
RANGELAND OAK
Regeneration
Rehabilitation
&
Conservation

in
VARIAN RANCH
Arroyo Grande, CA

Tiffany Lappinga & Ivy Ku

Natural Resources Department
California Polytechnic State University
San Luis Obispo, California
Submitted to Dr. Walter Mark

SPRING 2011

In Partial Fulfillment of the Requirements
for the Degree Bachelor of Science
© 2011 Tiffany Lappinga and Ivy Ku

Acknowledgements

We would like to thank Paula Lowe for helping us get in touch with the residents of Varian Ranch, providing valuable research information, editing our senior project, and giving us time and support. Her constant enthusiasm inspired us from beginning to end – this project simply would not have been possible without her.

We truly appreciate the residents of Varian Ranch who so graciously allowed us on their property to conduct research and work. We would also like to thank them for valuable feedback during the homeowners' association meetings.

Thank you, Mike McGovern, for allowing us full access to the tools and materials necessary for completing our project, as well as valuable advice on methodology.

And lastly, we would like to give special thanks to Dr. Walter Mark for being our advisor and offering helpful insight and recommendations for our project. We would also like to express our gratitude and appreciation for having him as a professor, who taught us everything we know about plant identification, pathology, and entomology. Dr. Mark has always pushed us to higher standards – and provided comic relief when those standards almost became unbearable. We wish him the best during his busy “retirement!”

Tiffany and Ivy

Executive Summary

The decline of oaks continues to be a prevalent problem throughout California and the United States. Since a large majority of oak woodlands are currently under private ownership, it is critical that property owners be educated and informed in order to ensure the oaks' continued existence. Our study region is located on Varian Ranch, in Arroyo Grande, California. Oaks on this site have demonstrated signs of decline for the past 50-100 years. Regeneration rates are low, and current saplings are struggling to survive. The reasons behind decreasing regeneration rates are complex and varied, whether they are natural or man-made. Some of the elements that impede oak regeneration include changes in land use, soil disturbances, altered water patterns, fire suppression, increased animal activity, and a variety of invasive plant species. There have been efforts aimed at oak regeneration on Varian Ranch, but those efforts appear marginally successful, most likely due to the considerable number of caged trees, the overall size of the rangeland, and the inadequate means to take care of them. Previously, oak seedlings were planted and caged in order to prevent cattle and deer grazing. However, the current conditions of the immature oaks on Varian Ranch property are dismal as some of the oaks have completely outgrown their cages or have died, leaving behind empty cages in a vast expanse of grassland. Our senior project hopes to revitalize previous efforts by adjusting existing cages, adding new cages to seedlings, increasing community outreach, and sparking collaboration among students and residents in order to continue oak stewardship efforts.

List of Figures

Figure 1: Sudden Oak Death Symptom.	11
Figure 2: Sudden Oak Death Symptom	11
Figure 3: Photo taken next to a Coast Live Oak of a gopher/ground squirrel hole.	16
Figure 4: A dead caged oak crowded by purple star thistle.....	18
Figure 5: Oak surrounded by grasss.	22
Figure 6: Four oaks classified as Priority 1	52
Figure 7: Three oaks classified as Priority 2.....	53
Figure 8: Dead oak classified as Empty Cage.....	54

Table of Contents

Executive Summary.....	4
List of Figures.....	5
Table of Contents.....	6
Background and Introduction.....	8
Varian Ranch Background and History.....	8
History and Issues Associated with Oaks in California.....	9
Sudden Oak Death.....	10
Purpose and Need.....	12
Objectives.....	13
Issues Present on Varian Ranch.....	15
Cattle, Deer, Ground Squirrels, Gophers, and other animals.....	15
Cages.....	17
Housing Development and Roads.....	17
Invasive Plant Species.....	18
Insects and Diseases.....	19
Methods.....	20
Regeneration.....	20
Rehabilitation.....	21
Conservation.....	22
Discussion.....	24
Categorization of Oaks.....	25
Conclusion.....	26
References.....	28

Appendices

Appendix A: Contact Information.....	31
Appendix B: Listed Plant and Animal Species on Varian Ranch	32
Trees.....	33
Shrubs.....	33
Herbaceous Plants.....	33
Reptiles and Amphibians	34
Birds	35
Mammals	36
Appendix C: Brochures	37
Adopt-an-Oak	38
Maintaining the Health of Your Oak	40
Appendix D: Map of General Project Location	42
Appendix E: Topography Map of Varian Ranch in Arroyo Grande, California.....	43
Appendix F: Aerial View of Varian Ranch.....	45
Appendix G: Caged Trees near Residential Areas	47
Appendix H: Proposed Limited Cattle Restriction Areas	49
Appendix I: Priority of Attention Needed for Caged Trees	51
North Varian Ranch	55
Central Varian Ranch	56
South Varian Ranch	57

Background and Introduction

Varian Ranch Background and History

Varian Ranch is located at 3865 Lopez Drive in Arroyo Grande, California. The ranch was initially purchased by Jack and Zera Varian in April of 1963 and included 3,452 acres of property that was formerly known as Biddle estate. In 1969 and 1970, seventy-four acres were conveyed to the County of San Luis Obispo for the building and extension of Orcutt Road and Lopez Drive. Then, in 1973, the property was signed into The California Land Conservation Act (“Williamson Act”) which placed about 852 acres of Varian Ranch into Land Conservation Protection. In 1974, 270 acres of Varian farmland was sold to The Lopez Company (Talley Farms). Then, on October 27, 1987, Varian Ranch Open-Space Easement Agreement was approved by the County Board of Supervisors in response to the approval of the development plan for 48 lots clustered on 738 acres. This agreement, named “agricultural land cluster division,” became the first of its kind authorized by San Luis Obispo County. Currently, Varian Ranch has forty-eight single-family residences on approximately sixty-five acres of the total 3,127 acres which gives it an overall density of 1 lot per 63.875 acres (San Luis Obispo Department of Planning and Building).

An agricultural cluster (ag cluster) could be simply defined as a rural development that preserves agricultural use while encouraging further agricultural operations. Ag clusters are highly valued within the county of San Luis Obispo. The Board of Supervisors encourages such development which is aimed at the creation of small parcels in

agricultural areas instead of dispersed units or larger parcels that break up agricultural lands. In addition, agricultural clusters are viewed as beneficial because they conserve agricultural lands that are decreasing at rapid rates. It is believed that more than one million acres of California's oak woodlands are developed and approximately 750,000 are at risk of development before 2040 (Gaman 06).

