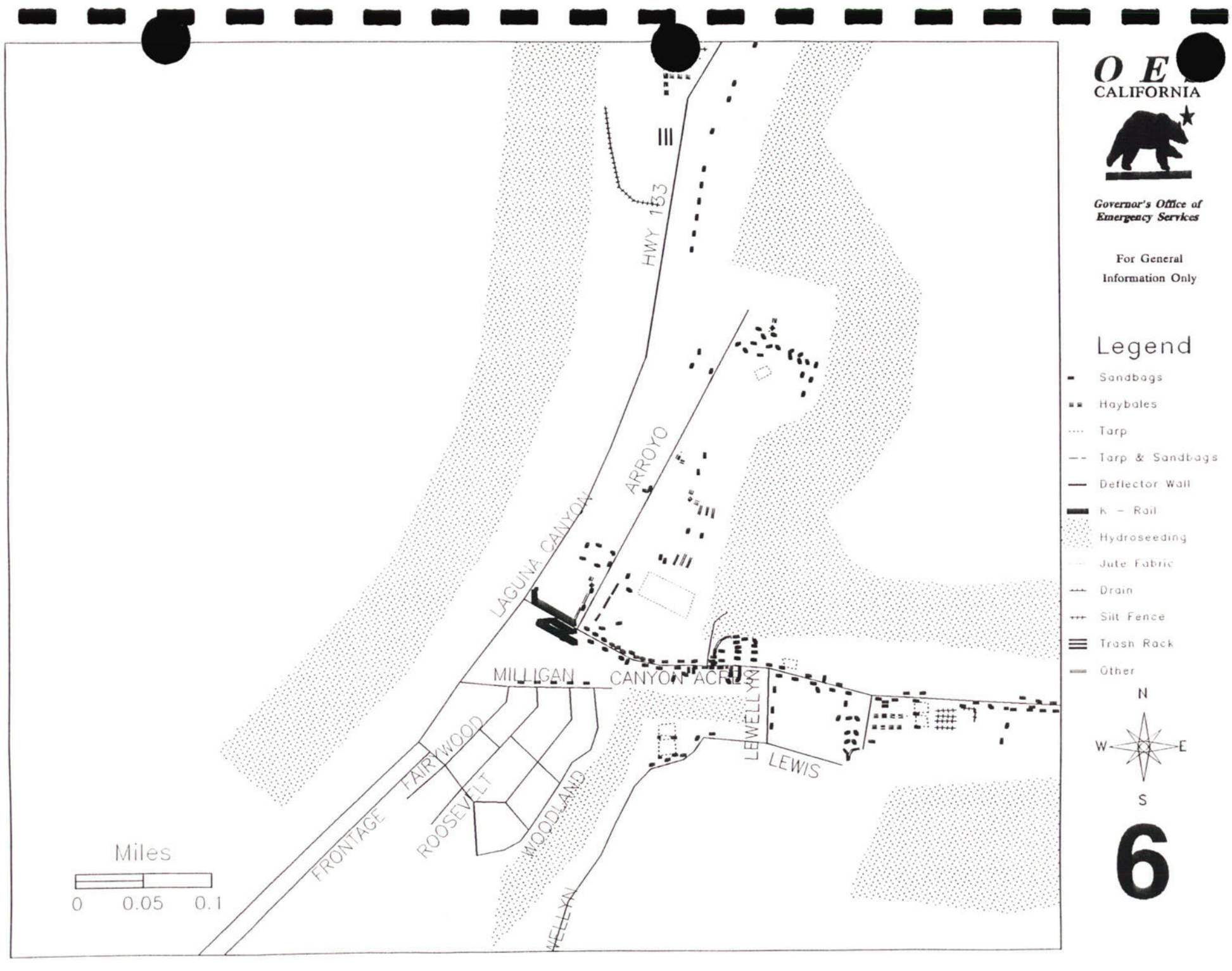
- Sandbags
- Haybales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- K - Rail
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Trash Rack
- Other

N

W E

S

5



OES CALIFORNIA

Governor's Office of Emergency Services

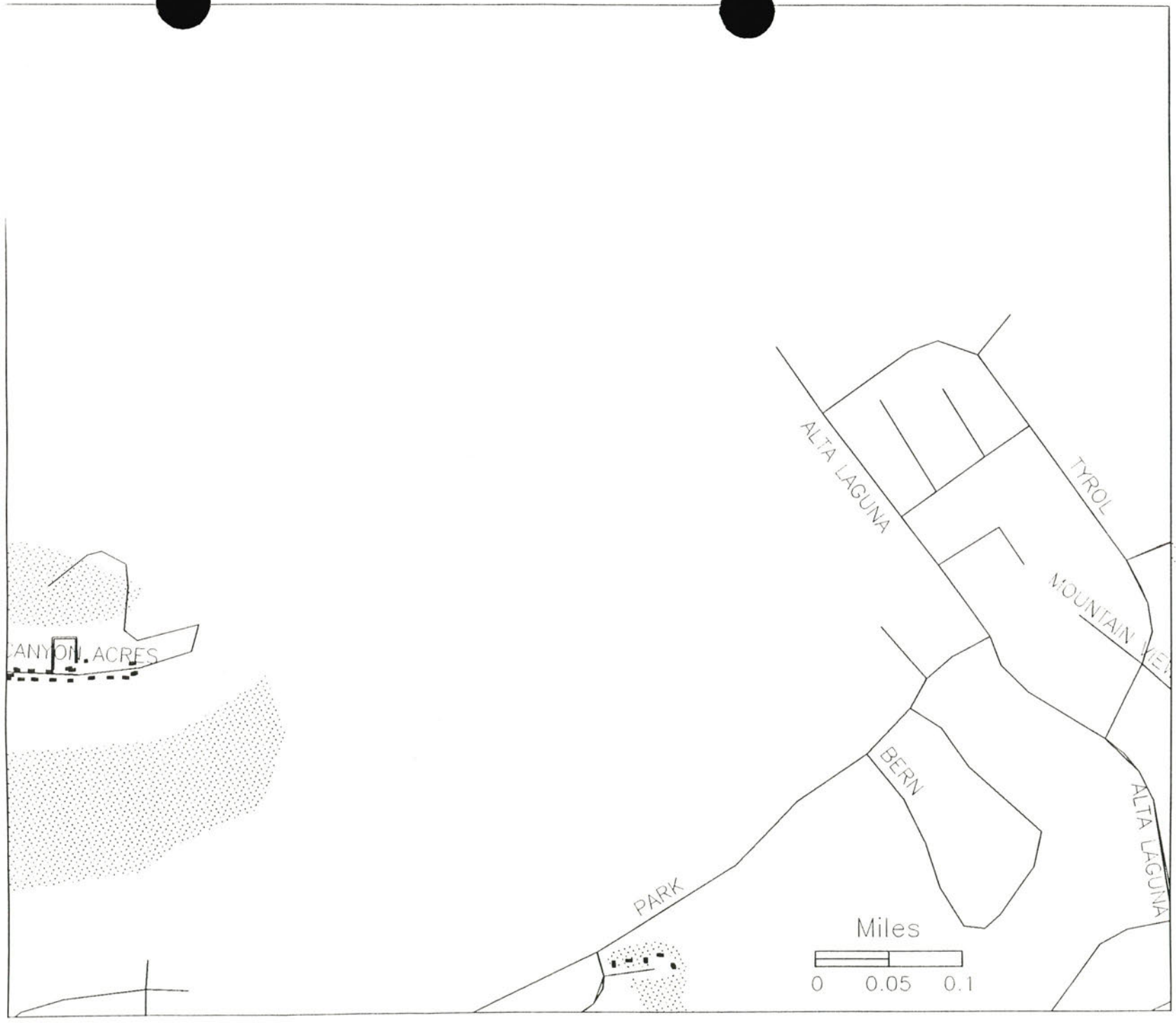
For General Information Only

Legend

- Sandbags
- Haybales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- K - Rail
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Trash Rack
- Other

N
W E
S

6



OES
CALIFORNIA

Governor's Office of Emergency Services

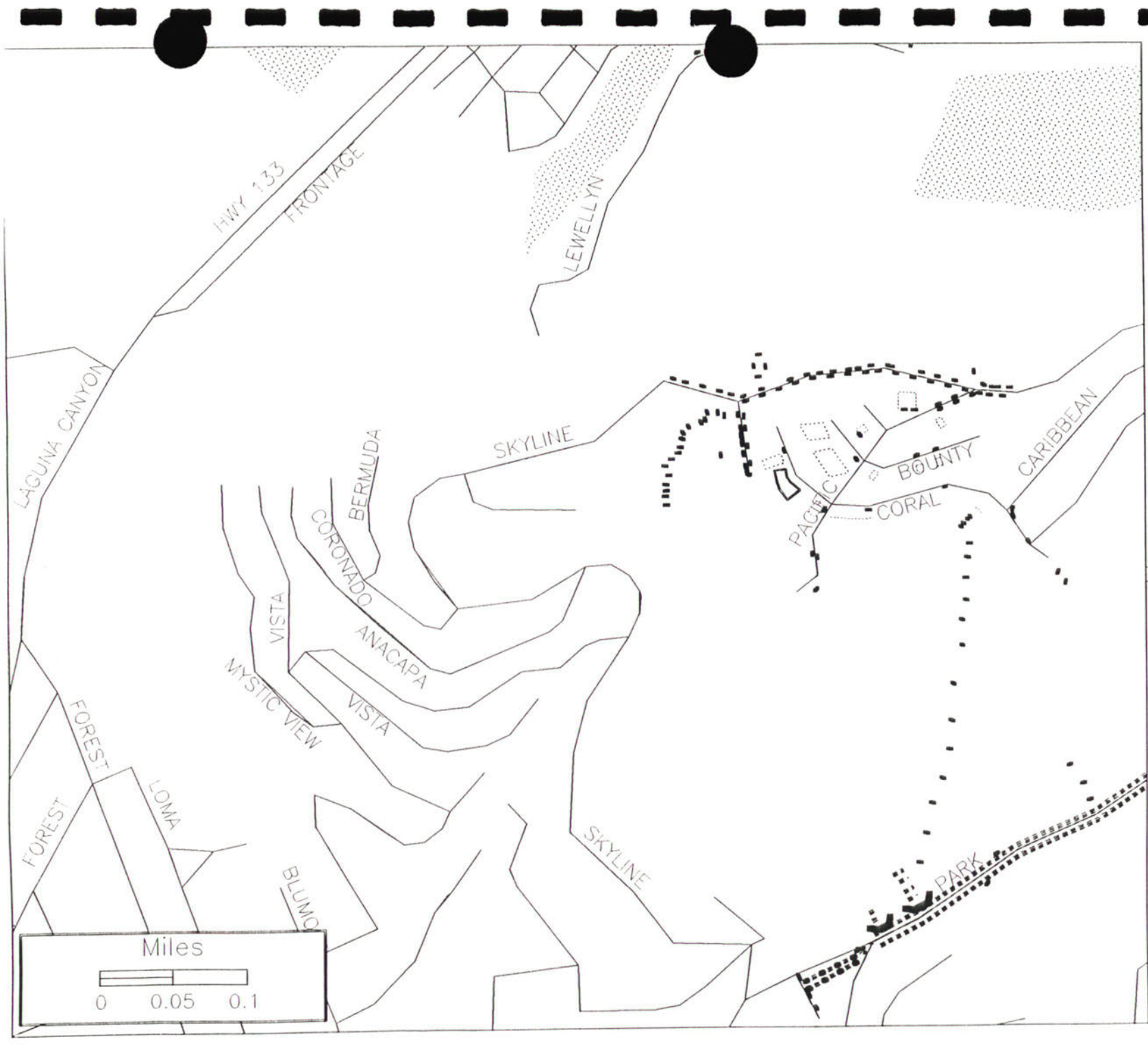
For General Information Only

Legend

- Sandbags
- Haybales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- K - Rail
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Trash Rack
- Other

N
W E
S

7



OES
CALIFORNIA

Governor's Office of Emergency Services

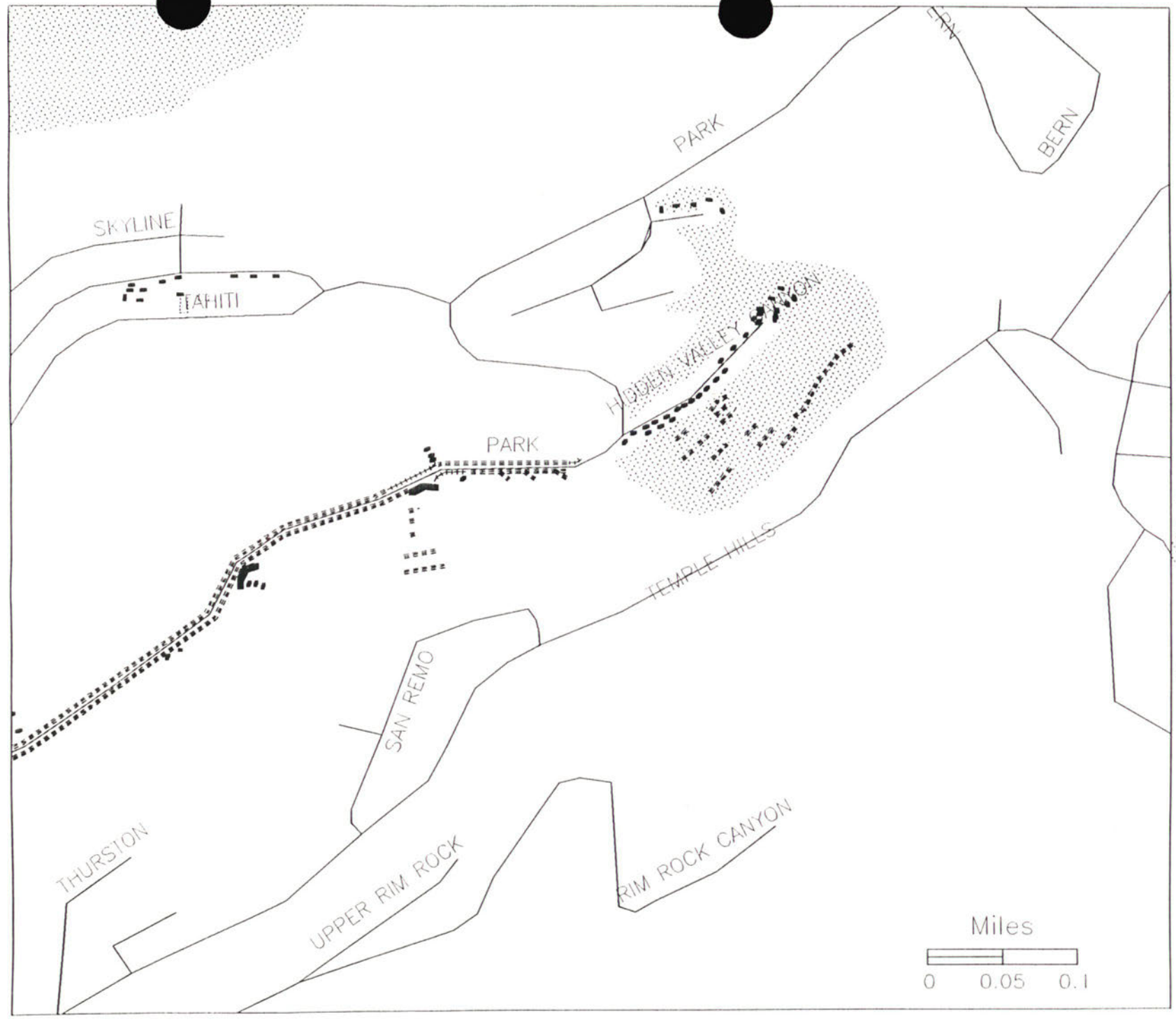
For General Information Only

Legend

- Sandbags
- Haybales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- K - Rail
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Trash Rack
- Other

N
W E
S

8



OES
CALIFORNIA

Governor's Office of Emergency Services

For General Information Only

Legend

- Sandbags
- Haybales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- k - Rail
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Trash Rack
- Other

