
Wolfback Ridge

Site Management Plan

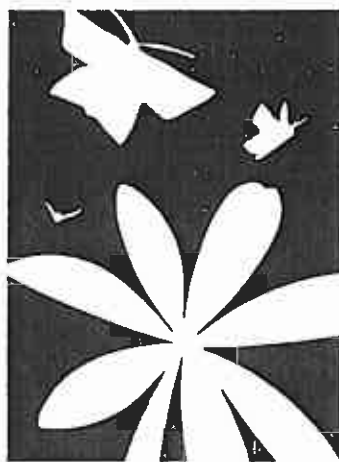
Golden Gate National Recreation Area



Site Stewardship Program
October 1995



This plan was prepared by Janet Klein, David Munro, and Dennis Kearney.
Assisting with their support were: Lisa DiGirolamo, Linda Lam, Lynn Warton, Gretchen
Ammerman, Ingrid Martin, Marc Albert, and Sue Gardner.



**Wolfback
Ridge**

WOLFBACK RIDGE SITE MANAGEMENT PLAN

Golden Gate National Recreation Area

Mission of the National Park Service:

"To conserve the scenery and natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

-From the National Park Service Act of 1916-

I. Site Name: Wolfback Ridge, Marin Headlands (Here in known as WBR)

II. Site Location:

Wolfback Ridge is located just north of the Golden Gate Bridge, between Highway 101 and East Fort Baker. It is a biological peninsula, surrounded on three sides by highway and linked to the rest of the Marin Headlands by a 1000 ft. wide corridor over the Waldo tunnel.

III. Site Description:

Restoration activities at Wolfback Ridge occur on a 100 acre wind-exposed, south-facing slope with a 40-60% grade. It supports a matrix of coastal scrub, annual grassland and perennial grassland communities. At its base, there is a small riparian corridor. A California Department of Transportation (Caltrans) right-of-way comprises the western boundry. The upper elevations of Wolfback Ridge, with rocky outcroppings, exposed soil and populations of *Lupinus albifrons* are habitat for *Plebejus icariodes missionensis*, the federal endangered Mission blue butterfly.

The primary threat to the ecology of WBR is the spread of invasive non-native vegetation. Intermittent grazing, highway construction and military activity have created opportunities for silent invaders such as French broom, eucalyptus, acacia, poison hemlock, sweet fennel and annual grasses to become established. The displacement of native plant communities, including those that support the Mission blue, may have a negative impact on wildlife. Likewise, changes to the site's hydrology have been problematic, drainages have been culverted, diverted and filled with debris. Large erosion gullies are growing under storm drains which catch highway run off or direct seasonal flow.

IV. Summary of Management Objectives:

The primary objective of the WBR stewardship team is to assist the staff of the GGNRA in the restoration and protection of the habitat for the Mission blue butterfly through the control of invasive non-native plant species, revegetation with native plant species, ongoing data collection, monitoring, and the continuing education of visitors to the Marin Headlands. While a significant degree of human intervention is necessary to achieve this objective at this time, the stewardship team hopes to restore the native vegetative communities to such a point that the ecological integrity of the watershed will be sustained with far less human involvement.

V. Role of the Site Management Plan:

This document is intended to serve as a general guideline for the cooperative management of WBR by the volunteer stewardship team, the Site Stewardship Program, and the Resource Management and Planning Division of the GGNRA. It details the history and resources of WBR as well as the management goals and implementation plans needed to acheive these goals over the next five to seven years.

Because of the dynamic nature of both WBR and the stewardship team, an additional document should be generated annually. This annual report should summarize and evaluate the preceding year's activities as well as detail specific management objectives for the coming year. After being reviewed by the Resource Management and Planning Division of the GGNRA, these annual reports will be added to **Appendix 6: Annual Reports**, of this Site Management Plan.

VI. Natural Resources

A. Geology

The core rocks beneath WBR are a Jurassic-Cretaceous (225-125 million years ago) accretionary complex, known as the Marin Headlands Terrane of the Franciscan Assemblage. The dominant components found at WBR are altered greenstone basalts, bedded radiolarian cherts and a capping of clastic sedimentary rocks of siliceous graywacke sandstones. Radiolarian cherts are weather-resistant and therefore form most of the ridge-tops and slope sides. See **Appendix 1: Geology of Wolfback Ridge**.

B. Soils

There are two main soil regions on WBR. The soil of the upper elevations is composed of 50% Tamalpais very gravelly loam and 40% Barnabe Variant very gravelly loam. The lower region is composed of 60% Tamalpais very gravelly loam and 30% Barnabe Variant very gravelly loam.

The Marin Soil Survey characterizes Tamalpais soil as moderately deep and well drained. Its permeability is moderately slow, and available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is rapid and the potential for erosion is significant. Barnabe Variant soil is characterized as shallow and well drained. Its permeability is moderate and available water capacity is very low. Effective rooting depth is 10-20 inches. Runoff is again rapid and the potential for erosion is significant. Although Tamalpais and Barnabe Variant are the dominant soil types found on Wolfback Ridge, soil and rooting depth are less than indicated by the Survey.

Chemical analysis of ten soil samples randomly chosen from around WBR has revealed an average pH of 4.5, except around the Eucalyptus stand between ridges 2 and 3. Analysis revealed an average pH of 4 directly beneath the trees and also directly downslope from the stand. Analysis revealed trace amounts of phosphorous and nitrogen as well as very high levels of potassium.

C. Climate

The climate of the Marin coast is generally cool and dry in the summer, then cool and moist in the winter. Most rain fall occurs between November and April and averages between 20 and 50 inches a year, depending on the location and micro-climate. As there is no weather station on or near Wolfback Ridge, site specific information is not available. However, frequent fog cover does add precipitation and helps to slow transpiration and evaporation. High winds are also common.

D. Hydrology

The Wolfback Ridge Watershed drains from north, east and south-facing slopes into a persistent riparian corridor which flows east from the Highway 101 right-of-way. During the height of the rainy season, the main branch of the riparian will run between 1 and 4 feet wide and between 1 and 6 inches deep. In the dry summer months, little running water is visible although the ground remains moist along much of the corridor. Two year-round seeps can be found on the Caltrans right-of-way.

Road construction and military development have dramatically altered the hydrological landscape. A series of storm drains, culverts and catch basins were installed to channel seasonal runoff in several drains which run under Alexander Avenue, out to San Francisco Bay.

Improper maintenance and poor design has resulted in several erosion problem sites. Seasonal flooding of the lower south-east corner near Alexander Avenue is controlled by a military sump-pumping station.

E. Vegetation

The WBR watershed sustains three native plant communities, following the Holland classification system: Coastal Scrub, Coastal Terrace Prairie Grassland, and Central Coast Riparian Scrub. A Freshwater Seep community can be found on the Caltrans right-of-way near Highway 101. The native plant communities at WBR are being invaded by a variety of non-native plants, the most aggressive of which are listed in **Appendix 2: Invasive Plant Species Removal Techniques**. The stewardship team is developing a site specific flora based on the GGNRA flora and field observations (See **Appendix 3: Flora**).

F. Fauna:

Using the Wildlife Habitat Relationship program (WHR), the stewardship team has generated a list of species likely to be present at WBR (See **Appendix 4: Fauna**). An inventory program using artificial cover boards and smoked track plates was conducted with partial success through the winter and spring of 1995. Heavy, prolonged rains interrupted track plate monitoring, while the availability of new information suggests the coverboards were not utilized properly. The following includes vertebrate species sighted and confirmed on WBR between February 1994 and June 1995.

Amphibians: California Slender Salamander (*Batrachoseps attenuatus*).

Reptiles: Western Fence Lizard (*Sceloporus occidentalis*), Alligator Lizard (*Gerrhonotus* sps.), Rubber Boa (*Charina bottae*), Gopher Snake (*Pituophis melanoleucus*), Garter Snake (*Thamnophis sirtalis*).

Mammals: Black-tailed Jackrabbit (*Lepus californicus*), Pocket Gopher (*Thomomys bottae*), Deer Mouse (*Peromyscus maniculatus rubidus*), Coyote (*Canis latrans*), Grey Fox (*Urocyon cinereoargeneus townsendi*), Raccoon (*Procyon lotor* spora), Striped Skunk (*Mephitis occidentalis*), Cat (*Felis catus*), Bobcat (*Lynx rufus*), Black-tailed Deer (*Odocoileus hemionus*).

Birds: Red-tailed Hawk (*Buteo jamaicensis*), Turkey Vulture (*Cathartes aura*), American Kestrel (*Falco sparverius*), Raven (*Corvus corax*), Dark-eyed Junco (*Junco hyemalis*), Bush Tit (*Psaltiriparus minimus*), Bewick's Wren (*Thryomanes bewickii*), Song Sparrow (*Melospiza melodia*), White-crowned Sparrow (*Zonotrichia atricapilla*), California Towhee (*Pipilo aberti*), Rufous sided Towhee (*Pipilo erythrophthalmus*), American Gold Finch (*Spinus tristis*), Scrub Jay (*Aphelocoma coerulescens*), Brewer's Blackbird (*Euphagus cyanocephalus*), Swallow species.

Insects: WBR supports a wide variety of invertebrate species, 170 of which were identified during an arthropod study conducted by Jot Lanford in the early 1990s. Pit fall traps were set in stands of French broom, native scrub and meadow in order to detect habitat relationships. While the greatest diversity (both native and non-native) was found in French broom, the greatest of native arthropods was found in native scrub.

The dominance of Argentinean ants was noted, along with the need for further research to determine the relationship between Mission blue butterflies and various ant species found on WBR.

G. Protected Taxon

Only one protected species is known to inhabit WBR: the Mission blue butterfly, *Plebejus icarioides missionensis*. Although the Mission blue has been on the federal and state endangered species lists since 1976, the Marin Headlands population was only discovered in the early 1980s. This population is believed to be the largest remaining, with smaller populations occurring on San Bruno Mountain, Milagra Ridge, and Sweeny Ridge in San Mateo county. Wolfback Ridge is one of five sites in the Headlands currently being monitored for the presence of Mission blues.

The year long life cycle of the Mission blue centers around its preferred larval host plant—*Lupinus albifrons*. The larvae spend much of the year on the lupine itself or in the litter at the base of the plant. The adult butterfly lays her eggs on the leaves which hatch 4-7 days later. After feeding on the mesophyll of the leaves for up to three weeks, the larvae go into an obligatory diapause or summer hibernation. The next spring, they awake and resume feeding. After 4-5 weeks, the larvae pupate and emerge as adult butterflies between March and mid-June. The adult butterflies live 6-10 days, in which time the females must mate and oviposit. *Lupinus albifrons* is generally preferred, although *L. varicolor* and *L. formosa* are also utilized. The adult butterfly may use plants such as buckwheat, blue dicks, and various grasses for nectaring or perching.