Varian Ranch is classified as oak woodland, primarily comprised of Coast Live Oak (*Quercus agrifolia* Nee.) The climate in Varian Ranch is mild, ranging from lows in the 40's and 50's during winter to 70's and 80's during the summer months. Average precipitation rates range from 20 to 24 inches, and dry seasons usually yield less than eight inches per year. Wind direction is from the west/northwest, with the strongest winds occurring in the spring (Declaration 1987). There is only one significant hydrological feature on Varian Ranch, the small portion of the Lopez Terminal reservoir that lies adjacent to Orcutt Road. There are five soil types present in developed areas: Chamice Shaly Loam, Santa Lucia Shaly Loam, Salinas Silty Clay Loam, and Tierra Loam. Soil depth is moderate, and erosion hazards for these soil types range from moderate to high. For a comprehensive list of the plant and animal species present, please refer to Appendix B.

History and Issues Associated with Oaks in California

Oaks are a valued species in California because of their ecological and cultural significance. They provide a multitude of ecological services, including: food, habitat, soil stabilization, wind break, water uptake, air purification, and shade. The Chumash Indians viewed the oak as a viable resource, commonly using acorns to make food. Presently, oaks are viewed as a

valuable commodity to people because of their aesthetic values - oaks are commonly seen as the identifying trait of California's coastlines, often synonymous with wine country (California 2003). Research has also proven oaks to be critical for stress relief, increased sociability, and other therapeutic purposes (California 2003).

Oaks are generally known as hardy tree species, especially *Quercus agrifolia* (Coast Live Oak) which contains thick bark and sprouting abilities, making it resistant to fire. *Quercus agrifolia* is a tolerant species and is found growing from Mendocino County south along the Coast Ranges into Baja California. Additionally, oaks can live for more than 250 years (Stewart and Sawyer 2001). However, the combination of various stressors on oaks have pushed them past the limits of tolerance. Oaks are no longer regenerating at rates fast enough to replace the mature oaks at the end of their lifespan. According to the Declaration of Covenants, Conditions, and Restrictions (CC&Rs) of Varian Ranch, "In areas of California studied, no oak regeneration has occurred in the last 50-100 years... the smallest trees on the site are probably well over 100 years old." The oldest oaks in the same study region are estimated to be 700 years or older (CC&Rs). The decrease in oaks is attributed to a number of factors, including overgrazing, fire suppression, excessive ground squirrel activity, gophers, development, poor management practices, invasive/nonnative species, and ultimately, lack of regeneration.

Sudden Oak Death

Sudden Oak Death is a disease caused by the pathogen *Phytophthora ramorum*, notorious for its rapid spread in wet or moist conditions. It commonly spreads through mud, that

adheres to boots and tires, thus allowing it to spread over long distances and overseas. The nearest confirmed cases are in Santa Cruz County and Monterey County. Though there are no confirmed cases within the county of San Luis Obispo, it is critical that residents be aware when entering into infected areas and take precautions such as sterilizing boots and vehicles upon return. If possible, residents should avoid entering into areas of known infection - especially during periods of high moisture and rain when the likelihood of exposure is increased. Symptoms of Sudden Oak Death include discoloration of foliage, bleeding cankers, and death. Images of such symptoms can be found in Figure 1 and Figure 2, below. If a tree is suspected to have Sudden Oak Death, it is critical that it is reported immediately to the San Luis Obispo County Agricultural Commissions Office at 805-781-5910.



Figure 1: Sudden Oak Death Symptom – ooze bleeds from a canker on an infected oak. Source: USDA Forest Service (O'Brien).

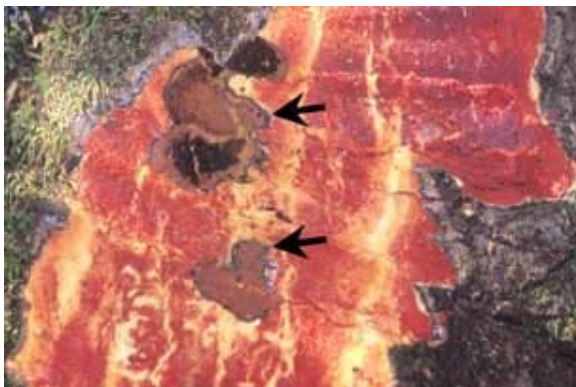


Figure 2: Sudden Oak Death Symptom – black zone lines are found under diseased bark in oak. Source: USDA Forest Service (O'Brien).

Purpose and Need

It is apparent that the Varian Ranch community is deeply concerned about the health of oaks as well as preserving the integrity of the property as an oak woodland. This is evident from the covenants establishing the principle use of the ranch to the individual residents who are deeply involved and knowledgeable about their surroundings. The issues with preserving oaks right now are several. First, the HOA does not have an earmarked budget for oak preservation. The ranch manager is responsible for the tantamount task of managing the entire Varian property. Oak preservation is but one of the many issues. Secondly, the ranch is leased as open rangeland to the Varians. Up to 250 cattle, in a cow-calf operation, graze on the property. Cows and calves cluster in small herds and are typically on the ranch October through April in large numbers. Our senior project seeks to provide residents with specific management solutions, labor, further education, and awareness. This will help fulfill the Objectives of Varian Ranch Project as listed in the CC&Rs.

Objectives

One of our main objectives is to aid Varian Ranch in the long-term fulfillment of the objectives set forth in their CC&Rs as listed below. We were quite enthused to be able to contribute to each and every one of these objectives.

1. To create an environment where people and agriculture can live in harmony with each other.
2. To create and maintain a viable Ag operation that will produce food and fiber for the public using accepted Ag practices and new technology as it develops
3. To maintain the natural beauty of the property while still allowing the production of Ag products.
4. To manage the land and its resources in such a manner as to preserve and protect native vegetation and wildlife.
5. To teach those who live on the land that care of the land and the crops and animals to be sustained through proper stewardship of the land.

Another objective was to create maps to allow for greater ease of oak management. The map in Appendix G displays the caged oaks near residential units, which are ideal candidates for the Adopt-a-Tree program listed later in the report. The map in Appendix H displays the proposed limited cattle restriction areas due to the large presence of volunteer oaks. Appendix I is broken into three sections, North Varian Ranch, Central Varian Ranch, and South Varian Ranch. Those maps prioritize the amount of attention

needed for the oaks. The prioritization is divided into two groups: priority one are oaks in most need of attention and priority two are those needing attention within the next year or two. Some of the tasks include re-caging to allow growth, watering, reducing of gopher activity, and reducing cattle browsing.

Education and further awareness is a key objective of our senior project. We believe that by providing images, maps, prioritization, and education, we will be able to encourage residents and others to maintain proper caging and care for a majority of oaks found on the front developed portion of the ranch. To achieve this objective, we have developed two pamphlets aimed at educating residents about how to plant and maintain oaks as well as encouraging them to “adopt an oak.” We feel education and awareness is crucial – without continued regeneration efforts, California’s oak woodlands may someday cease to exist.

Finally, a key objective in choosing Varian Ranch as the setting of our senior project was to make Natural Resource majors and San Luis Obispo community members aware of agricultural clusters and their valuable role within the County of San Luis Obispo and California as a whole. By doing so, we hope that we can spark the interest of others in need of completing their senior projects and provide them with a location full of endless resources for further research and observation.