N
W E
S

9

OES
CALIFORNIA

Governor's Office of Emergency Services

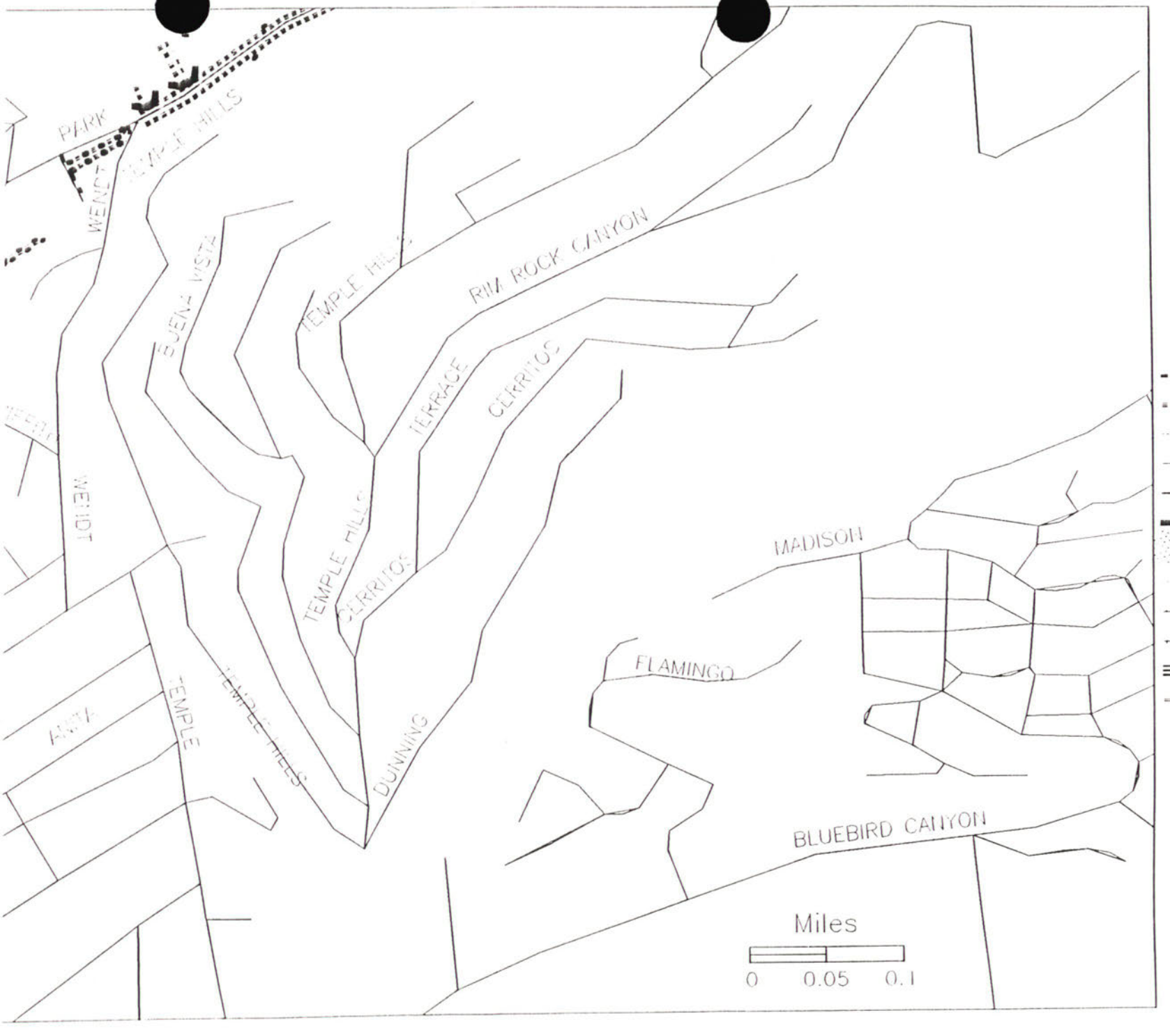
For General Information Only

Legend

- Sandbags
- Haybales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- K-Rail
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Trash Rack
- Other

N
W E
S

10



OES
CALIFORNIA

Governor's Office of Emergency Services

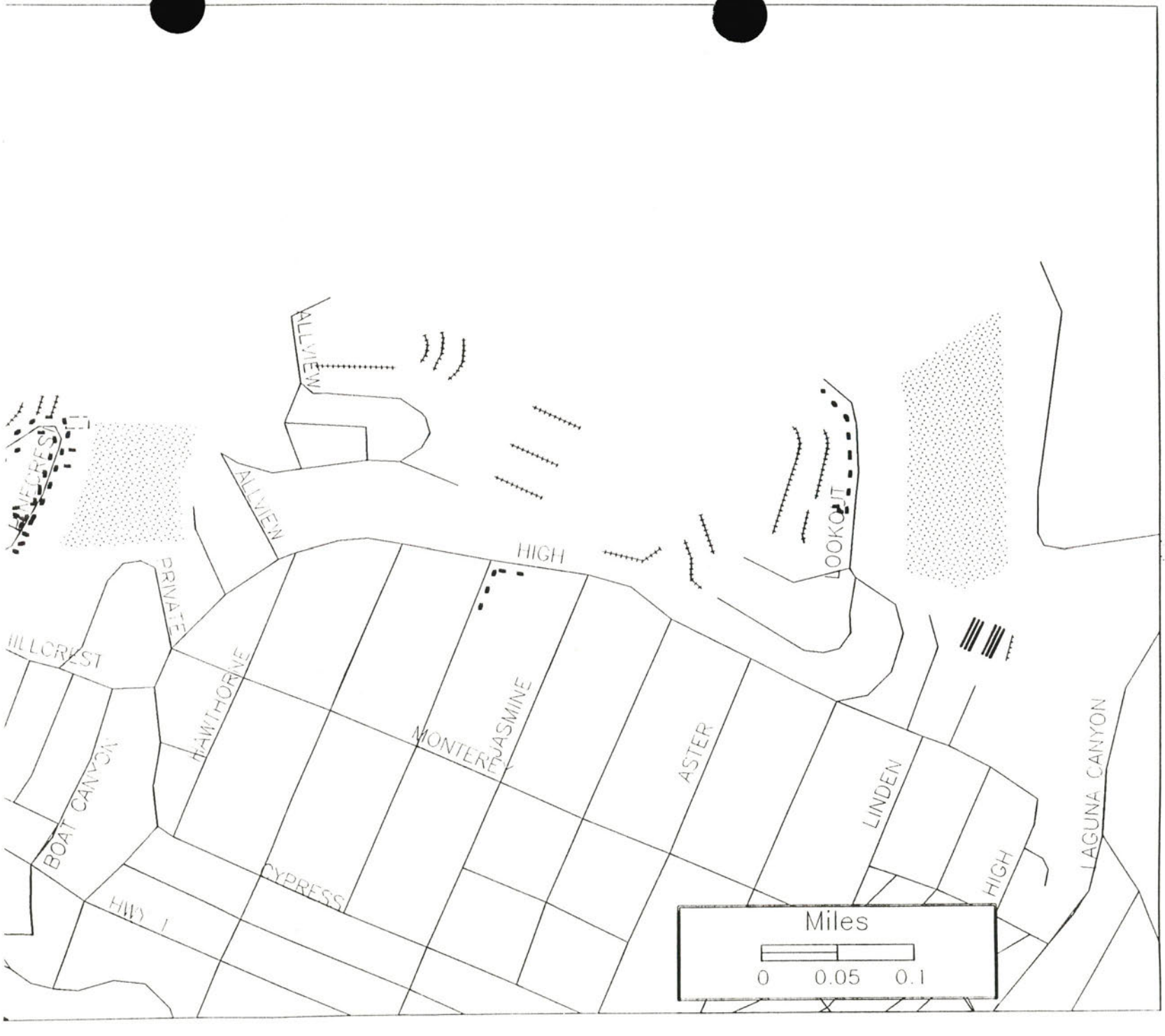
For General Information Only

Legend

- Sandbags
- Haybales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- Berm - Rail
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Trash Rack
- Other

N
W E
S

11



OES CALIFORNIA

Governor's Office of Emergency Services

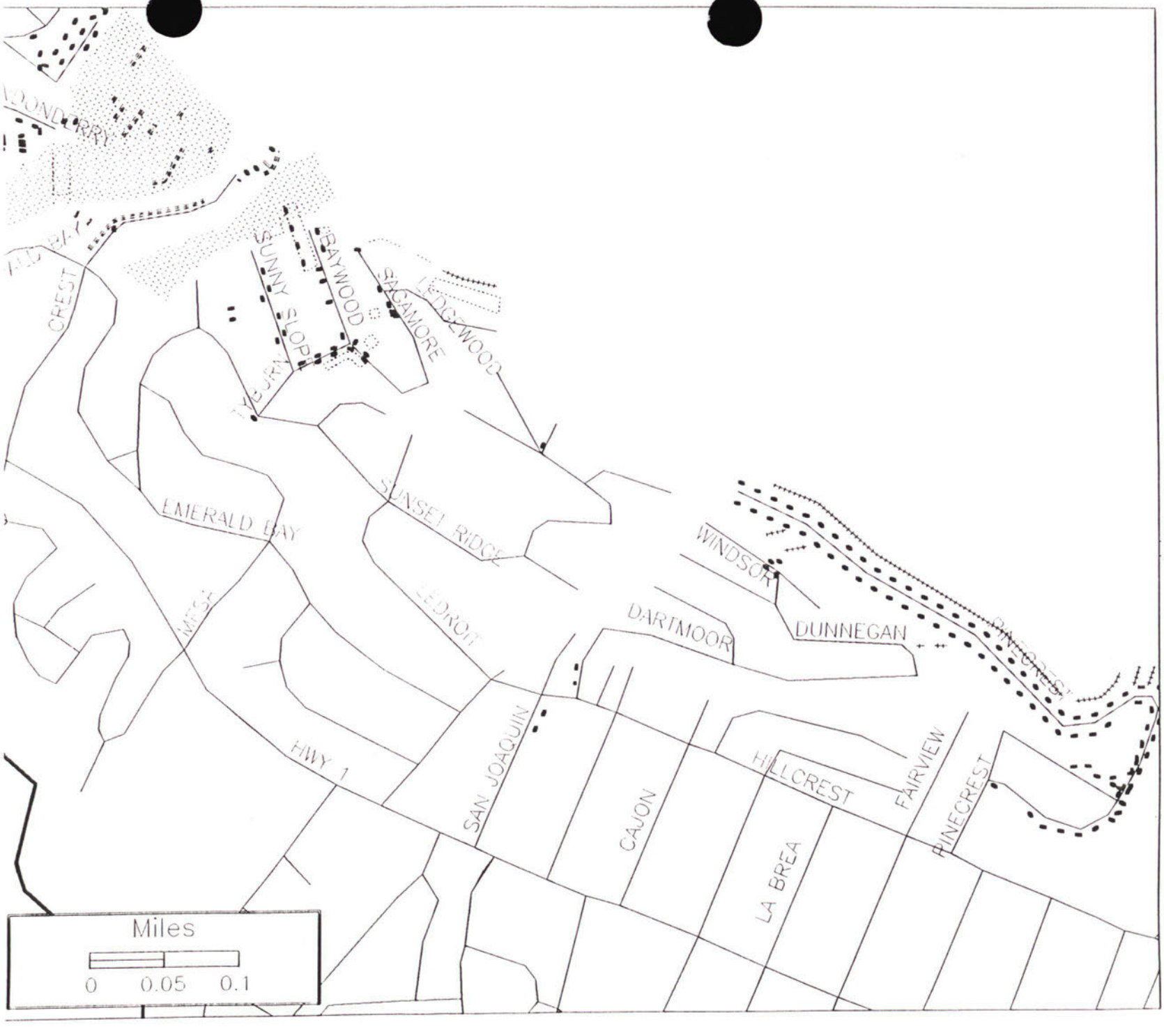
For General Information Only

Legend

- Sandbags
- Haybales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- K - Rail
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Trash Rack
- Other

N
W E
S

12



OES
CALIFORNIA

Governor's Office of Emergency Services

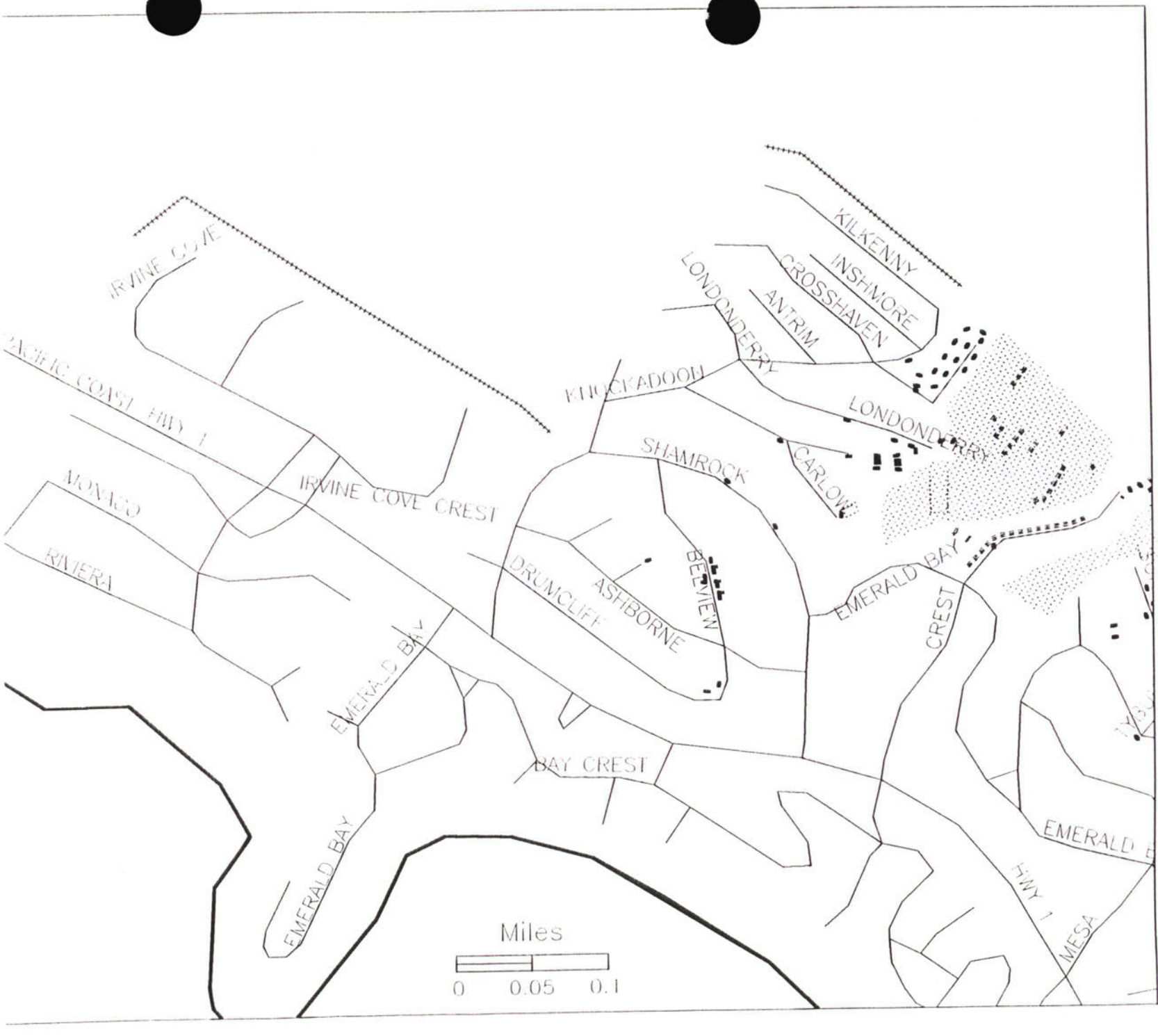
For General Information Only

Legend

- Sandbags
- Hayboles
- Tarp
- Tarp & Sandbags
- Deflector Wall
- K - Rail
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Trash Rack
- Other

N
W E
S

13



OE
CALIFORNIA

Governor's Office of Emergency Services

For General Information Only

Legend

- Sandbags
- Haybales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- K - Rail
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Trash Rack
- Other

N
W E
S

14

O E
CALIFORNIA

Governor's Office of Emergency Services

For General Information Only

Legend

- Sandbags
- Haybales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- Rail
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Trash Rack
- Other