The GGNRA's yearly Mission blue butterfly Census in the Marin Headlands started in 1991, as a method of assessing the relative densities of the butterfly population throughout the Headlands. Although it does not provide an actual population count, the program provides valuable information on population trends or patterns, behavior, and preferred vegetation. This information in turn aids in revegetation and restoration efforts. Many questions still remain about the Mission blue butterfly. In order to best manage the remaining habitat, future study is needed on topics such as the relationship between the Mission blue and ants (a common phenomenon among lycaenid butterflies), and preferred habitat.

VII. Cultural Resources and Land Use History:

As there has been little research regarding Native American activity on surrounding Park lands, it is difficult to determine if and how Native Americans used WBR. Topographical and hydrological features make it an unlikely dwelling or burial site. To date, no archeological artifacts have been found.

From 1775, WBR was included in the cattle lands of the Rancheria de Socorro and then passed in 1838 to William Antonio Richardson as part of a 19,571 acre land grant. The Sausalito Dairy Corporation owned it and grazed cattle there for a number of years. No artifacts from this period have been found or identified on the site.

In 1866, the military purchased WBR hoping to find a water source for Forts Baker and Barry. Despite several drilling attempts in the drainage area, a potable water supply was never found. Anecdotal evidence as well as aerial photos from 1925 and 1928 suggest that the military allowed neighbors to continue grazing cattle or goats there for a number of years. Several fences were erected near the water course after 1928, thus limiting grazing to the upper elevations. By 1945, the fences had been removed and grazing resumed down to Danes Drive. Two large water tanks were erected in the 1930s as well as a generator, a pumphouse and several small guard stations.

The watercourse was diverted into an underground pipe which carried intermittent flow under East Fort Baker and out to San Francisco Bay. Remnants of military activity can still be found in the scrub. Subterranean water, gas, and electrical lines installed along the Pumphouse road corridor to provide service to Fort Cronkhite are still in use. A subterranean fuel tank installed by the military will be removed by the Army Corps of Engineers in the near future.

During the 1960s, WBR passed from military control to the Marin Headlands State Park and was incorporated into the GGNRA in the 1970s. Today, WBR is an undeveloped area with no roads or trails open to the public. The SCA trail passes within 100 yards of the Waldo tunnel corridor. Although a few mountain bikers, cross country joggers, and dog walkers have been seen on the ridge flanks, most off trail activities appear to be concentrated on Pumphouse Road and the gravel jeep road which runs along the ridge tops. Completion of the retrofit on the Baker-Barry tunnel and the construction of a small parking lot in the spring of 1995 has greatly increased passing traffic and could increase off-trail exploration of WBR.

VIII. Restoration History:

Between 1990 and 1993, the GGNRA supervised conservation corps crews in the removal of over 70 acres of French broom from the southern face of WBR as part of an effort to protect Mission blue butterfly habitat. Funding came through a three-year grant from the Department of Interior's Natural Resources Preservation Program. After the grant was exhausted, cyclical maintenance funds and money from the Baker/Barry tunnel restoration were used to pay for additional conservation corps crew time between 1994-1996. However, seedlings and resprouts pose a long-term threat to Mission blue habitat. Persistent follow up continues to be necessary in order to prevent the reestablishment of a mature broom population. For this reason, WBR was designated a stewardship site in December of 1993.

In 1992, several experimental plots were established, comparing various removal techniques. Pulling broom with weed wrenches, seeding with native grasses and leaving the pulled broom on site proved to be both a practical and effective method of reducing the number of broom seedlings the following year. Both the GGNRA staff and the stewardship team are aiming to prevent any broom plants from setting seed in areas where mature plants have been previously cleared. Achieving this goal requires increased planning and crew/volunteer work time as the number of cleared acres increases.

The severe slope at WBR has made erosion prevention a primary concern when large stands of French broom are being removed. Slash has therefore been left on site to hold the soil down as well as shade out broom seedlings. The Marin Conservation Corps laid a large curlex blanket down over one particularly large, steep patch rendered bare by the wholesale removal of broom from Ridge 2. Native grasses were seeded in resulting in the successful prevention of erosion. While mostly annual grasses came back and not much native grass, lupines did become successfully established.

GGNRA revegetation efforts have focused primarily on the reestablishment of native grasslands. Between 1990 and 1993, *Elymus glaucas*, *Bromus carinatus*, *Stipa pulchra* and *Festuca rubra* seeds have been broadcast and raked in following the removal of French broom. *Bromus* can now be found in significant numbers midway up Ridge 2 near the curlex site and in an erosion gully. *Elymus* appears to be limited to lower Ridge 2 and 3 and to the Pumphouse Road area. *Festuca rubra*, while abundant on upper Ridge 3 and 4, does not appear to have established in the areas it was seeded in.

Stipa is now plentiful along Pumphouse road where a *Stipa* straw mulch was laid down, but does not appear in on Ridges 3 or 4 where it may have been broadcast. It is most abundant on Ridge 2 where it occurs naturally.

Following a 1991 pipeline excavation project along Pumphouse Road, a native scrub seed mix was broadcast in the disturbed area. Native scrub plants are establishing themselves but face competition from French broom and harding grass. In 1995, a contractor collected several large bags of *Stipa* from both WBR and Battery Duncan. The seeds will be grown into plugs and outplanted during the 1995-1996 rainy season. Approximately 45,000 plugs will be planted out in a half acre near the old water tanks. See Appendix 5: Summary of Broom Removal and Revegetation at Wolfback.

IX. Management Goals and Implementation:

Implementation of goals outlined below will be done in accordance with NPS guidelines for NPS invasive plant removal, seed collection, revegetation and monitoring. Complete revegetation and restoration action plan will be prepared for major projects not detailed below and will be submitted to project review before initiation.

A. Assess, monitor, enhance and protect Mission blue butterfly habitat.

Mission blue butterflies were first noted above East Fort Baker, in the WBR area in 1986. Neighboring populations can be found across Alexander Avenue at Batteries Duncan and Cavallo and across Highway 101 at Slacker Ridge. *Lupinus albifrons*, the butterflies' preferred host plant is found in abundance on the upper elevations of WBR, as are several other native plant species utilized by the Mission blue. In 1992, the GGNRA Fish and Wildlife specialist implemented a butterfly monitoring program in the Marin Headlands designed to detect gross changes in butterfly population dynamics over time. Sixteen permanent transects were established in known Mission blue sites, four of which were placed on WBR. A total of eight Mission blue butterfly sightings on WBR transect lines were recorded during the 1994 flight season. Numerous incidental sightings the same year indicate the population was larger. Stewardship team members participated in butterfly monitoring during the 1995 flight season, results are pending.

Management of the Marin Headland's Mission blue colony will focus on long-term monitoring and the enhancement and expansion of suitable habitat. Future restoration efforts will focus on the continued removal of invasive non-native plants and on the continued re-establishment of native vegetation. Because the WBR colony appears to be small, genetic exchange with neighboring colonies at Slacker Ridge and Battery Duncan may be necessary in order to ensure survival. Therefore, attempts will be made to create "stepping stone" corridors to butterfly habitat along the Waldo tunnel corridor in order to facilitate cross migration between the Slacker and WBR Mission blues. A genetic exchange between the WBR Mission blues and those to the east at Battery Duncan seems less likely due to the barrier created by Alexander Avenue. Eastern expansion of Mission blue habitat on WBR will still be encouraged in order to increase overall available habitat.

Implementation:

1. Coordinate with Fish and Wildlife Service and NPS staff to continue monitoring population dynamics of the Mission blue colony on Wolfback and elsewhere in the Marin Headlands.
2. Monitor butterfly habitat for changing patterns of vegetation through use of photo monitoring, annual vegetation transects, aerial photographs and GPS/GIS generated maps.
3. Expand Mission blue habitat by removing non-indigenous invasive plants and revegetating with native grasses as well as the butterflies' host and nectar plants.

4. Improve signage and fencing near access points at the base and top of Wolfback Ridge to inform the public of the presence of an endangered species and protected habitat.

B. Restore native plant communities.

Continue eradication of invasive non-native plants.

The greatest threat to the biodiversity of WBR at this time is the presence of invasive non-native plant species which are displacing native communities. Thus far, restoration efforts have focused on the removal of *Genista monspessulana* (French broom) and have been successful in eradicating most of the mature plants in or adjacent to the present Mission blue habitat. However, numerous problems remain. Slash left on site to prevent erosion and shade out broom seedlings, has been slow to decompose and may now be preventing native vegetation from re-establishing itself. Broom seedlings from the seed bank are numerous and wide spread. A number of other invasive species are now spreading in areas once covered by French broom. The following species are currently considered to be the most problematic for WBR (listed in alphabetical order):

acacia (<i>Acacia longifolia</i>)	Monterey pine(<i>Pinus radiata</i>)
cotoneaster (<i>Cotoneaster species</i>)	mustard (<i>Brassica campestris</i>)
eucalyptus (<i>Eucalyptus globulus</i>)	pampas grass (<i>Cortaderia jubata</i>)
eupatorium (<i>Ageratina adenophorum</i>)	poison hemlock (<i>Conium maculatum</i>)
fennel (<i>Foeniculum vulgare</i>)	radish (<i>Raphanus sativa</i>)
French broom (<i>Genista monspessulana</i>)	Scotch broom(<i>Cytisus scoparius</i>)
harding grass (<i>Phalaris tuberosa</i>)	striated broom (<i>Cystisus striatus</i>)
Italian thistle (<i>Carduus pycnocephalu</i>)	yellow star thistle (<i>Centaurea solstitialis</i>)

In developing control plans for non-native vegetation, priority will be given to patches in or bordering Mission blue butterfly habitat. Pioneer individuals will be removed as soon as they are identified. When mature individuals cannot for logistical reasons be removed in their entirety, seed heads will be removed prior to maturation each season in order to prevent seed dispersal. Where invasives occur in large patches, control efforts will be directed first along the edges and proceed gradually toward the center. Control and eradication techniques that minimize erosion will be favored where the slope is particularly dramatic or in drainages where seasonal runoff is anticipated.