Issues Present on Varian Ranch

While no one issue is solely responsible for the decline of oaks in Varian Ranch, a combination of problems are most likely causing the decrease in the oak regeneration rates. This scenario is not unique for Varian Ranch, but rather, for most rangelands in California. Here, we will discuss some of the issues we have witnessed and learned about while studying the Ranch.

Cattle, Deer, Ground Squirrels, Gophers, and other animals

The cattle on Varian Ranch are responsible for soil compaction and over-grazing of young oaks. Since the oaks provide shade on sunny days, it is common to see a multitude of cattle resting within the drip line of large oaks. Heavy traffic from the cattle causes soil compaction and seedlings are subject to trampling. For established oaks, this has a number of negative implications, which include: decreased aeration, altered soil moisture, and increased soil strength (Jordan 2003). Seedlings are usually naturally established in close proximity to the host tree, and soil compaction reduces oak seeding germination, establishment, and growth (Jordan, 2003). Common issues arising from browsers include bark stripping, defoliation, and root clipping (McCreary 2009). Tender oak seedlings are especially appetizing to browsing animals, as are the acorns. The threat of browsing is greater if surrounding vegetation have died off, leaving small green oaks behind. If the impacts from browsing animals are moderate, the oaks can usually recover and regenerate at a sufficient rate. Unfortunately, given the limited amount of seedlings and saplings, any

browsing will usually stunt growth and regeneration rates, if not, halt it completely. Extra care has been taken to fence existing seedlings and saplings out of the reach of browsing animals until they reach heights greater than six feet, when cattle browsing is not believed to be detrimental to the oaks survival.

Evidence of ground squirrel and gopher activity was very apparent when we made our initial visit to Varian Ranch (see Figure 3). These holes are usually found in abundance under oak trees.



Figure 3: Photo taken next to a Coast Live Oak of a gopher/ground squirrel hole.

This was a common scenario for most established oaks and saplings. Rodents are known to consume and dig up acorns. Gophers are noted to clip roots below the soil surface, and this type of activity is not only limited to saplings, but well-established oaks (McCreary, 2009).

Cages

Cages were initially installed to protect establishing oaks from cattle grazing. However, of the few young oaks that have thrived, most have outgrown their cages and the oaks' development appears inhibited by these cages. The conditions of these caged oaks vary, ranging from oaks that are severely inhibited to cages that are about ready for an adjustment. Some of the planted saplings are being rubbed up against cages, creating wounds and increasing its susceptibility to disease. Please refer to Appendix J for pictures of caged saplings and descriptions.

Housing Development and Roads

Urban development is usually a major cause for loss of oak woodlands. One solution to limit the amount of woodland habitat taken for development is ag clustering. Relatively small parcels and narrow roads help preserve valuable oak woodland habitat. However, it must be noted that the ranch is not immune from the effects of development. It has been observed that a number of slopes near homes and roads contain many stressed, declining, and uprooted mature oaks. Since these oaks are down slope or contiguous to development, the causes may be attributed to compacting or removing topsoil, changes in drainage, introduction of incompatible plants, presence of leach fields on hill tops, and over-watering of residential landscape. These causes need to be addressed and mitigated or at least minimized further to avoid degradation of woodland habitat, and to ensure that young oaks are not prematurely stressed into decline. Once new oaks are planted and established, they are less likely to be uprooted since the tree will be acclimated to its surroundings.

Invasive Plant Species

Introduced Mediterranean grasses are now prevalent throughout California, and they are more water-intensive than their native California counterparts (McCreary, 2009.) The prevalence of these introduced grasses not only take up the water necessary for the oaks, but valuable minerals and nutrients. Many cages were observed to contain many invasive species such as purple star thistle (*Centaurea calcitrapa* L.). Please refer to Figure 2. The grey arrow points out the thistle, as it tends to blend in to the surrounding vegetation – when this picture was taken, it was apparent that the entire cage was overtaken by purple star thistle. The increased water competition may have led to the death of this oak seedling.



Figure 4: A dead caged oak crowded by purple star thistle.

Purple star thistle, like most non-native species, creates a host of issues. These include crowding, increases in water competition, and creating unfavorable grazing conditions. Purple star thistle is generally undesirable to cattle.

Insects and Diseases

Overall, the health of the caged oaks on Varian Ranch was good. A noted pathogen was what appeared to be oak leaf blister (*Taphrina caerulescens*). It was observed on a number of caged seedlings primarily on the right-hand slope of Softchess. Oak leaf blister is a fungal disease that causes rounded light green to yellow bumps on the upper surface of young oak leaves, which when viewed from below appears as depressions. However, it is critical to note that this blistering may also be due to erineum mites. Differentiating between these two pathogens can only be determined via microscopic examination of symptomatic tissues (Swiecki 80). Though oak leaf blister is visually unpleasing it generally does not cause detrimental harm. With severe cases, young oaks may lose infected foliage creating conditions of decreased photosynthesis and exposure to sun damage.

Methods

In order to ensure the long-term success and health of oaks in Varian Ranch, the oaks will require three approaches: regeneration, rehabilitation, and conservation.

Regeneration

In 2009 and 2010, Varian Ranch received an ideal amount of rainfall for oaks. As such, more acorns have been established and are now young seedlings. Our efforts will include caging these new seedlings from the additional fencing material taken from empty plots and from the ranch's stored cages. Care will be made to ensure that the cages provide sufficient room for growth until the oak can achieve heights of at least 6 feet, where the leading apical meristem is safe from the reaches of cattle. Even though oaks are able to withstand moderate amounts of browsing, the limited amount of oaks and the scarcity of saplings require us to protect them from intensive browsing activity. After the oaks are allowed to grow to the desired height of 6 feet, the cages may be permanently removed.

Oaks generally have a higher chance of survival on north-facing slopes because of favorable water and shade conditions. As such, we recommend planting seedlings in these areas. Based on our observation of uprooted oaks near development, we also recommend having at least a 10-15 foot setback from roads and development.

In Appendix C, we discuss the common issues with taking care of a seedling or sapling. The

main focus of this brochure is to keep the habitat of the seedling/sapling as natural as possible because human alterations might do more harm than good. For example, pruning may increase susceptibility to disease, and mulching near established oaks may cause root rot. This brochure will be passed out to residents and property managers if they decide to adopt an oak.

Rehabilitation

Several trips were made to Varian Ranch to observe, record, map, and re-cage oaks. The initial trip to Varian Ranch gave us a rough idea of what condition the oaks were in and how many oaks will need immediate attention. We took pictures of the various states of the saplings which ranged from dead to overflowing from their cages. Next, GPS coordinates were taken to record the locations of these saplings. Coordinates were determined with the aid of a Topcon GMS-2 positioning system. The coordinates were then put into the Geographic Information Systems (GIS) program, which helped us extrapolate data regarding conditions that either supported oak growth or inhibited oak growth. This will also help us generate a map of the oaks which need attention, to be used in the monitoring and community outreach portion of our project.