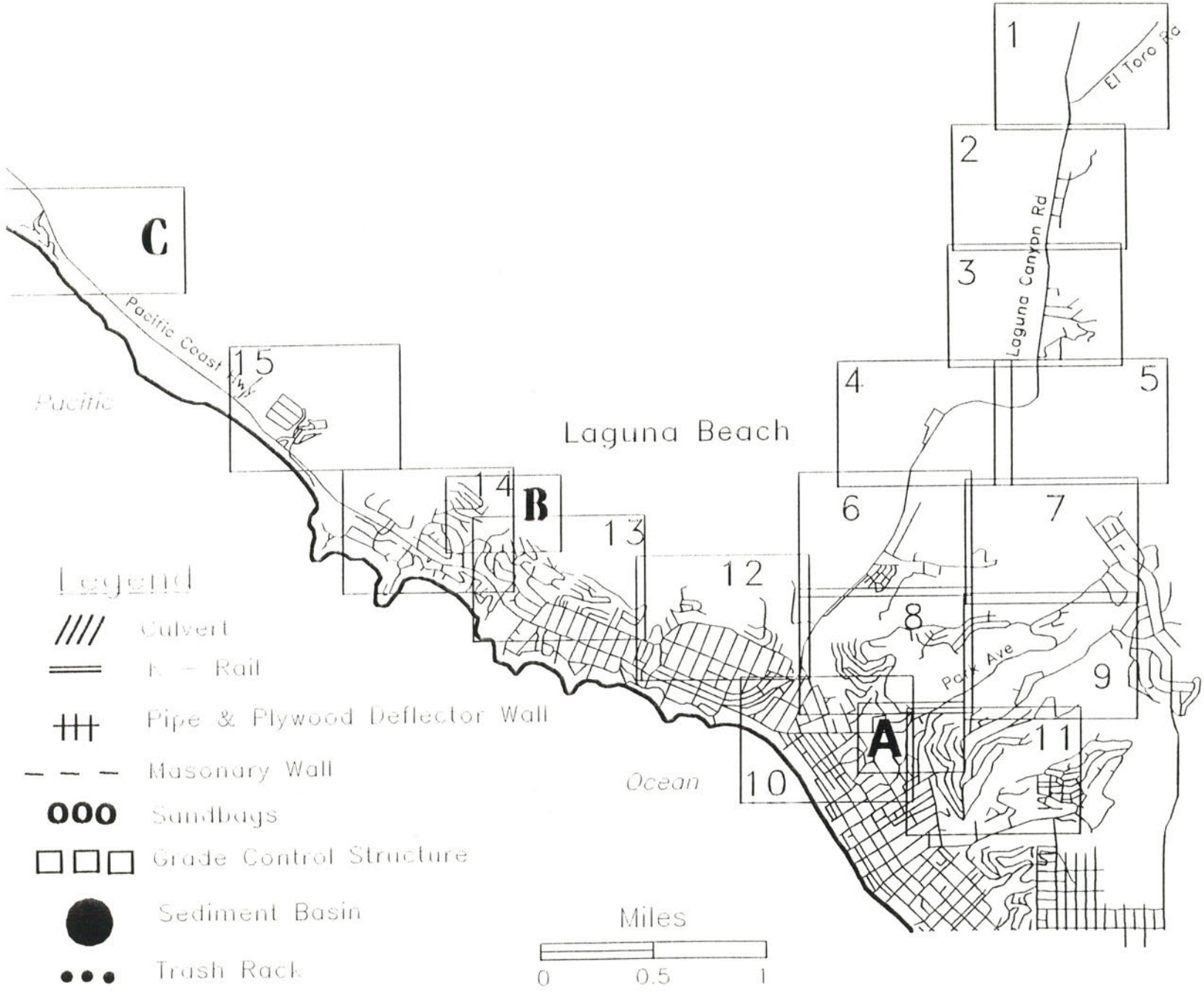
N
W E
S

Miles
0 0.05 0.1

15

APPENDIX C

MAPS OF RECOMMENDED PROTECTIVE MEASURES

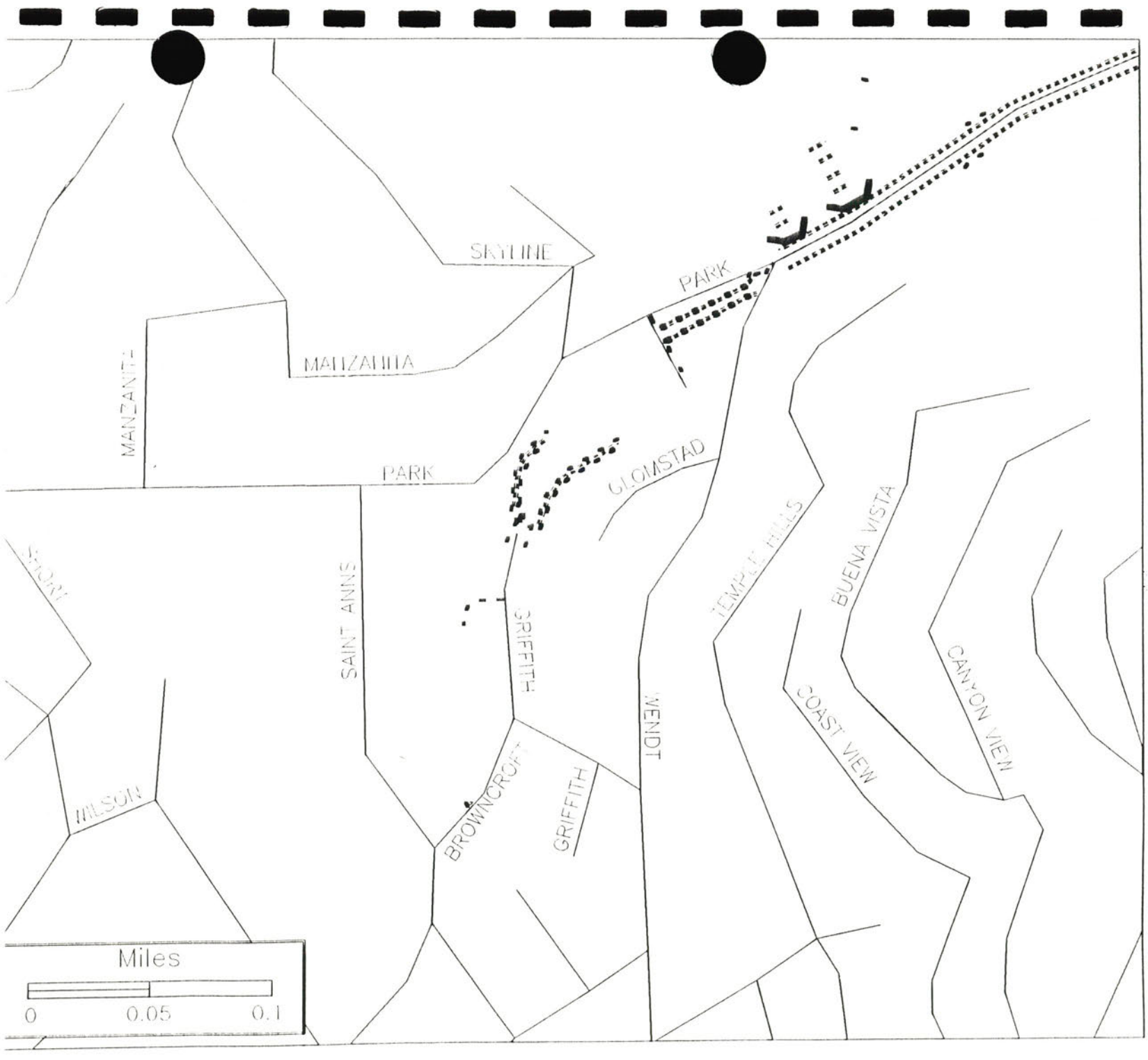


KEY

OE
CALIFORNIA

Governor's Office of Emergency Services

For General Information Only



OES
CALIFORNIA

Governor's Office of Emergency Services

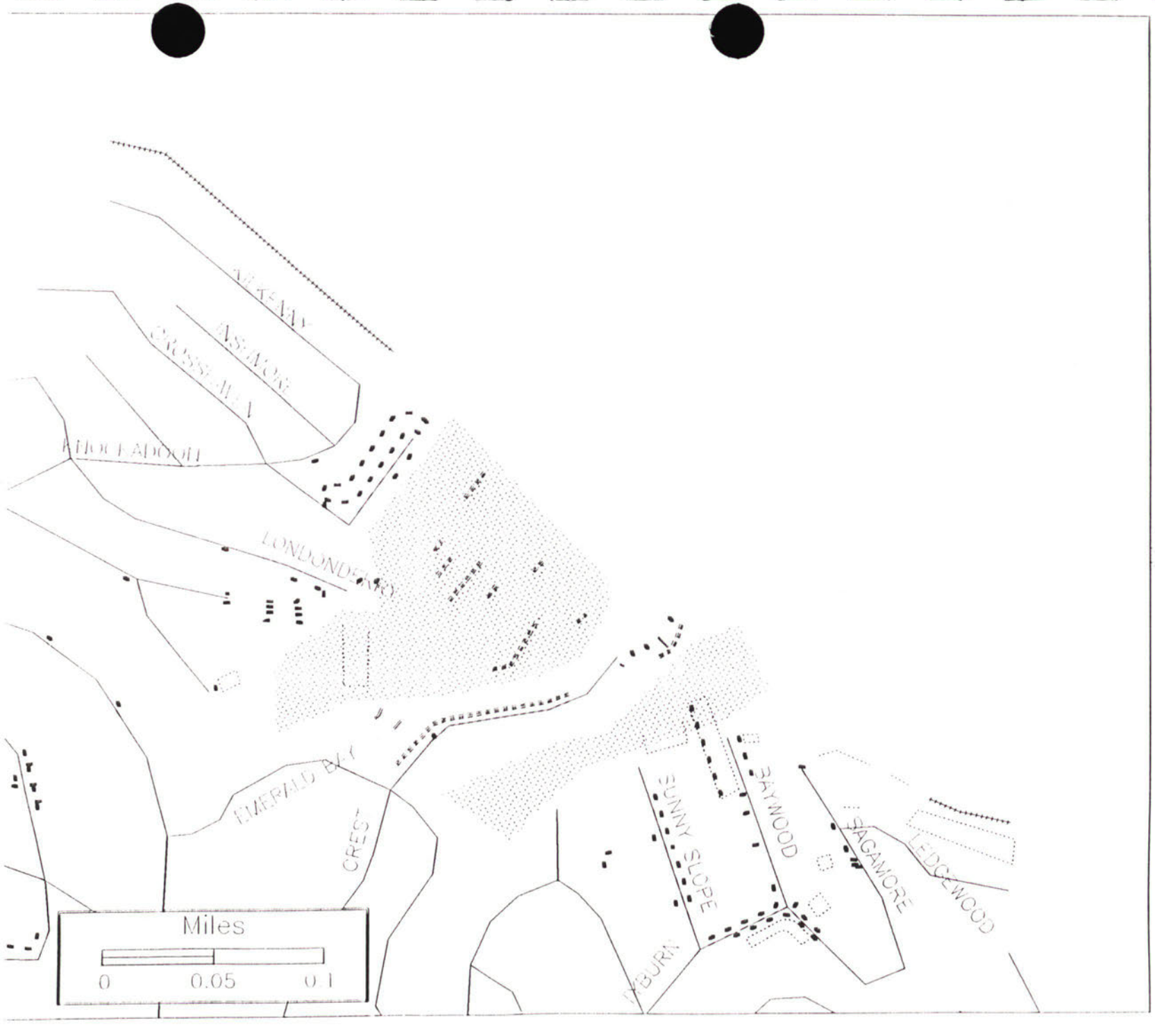
For General Information Only

Legend

- Sandbags
- Haybales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- Rail
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Trash Rack
- Other

N
W E
S

A



OES
CALIFORNIA

Governor's Office of Emergency Services

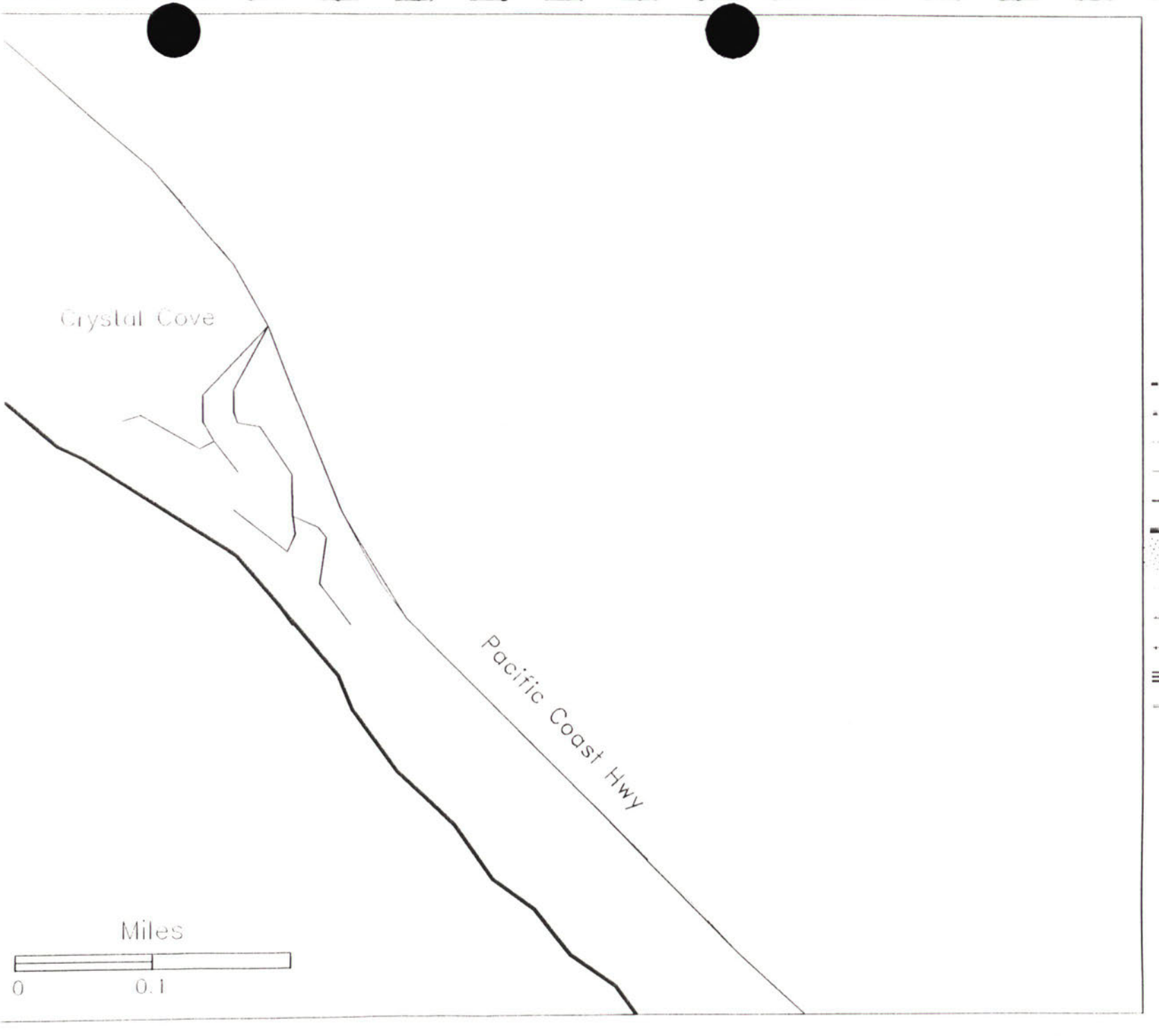
For General Information Only

Legend

- Sandbags
- Hay/Bales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- Berm
- Hydroseeding
- Jute Fabric
- Drain
- Silt Fence
- Brush Rack
- Other

N
W E
S

B



OES
CALIFORNIA

Governor's Office of Emergency Services

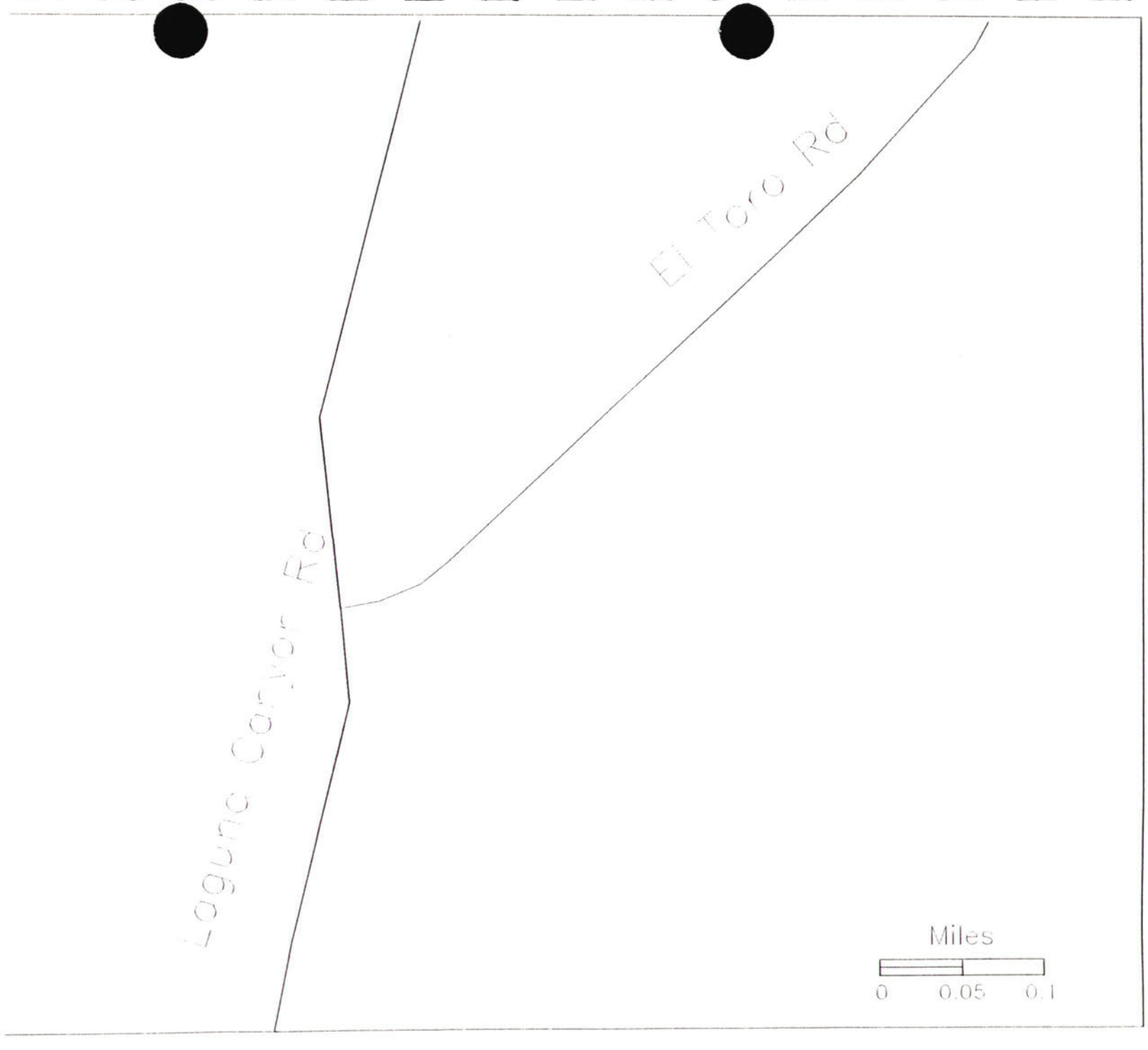
For General Information Only

Legend

- Sandbags
- Hay Bales
- Tarp
- Tarp & Sandbags
- Deflector Wall
- Berm
- Hydroseeding
- Jute Fabric
- Brush
- Silt Fence
- Trash Rack
- Other