Implementation:

1. Identify and map the distribution of invasive non-native plants in the Wolfback Ridge watershed. Update this information on a yearly basis.
2. Develop annual schedules of invasive species removal work days, giving priority to invasives within Mission blue butterfly habitat and those previously cleared areas in need of follow up work. Consult with the park botanist in order to coordinate volunteer activities with contracted conservation corps work.
3. Designate sensitive habitat as "micro-sites" to be rehabilitated slowly by small groups of trained co-stewards, rather than by groups of inexperienced volunteers.

4. Conduct regular patrols of the entire watershed, marking or removing pioneer invaders.
5. Monitor existing transect lines annually to detect changing patterns of vegetation and evaluate the success of control techniques. Establish new transects as needed to monitor vegetation dynamics which may influence future revegetation planning.
6. Develop a management plan for slash piles, downed trees and other decaying vegetative materials created by large-scale removal projects.
7. Continue compiling current information on invasive species control techniques from both GGNRA and non-GGNRA sources. Update **Appendix 3: Invasive Plant Species Removal Techniques** with the assistance of the Natural Resource staff as needed.

C. Continue revegetation of appropriate native plant species.

Prolonged grazing, military activity and extensive infestation by non-native plant species has severely compromised the diversity and integrity of the native plant communities found on WBR. Without active revegetation with native plant species, large areas currently dominated by non-native forbes and grasses are unlikely to convert to native grassland in the foreseeable future. Likewise, patches of disturbed soil caused by large scale weed removal, erosion and structural maintenance work will most likely be recolonized by aggressive non-natives. Carefully planned revegetation can tip the balance in favor of native species.

Revegetation at WBR will follow the protocol developed by the GGNRA and occur on a microsite scale. Sites needing revegetation will be identified, and individual restoration action plans will be written and submitted to the Resource Management and Planning Division for review. Highest priority will be given to sites within or bordering Mission blue butterfly habitat, areas heavily disturbed by invasive removal or construction, and areas prone to erosion. Composition and number of species to be outplanted or seeded will be determined on a site by site basis. Preference will be given to Coastal Terrace Prairie wherever possible in order to promote suitable habitat for the Mission blue butterfly.

Implementation

1. Identify microsites in need of revegetation and develop site-specific restoration action plans in accordance with GGNRA protocol.
2. Integrate revegetation activities such as data collection, planning, seed collection, propagation, monitoring and outplanting into annual management plans.
3. Maintain a close working relationship with the Tennessee Valley and Presidio nurseries to ensure all seeds and seedlings are properly maintained.
4. Develop strategies (i.e. mowing and planting regime) for converting non-native grasslands to native grasslands.
5. Continue observing the species composition of similar sights in the Marin Headlands to determine what components may be missing at WBR.

D. Maintain a limited supply of seeds and/or seedlings to facilitate revegetation after unforeseen soil disturbances.

Because of the proximity of Highway 101 and the presence of numerous subterranean utility lines in the Pumphouse Road area, WBR is subject to periodic unpredictable soil disturbance. Historically, invasive vegetation has been quick to take advantage of openings caused by sudden maintenance activities or accelerated erosion. The maintenance of a small supply of native grass seed and native scrub seedlings would facilitate rapid revegetation and prevent whole-sale takeover by invasives.

Implementation:

1. Develop a list of suitable native grass species for rapid revegetation of the portion of Pumphouse Road most frequently subjected to soil disturbance.
2. Develop an annual cycle of seed collection and propagation of those species deemed appropriate. Include plans for broadcasting any seed or outplanting any seedlings not utilized the previous year in "emergency" revegetation activities.
3. Monitor seeds and seedlings frequently to ensure nursery space is not wasted, that plants are not kept in the nursery more than one season, and ensure proper seed storage.

E. Assess riparian area and assist NPS staff in its restoration if needed.

Numerous culverts, storm drains and trash heaps have significantly altered the water flow through the riparian corridor on WBR. While it is unlikely that a free flowing water course can be restored, the removal of debris and the proper maintenance of water-diverting structures will do much to improve the health of the riparian corridor. Animal tracks and sightings indicate the area provides cover, forage and water for a variety of animal species. Rehabilitation efforts will focus on the removal of aggressive non-native plant species which are spreading up drainages into butterfly habitat. Native riparian vegetation will be seeded or planted throughout the corridor in order to enhance cover and forage. Efforts will be made to prevent erosion.

There is currently little data pertaining to water quality or micro fauna. The GGNRA Aquatic Biologist have toured the site and recommended a series of water quality tests to determine the extent and impact of highway run off.

Implementation:

1. Map seasonal and year-round flow throughout watershed, including natural seeps and man-made structures.
2. Determine the joint and separate responsibilities of the GGNRA and Caltrans in regards to maintaining, repairing or removing man-made structures such as culverts, storm drains and debris.
3. Analyze water quality by measuring pH, nitrogen and phosphorus levels. Test for the presence of hydrocarbons and heavy metals such as lead, zinc, mercury, arsenic and copper. Also analyze for bacteria and micro fauna.
4. Establish water depth and temperature monitoring station at the largest seep on the Caltrans right of way.

5. Develop a revegetation plan for the riparian corridor, focusing on the removal of non-native species and the restoration of a native riparian plant community.

F. Continue collecting data on the biotic and abiotic features of the site, while developing a long-term monitoring plan.

Because much about the ecology of WBR remains unknown and because the field of restoration ecology is relatively new, the ongoing collection of data is necessary in order to evaluate the impact of restoration activities on the site.

Implementation:

1. Design and implement a long-term wildlife inventory and monitoring program which can determine wildlife habitat relationships and detect gross changes over time.
2. Collect weather data (temperature, wind speed, relative humidity, cloud cover) whenever the site is visited.
3. Remove miscellaneous equipment such as rebar, plastic stakes, flags, lines and landscape fabric after the completion of any data collection or monitoring project.
4. Keep comprehensive records of all work performed on the site consistent with those methods used by the rest of the park.
5. Develop a system for storing and maintaining data collected with regards to the fauna on WBR. By working with City College of San Francisco and the NPS, a database of this information could be established.
6. Continue collecting information from such organizations as the Xerces Society, the California Exotic Pest Plant Council (CalEPPC), the California Native Plant Society (CNPS), and the California chapter of the Society for Ecological Restoration (SER-CAL).
7. Develop program to monitor the vegetation trends on the site.

G. Address social trail and erosion problems.

A series of social trails have developed as a result of ongoing work by conservation corps crews and the stewardship team. While work crews need access to restoration sites, visible trails may lure recreational visitors into sensitive habitat and lead to trampling.

Dog walkers, mountain bikers and cross country runners are currently using Pumphouse road and the social trail leading from the SCA trail to the old jeep road along the ridge top.

1. Survey social trails with NPS Roads and Trails staff and develop a control plan.
2. Limit trails to those necessary to the accomplishment of restoration activities such as weed removal, revegetation and Mission Blue monitoring.

3. Run necessary trails beside scrub where possible to prevent visual impact from the road and to limit damage to native grasslands and Mission blue habitat.
4. Develop eradication/revegetation plans for trails created by recreationists or work crews that are not essential to accomplishing restoration goals.
5. Monitor site for changes in off-trail use by the general public.
6. Improve signage along Pumphouse road and at the SCA/social trail junction.
7. Develop a system for reporting erosion problems to the appropriate NPS and Caltrans personnel.

H. Inventory cultural resources on site and work with NPS cultural resource staff to develop a management plan.

The south face of WBR is currently littered with numerous objects testifying to the watershed's varied history. A defunct power generator, two lines of fence posts, the remnants of two water tanks, assorted cement water diverters, and a few rusting car bodies adorn the scrub. While aerial photos have revealed that none of the vegetation on the south face of WBR results from military landscaping or camouflage efforts, some questions remain about the Torrey pines on the east face. The origin of these pines needs to be determined before any management goals can be set.

Implementation:

1. Determine which artifacts are cultural resources in need of protection and which are litter.
2. Develop a management plan with NPS cultural resources staff to preserve structures of historical significance.
3. Work with NPS maintenance staff and Caltrans to develop a removal plan for miscellaneous debris.

I. Continue development of a stable volunteer team to implement management objectives.

The management goals outlined in this plan could not be achieved without a committed and well trained core of volunteers. To this end, the WBR stewardship team has developed a partnership with City College of San Francisco (CCSF). With assistance from the Biology department, a work/credit exchange program has been designed which awards academic credit to students who participate in WBR-related activities for at least seven hours per week. This arrangement provides the stewardship team with a renewable, diverse pool of volunteers with a broad range of experiences and interests. Faculty are encouraged to integrate restoration-related material into their curriculum and to bring their classes out for field trips and work parties. The relationship between CCSF and GGNRA has generated an overwhelmingly positive response on both sides. Maintenance and controlled expansion will be of primary importance in the years to come.

Implementation:

1. Continue ongoing outreach to interested students within the CCSF Biology department, for those who would likely be the most interested participants in the stewardship program.
2. Meet with the Biology department head two months prior to upcoming semester to discuss the needs and direction of the stewardship program and make any necessary changes.
3. During the first 1-2 weeks of the new semester, make presentations to Biology department classes regarding the history and goals, as well as the opportunities available with the WBR stewardship team.
4. Provide new stewards with the necessary training and skills to foster a confidence within the stewardship team.

J. In cooperation with CCSF, GGNRA, and GGNPA, develop a transition program to select a new CCSF liaison when current department head leaves.

The unique program which has developed between CCSF and the GGNRA has been very successful. The current department head of the Biology department at CCSF has played a vital role in the upstart and continuing development of this program. Unfortunately, he will only be around for a couple of more years, creating the eventual need for someone else to take his place as liaison between CCSF and GGNRA.

Implementation:

1. If new liaison is not the new department head, selecting a full-time faculty member will guarantee continuity because of their full-time status.
2. As a partner in this project, the National Park Service can participate in the selection process by:
 - a) Requesting that duties and responsibilities be written into job description, whether liaison is full time faculty or department head.
 - b) Assisting as advisors to the hiring committee for the selection of the new liaison.
 - c) Requesting from the CCSF chancellor or college board, perhaps by the Park Superintendent, that an incentive in the form of a unit of release time be given to the new liaison.
3. To insure genuine interest and knowledge of the program, select new liaison from appropriate area of Biology department; ie, Ecology or General Biology.

K. Develop outreach and environmental education for the local community to foster an appreciation of the value of protecting and preserving natural resources within public lands.