In order to tackle the issues associated with ground squirrels and gophers, our main method was to prune back some of the surface vegetation surrounding saplings because this is usually an ideal habitat for these pests. Some of the vegetation include dense patches of dead grass and forbs, or thatch (McCreary 2009). In one instance, we observed an oak whose cage was filled with grass. See figure 3, located on the following page.

Figure 5: Oak surrounded by grass, creating an ideal habitat for ground squirrels and gophers.



In situations such as this, we took care to remove most of the vegetation. Other measures, such as baiting the gophers with poisoned grain, was not considered because of the cost and uncertainty of the outcome.

Conservation

Pruning is not recommended for any of the *Quercus agrifolia* observed at Varian Ranch. This is due to the fact that the cattle are going to contribute to removal of lower canopy limbs and any additional pruning will cause significant alterations in xylem-phloem systems, creating problems with the transport of water, nutrients and photosynthates. To add, additional pruning will increase disease susceptibility, which creates potential threats to surrounding trees.

Many people see trees in decline and automatically assume that it is lack of water causing such evidence of stress. However, this is usually to the contrary with regard to many tree species including oaks. *Quercus agrifolia* in particular, is prone to root rot and increasing water availability of a mature tree can cause significant decline or death. However, if high levels of moisture and water are originally exposed to seedlings upon sprouting it can tolerate and later require such conditions in the future. Thus, it is recommended that all planted acorns receive adequate amounts of water to initially become established and then have water supplies gradually reduced so that mature trees can maintain healthy conditions solely based off of rainfall.

Community outreach was an extremely important segment of our project because the health of the oaks ultimately depends on the residents. We have created two brochures (see Appendix C) in order to educate the residents on the value of the oaks as well as ways to increase the likelihood of oak survival. During the HOA meeting, we also discussed the possibility of an “Adopt-an-Oak” program where each resident signs up to “adopt” an oak. Some responsibilities would include semiannual check-ups to make sure there is no breach in the cage and to adjust the cage accordingly when the oaks outgrow or no longer need the cage. The next pamphlet, “Maintaining the Health of Your Oak,” covers the basic tips of oak care and maintenance.

Discussion

Most landowners are not willing to undertake land management practices in order to preserve oaks. This is usually due to the increased costs and time required on their behalf. Fortunately, we were able to contribute our time and labor in order to preserve the health of the young oaks on Varian Ranch. During our attendance at the Homeowner's Association (HOA) meeting, we were met with positive and encouraging feedback when we notified them of our activities. We even gained valuable suggestions that benefited our project on a whole. For example, it was brought to our attention that we should include a map of where cattle should be fenced off to better improve oak regeneration. Further, when we proposed the possibility of opening up the residence to potential future senior projects, they were all in favor and even suggested a number of potential ideas. We believe that this new channel will benefit both students and residents alike: students will have a valuable opportunity for research and community service, while residents will benefit from perpetual maintenance and monitoring of the oak woodlands.

Some of the ideas supported by residents include:

- Regeneration in Varian Ranch's back country
- Survey and analysis of mature oak stands
- Reconsideration of current rangeland grazing procedures
- Riparian area analysis
- Water quality analysis
- Stream bank stabilization
- Review and mitigation for erosion
- Biological assessment
- Reevaluation and reprioritization of oaks in five to ten years

Categorization of Oaks

In order to improve management practices, prioritization of oaks regarding their need for attention was made. Please refer to **Appendix I** for full description and photographs of the prioritized oaks.

Conclusion

This project allowed us to learn more about our surroundings as well as actively engage in problems common with oak regeneration in California. Our project focused on the needed role of Varian Ranch residents and community members to insure that there will be healthy oak woodlands for generations to come. We hope that we have made a positive impact at Varian Ranch and that we have been able to spread awareness of the need for people to foster oak health and regeneration. However, we would like to note that due to the size and available resources at Varian Ranch there is much more to learn, research and observe. As such, we would like to open up a similar opportunity to future Cal Poly students in the Natural Resource Management department who are hoping to complete their senior project requirement.

Future Opportunities

As briefly stated in the discussion section, the residents expressed great interest and consent in allowing Cal Poly students to study, care for, and monitor their oaks. Paula Lowe has volunteered to be the liaison and the primary point of contact between Varian Ranch residents and Cal Poly students. Her contact information is listed in Appendix A, under Contact Information. Cal Poly students who are interested in continuing or expanding oak preservation efforts established by this senior project should first contact and meet with Ms. Lowe. Approved projects will be posed on the Varian Ranch website. It is important for students to respect the privacy of residents and to demonstrate professional behavior at all

times. If funding proves to be an issue to continue oak conservation efforts, the Oak Woodland Conservation Program may provide aid, given all the requirements under the **Criteria for Education, Outreach, and Technical Assistance Projects** are met. Specific eligibility requirements are available at the following link:

<<http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=18730>>

References

California Oak Mortality Task Force. USDA Forest Service, 2011. Web. 21 May 2011.

<<http://www.suddenoakdeath.org/>>.

California. Santa Margarita Community Forestry. Native Tree Committee of San Luis Obispo County. *Voluntary Oak Woodlands Management Plan*. Autumn 2003. Web. 21 May 2011.

<http://www.smcf.org/oak_woodlands_resources/voluntary_oak_woodlands_management_plan.pdf>.

Dagit, Rosi, and James Downer. "To Prune or Not to Prune: Responses of Coast Live Oaks (*Quercus Agrifolia*) to Canopy Retention during Transplanting1." USDA Forest Service, 2002. Web. 20 May 2011.

<<http://www.californiaoaks.org/ExtAssets/RosiDagitTransplantingOaks.pdf>>.

Declaration of Covenants, Conditions and Restrictions of Varian Ranch. 02 Nov. 1987. San Luis Obispo County.

Gaman, Tom, and Jeffrey Firman. "Oaks 2040-The Status and Future of Oaks in California." California Oak Foundation, Oct. 2006. Web. 04 Apr. 2011.

<<http://www.californiaoaks.org/ExtAssets/Oaks2040%20Final.pdf>>.

Jirka, Amy. *Sudden Oak Death in California...and beyond*. Presentation.

Jordan, D. "Effects of Soil Compaction, Forest Leaf Litter and Nitrogen Fertilizer on Two Oak Species and Microbial Activity." *Applied Soil Ecology* 23.1 (2003): 33-41. Print.

Knoot, T. G., L. A. Schulte, J. C. Tyndall, and B. J. Palik 2010. The state of the system and steps toward resilience of disturbance-dependent oak forests. *Ecology and Society* **15**(4): 5. [online] URL: <http://www.ecologyandsociety.org/vol15/iss4/art5/>

McCreary, Douglas D. "Regenerating Rangeland Oaks in California." *California Oaks*. University of California Agriculture and Natural Resources, 2009. Web. 2 Apr. 2011. <<http://www.californiaoaks.org/ExtAssets/Regenerating%20Rangeland%20Oaks%20in%20California.pdf>>.