N
W E
S

C



OES
CALIFORNIA

Governor's Office of Emergency Services

For General
Information Only

N
W
E
S

1

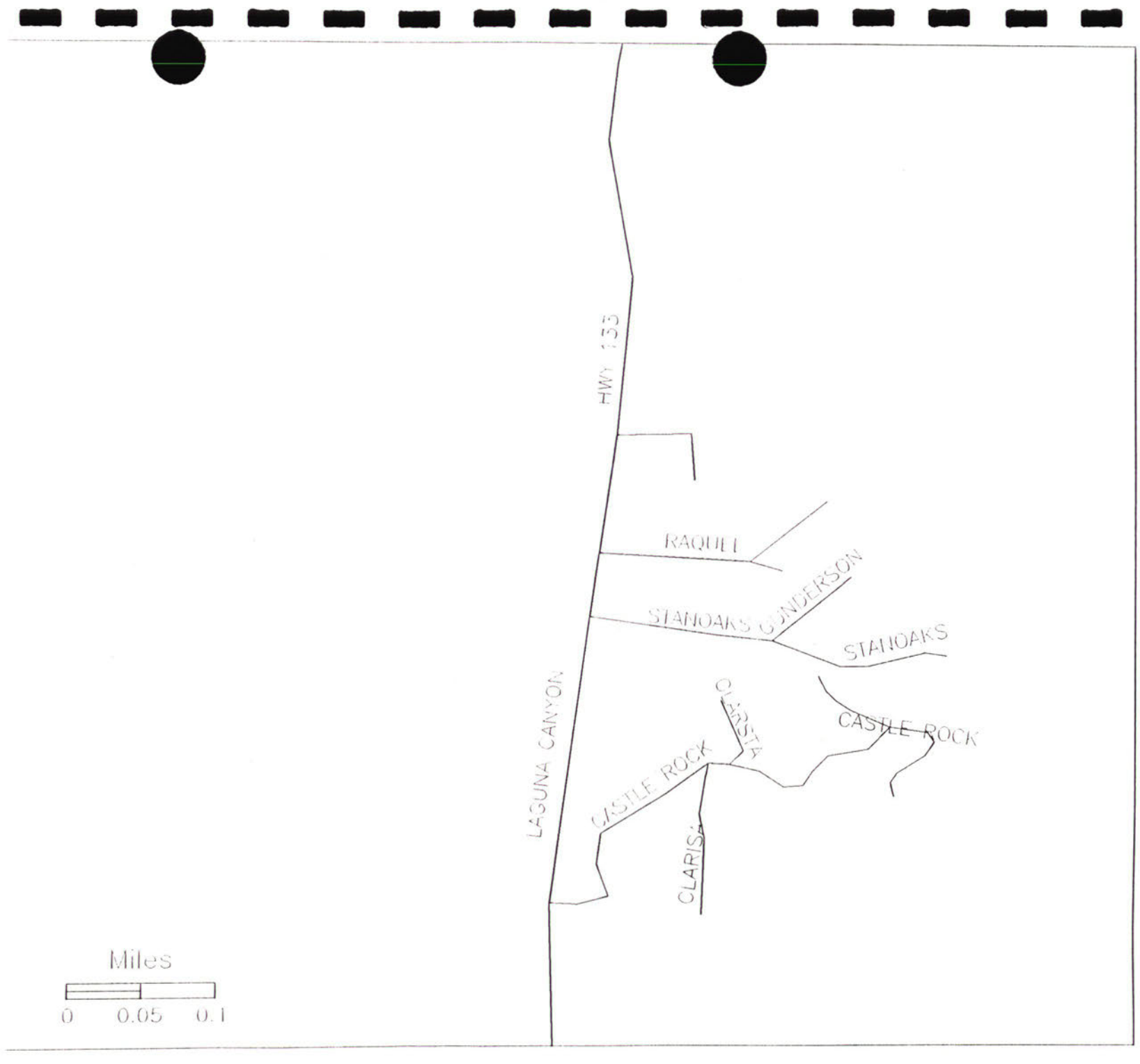
O E
CALIFORNIA

Governor's Office of Emergency Services

For General Information Only

N
W E
S

2



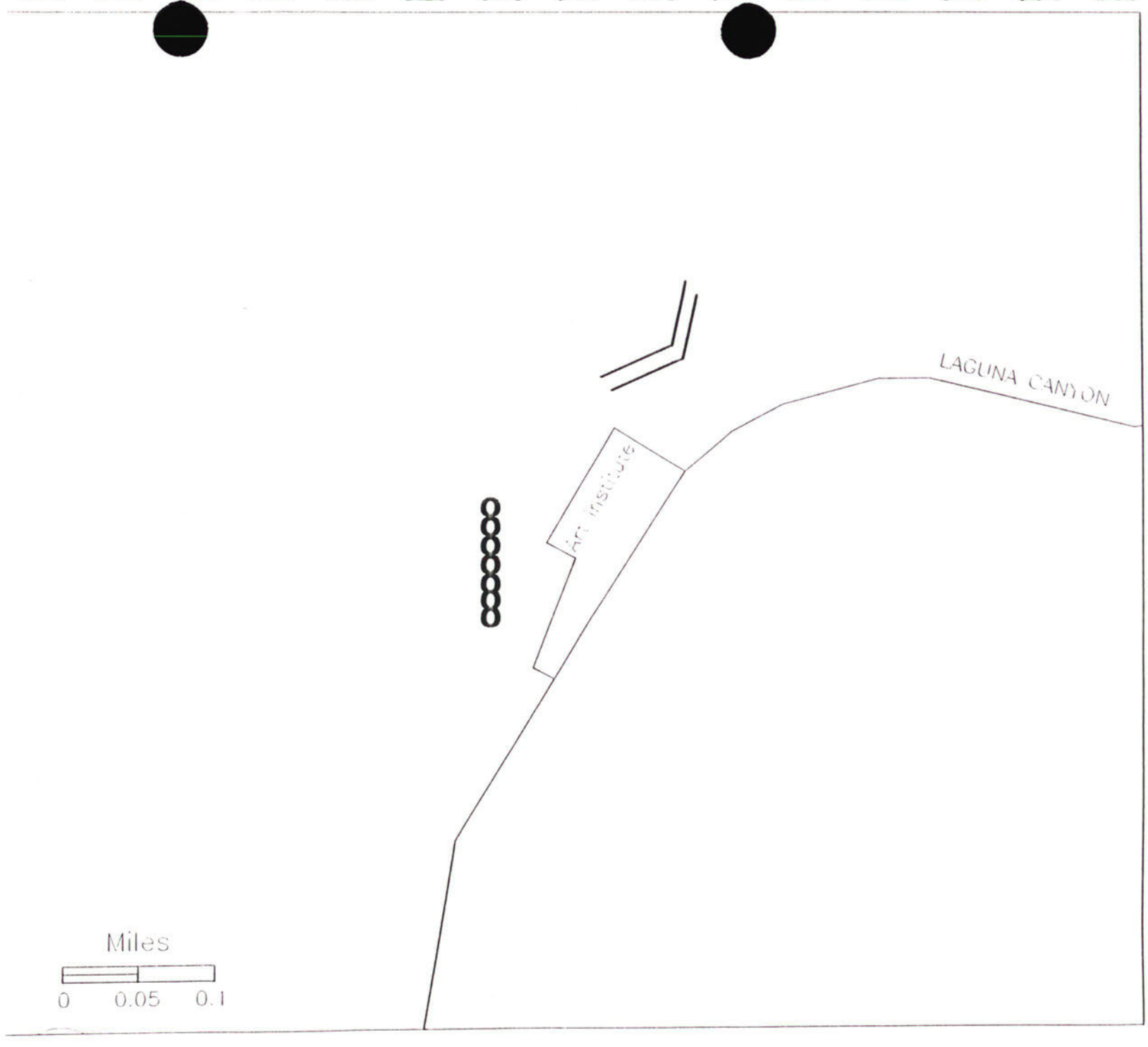
OES
CALIFORNIA

Governor's Office of Emergency Services

For General
Information Only

N
W E
S

3



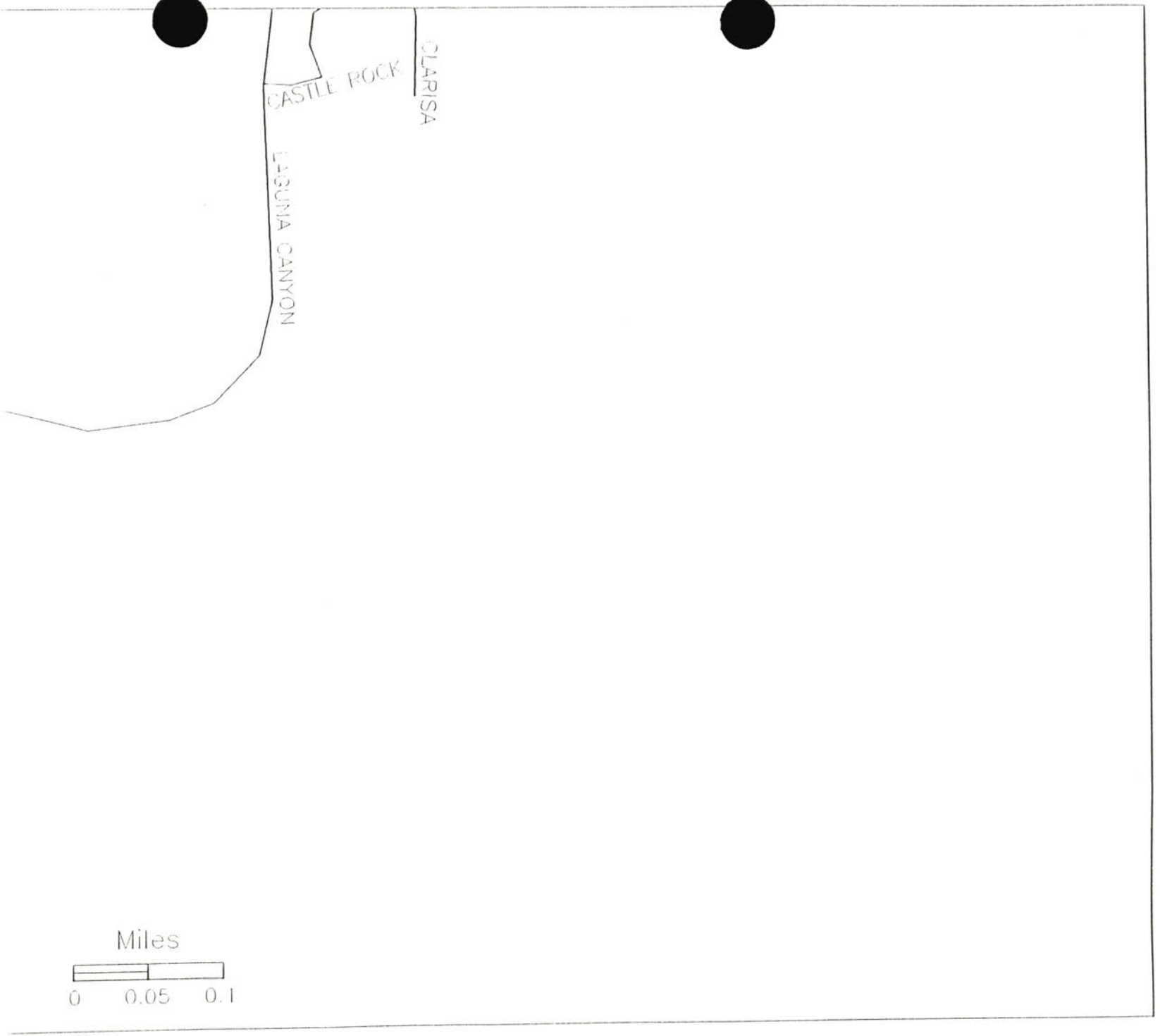
O E S
CALIFORNIA

Governor's Office of Emergency Services

For General
Information Only

N
W E
S

4



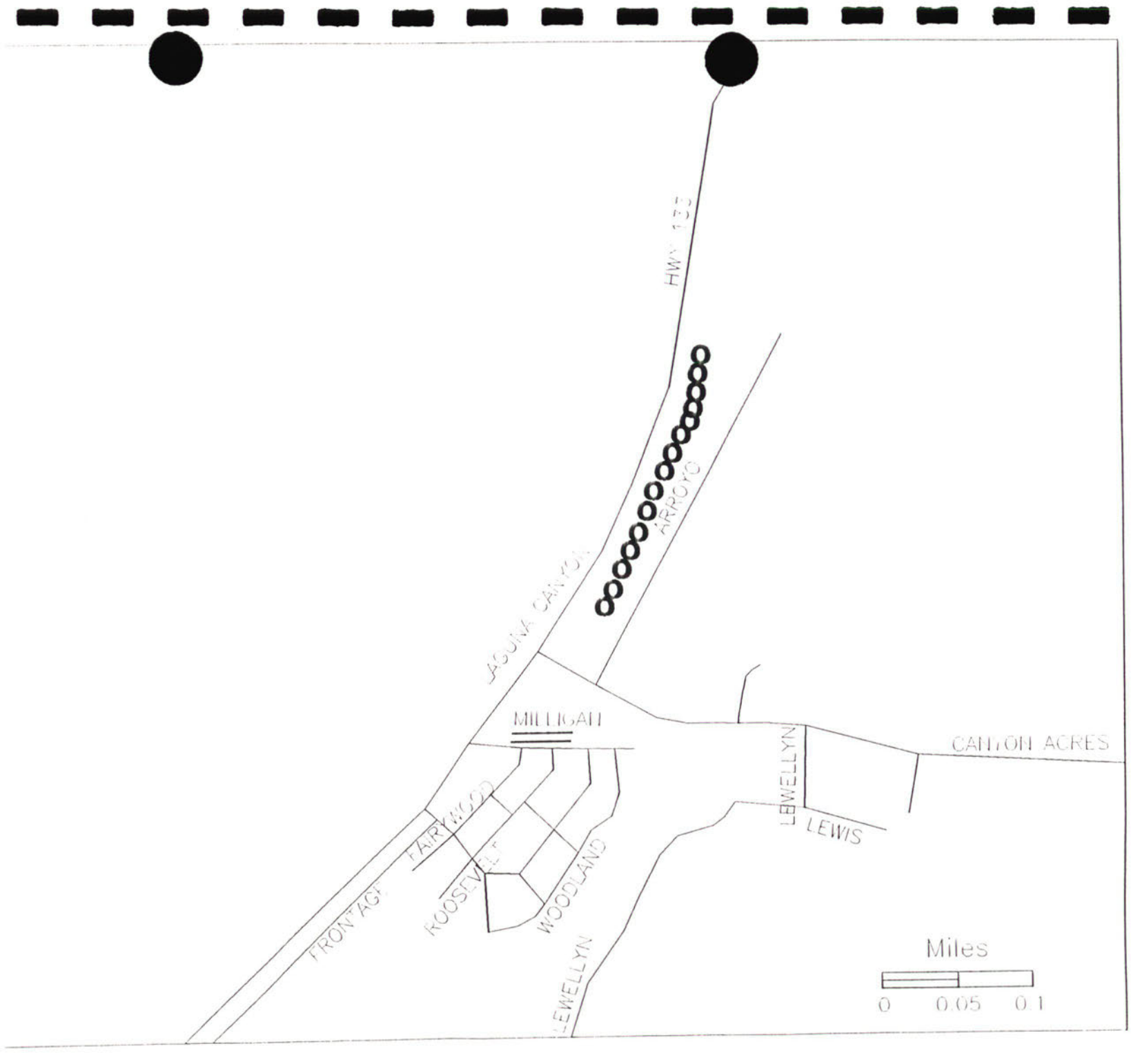
OES
CALIFORNIA

Governor's Office of Emergency Services

For General
Information Only

N
W E
S

5



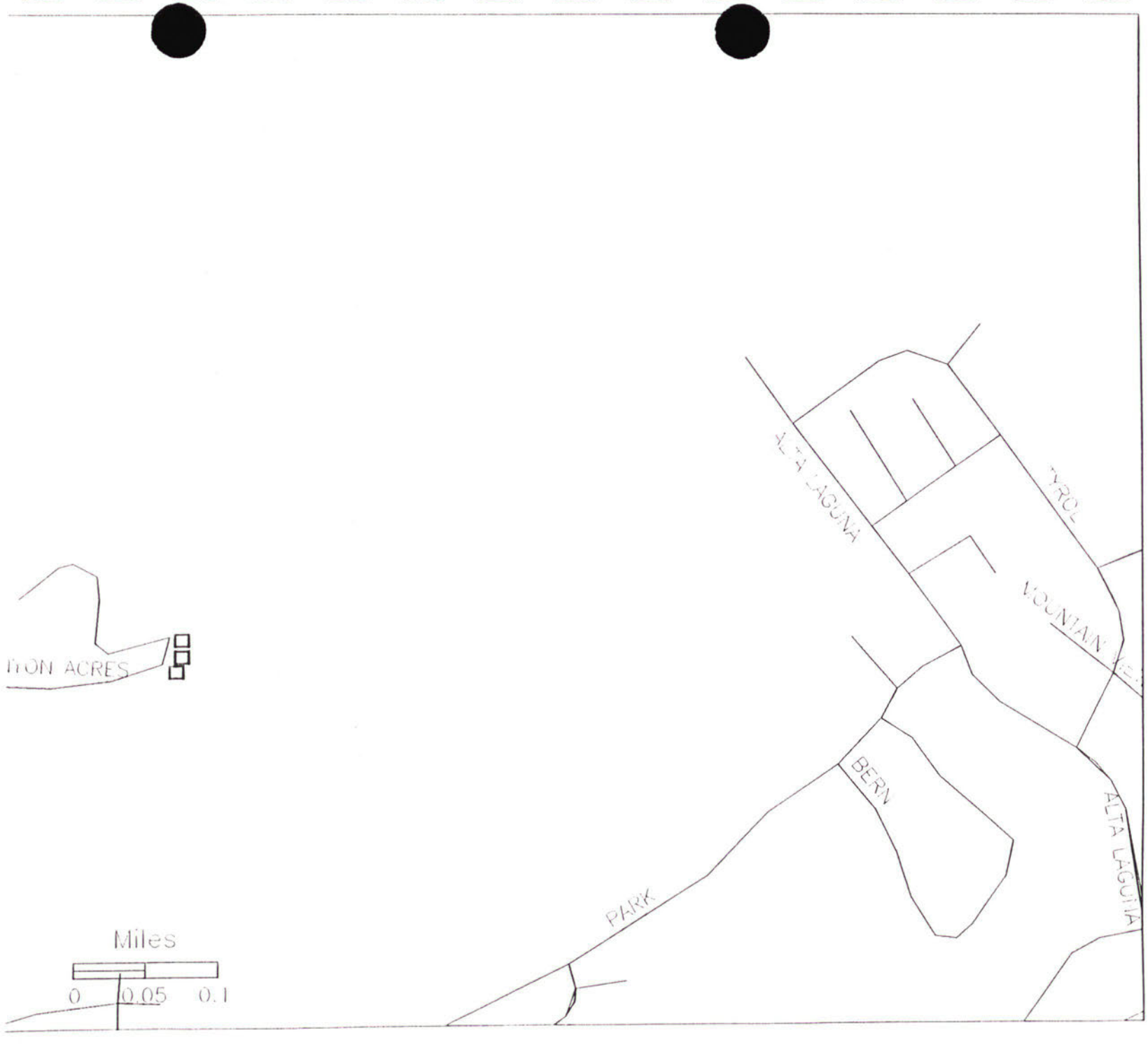
OES
CALIFORNIA

Governor's Office of Emergency Services

For General
Information Only

N
W
E
S

6

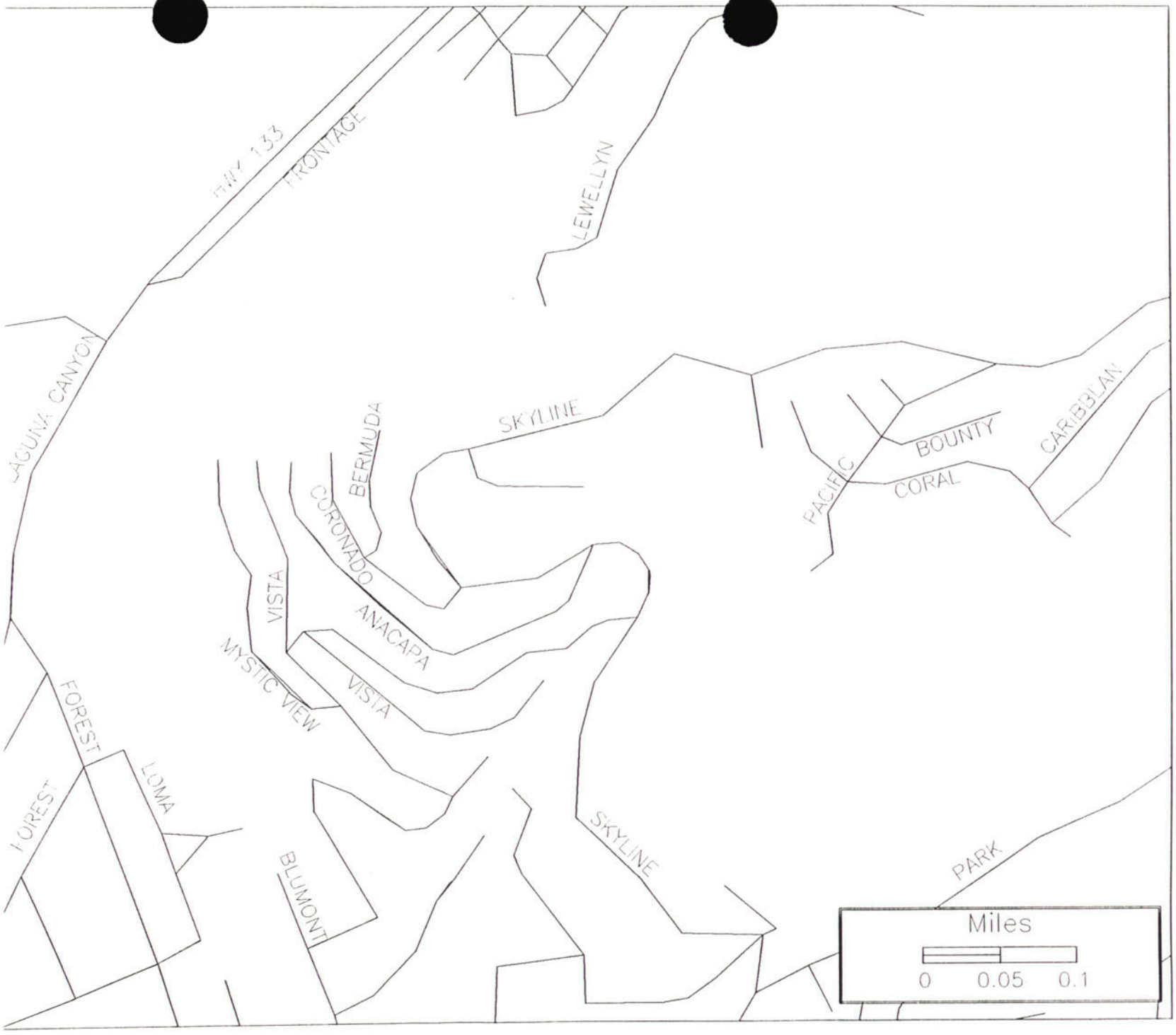


OE
CALIFORNIA

Governor's Office of Emergency Services

For General
Information Only

7



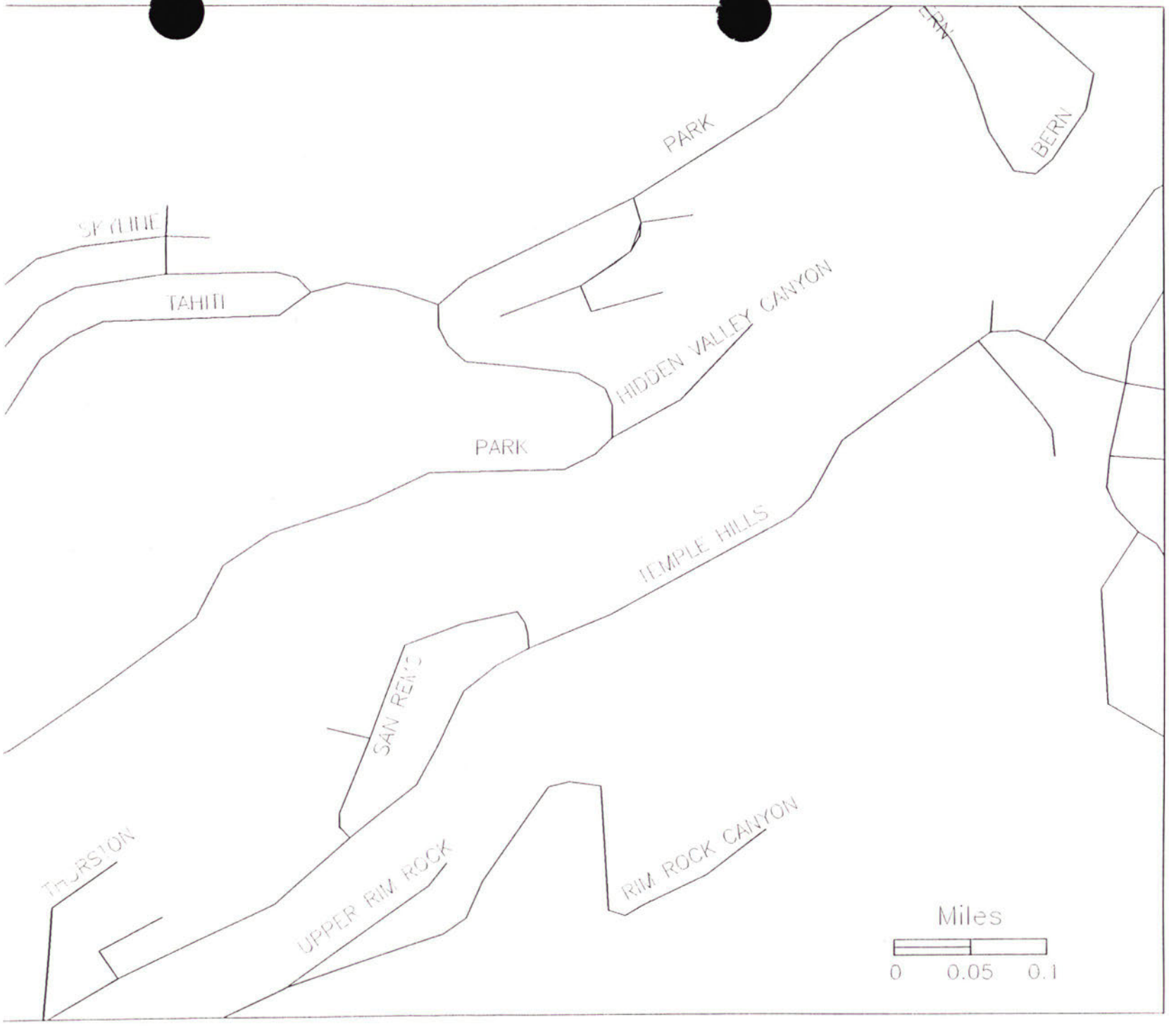
OE
CALIFORNIA

Governor's Office of Emergency Services

For General
Information Only

N
W E
S

8



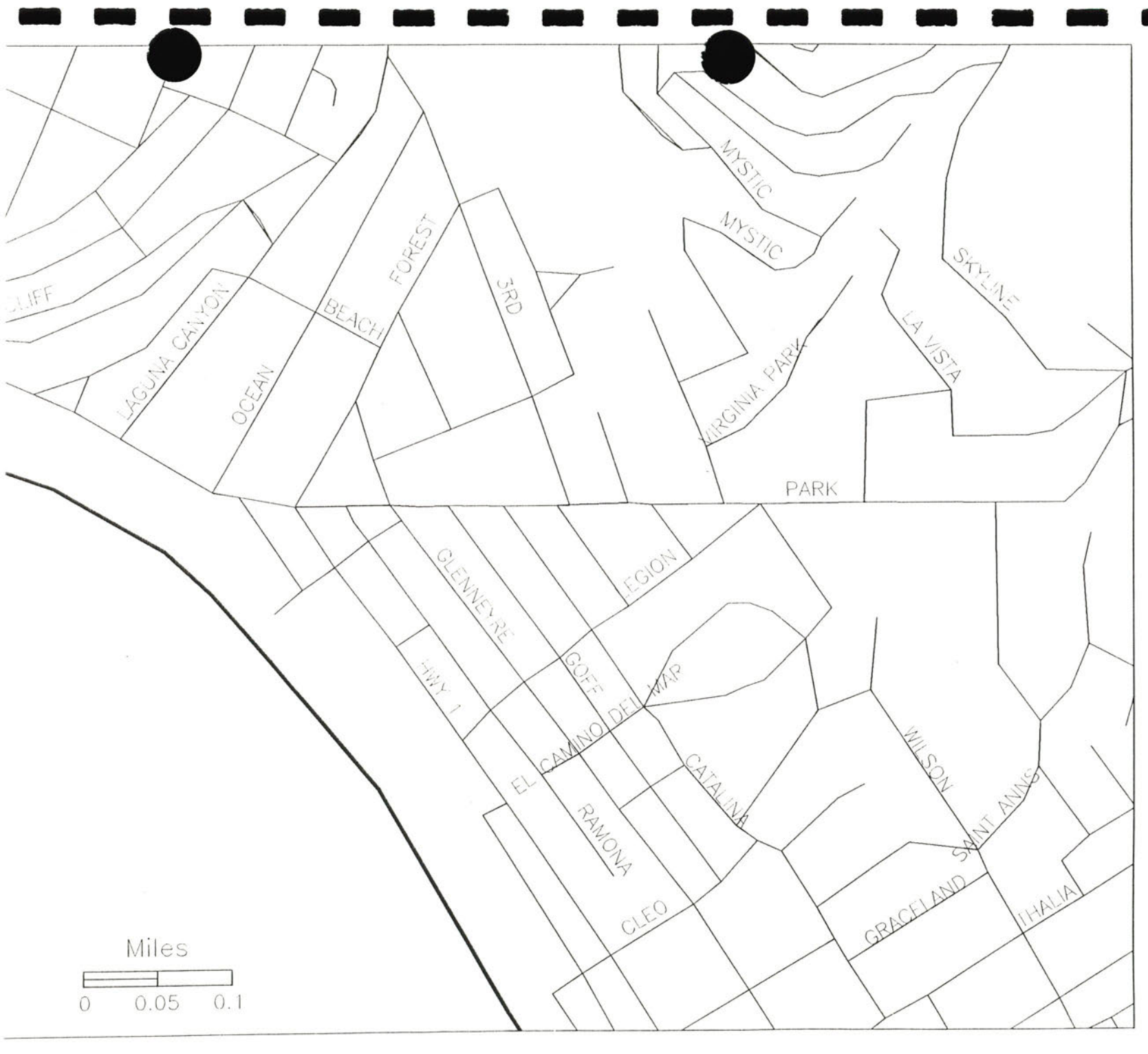
OES
CALIFORNIA