The emphasis of community outreach at WBR has thus far focused on developing and maintaining a relationship between GGNRA and the Biology department at City College of San Francisco. This program provides WBR with a committed core of volunteers drawn from a pool of students with a diversity of field experience, educational, and ethnic backgrounds.

It also ensures a self-renewing resource base as new students learn of the unique educational opportunities offered through this program.

Implementation:

1. Work with CCSF Biology Department faculty to promote WBR as an educational site where students can receive extra credit and fulfill community service requirements by spending several hours on WBR participating in educational and work field trips.
2. Develop a formal cooperative agreement with the National Park Service and CCSF which outlines specific elements of the partnership.
3. Develop ongoing communication between the WBR stewardship team and organizations such as California Native Plant Society (CNPS), the Xceris Society, The California Exotic Pest Plant Council (Cal-EPPC), and the California chapter of the Society for Ecological Restoration (SER-CAL).
4. Establish a working relationship between members of the stewardship team and a member of one of the above organizations to promote greater understanding for stewards and possibly prolong the length of stewardship participation.
5. The preparation of a pamphlet explaining the ecological problems occurring at WBR and the efforts to solve those problems. The pamphlet could include information on volunteer opportunities and be made available through the Biology office at City College.

L. Develop and maintain positive working relationships with staff from the National Park Service including those from the Division of Resource Management and Planning, Interpretation, Maintenance, Roads and Trails, Law Enforcement, and Park Police.

Cooperation and communication between the Wolfback stewardship team and the GGNRA staff is essential to the success of any restoration efforts. Joint planning regarding invasive plant control, revegetation, monitoring and maintenance will enhance the overall ecological health of the watershed. Much of the information gathered in the field by stewardship team members will be of interest to NPS staff. Likewise, the experience and guidance of NPS staff are invaluable to the stewards.

Implementation:

1. At the start of each work year (Aug through July), submit the annual stewardship goals to NPS staff for suggestion and commentary.
2. Consult the park botanist every August and February regarding cyclical maintenance funding and planned use of conservation corp crews.
3. Compile and distribute data and information collected on site to the appropriate divisions.
4. Obtain copies of any data collected on WBR by NPS biological technicians and consultants.

5. Invite NPS from various divisions to the monthly stewardship meetings.
6. Distribute copies of the quarterly newsletter and monthly minutes to NPS staff.
7. Take stewardship team on occasional "field trips" to other sites throughout the GGNRA.
8. Notify Law Enforcement or Park Police of any large work parties that may need special attention.

M. Develop ongoing communication with Caltrans concerning highway right-of-way maintenance, landscaping, erosion and hydrology problems.

The Caltrans rights-of-way along Highway 101, Alexander Avenue and Danes Drive have a significant impact on the overall ecology of WBR. Historically, invasive vegetation has spread from the rights-of-way onto GGNRA managed land. In 1991, Caltrans and the GGNRA entered a cooperative effort to remove French broom from the right-of-way below Highway 101. Caltrans submitted a proposal to the GGNRA to brush cut in the spring of 1991, with their efforts continuing in both 1993 and 1994. As of May 1995, plans to spray resprouts with a foliar application of Garlon have not been carried out. While communication between Caltrans and the GGNRA has improved significantly during this process, the establishment of a stronger relationship could prevent future misunderstandings concerning revegetation, road access, and storm drainage maintenance. See pages 7-8 of "Butterfly Habitat Restoration Project: Concluding Document"(Nelson, 1994) for detailed account of Caltrans activity on Wolfback Ridge.

Implementation:

1. Establish and maintain contact with a Caltrans representative or identify a NPS liaison to do so.
2. Develop a system of reporting erosion, drainage, landscaping or other maintenance problems to both the proper division within the GGNRA and within Caltrans.
3. Request that Caltrans notify the GGNRA and the stewardship team of any planned activity on the site by Caltrans itself or by contractors prior to its commencement.

N. Develop a comprehensive, long-term restoration action plan for the east facing slope of Wolfback Ridge.

To date, the stewardship team has focused its efforts on the south facing slopes of WBR where the Mission blue butterfly and its host plants can be found. Within the next five years, the French broom problem will be largely under control. Other invasive vegetation, while present, appears unlikely to spread into and dominate Mission blue habitat in the foreseeable future. However, large mono-stands of French broom and a grove of Torrey pines on the east facing slope do pose a threat to the integrity of the south face.

As the need for work on the south face diminishes, attention should be given to the east face. The lack of previous work in this relatively isolated area makes this an ideal situation for the collection of data regarding the habitat for the Mission blue butterfly which is contingent on existing habitat and analyzing the impact of restoration activities.

Implementation:

1. Develop criteria for judging the success of restoration efforts on the south facing slope to ensure equipment and human resources are not prematurely diverted to the east-facing slope.
2. Determine how volunteers can gain access to the site without passing through previously restored Mission blue butterfly habitat.
3. Determine exact boundaries of the GGNRA on the north and east-facing slopes.
4. Research the cultural history of the site, paying particular attention to the period in which East Fort Baker was active.
5. Estimate long-term funding, equipment and labor needs for an east face restoration.
6. Prior to commencing any broom removal activities on the east face, collect baseline data pertaining to its flora and fauna for a minimum of one year.

X. Special Considerations:

1. The upper elevations of Wolfback Ridge support a colony of the federally listed endangered Mission blue butterfly. All restoration and maintenance plans should be evaluated for potential impact on Mission blue habitat.
2. The California Department of Transportation (Caltrans) has easement rights on the land immediately bordering Highway 101. Highway maintenance and mitigation projects will necessitate periodic construction and re-landscaping along the Caltrans right-of-way. Likewise, water, gas, and electrical lines underneath Pumphouse Road require maintenance. Restoration plans should account for these periodic disturbances and work to minimize adverse impacts.
3. Activity on Wolfback Ridge is easily visible to motorists on Highway 101 and Danes Drive. All activities should be evaluated to visual disturbances and potential hazards. Caltrans should be notified of major projects such as large scale tree removal.

APPENDIX 1: GEOLOGY OF WOLFBACK RIDGE

The core rocks of the Marin Headlands are a Jurassic-Cretaceous (225-125 million years ago) accretionary complex, named for their proximity, the Franciscan Assemblage. During the Nevadan Orogeny (225 mya), a deep-sea trench, the Franciscan geosyncline, was formed far away from the continental margin. While ocean-floor sediments and radiolarian ooze were being deposited, subductive wedging was pushing the trench higher until approximately 30 million years ago. The East Pacific Rise collided with the west-moving North American Plate, elevating the Franciscan Trench out of the sea to form the Coastal range. (Blake, Honell, Jayko; 1984).

The Franciscan Assemblage (one of two core assemblages in the Coastal range) is further subdivided into seventeen terranes. The Marin Headlands Terrane is separated from the neighboring Central Terrane by the Mount Tamalpais thrust fault and is isolated from related blocks of Marin Terrane found at Twin Peaks and the Coyote Hills. It is also suggested that the Marin Headlands were rotated 120° counter clockwise during its uplift (Wahrhaftig, 1984).

The dominant components of Marin Headlands Terrane found at Wolfback Ridge are altered greenstone basalts, bedded radiolarian cherts and a capping of clastic sedimentary rocks of siliceous graywacke sandstones. The much-studied cherts record over 100 million years of oceanic sedimentation shown by seven radiolarian assemblages. Radiolarian cherts are weather-resistant and therefore, form most of the ridge-tops and slope sides. The complete absence of a calcium carbonate fossil record in the franciscan assemblage validates the theory of deep sea deposition (greater than 3000 meters), given that CaCO_3 dissolves at these depths.

APPENDIX 1: FAUNA OF WOLFBACK RIDGE

As of this writing, a WHR report has been run on the fauna most likely to exist at Wolfback Ridge. It is currently being adjusted to show a more true listing of the species which are thought to reside there.

APPENDIX 2: GEOLOGY OF WOLFBACK RIDGE

The core rocks of the Marin Headlands are a Jurassic-Cretaceous (225-125 million years ago) accretionary complex, named for their proximity, the Franciscan Assemblage. During the Nevadan Orogeny (225 mya), a deep-sea trench, the Franciscan geosyncline, was formed far away from the continental margin. While ocean-floor sediments and radiolarian ooze were being deposited, subductive wedging was pushing the trench higher until approximately 30 million years ago. The East Pacific Rise collided with the west-moving North American Plate, elevating the Franciscan Trench out of the sea to form the Coastal range. (Blake, Honell, Jayko; 1984).

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APPENDIX 3: INVASIVE PLANT SPECIES REMOVAL TECHNIQUES

As research into invasive species management is ongoing and NPS protocol subject to change, it will be necessary to periodically update the information below. Ongoing monitoring may well prove the ineffectiveness of some methods while suggesting others. All proposed changes to control plans or additions of new species to the control list will be submitted to the Natural Resources Staff for review.

Controlled Species on Wolfback Ridge, 1995-1996:

acacia (<i>Acacia longifolia</i>)	cotoneaster (<i>Cotoneaster species</i>)
eucalyptus (<i>Eucalyptus glabulus</i>)	eupatorium (<i>Ageratina adenopnora</i>)
fennel (<i>Foeniculum vulgare</i>)	French broom (<i>Genista monspessulanus</i>)
harding grass (<i>Phalaris tuberosa</i>)	Italian thistle (<i>Carduus pyncephalus</i>)
Monterey pine (<i>Pinus radiata</i>)	mustard (<i>Brassica campestris</i>)
pampas grass (<i>Cotendera jubata</i>)	poison hemlock (<i>Conium maculatum</i>)
Scotch broom (<i>Cystisus scoparius</i>)	striated broom (<i>Cystisus striatus</i>)

Recommended Control Treatments:

Acacia (*Acacia longifolia*)

There are currently three groves of acacia Wolfback's southern slope, totally eighty-seven individuals. Isolated seedlings are spreading out from the established groves. The stewardship team has submitted a restoration action plan to Project Review which calls for the removal of large trees by GGNRA foresters, followed by revegetation and monitoring. Seedlings under eight inches in diameter will be pulled up with weed wrenches where possible or top cut with hand saws and then covered with landscape fabric in order to prevent resprout. Stumps will be monitored for several years, and the landscape fabric will be removed once resprouting appears to have ceased.

Cotoneaster (*Cotoneaster species*)

Only a few cotoneaster have been found on Wolfback, and while slow to spread, they prove difficult to eradicate. Plants will be top cut with hand saws, and the stumps will be macerated before being covered with landscape fabric to prevent resprouts. Stumps will be monitored for several years, and the landscape fabric will be removed once resprouting appears to have ceased.