McCreary, Douglas D., and Jerry Tecklin. "Restoring Native California Oaks on Grazed Rangelands." *California Oaks*. USDA Forest Service Proceedings, 2005. Web. 12 Apr. 2011. <http://www.californiaoaks.org/ExtAssets/Oaks_Grazing.pdf>.

O'Brien, Joseph G., Manfred E. Mielke, Steve Oak, and Bruce Moltzan. "Pest Alert - Sudden Oak Death, Eastern." *Northeastern Area State & Private Forestry - USDA Forest Service*. United States Department of Agriculture Forest Service State and Private Forestry Northeastern Area, Jan. 2002. Web. 24 May 2011. <http://www.na.fs.fed.us/spfo/pubs/pest_al/sodeast/sodeast.htm>.

San Luis Obispo Department of Planning and Building, 17 Feb. 2009. Web. 20 May 2011. <http://slocounty.granicus.com/MetaViewer.php?view_id=2&clip_id=641&meta_id=129309>.

Stuart, John David., and John O. Sawyer. *Trees and Shrubs of California*. Berkeley: University of California, 2001. Print.

Swiecki, Tedmund J., and Elizabeth A. Bernhardt. "A Field Guide to Insects and Diseases of California Oaks." USDA Forest Service, July 2006. Web. 22 May 2011. <http://www.fs.fed.us/psw/publications/documents/psw_gtr197/psw_gtr1>.

Appendices

Appendix A: Contact Information

Listed below are the primary contacts for Varian Ranch related inquiries. They may be contacted for additional information about the property, granting access to the property, senior project research opportunities, and any other related questions and concerns. Please be respectful and professional when contacting Ms. Lowe and Mr. McGovern, as they have generously allowed us to work on the ranch and we want this opportunity to continue being open to students.

Paula Lowe

Homeowner and Varian Ranch HOA Senior Project Liaison
p414@sbcglobal.net

Mike McGovern

Varian Ranch Manager
mike.mcgovern@yahoo.com

Appendix B: Listed Plant and Animal Species on Varian Ranch

A list of the flora and fauna present in Varian Ranch are included to help gain a better understanding of the local ecosystem. They are split up into several categories: trees, shrubs, herbaceous plants, reptiles, amphibians, birds, and mammals. This list was taken from the Declaration of Covenants, Conditions, and Restrictions of Varian Ranch. Please note that this is not a comprehensive list and is only meant for quick reference. In addition, the scientific names should be up to date as of June 2011, but keep in mind that the scientific names may have changed since this document was last updated.

Trees

<i>Quercus agrifolia</i>	Coast live oak
<i>Platanus racemosa</i>	California sycamore

Shrubs

<i>Lonicera involucrata</i>	Twinberry
<i>Toxicodendron diversilobum</i>	Poison Oak
<i>Sambucus nigra</i>	Elderberry
<i>Symphoricarpos ssp.</i>	Snowberry
<i>Ribes speciosum</i>	Fushia-flowered gooseberry

Herbaceous Plants

<i>Erodium cicutarium</i>	Filaree
<i>Erodium botrys</i>	Red-stemmed filaree
<i>Hemizonia sp.</i>	Tarweed
<i>Salvia spathacea</i>	Hummingbird sage
<i>Stellaria media</i>	Chickweed
<i>Lupinus bicolor</i>	Bicolored lupine
<i>Lupinus nanus</i>	Sky lupine
<i>Plagiobothrys sp.</i>	Popcorn flower
<i>Geranium dissectum</i>	Cranesbill, geranium
<i>Trifolium sp.</i>	Clover
<i>Gnaphalium sp.</i>	Everlasting flower
<i>Montia perfoliata</i>	Miner's lettuce
<i>Galium sp.</i>	Bedstraw
<i>Malva sp.</i>	Mallow
<i>Lotus sp.</i>	Lotus
<i>Potentilla sp.</i>	Potentilla
<i>Viola pedunculata</i>	Johnny jump-up
<i>Urtica holosericea</i>	Nettle
<i>Bromus diandrus</i>	Ripgut brome grass
<i>Bromus rubens</i>	Red brome grass
<i>Bromus mollis</i>	Soft chess brom grass
<i>Festuca sp.</i>	Fescue grass
<i>Avena fatua</i>	Wild oats
<i>Avena barbata</i>	Slender wild oats
<i>Lolium sp.</i>	Wild rye grass
<i>Hordeum sp.</i>	Wild barley
<i>Ranunculus californicus</i>	Buttercup
<i>Anagallis arvensis</i>	Pimpernel

(Herbaceous Plants, continued.)

<i>Chlorogalum pomeridianum</i>	Soap root
<i>Medicago hispida</i>	Bur clover
<i>Sanicula sp.</i>	Sanicula
<i>Lomatium sp.</i>	Lomatium
<i>Cirsium sp.</i>	Thistle
<i>Silybium marianum</i>	Milk thistle
<i>Brodiaea sp.</i>	Brodiaea
<i>Vicia sp.</i>	Vetch
<i>Stipa pulchra</i>	Purple needlegrass
<i>Foeniculum vulgare</i>	Sweet fennel
<i>Orthocarpus erianthus</i>	Butter-and-eggs
<i>Gilia sp.</i>	Gilia
<i>Sonchus oleraceus</i>	Sow-thistle
<i>Taraxacum officinale</i>	Dandelion
<i>Chenopodium sp.</i>	Pigweed
<i>Amsinckia sp.</i>	Fiddleneck
<i>Dicentra sp.</i>	Bleeding heart
<i>Matricaria matricariodes</i>	Pineapple weed
<i>Thysanocarpus curipes</i>	Fringe-pod
<i>Sisymbrium officinale</i>	Hedge-mustard
<i>Pityrogramma triangularis</i>	Goldenback fern

Reptiles and Amphibians

<i>Batrachoseps attenuatus</i>	California Slender Salamander
<i>Aneides lugubris</i>	Arboreal Salamander
<i>Plestiodon skiltonianus</i>	Western Skink
<i>Elgaria multicarinata</i>	Southern Alligator Lizard
<i>Pseudacris regilla</i>	Pacific Treefrog
<i>Sceloporus occidentalis</i>	Western Fence Lizard
<i>Pituophis catenifer</i>	Gopher Snake
<i>Lampropeltis getul</i>	Common Kingsnake
<i>Crotalus oreganus</i>	Rattlesnake