Governor's Office of Emergency Services

For General Information Only

N
W
E
S

9



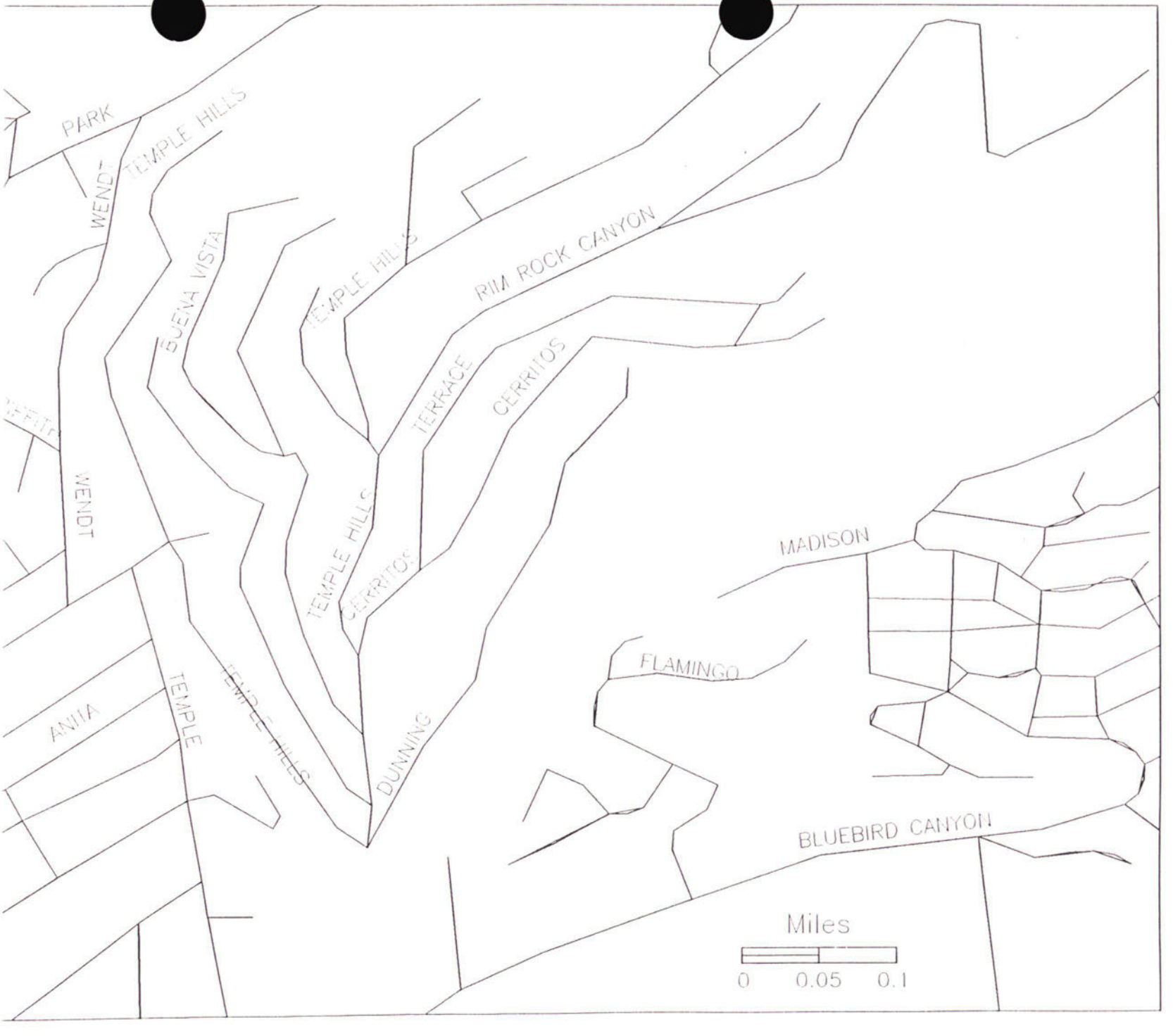
OES CALIFORNIA

Governor's Office of Emergency Services

For General Information Only

N
W E
S

10



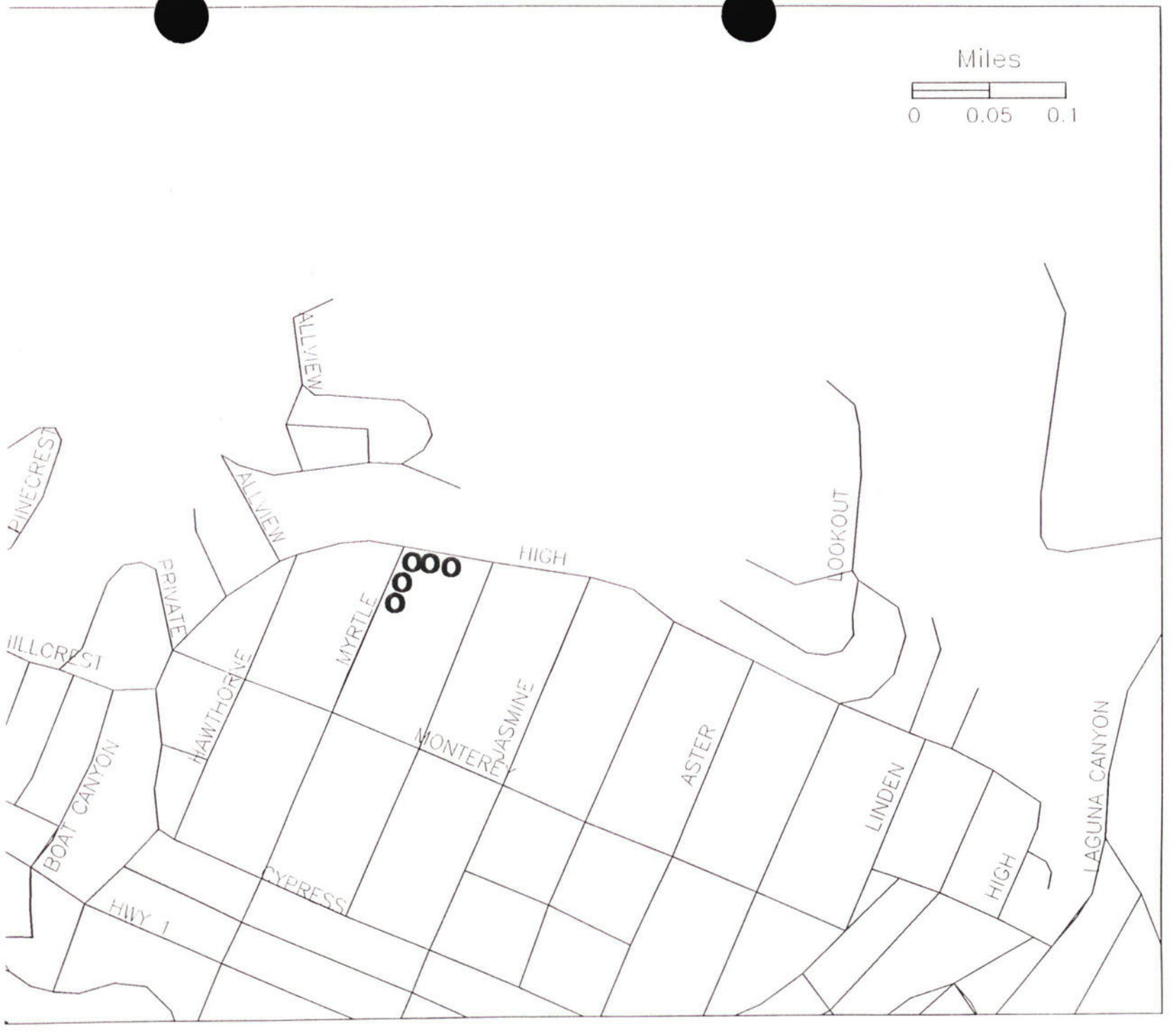
OES
CALIFORNIA

Governor's Office of Emergency Services

For General
Information Only

N
W
E
S

11



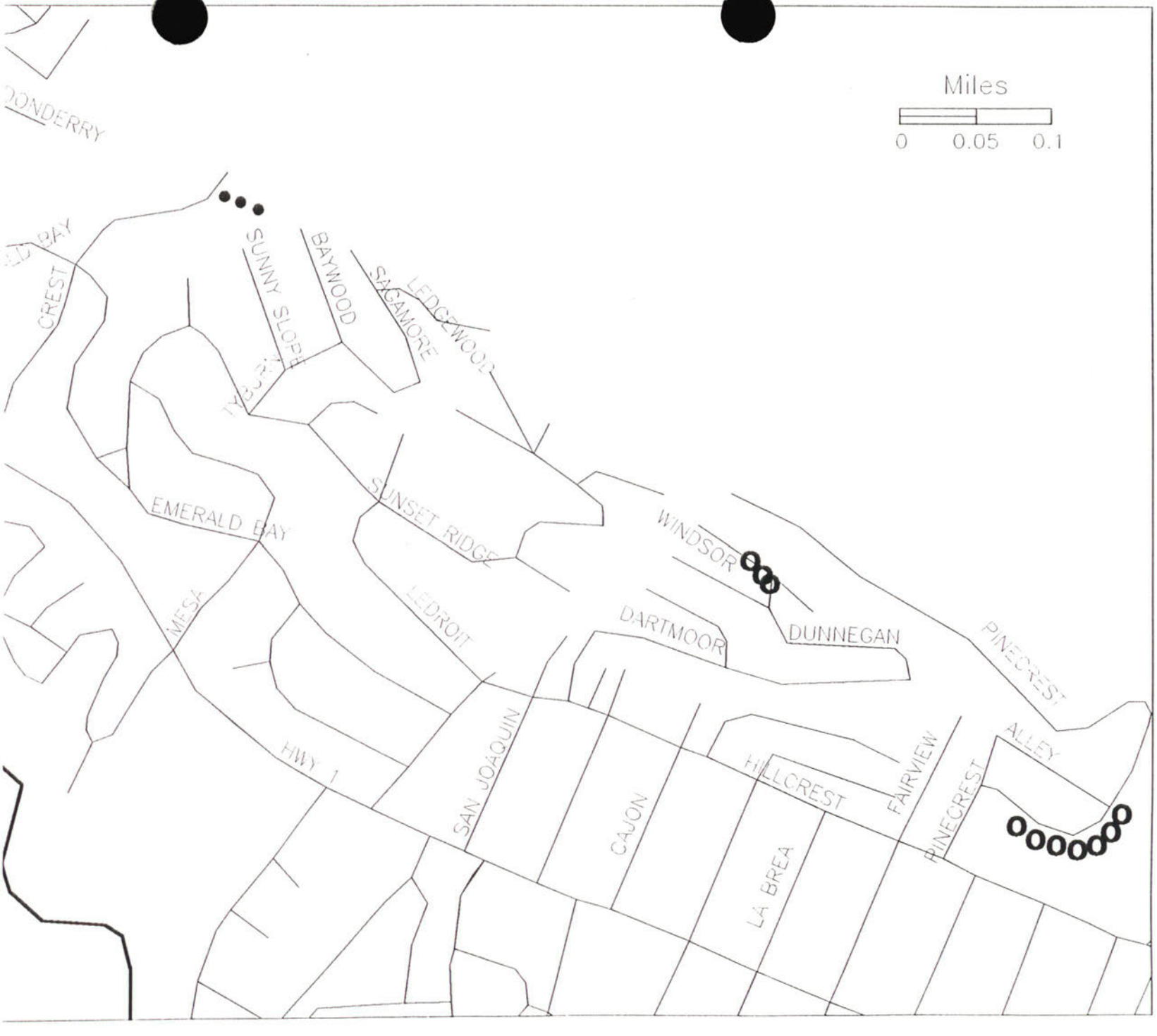
OES
CALIFORNIA

Governor's Office of Emergency Services

For General Information Only

N
W E
S

12



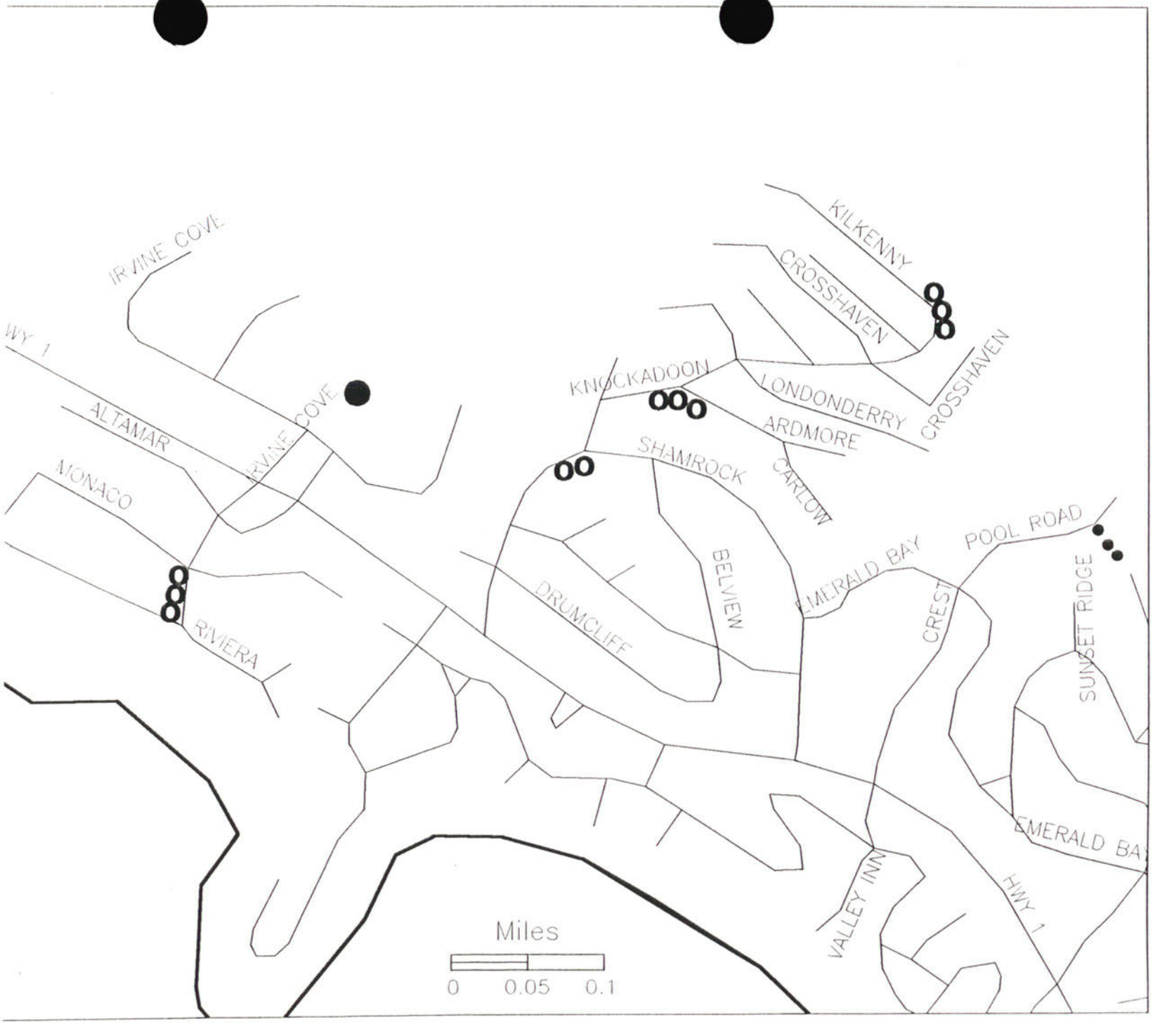
OES
CALIFORNIA

Governor's Office of Emergency Services

For General
Information Only

N
W E
S

13



OES
CALIFORNIA

Governor's Office of Emergency Services

For General
Information Only

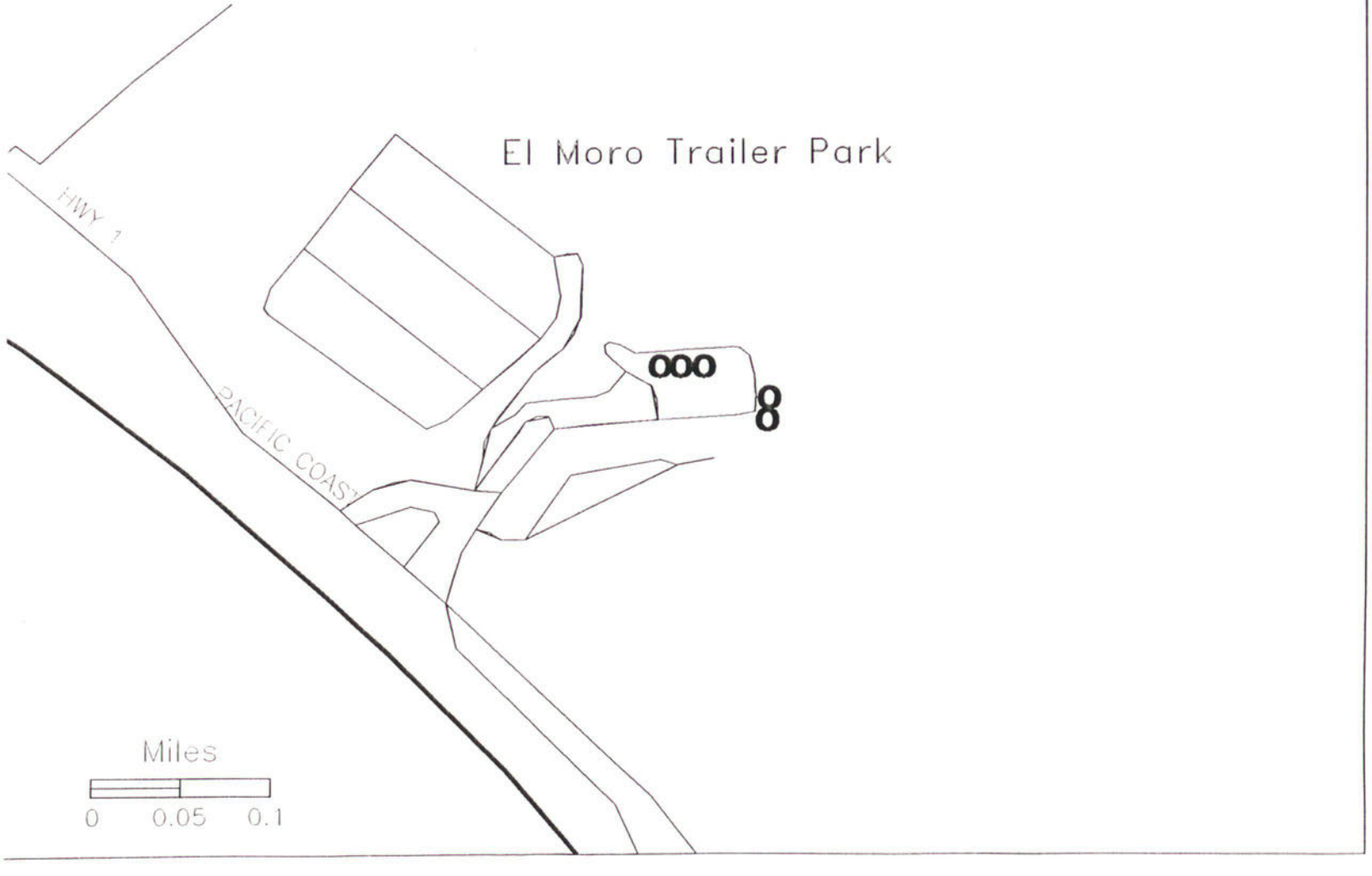
N
W E
S

14

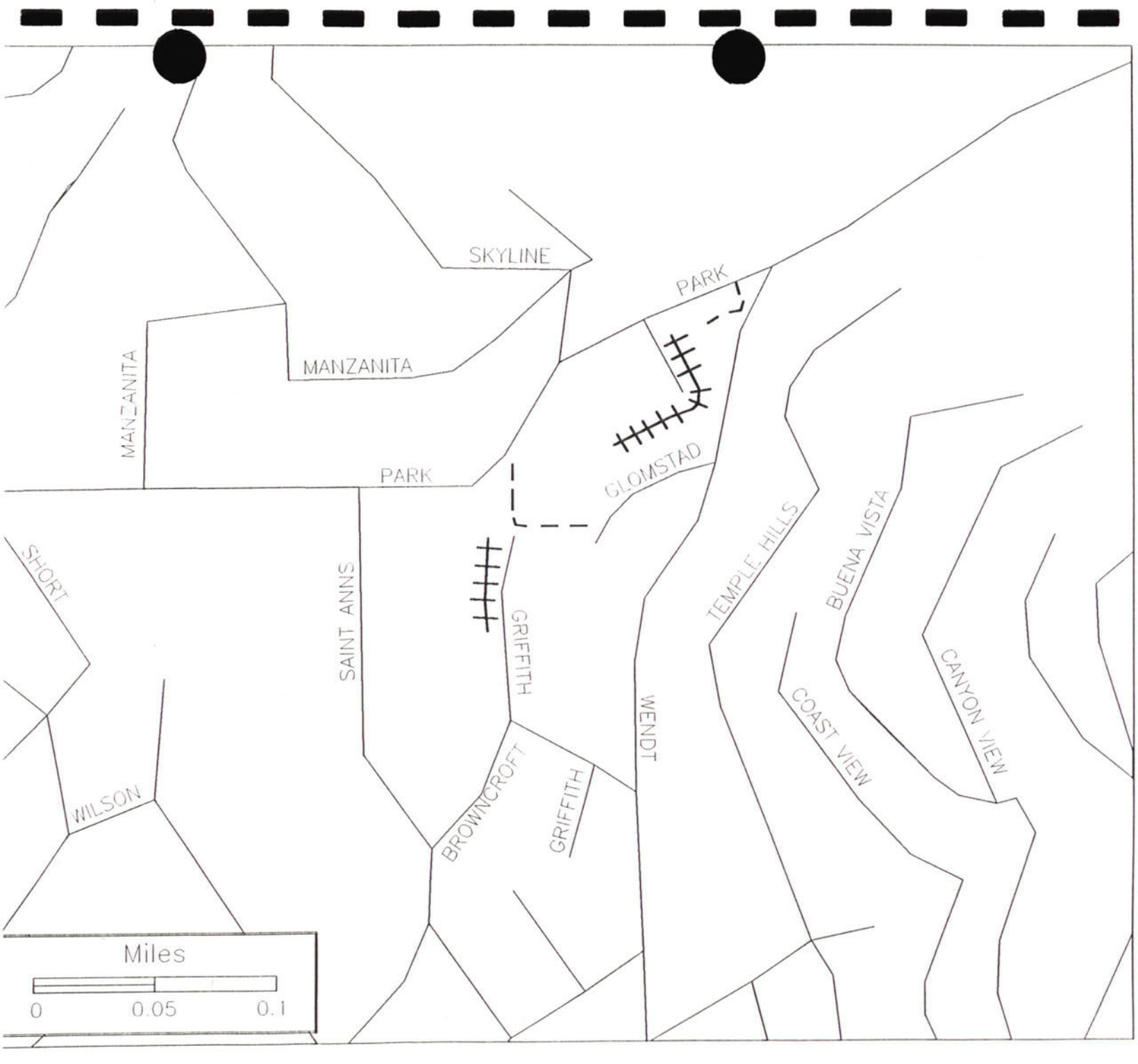
OES
CALIFORNIA

Governor's Office of Emergency Services

For General
Information Only



15



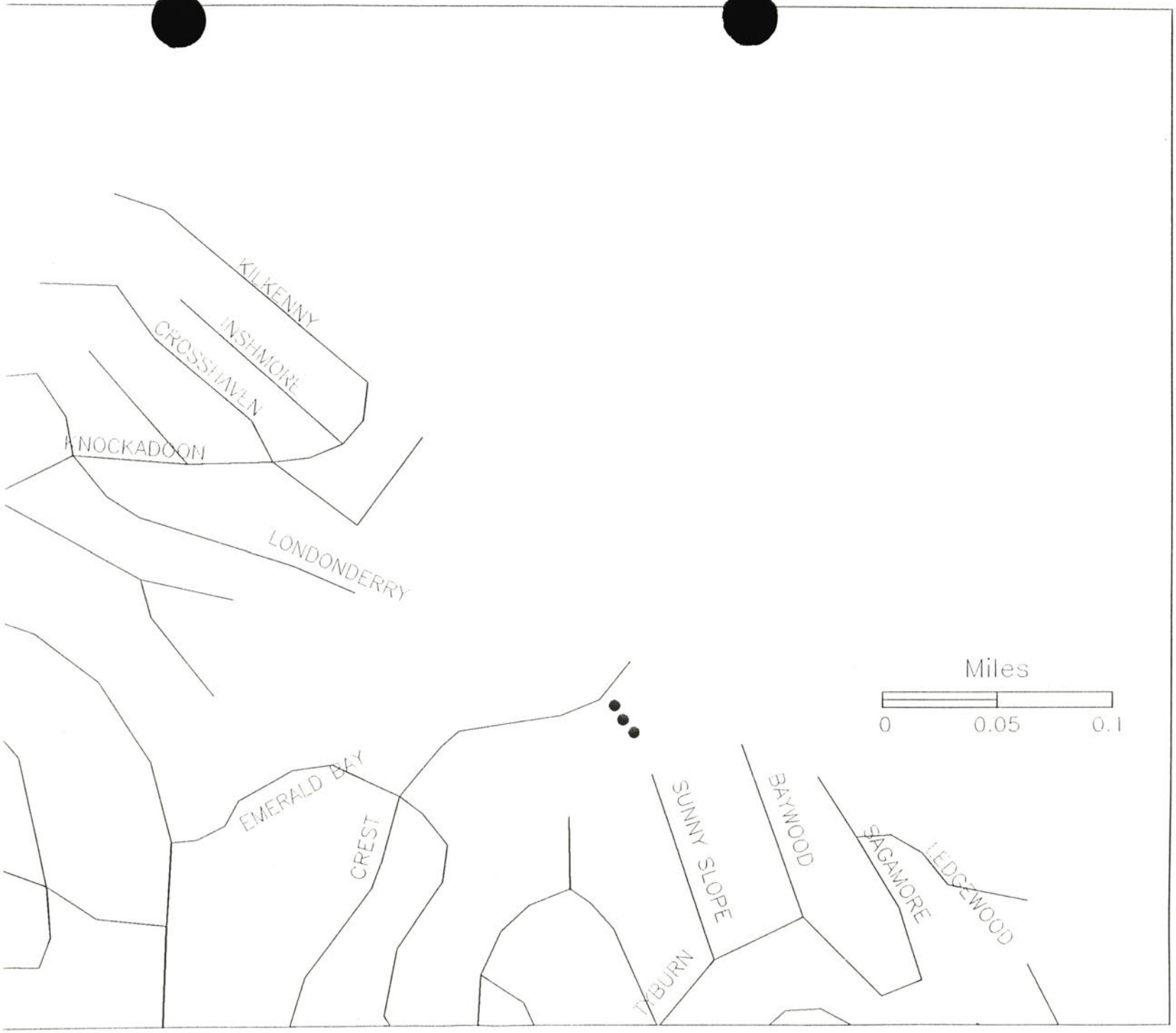
OES
CALIFORNIA

Governor's Office of Emergency Services

For General Information Only

N
W E
S

A

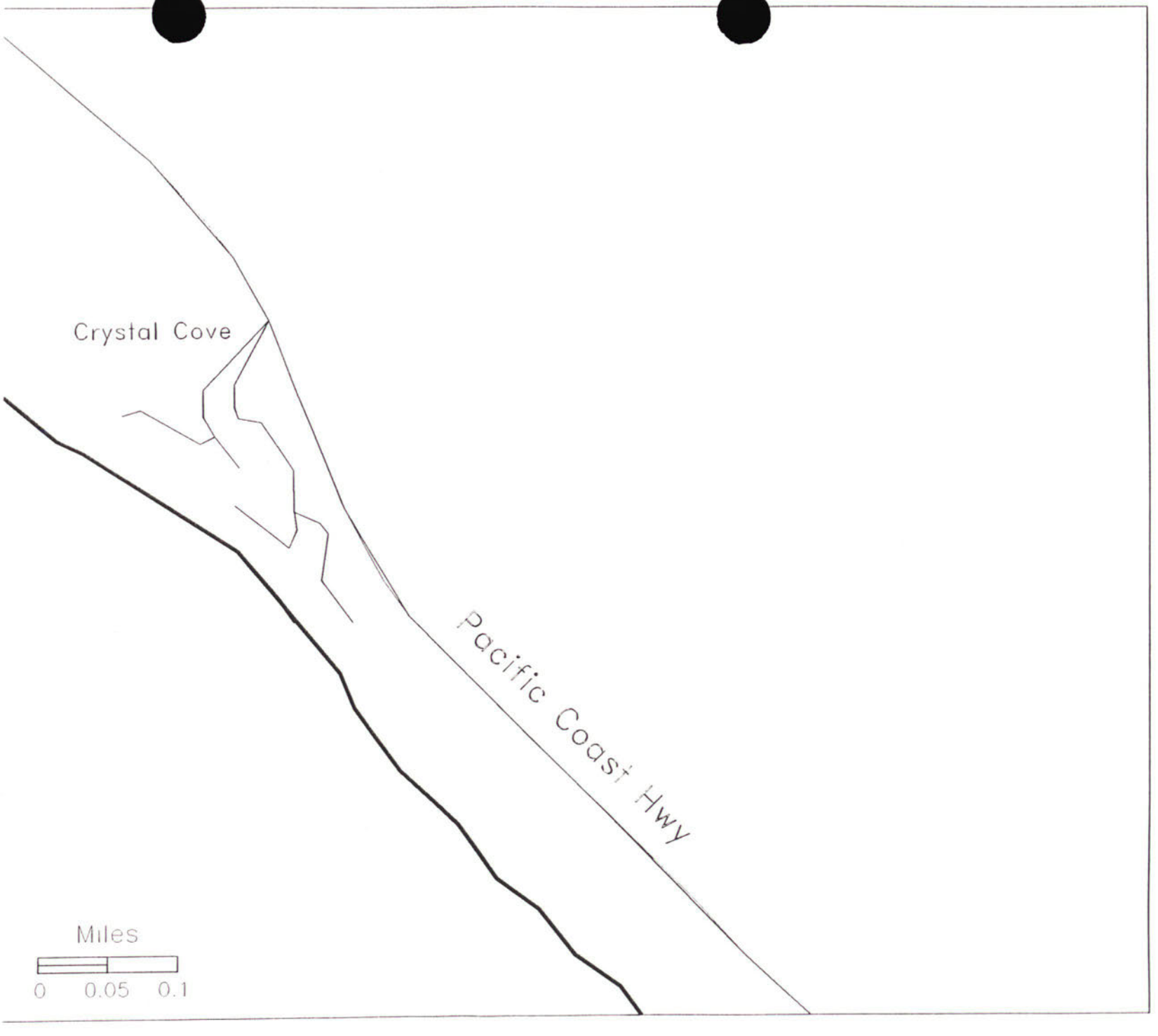


OES
CALIFORNIA

Governor's Office of Emergency Services