Eucalyptus (*Eucalyptus glabulus*)

A stand of thirty-nine eucalyptus is expanding in Mission Blue butterfly habitat. The stewardship team has submitted a restoration action plan to Project Review which calls for the removal of the established groves by GGNRA foresters, followed by revegetation and monitoring. Seedlings under eight inches in diameter will be pulled up with weed wrenches where possible or top cut with hand saws and then covered with landscape fabric in order to prevent resprout. Stumps will be monitored for several years; any resprouts will be removed with hand saws and painted with Round-up if necessary. Landscape fabric will be removed once resprouting appears to have ceased.

Eupatorium (*Ageratina adenophora*)

Well established in the riparian corridor and quite to colonized moist, disturbed areas, eupatorium has recently emerged as a major problem at Wolfback. Little information concerning successful control techniques is available. Hand pulling is effective for small, newly established plants but impossible in large stands. Because it is a rhizomous perennial, a single round of top cutting appears to encourage growth. Repeated brush cutting throughout the year will be tried. An experimental patch of brush-cut stumps covered with landscape fabric will also be monitored for successful control. In all cases, flower heads will be removed as they appear. In the event brush cutting and hand pulling prove ineffective or overly inefficient, herbicide application by a contractor should be considered.

Fennel (*Foeniculum vulgare*)

Most fennel is currently concentrated along Pumphouse Road and on the Dane's Drive right-of-way, although pioneer plants are appearing in butterfly habitat. Small plants can be dug out of the ground. In the short term, large plants should be cut down to the ground each spring before they are able to produce flower head. In the long term, application of herbicides will be necessary.

French broom (*Genista monspessulanus*)

Until recently, French broom was the dominant species at Wolfback Ridge. Four years of intensive removal by conservation corp crews and stewardship volunteers have removed most of the adult plants, but the historic seed bank is far from exhausted. The stewardship strategy to date consists of revisiting previously cleared areas every rainy season when the soil is loose. Flowering plants and those deemed large enough to produce flowers within the next year (usually those with woody stems) are removed with weed wrenches. The goal is prevent new seeds from developing while the historic seed bank is depleted. Once the major flushes are under control, only periodic sweeps will be necessary to keep the broom under control. In areas where the possibility of erosion precludes pulling broom up by the roots, individuals will be top cut at the height of the drought season and the stumps will be flayed to encourage desiccation and disease.

Because broom seedling continue to be abundant in Mission Blue butterfly habitat, a series of microsites will be established. Small, trained groups of co-stewards will be responsible for the removal of broom from these micro-sites. Where large stands of broom still exist and the habitat is not deemed particularly sensitive, larger work parties of less experienced volunteers will be used.

Cleared of broom in March of 1994, the Caltrans right-of-way has not received any follow up attention. Resprouts and seedlings threaten to overtake the entire slope below Highway 101. Negotiations with Caltrans concerning ongoing maintenance of the right-of-way is necessary.

Harding grass (*Phalaris tuberosa*)

Originally appearing along Pumphouse Road after a pipeline excavation in 1991, harding grass is starting to spread up the riparian corridor and into the drainages. A rhizomonous, perennial bunch grass, it is difficult to dig out entirely. Repeated brush cutting has been suggested as a control method, beginning in February and continuing monthly until the root stock has been exhausted. Continual monitoring will be necessary to ensure brush cutting occurs frequently enough to prevent seeds from maturing. Small pioneering bunches can be dug out with a pulaski. Revegetation plans for areas with dense harding grass stands will be developed.

Italian thistle (*Carduus pynoccephalus*)

Occurring throughout the watershed, Italian thistle immediately moves into areas disturbed by large scale broom removal or construction. Where large stands develop, it can be brush cut during the spring before seeds have begun to develop. Brush cut patches will be monitored. Additional infestation can be decreased by limiting soil disturbance and increasing revegetation efforts.

Monterey pine (*Pinus radiata*)

A grove of thirteen eucalyptus is expanding up a drainage, into Mission Blue butterfly habitat. Numerous lone trees now dot the upper slopes. The stewardship team has submitted a restoration action plan to Project Review which calls for the removal of the established grove by GGNRA foresters, followed by revegetation and monitoring. Seedlings under eight inches in diameter will be pulled up with weed wrenches where possible or top cut with hand saws.

Mustard (*Brassica campestris*)

Widely dispersed across Wolfback Ridge mustard is an opportunistic annual that colonizes disturbed soil. Rosettes can be easily removed by hand or with a pick-and-hoe tool. Flowering plants can also be top cut with brush cutters or hand sickles. Mustard is not a high priority.

Pampas grass (*Cortaderia jubata*)

Pampas grass appears to be spreading from the Caltrans right-of-way below Highway 101 on the steep slopes Caltrans right-of-way into the drainages on GGNRA managed land. Many plants are located on steep slopes where footing is poor; they have proved difficult to dig out. In the short term, plumes on both park land and the Caltrans right-of-way will be removed every summer before seeds are dispersed. Pioneer plants found in drainages will be removed entirely by digging the root balls with pulaskis. In the long term, arrangements should be made with Caltrans to keep the right-of-way pampas grass free.

Poison hemlock (*Conium maculatum*)

The riparian corridor and moister drainages are heavily infested with poison hemlock. Any control efforts should be part of a larger revegetation plan, because broad removal will decrease cover and perhaps lead to increased erosion in the drainages. Infested areas can be brush cut in the spring before flower heads have a chance to mature.

Scotch broom (*Cystisus scoparius*) and striated broom (*Cystisus striatus*)

Both scotch and striated broom occur in steep drainages and on the land directly over the Waldo tunnel. Because neither plant produces a single stem it is difficult to uproot with a weed wrench. The uprooting of large roots balls may also lead to erosion. It is therefore preferable to top cut scotch and striated broom at the height of the draught season. If the stumps are macerated, resprouts are unlikely. Cleared areas should be monitored for resprouts which can be covered with landscape fabric if abundant.

APPENDIX 4: FLORA OF WOLFBACK RIDGE

SCIENTIFIC NAME	COMMON NAME	NATIVE
<i>Achilea millefolium</i>	yarrow	yes
<i>Anagallis arvensis</i>	scarlet pimpernel	
<i>Artemesia californica</i>	sage brush	yes
<i>Artemesia douglasiana</i>	mugwort	yes
<i>Aster chilensis</i>	california aster	yes
<i>Aster radulinus</i>	broad leaf aster	yes
<i>Avena barbata</i>	wild oat	
<i>Avena fatua</i>	wild oat	
<i>Baccaris pilularis</i>	coyote brush	yes
<i>Brassica rapa</i>	common mustard	
<i>Brodiaea elegans</i>	harvest brodiaea	yes
<i>Brodiaea hycinth</i>	wild hyacinth	yes
<i>Brodiaea terrestris</i>	dwarf brodiaea	yes
<i>Bromus carinatus</i>	california brome	yes
<i>Bromus diandrus</i>	ripgut	
<i>Bromus hordeaceus</i>	soft chess	
<i>Bromus rubens</i>	foxtail brome	
<i>Calandrinia ciliata menziesii</i>	red maids	yes
<i>Calystegia occidentalis</i>	bush morning glory	yes
<i>Calystegia purpurata</i>	purple western morning glory	yes
<i>Cardamine californica</i>	california toothwort	yes
<i>Cardamine oligosperma</i>	bitter cress	yes
<i>Carduus pycnocephalus</i>	italian thistle	
<i>Carex sp.</i>	sedge	yes
<i>Castilleja wightii</i>	indian paintbrush	yes
<i>Chamomilla suaveolens</i>	pineapple weed	
<i>Chlorogalum pomeridianum divaricatum</i>	soap plant	yes
<i>Cirsium occidentale</i>	cob web thistle	yes
<i>Cirsium quercatorum</i>	brownie thistle	yes
<i>Cirsium vulgare</i>	bull thistle	
<i>Claytonia perfoliata</i>	miners lettuce	yes
<i>Colochortus albus</i>		
<i>Conium maculatum</i>	poison hemlock	
<i>Convolvulus arvensis</i>	orchard morning glory	
<i>Cortaderia selloana</i>	pampas grass	
<i>Cynosurus echinatus</i>	dogtail grass	
<i>Cytisus scoparius</i>	scotch broom	
<i>Cytisus striatus</i>	striated broom	
<i>Daucus pusillus</i>	rattlesnake weed	yes
<i>Dechampsia caespitosa</i>	california hairgrass	yes
<i>Dichilostema pulchellum</i>	blue dicks/wild hyacinth	yes
<i>Dodecatheon hendersonii cruciatum</i>	shooting star	yes
<i>Dudleya farinosa</i>	sea lettuce/bluff lettuce	

SCIENTIFIC NAME	COMMON NAME	NATIVE
Echium fastuosum	pride of midiera	
Echium wildpretii	tower of jewels	
Elymus glaucus	blue wild rye	yes
Erechtides sp.	fireweed	
Eriogonum latifolium	coast eriogonum	yes
Erodium brachycarpum	filaree	
Eschscholzia californica	california poppy	yes
Eucalyptus globulus	blue gum/eucalyptus	
Eupatorium adenophorum	western goldenrod/thoroughwort	
Festuca californica	california fescue	yes
Festuca rubra	red fescue	yes
Foeniculum vulgare	fennel	
Galium trifidum	bedstraw	yes
Gaura parviflora	lizard tail	yes
Genistra monosperma	french broom	
Geranium dissectum	cut-leaved geranium	
Gnaphalium sp.	cudweed	yes
Heracleum lanatum	cow parsnip	yes
Heteromeles arbutifolia	toyon/christmas berry	yes
Heterotheca bolanderi	golden aster	yes
Holcus lanatus	velvet grass	
Hordeum sp.	barley	
Hypochoeris radicata	hairy cats-ear	
Juncus sp.		
Lolium multiflorum	italian rye grass	
Lonicera hispidula	california honeysuckle	yes
Lupinus albus	silver leaf lupine	yes
Lupinus bicolor	annual lupine	yes
Lupinus varicolor	varied lupine	yes
Madia anomala	tarweed	yes
Marah fabaceus	wild cucumber	yes
Melica sp.		yes
Mentha pulegium	pennyroyal	
Mimulus aurantiacus	sticky monkey flower	yes
Mimulus guttatus	common monkey flower	yes
Nasturtium officinale	watercress	
Oxalis sp.	sour grass	
Phacelia distans	wild heliotrope	yes
Phalaris aquatica	harding grass	
Physocarpus sp.	ninebark	
Pickeringia montana	chaparral pea	yes
Pinus radiata	monterey pine	
Plantago sp.	plantain	
Polygonum sp.	knotweed	
Pteridium aquilinum	bracken fern	yes
Pyroantha crenato-serrata	firethorn	
Quercus agrifolia	coast live oak	yes
Raphanus sativus	wild radish/jointed charlock	