Birds

<i>Cathartes aura</i>	Turkey Vulture
<i>Accipiter cooperii</i>	Cooper's Hawk
<i>Buteo jamaicensis</i>	Red-tailed Hawk
<i>Accipiter ssp.</i>	Sparrow Hawk
<i>Callipepla californica</i>	California Quail
<i>Zenaida macroura</i>	Mourning Dove
<i>Bubo virginianu</i>	Great Horned Owl
<i>Calypte anna</i>	Anna's Hummingbird
<i>Colaptes ssp.</i>	Common Flicker
<i>Melanerpes formicivorus</i>	Acorn Woodpecker
<i>Sayornis nigricans</i>	Black Phoebe
<i>Tachycineta thalassina</i>	Violet-green Swallow
<i>Petrochelidon pyrrhonota</i>	Cliff Swallow
<i>Aphelocoma ssp.</i>	Scrub Jay
<i>Pica nuttalli</i>	Yellow-billed Magpie
<i>Corvus ssp.</i>	Common Crow
<i>Baeolophus inornatus</i>	Oak Titmouse
<i>Aegithalos caudatus</i>	Common Bushtit
<i>Sialia mexicana</i>	Western Bluebird
<i>Lanius ludovicianus</i>	Loggerhead Shrike
--	Starling
<i>Dendroica coronata</i>	Yellow-rumped warbler
<i>Sturnella neglecta</i>	Western Meadowlark
<i>Euphagus cyanocephalus</i>	Brewer's Blackbird
<i>Carpodacus mexicanus</i>	House Finch
<i>Carduelis psaltria</i>	Lesser Goldfinch
<i>Carduelis tristis</i>	Common Goldfinch
<i>Melospiza fusca</i>	Brown Towhee
<i>Chondestes grammacus</i>	Lark Sparrow
<i>Junco hyemalis</i>	Oregon Junco
<i>Zonotrichia leucophrys</i>	White-crowed sparrow
<i>Zonotrichia atricapilla</i>	Golden-crowned sparrow

Mammals

<i>Didelphimorphia</i>	Opossum
<i>Chiroptera</i>	Bats
<i>Procyon</i>	Raccoon
<i>Mustela frenata</i>	Long-tailed weasel
<i>Mephitis mephiti</i>	Striped skunk
<i>Mustelidae</i>	Badger
<i>Urocyon cinereoargenteus</i>	Gray Fox
<i>Canis latrans</i>	Coyote
<i>Lynx rufus</i>	Bobcat
<i>Otospermophilus beecheyi</i>	California Ground Squirrel
<i>Thomomys bottae</i>	Botta Pocket Gopher
<i>Chaetodipus californicus</i>	California Pocket Mouse
<i>Peromyscus</i>	Deer Mouse
<i>Neotoma fuscipes</i>	Dusky-foot Wood Rat
<i>Scapanus orarius</i>	California Mole
<i>Lepus californicus</i>	Black-tailed Jack Rabbit
<i>Odocoileus hemionus</i>	Mule Dee (Black-tailed)

Appendix C: Brochures

The following brochures were created as an aid for residents to gain awareness and to provide oak troubleshooting tips. The first brochure, **Adopt-an-Oak**, is meant to encourage residents to “adopt” a caged oak. It also lists the necessary duties and benefits for the program.

The next brochure, **Maintaining the Health of Your Oak**, provides essential tips to keeping an oak healthy. This brochure should supplement the Adopt-an-Oak brochure, but may also be given to residents by itself if they wish to know general oak care information.

These brochures are meant to be accessible to residents. The resolution for these brochures has been scaled down in this document. If needed, a PDF of these documents are available through Paula Lowe, as listed in Appendix A: Contacts.

Benefits

- Preserve valuable oak woodland habitat
- Build a stronger sense of community
- Cost-effective way to monitor
- Maintains property value
- Increases awareness of your surroundings
- Fulfill Vanan Ranch objectives by managing "the land and its resources in such a manner as to preserve and protect native vegetation and wildlife."



How do I get started?

We have created map showing the locations of oaks which are in need of attention

Simply choose an oak that is available, put an identifying marker on the cage, and it's all yours!

Remember to visit your oak at least twice a year to make sure that it's properly protected from browsing animals, and make adjustments to the cages as needed. It's that simple!



Thank you for your help!

Adopt-an-Oak

to preserve and ensure the long term success of oak woodlands

Why Adopt an Oak?

The sheer amount of oak saplings which are in need of attention seems like a huge task for one person. But, if it becomes a community effort, this task will prove to be much easier.

Adopting an oak is a great way to put forth minimal effort, but yield maximum results. If each household adopted two oaks, then that's almost 100 oaks that will be taken care of. It's also a great way to give back to your community!



What do I have to do?

Visit your oak at least twice a year.

This is to make sure that there aren't any breaches in the cage which would allow browsing animals to harm saplings. It's easy—just check up on your oak on a daily walk, or when you're driving by!

Learn about basic maintenance techniques.

Knowing how and when to take care of your oak is important. Usually, the oaks do not require much attention—we just want them to grow naturally. The main goal is to minimize some of the hazards which would impede their growth.

What supplies do I need?

The necessary materials are provided by Mike McGovern. He can be contacted at mike.mcgovern@yahoo.com. Shoot him an email if you need materials to fix the fence or to enlarge the fence.

How long do I have to tend to my oak?

The oaks should at least be 6 feet tall before they may be uncaged. At this height, the leading branches are well out of any browsing animals' reach. The amount of years you have to tend to your oak is highly variable, depending on how old your oak is and how fast it grows.



Coast Live Oak

Quercus agrifolia

- Shade tolerant
- Well-drained soils
- Somewhat tolerant of drought
- Thrives on north-facing hills

Common Understory Plants:

- Toyon
- Various Manzanitas
- Western Poison-Oak

Associated Plants

- California Bay Laurel
- California Buckeye

Keeping things in perspective

Oak trees are an established native species in California and can handle most stressors placed upon them: low-intensity fire, wind, precipitation (or lack of), and various animal activities. The reason why regeneration rates have been declining in the past 50-100 years is because humans have created additional sources of stress by introducing invasive plant species, development, grazing, and pollution.

The best thing we can do now is to try and allow these oaks to regenerate as naturally as possible, but with a little help along the way. In order to do this, we can alleviate one of the biggest stressors: keeping browsing animals from eating the tender seedlings, which may one day grow into a stately oak.

Maintaining the Health of Your Oak

Quick tips and facts to achieve optimal results



Planting an Oak

There are two ways to get an oak started – either with an acorn or with a seedling. There are advantages to both:

Acorn:

- Deeper root development
- Better adapted to its surroundings (soil type, water level)

Seedling:

- Higher chance of survival and establishment

If proper steps and care are taken, your oak should be able to survive. Oaks are a hardy species once they are established! +



How to Take Care of an Established Tree

Common issues and concerns that crop up and how to handle them

Should I water my oak?

Your oak should only be watered sparingly when it is a seedling. Once the seedling is well established, watering is not recommended unless there are periods of severe drought.

Should I prune my oak?

It is generally unnecessary to prune your oak, as you want the tree to grow as naturally as possible. Once the oak is taller than 6 feet and has been uncaged, browsing animals will usually clip off sprouts near the base of the oak. Saplings are better able to handle herbivory activity by sprouting quickly after, while seedlings are not.