For General
Information Only

B



OES
CALIFORNIA

Governor's Office of Emergency Services

For General
Information Only

N
W E
S

C

APPENDIX D

STRUCTURAL DESCRIPTIONS AND DRAWINGS

Structure 1 Pipe and Plywood Deflector Walls

Introduction

This general concept may be applied wherever small flows down roadways or across open areas may threaten homes or businesses.

Description

A deflector wall protects threatened structures by directing flow around them. When placed parallel to a historic flow path, the walls guide the flow and force it to remain in the flow path, reducing the damage to adjacent structures. The walls should not be placed across a flow path to block flow, nor should they be used to contain standing water.

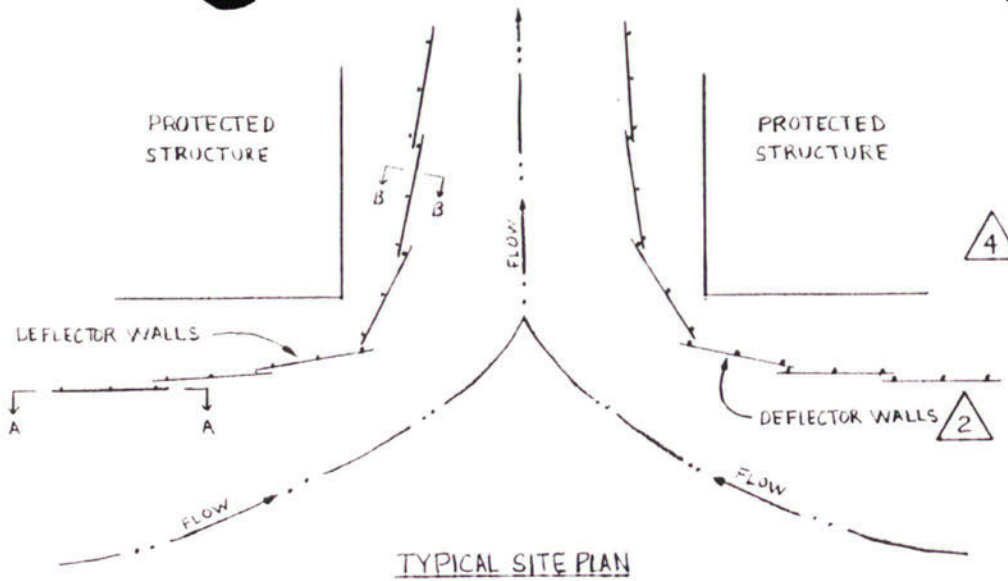
Situation

The wildfires last fall not only reduced the hydrologic condition of the soil, they also destroyed the grasses and brush in the watersheds. As a result, more water will run off those areas than in a normal year and the probability of debris flows will be increased. Areas that normally see some flow along their roadways will probably see increases in the flow amounts until the watersheds recover.