SCIENTIFIC NAME	COMMON NAME	NATIVE
Ranunculus californicus	california buttercup	yes
Rhamnus californica	coffee berry	yes
Rubus discolor	himalayan blackberry	
Rubus ursinus	california blackberry	yes
Rumex sp.	dock	yes
Salix lasiolepis	arroyo willow	yes
Sanicula actopoides	footsteps of spring	yes
Satureja douglasii	yerba buena	yes
Scrofularia californica	california bee plant	yes
Sidalcea sp.	checkermallow	yes
Silybum marianum	milk thistle	
Sisyrinchium bellums	blue-eyed grass	yes
Solonum sp.	nightshade	
Sonchus oferaceus	sow thistle	
Stachys sp.	hege nettle	yes
Toxicodendron diversilobum	poison oak	yes
Wassela pulchra		

Appendix 5: Summary of Broom Removal and Revegetation at Wolfback Ridge 1991-1995

The following table was compiled from stewardship team vegetation notes (1994-1995), MCC Broom Removal notes (1991-1993) and Appendix A of "Butterfly Habitat Restoration Project: Concluding Document" (Nelson, April 1994). The Various recorders did not use the same system to indicate plot locations. The area names below follow the table in Appendix A of "Butterfly Habitat Restoration Project: Concluding Document" (Nelson, 1994) and represent a compromise. It should also be noted that no clear boundaries exist in the field. Work performed in neighboring areas often overlapped. Map

Area Description	Date Initially Cleared	Follow-up	Revegetation Notes	
1	Above Waldo Tunnel	May 91-- MCC hand-pulled french, striated broom with weed wrench.	April, July 93--MCC April 94--MCC Oct 94--MCC Jan, Feb 95--volunteers	
2	Ridge #1: Near Cal-trans fence	May 91-- MCC hand-pulled french, striated broom with weed wrench.	May 93--MCC April 94--MCC Oct 94--volunteers	May 91--MCC seeded <i>Bromus carinatus</i> and <i>Stipa pulchra</i> . May 1995-- <i>Stipa</i> plentiful. <i>Bromus</i> present but sparse.
3	Drainage #1	May 93-- MCC hand-pulled french, striated broom with weed wrench.	April 94--MCC Oct 94--volunteers	May 91--MCC seeded <i>Bromus carinatus</i> and <i>Stipa pulchra</i> . May 1995-- <i>Stipa</i> plentiful. <i>Bromus</i> present but sparse.
4	Ridge #2: Erosion gully	May 91-- MCC hand-pulled french, striated broom with weed wrench.	April 94--MCC	May 91--MCC seeded <i>Bromus carinatus</i> and <i>Stipa pulchra</i> . Oct 91--MCC seeded with <i>Elymus glaucus</i> . Apr 94-- <i>Lupinus arboreus</i> seedlings outplanted by volunteers. Only 4 found 1995. May 95-- <i>Bromus carinatus</i> abundant.
5	Ridge #2: West side	April, May, July, Sept 92-- MCC hand-pulled french, striated broom with weed wrench.	May 94--MCC Sept, Nov 94--volunteers Feb, Mar 95--volunteers	
6	Ridge #2: Big Patch	May 93 and March, April 94-- MCC hand-pulled french, striated broom with weed wrench.	Sept, Nov 94--volunteers Feb, Mar 95--volunteers	

Map	Area Description	Date Initially Cleared	Follow-up	Revegetation Notes
7	Drainage #2: Above eucalyptus	May 91, Aug 92-- MCC hand-pulled french, striated broom with weed wrench.	May 92--MCC Mar 94--MCC, CCC Oct 94--volunteers	May 91--MCC seeded <i>Bromus carinatus</i> and <i>Stipa pulchra</i>
8	Drainage #2: Curlex site	Oct 91-- MCC hand-pulled french, striated broom with weed wrench.	Mar 94--MCC, CCC Feb, Mar 95--volunteers Mar, April 95--MCC	Oct 91--MCC seeded with <i>Baccharis</i> and <i>Artemisia</i> , then laid down curlex. Seeded with <i>Elymus glaucus</i> and <i>Bromus carinatus</i> . Feb 1992--Returning vegetation mostly <i>Avena</i> and <i>Vulpia</i> , with some <i>Lupinus albus</i> .
9	Drainage #2: From plums to pines	Feb, Jul 92-- MCC hand-pulled french, striated broom with weed wrench.	Mar 94--MCC, CCC Dec 94--volunteers	
10	Drainage #2: Above pines	Aug 92--hand-pulled French broom with weed wrenches by MCC	Mar 94--MCC, CCC Mar, April 95--MCC	
11	Ridge #3: Above Ed's Rock	May 91-- MCC hand-pulled french, striated broom with weed wrench.	April 95--volunteer	May 91--MCC seeded <i>Bromus carinatus</i> and <i>Stipa pulchra</i> . May 95-- <i>Stipa</i> and <i>Bromus</i> sparse or absent.
12	Ridge #3: Experimental plots	Jul 91--Various techniques used by MCC	Apr 93--MCC Apr 94--volunteers Feb, Mar 95--volunteers	Jul 91-- <i>Festuca rubra</i> seeded in some plots. May 95--Area dominated invasive <i>Briza maxima</i> . <i>Festuca</i> can be found further up the slope.
13	Ridge #3: Around tank pits	Jan, Feb 92-- MCC hand-pulled french, striated broom with weed wrench.	May 93--MCC April, Jul 94--volunteers Oct-Dec 94--volunteers Feb, Mar 95--volunteers	Jan 92--MCC seeded with <i>Elymus glaucus</i> and <i>Bromus carinatus</i> . 1992-- <i>Stipa</i> plugs outplanted near knoll. May 95--Various native grasses are mixed with non-natives. <i>Elymus glaucus</i> found only near riparian.
14	Ridge #3: Above plots	Jun 92-- MCC hand-pulled french, striated broom with weed wrench.	April 94--volunteers April 95--volunteers	Jun 92--MCC seeded with <i>Bromus carinatus</i> . May 1995-- <i>Bromus carinatus</i> not found.
15	Ridge 3: West of plots	Jun 92-- MCC hand-pulled french, striated broom with weed wrench.	May 94--MCC, CCC Apr, Dec 94--volunteers Feb, Mar 95--volunteers	

Map	Area Description	Date Initially Cleared	Follow-up	Revegetation Notes
16	Ridge 3: East of plots	Jun 92-- MCC hand-pulled french, striated broom with weed wrench.	Apr 94--volunteers Feb, Mar 95--volunteers	
17	Drainage #3: upper only	Jun 91-- MCC hand-pulled french, striated broom with weed wrench.	May 93--MCC April 95--volunteers	
18	Drainage #3: Bottom of drainage	Oct, Nov 91-- MCC hand-pulled french, striated broom with weed wrench.	May 93--MCC Mar 94--volunteers Mar 95--volunteers	Oct 91--MCC seeded with <i>Elymus glaucas</i> .
19	Drainage #3: Mid section	Aug, Sept 92-- MCC hand-pulled french, striated broom with weed wrench.	May 93--MCC Mar 94--volunteers Mr 95--volunteers	Sept 92--MCC seeded with native grass--species not recorded.
20	Ridge #4: Upper	Jun 91-- MCC hand-pulled french, striated broom with weed wrench.		Oct 91-- <i>Festuca rubra</i> seeded in Nov 91--MCC seeded with <i>Elymus glaucas</i> and <i>Bromus carinatus</i> . May 95--No <i>Elymus</i> or <i>Bromus</i> present. <i>Festuca</i> can be found.
21	Ridge #4: Lower	Nov 91-- MCC hand-pulled french, striated broom with weed wrench.	Mar 94--volunteers Feb, Mar 95--volunteers	Oct 91-- <i>Festuca rubra</i> seeded in Nov 91--MCC seeded with <i>Elymus glaucas</i> and <i>Bromus carinatus</i> . May 95--No <i>Elymus</i> or <i>Bromus</i> present. <i>Festuca</i> can be found.
22	Lower Ridge 3	Apr 92--Cut and sprayed with 50% solution of roundup	Apr 93--resprayed Mar 94--volunteer pull Jul 94--MCC/CCC pull Mar 95--MCC pull Mar 95--volunteer pull	1993-- <i>Stipa</i> plugs outplanted.
23	Pumphouse Road:A	Nov 91--Native scrub and French broom removed by heavy machinery	Jul 93--MCC pulled Mar 95--volunteers brushcut	
24	Pumphouse Road:B			

Map	Area Description	Date Initially Cleared	Follow-up	Revegetation Notes
25	Pumphouse Road:C			
26	Grasslands near Caltrans right-of-way			
27	West side of Highway 101, above tunnel	July 93-- MCC hand-pulled french, striated broom with weed wrench.	Mar 94--volunteers Jan 95--volunteers	