Should I cut back on vegetation around my oak?

It depends on what stage the oak is in. If it's a seedling, then yes. Excess vegetation around the oak means increased competition for water, and it

provides habitat for ground squirrels and gophers. These animals usually end up clipping the roots and impeding the seedling's growth – it is in a critical stage where it's rapidly establishing its roots. If the oak has already developed into a sapling, then you probably don't have to worry about maintaining it as much.

Should I mulch my oak?

Mulching your seedling will be beneficial because it helps retain moisture. However, keep in mind that you want to keep the under canopy as natural as possible. When the oaks are mature, you will want to avoid mulching because it actually causes root rot.

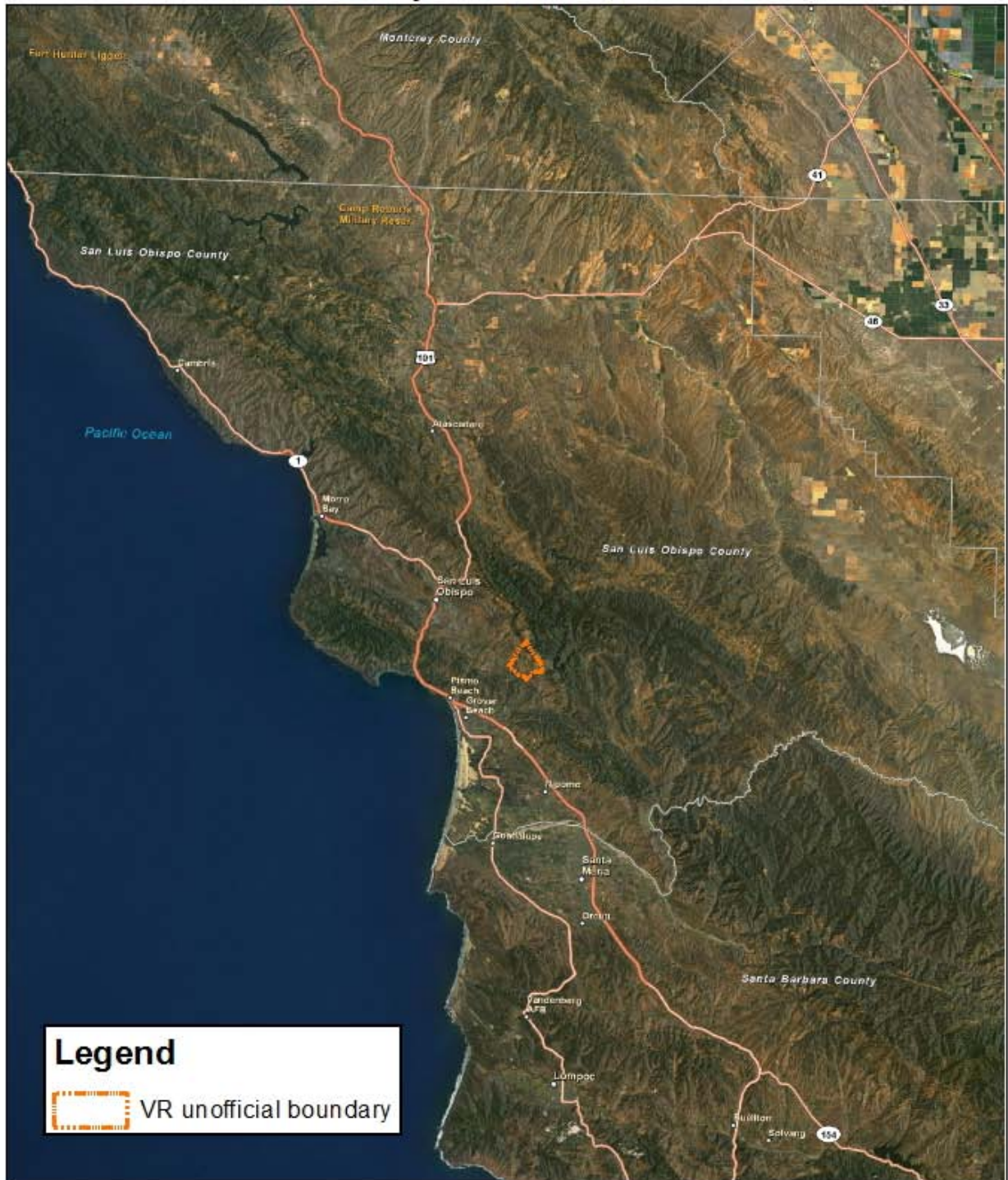
What about putting other plants near the oak?

It is recommended that you only plant native/ non-water intensive species around the oaks to decrease water competition.

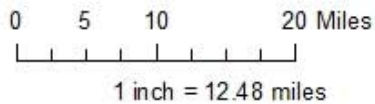
Appendix D: Map of General Project Location

The following map shows the unofficial border for Varian Ranch in San Luis Obispo County.

General Project Location Arroyo Grande, Ca



Created By: Tiffany Lappinga and Ivy Ku
Created For: Dr. Wally Mark
Created On: May 24, 2011