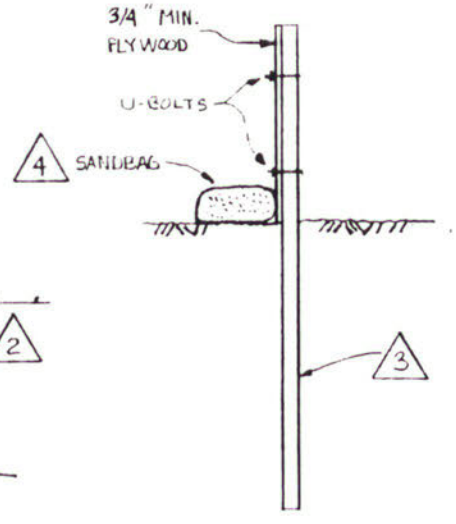
Deflector walls should be placed along routes where flow may occur. They should be placed parallel to flow and be used to direct the flow path past threatened structures. These structures are permeable, and some water is to be expected through them. They will, however, provide a level of protection that sandbags will not. The walls will also take up less space, and be more easily maintained and removed than sandbags.

The attached drawings show, conceptually, how the deflector walls should be constructed. A more permanent structure may have the pipes driven into the ground, while a temporary structure may utilize a sleeve set in concrete that may be removed and replaced as needed. Both alternatives are shown. Pipes must be set into the ground at least as deep as the structure's height out of the ground, otherwise the risk of failure increases.

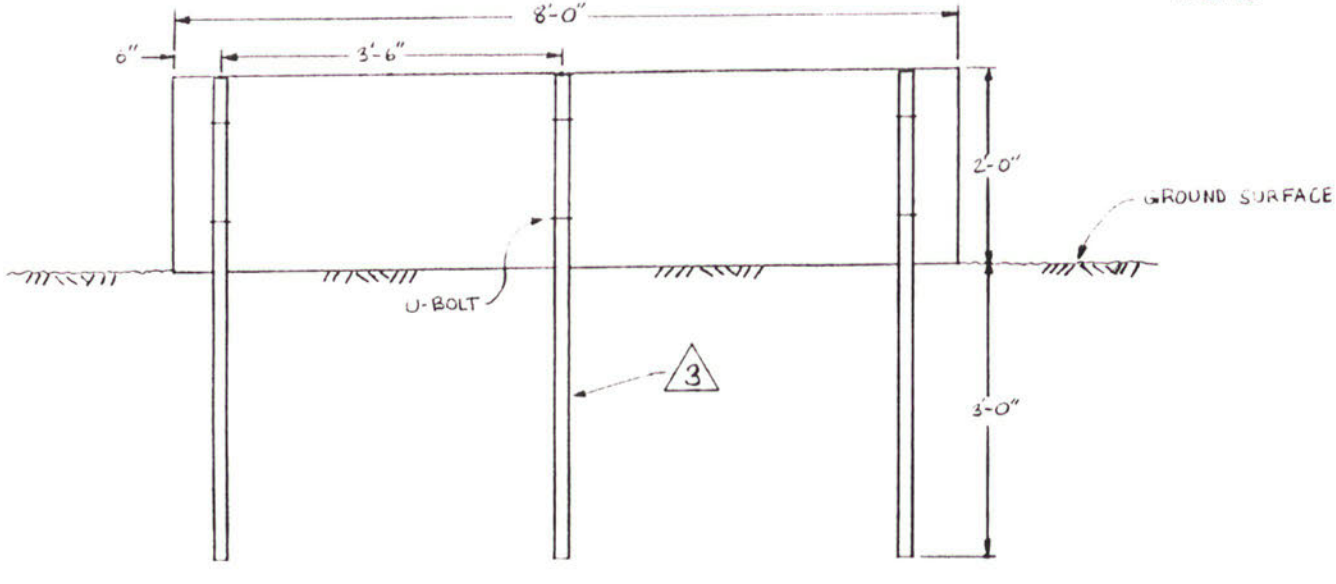
These walls should be designed separately for each site. The attached drawings are for concept only and are not to be used for bidding or construction purposes.