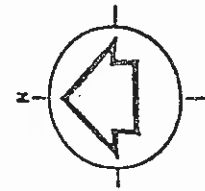
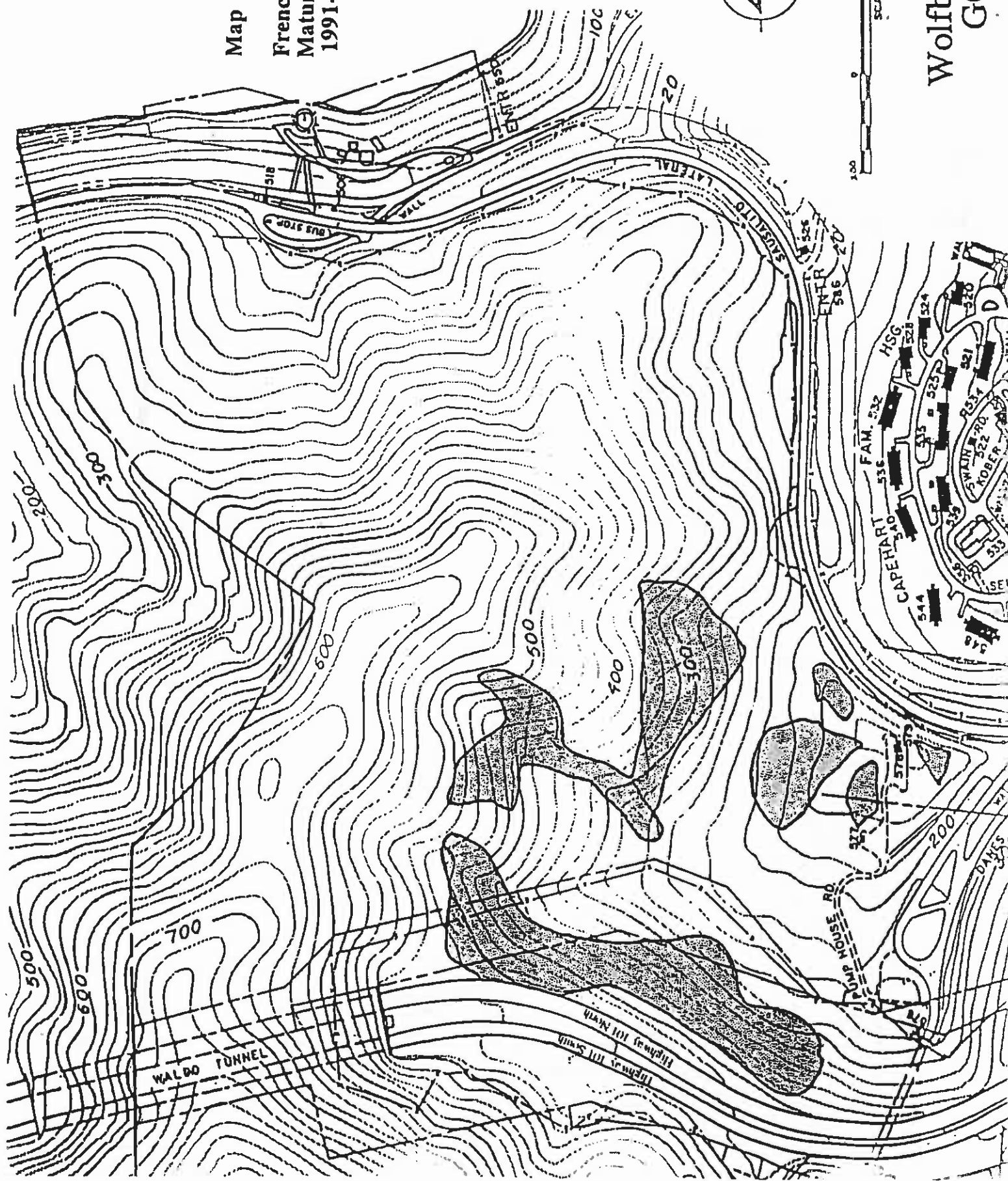
Appendix 7: Wolfback Ridge Yearly Non-Indigenous Plant Control Cycle

	French Broom	Striated Broom	Eupatorium	Pampas Grass	Harding Grass	Italian Thistle	Eucalyptus/ Acacia/ Monterey Pines
AUG		Top cut and masticate stumps.		Remove plumes and dig out root ball of pioneers.			Remove trees under eight inches in diameter.
SEP		Top cut and masticate stumps.		Remove plumes and dig out root ball of pioneers.			Remove trees under eight inches in diameter.
OCT			Establishment of experimental treatment plots				Remove trees under eight inches in diameter.
NOV			Establishment of experimental treatment plots.				Remove trees under eight inches in diameter.
DEC	Prioritize problem sites. Pull with weed wrenches.						
JAN	Prioritize problem sites. Pull with weed wrenches.						
FEB	Pull with weed wrenches.		Prioritize problem sites.				
MAR	Pull with weed wrenches.		Brush cut or remove flower heads.		First brush cutting. Dig out root balls of pioneer plants.		
APR	Pull with weed wrenches.		Brush cut or remove flower heads.		Second brush cutting.	Identify problem patches.	
MAY			Brush cut or remove flower heads.		Third brush cutting.	Brush cut.	
JUN			Brush cut or remove flower heads.		Brush cut if necessary.	Brush cut.	
JUL							Remove trees under eight inches in diameter.

Appendix 8: Wolfback Ridge Yearly Restoration Cycle

	PLANNING	TRAINING	* REVEGETATION	MONITORING	MISSION BLUE	COMMUNITY OUTREACH
AUG	Recruit new stewards. Schedule fall trainings and work parties.	New co-steward orientation.	Seed collection. Plant propagation.			Visit CCSF classes
SEP		Invasive plant /scrub ID. Photo monitoring. Brush density transecting.	Seed collection. Plant propagation.			Newseletter Visit CCSF classes
OCT		Plant ID. Revegetation Planning. Tool Use.	Seed collection. Plant propagation.			
NOV	Plan outplanting activities for raining season.	Wildlife track and bird ID. Planning/management/ leadership skills.				
DEC	Begin mapping french broom problem areas	Nursery procedures.	Outplanting.			Newseletter
JAN	Recruit new stewards. Schedule spring work parties.	New co-steward orientation. Invasive plant ID. Planning/management.	Outplanting.		Contact Fish and Wildlife specialist regarding flight season activities.	Visit CCSF classes
FEB		Mission Blue life cycle and ID. Revegetation. Brushcutter training.	Outplanting		Begin monitoring butterfly transects	Visit CCSF classes
MAR	Identify herbaceous Invasive problem sites	Spring flower ID. Revegetation planning. Photo monitoring.	Outplanting. Identify future revegetation sites. Write restoration action plans	Take landscape photo from base of ridge, end of the month.	Monitor butterfly transects.	
APR		Grass ID. Point Intercept transecting.	Outplanting. Identify future revegetation sites. Write restoration action plans	Begin vegetation transects towards end of month	Monitor butterfly transects	Newseletter
MAY	Asses previous year's work.	Nursery procedures.	Seed collection. Plant propagation.	Complete vegetation transects	Monitor butterfly transects.	
JUN	Identify problem sites. Define goals for the year.		Seed collection. Plant propagation.		End of transect monitoring.	Newseletter
JUL	Define labor and training needs for the year.		Seed collection. Plant propagation.			

Map B-1)
 French Broom
 Mature Stands
 1991-1992



Wolfback Ridge
 GGNRA

Map B-2)

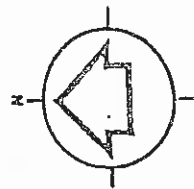
French Broom Stands
1995

 Mature stand

 Young seedlings

NOTE:

While only one major stand
of French Broom remains, see
continue to dominate in many



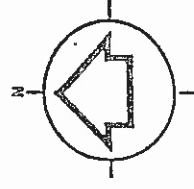
Wolfback Ridge
GGNRA



Map C) Trees

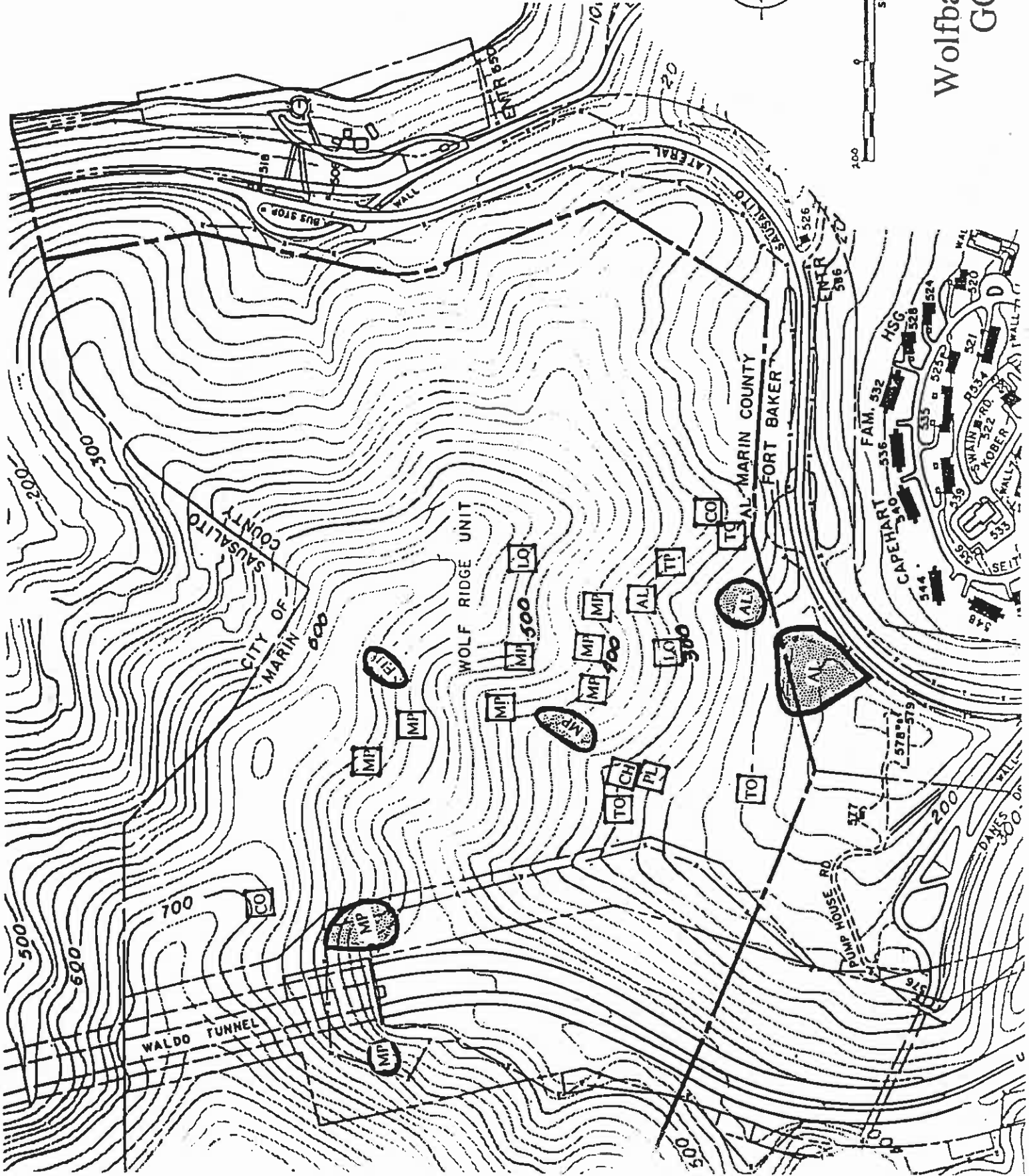
Legend

- (EU) Eucalyptus
- (LO) Coastal Liv
- (TO) Toyon
- (CH) Cherry
- (PL) Plum
- (TP) Torrey Pine
- (AL) Acacia Lon
- (MP) Monterey P
- (CO) Cotoneaste
- (□) Lone tree