TYPICAL SITE PLAN
NO SCALE



SECTION B
NO SCALE



SECTION A
NO SCALE

CONSTRUCTION NOTES

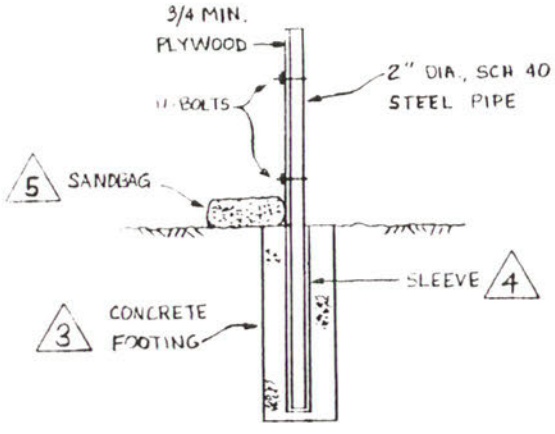
1. These drawings are not for construction or bidding purposes. They are intended for concept only. Pipe and Plywood Deflector Walls must be designed for each specific site.
2. Deflector wall ends to overlap approximately 1 foot, with the upstream section adjacent to the flow.
3. The pipe shall be 2" diameter, schedule 40 steel pipe, driven into the ground. For removable defector walls, pipes may be sleeved and set in concrete footing as in Alternate Section B on sheet 1B.
4. Sandbag layer to be set against plywood to reduce leakage under deflector wall.

PIPE AND PLYWOOD DEFLECTOR WALLS

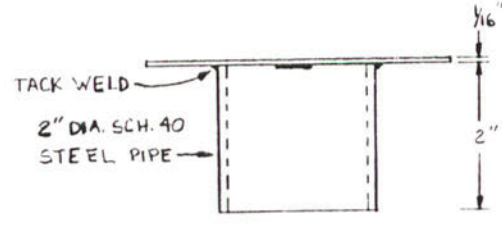
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed D.W. LUNDIN	Date 12/94	Approved by	
Drawn D.W. LUNDIN	12/94	Title	
Traced		Title	
Checked		Sheet No 1A	Drawing No 95-002

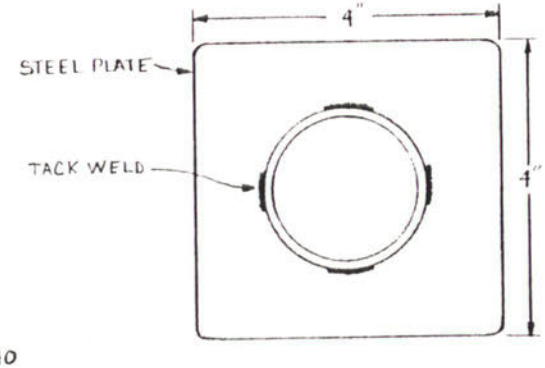
SCS ENG-513A REV 8-75



ALTERNATE SECTION B
NO SCALE

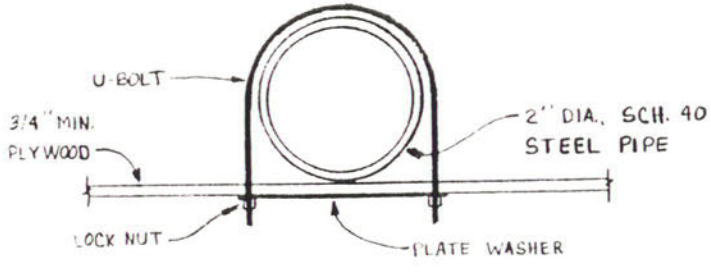


SIDE VIEW



BOTTOM VIEW

SLEEVE CAP DETAIL
NO SCALE



ATTACHMENT DETAIL
NO SCALE

CONSTRUCTION NOTES

1. If it is desired that the Pipe and Plywood Deflector Walls be removable for access, Alternate Section B and the Sleeve Cap Detail should be used.

2. Sleeve cap should be used to cover sleeve when deflector walls are not in place to prevent debris from entering sleeve.

3. The concrete footing is to be standard pre-mixed concrete for fence posts, or a 5-sack concrete mix. Footing diameter is to be approximately 12 inches.

4. The pipe for the sleeve is to be 2 1/2" diameter, schedule 40 steel pipe. The sleeve is to be capped on the bottom end to prevent floating during installation.

5. Sandbag layer to be set against plywood to reduce leakage under deflector wall.

PIPE AND PLYWOOD DEFLECTOR WALLS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed D.W. Lundin	Date 12/94	Approved by	
Drawn D.W. Lundin	12/94	Title	
Traced		Title	
Checked		Sheet No. 18	Drawing No. 95-002

SCS-ENG-31A - REV. 8-75

Structure 2 Pipe Trash Rack

Introduction

This general concept may be applied wherever the existing watershed is loaded with debris and sediment and threatens structures downstream.

Description

A pipe trash rack acts by trapping large debris and preventing it from plugging culverts, bridges or other restrictions, and damaging downstream structures. When placed in a channel upstream from a restriction, the rack removes rocks and limbs from the flow and will store some sediment behind it. The rack should be constructed using a concrete footing and steel pipe. For a temporary structure, a low strength, erodible concrete may be used. When the structure is no longer desired, the pipes should be cut off, and the footing allowed to erode.

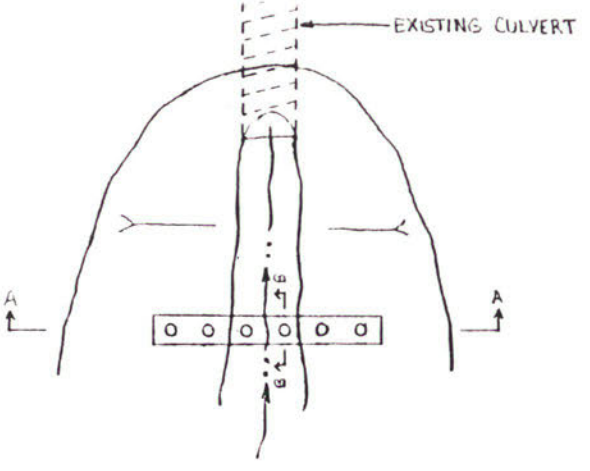
Situation

As a result of the wildfire in the fall of 1993, and the mild rains of the following winter, channels in the burn area are loaded with a great deal of sediment and loose brush. Culverts could plug with debris, including rocks and limbs, causing local or even widespread flooding. Downstream areas are in need of protection from possible debris flow and flooding.

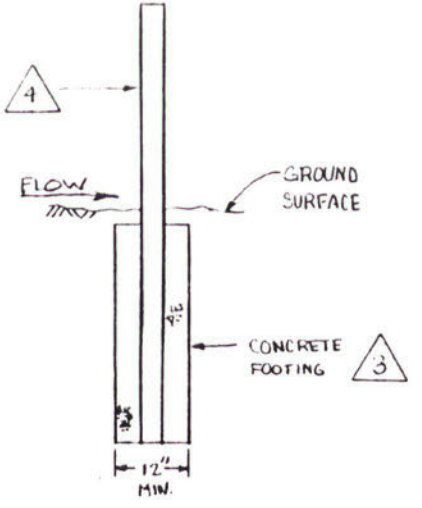
Pipe trash racks should be placed in channels where debris threatens downstream areas. The rack should be placed to provide the maximum amount of protection with as much storage behind it as possible. The site should have stable channel side slopes for the rack to tie into, as well as a stable channel bottom. The rack should be cleaned out on a regular basis to maintain its effectiveness.

The attached drawings show, conceptually, how the pipe trash rack should be constructed. Watershed size, size of debris and the size of the downstream restrictions should be considered when designing the rack height, pipe size, and spacing. The top of the pipes should be low enough to allow the full flow of the stream to pass over the top of the structure, while remaining in the stream channel. The footing depth measurement should be greater than or equal to the above ground structure height and excavation should be as nearly to the neat lines as possible. The footing may consist of a permanent, 5 sack concrete mix or a temporary, erodible 3 sack sand slurry to facilitate removal of the structure when the watershed has fully recovered.

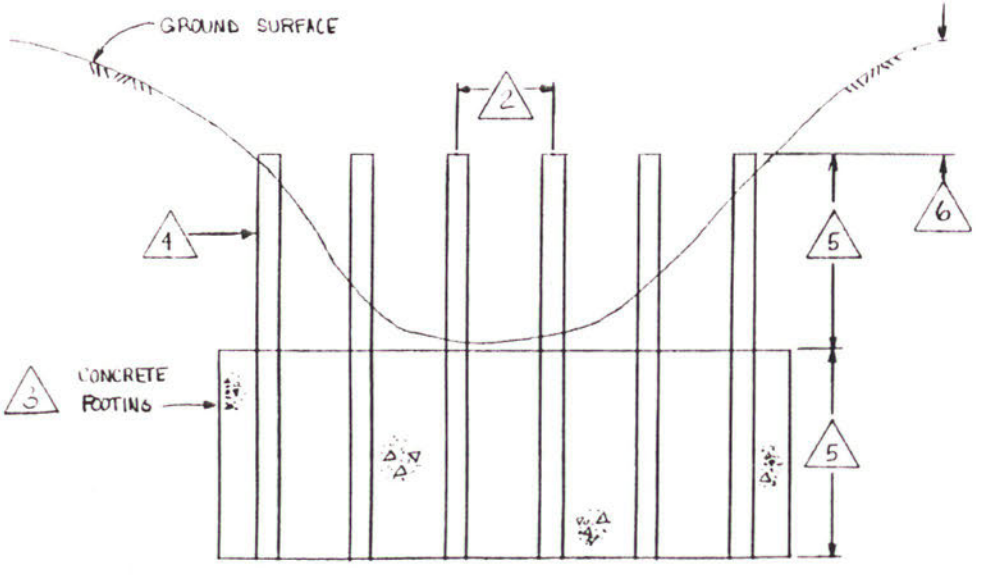
The attached drawings are for concept only. They are not for bidding or construction purposes. The trash rack should be designed specifically for each site.



TYPICAL SITE PLAN
NO SCALE



SECTION B
NO SCALE



SECTION A
NO SCALE

CONSTRUCTION NOTES

1. These drawings are not for construction or bidding purposes. They are intended for concept only. Pipe Trash Racks must be designed for each specific site.
2. Spacing between vertical pipes should be approximately 1/2 the smallest dimension of the downstream restriction.
3. The footing may be standard 3000 psi concrete or a low strength, erodible concrete for a temporary structure.
4. The pipe shall be 4" diameter, schedule 40 galvanized steel pipe, set in concrete footing.
5. Footing depth measurement should be equal to or greater than pipe height measurement.
6. Enough freeboard should remain such that full flow may pass over the tops of the pipes without overflowing the banks.

PIPE TRASH RACK

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	D. LUDIN	Date '95	Approved by
Drawn	D. LUDIN	'95	Title
Traced			Title
Checked			Sheet No. 2 of
			Drawing No. 95-002

SCS ENG 313A (REV. 8-75)

Structure 3 Reinforced Masonry Wall

Introduction

This general concept can be applied wherever a permanent structure is needed to protect a home or business from debris flow.

Description

A masonry wall protects threatened structures by deflecting flows and diverting them around the structures. When placed on an engineered foundation, the masonry wall can withstand a greater amount of flow than pipe and plywood walls and offer a greater amount of protection.

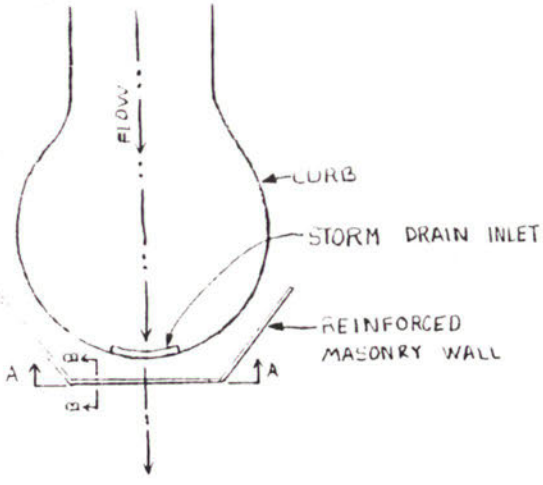
Situation

As a result of the 1993 wildfires last, the probability of increased amounts of runoff and debris flows from the impacted watersheds has increased. Areas that see flows along their roadways during normal years should expect more than usual amounts of water and debris until the watersheds recover fully.

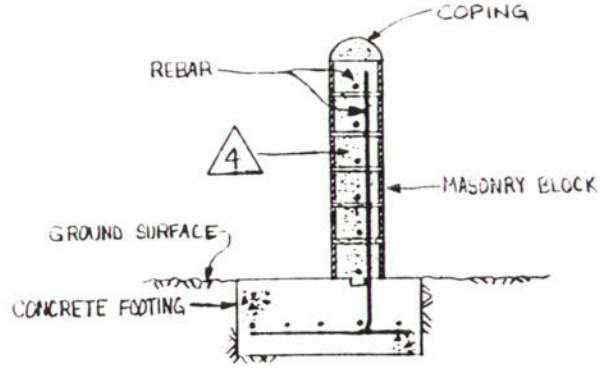
Masonry walls should be placed in areas where flow may occur. They may be placed along historic flood paths to channel flows away from structures. Low masonry walls may be placed to divert flows provided there is a safe outlet for the water. Care must be taken when placing the walls so as not to affect neighboring structures with diverted flows.

The attached drawings show, conceptually, how the masonry walls should be constructed. A trench must be excavated for the footing, reinforcing bar placed, the footing poured and the wall constructed on the footing. A spillway may or may not be required If a spillway is utilized, an energy dissipating apron is needed to prevent undercutting of the wall foundation. This is a permanent structure, therefore, permits may be required by the local governing body before construction begins.

These walls should be designed specifically for each site. The attached drawings are for concept only and are not to be used for bidding or construction purposes.



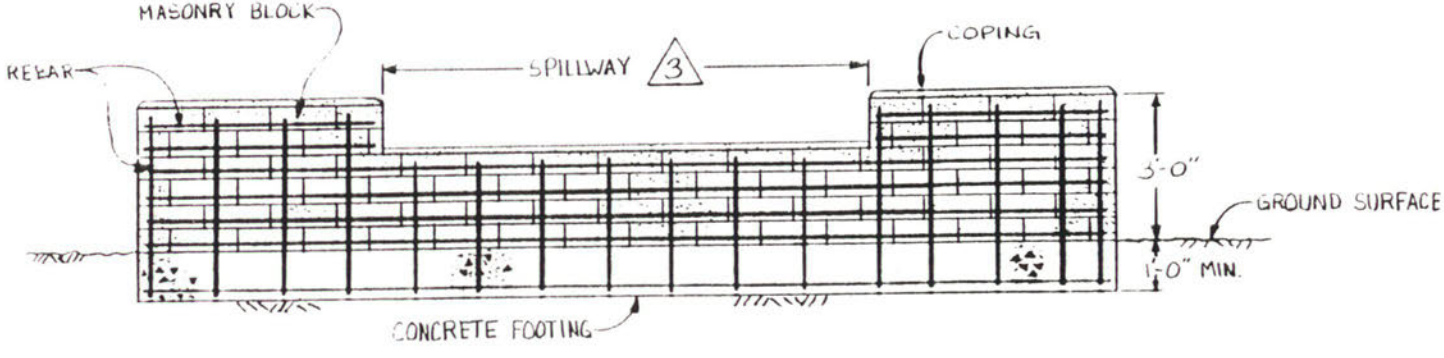
TYPICAL SITE PLAN
NO SCALE



SECTION B
NO SCALE

CONSTRUCTION NOTES

1. These drawings are not for construction or bidding purposes. They are intended for concept only.
2. Wall height, concrete masonry block and concrete footing dimensions, and rebar diameter and spacing must be specifically designed for each Reinforced Masonry Wall site.
3. Spillway may or may not be required. Spillway for overflow outlet must have adequate weir capacity for expected flow and an adequate energy dissipating apron below spillway.
4. All cells to be grouted solid.



SECTION A
NO SCALE

REINFORCED MASONRY WALL

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed D.W. LUNDIN 12/84	Date	Approved by	
Drawn D.W. LUNDIN 12/84		Title	
Traced		Title	
Checked		Sheet No 3	Drawing No 45-002

APPENDIX E

REFERENCES

APPENDIX E - References

Barbour, Michael G. and J. Major (eds.) Terrestrial Vegetation of California. California Native Plant Society. Special Publication No. 9. 1988.

Emergency Watershed Protection Plan. Post-Fire Rehabilitation Report and Emergency Watershed Protection Plan. Laguna Fire Rehabilitation Team. Dec. 1993.

Federal Emergency Management Agency. Flood Insurance - City of Laguna Beach, California, Orange County. 1985 (revised).

Hickman, James C., Ed. The Jepson Manual Higher Plants of California. University of California Press, Berkeley, CA 1993.

Orange County Environmental Management Agency (OCEMA). Rainfall - Laguna Beach, 1927-1994.

Radtke, Klaus W.H. Living more safely in the chaparral-urban interface. Gen. Tech. Rep. PSW-67. Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture; 1983.

USDA Soil Conservation Service and Forest Service in cooperation with University of California Agricultural Experiment Station. Soil Survey of Orange County and Western Part of Riverside County, California. 1978.

Westman, W.E. Coastal sage scrub succession. In: Proceedings of the Symposium on Dynamics and Management of Mediterranean-Type Ecosystems. June 22-26, 1981; San Diego, CA.

Woodward-Clyde Consultants. Phase I Erosion and Sedimentation Control Plan El Moro, Crystal Cove/Los Trancos, Emerald Bay and Laguna Canyon Road Sites. Nov. 1993.