SCALE IN FEET
0 100 200

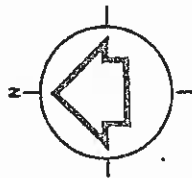
Wolfback Ridge GGNRA



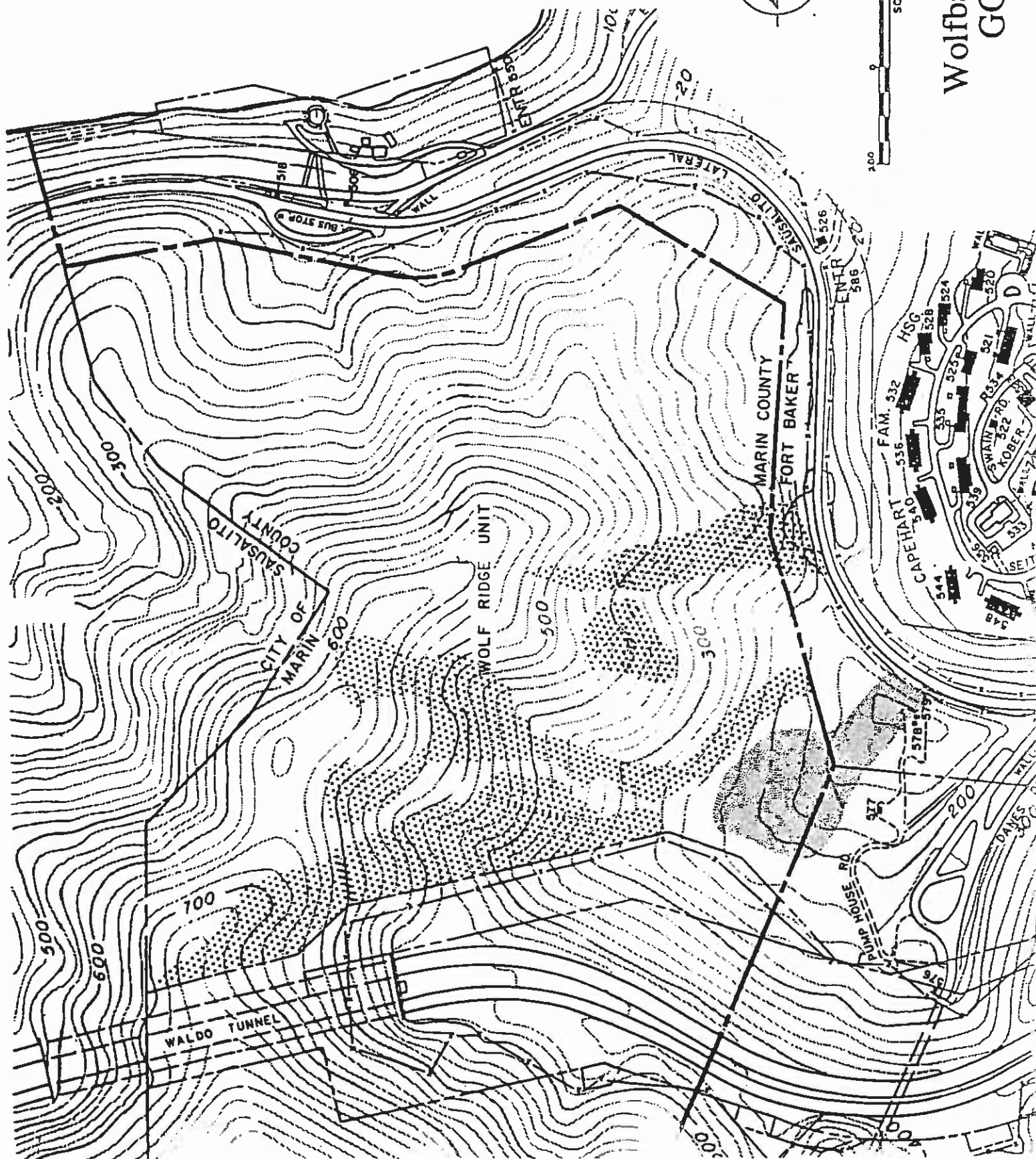
Map D) General Vegetal

Legend

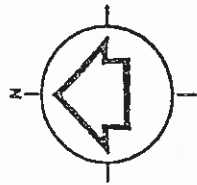
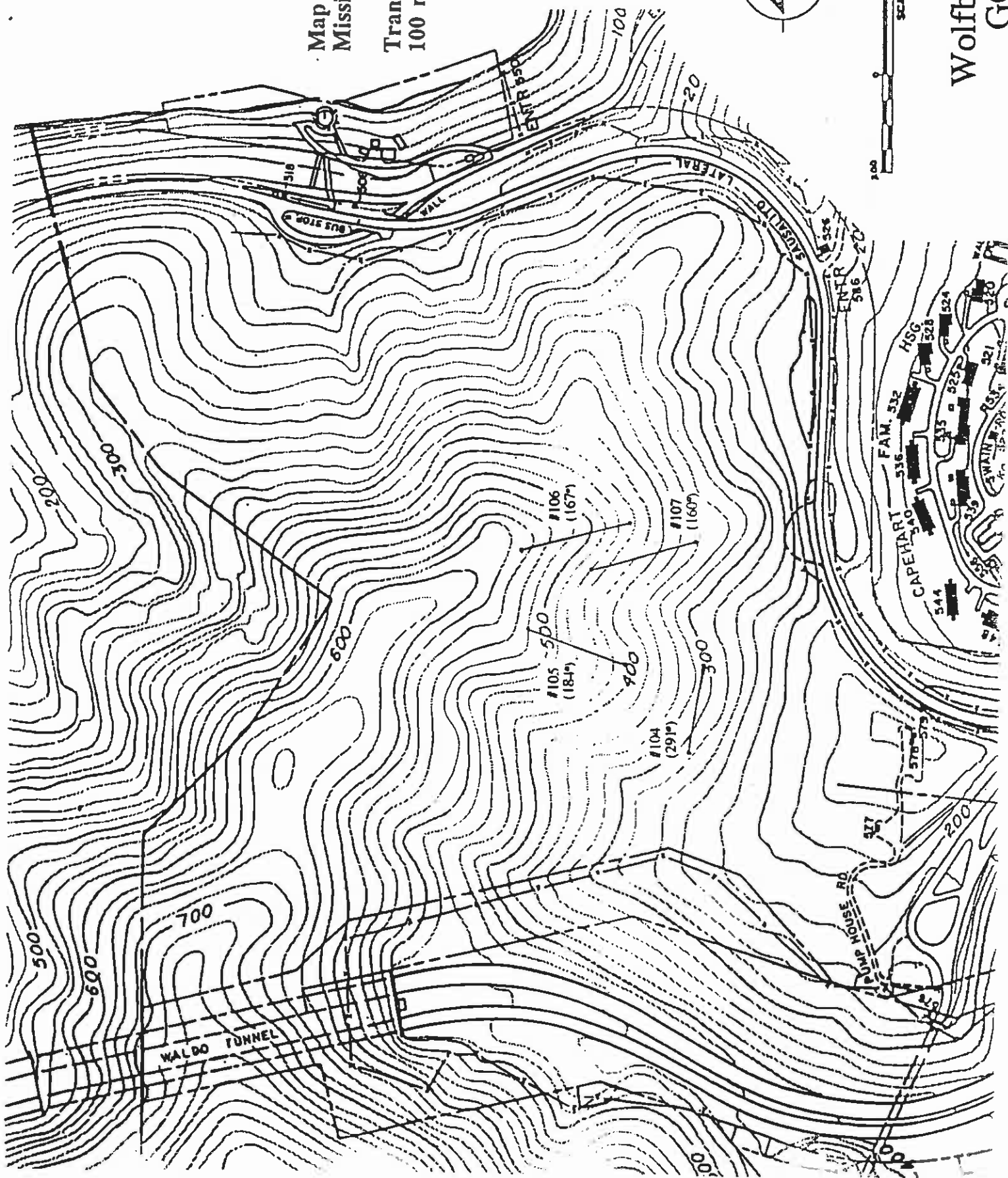
-  Native Scrub
-  Riparian
-  Grassland



Wolfback Ridge GGNRA



Map E)
Mission blue transe
Transects 104-107,
100 meters each



Wolfback Ridge
GGNRA

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***II. Maps and Aerial Photographs.**

1906 Blue print of East Fort Baker Area from GGNRA archives, Presidio.

1910 Blueprint, Fort Baker, CA. #14 s/s. National Archives RG92. Presidio Museum/GGNRA Archives, Marin Headlands Study Collection.

1925 Aerial Photograph from the Sausalito Historical Society Archives.

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1946 Aerial Photograph Copy, "Fort Baker, California", Sheet 26 of 27. Presidio Museum / GGNRA Archives, Marin Headlands Study Collection

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1956 USGS 7.5 Minute Series Topographic Map: San Francisco North Quadrangle.

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1982 Aerial Photograph #AV-2140-07-27, Pacific Aerial Surveys.

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*Copies of maps and photos can be found in Building 37S, Fort Mason.

III. Consultations

Maria Alvarez, Biological Technician, GGNRA.

J. Hall Cushman, Biologist, Sonoma State University.

Garry Feller, Research Ecologist, National Biological Service.

Darren Fong, Aquatics, GGNRA.

Sue Gardner, Site Stewardship Coordinator, GGNPA.

Steve Haller, Park Historian, GGNRA.

Daphne Hatch, Wildlife and fisheries Specialist, GGNRA.

Judd Howell, Research Ecologist, National Biological Service.

Brian Mattos, Forester, GGNRA.

Marty Mayer, Archeologist, GGNRA.

Laura Nelson, Botanist, GGNRA.

Vanessa K. Rashbrook, Biologist, Stanford University.

Seth Riley, Biological Science Technician, GGNRA.

Terri Thoma, Natural Resource Management Specialist, GGNRA.

Denise Vore, Hydrologist, GGNRA.

Catherine Wardner, Biological Science Technician, GGNRA.