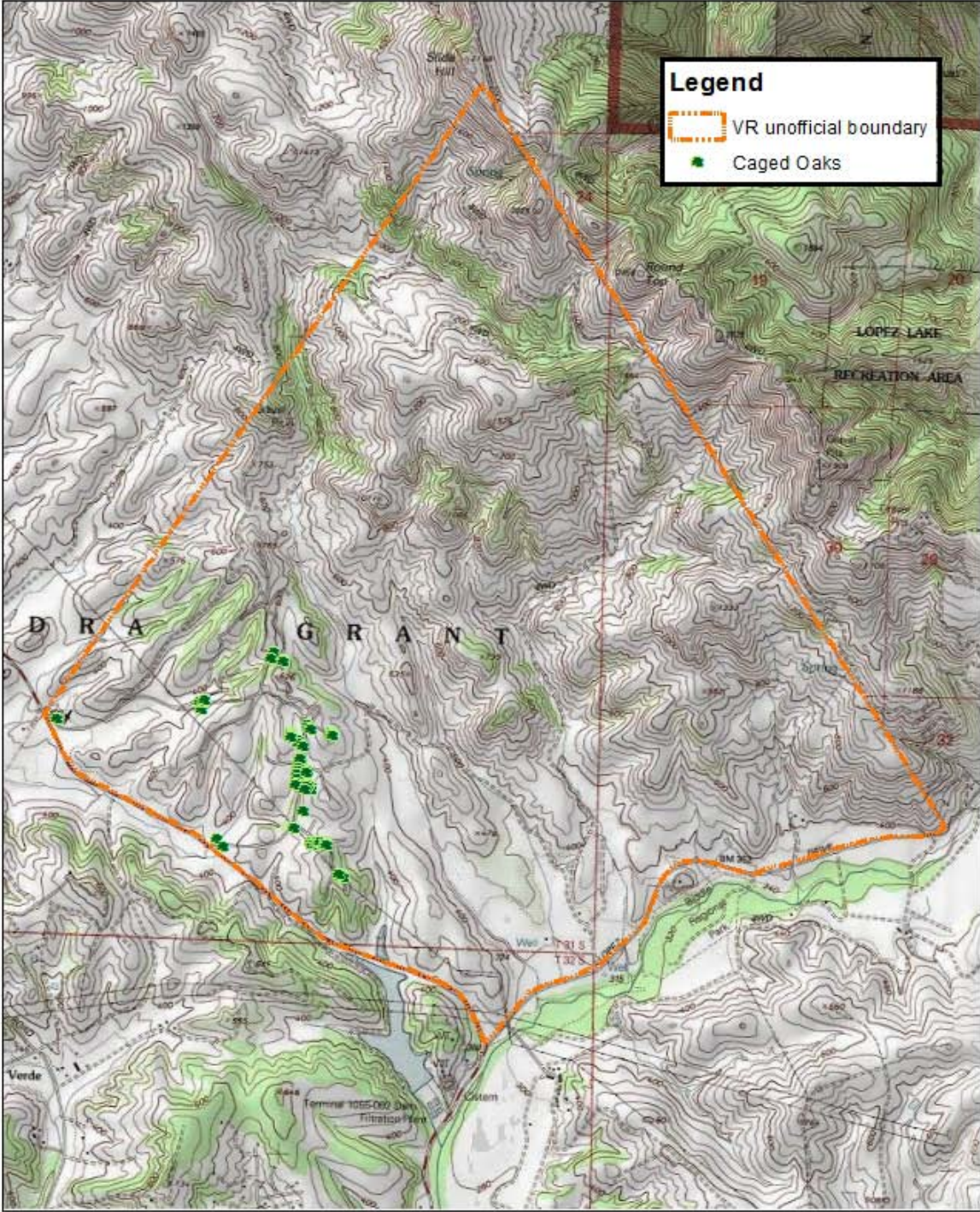


Appendix E: Topography Map of Varian Ranch in Arroyo Grande, California

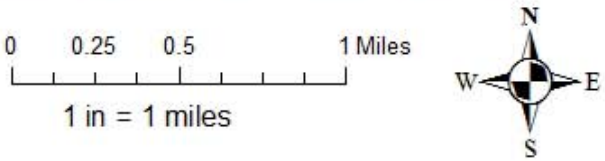
A topographical map is included to help determine slope conditions around caged oaks.

This map also shows elevation.

Topography of Varian Ranch Arroyo Grande, California



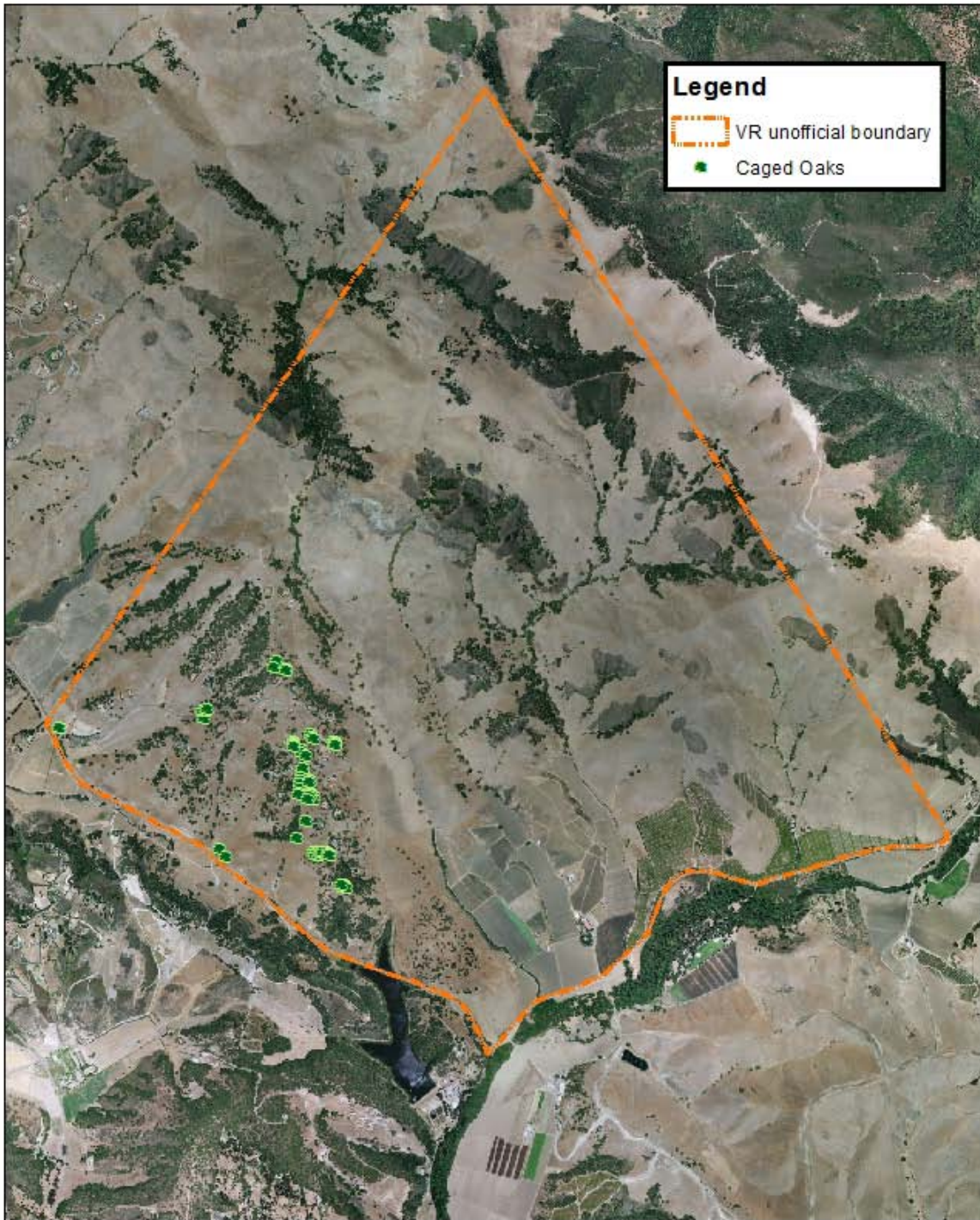
Created By: Tiffany Lappinga and Ivy Ku
Created For: Dr. Wally Mark
Created On: May 24, 2011



Appendix F: Aerial View of Varian Ranch

An aerial view of the caged oaks is provided to show the existing vegetation around the caged oaks. The aerial photograph was obtained from San Luis Obispo County, accessed via SLO Data Finder on the Kennedy Library website.

Caged Oaks on Varian Ranch Arroyo Grande, California



Created By: Tiffany Lappinga and Ivy Ku
Created For: Dr. Wally Mark
Created On: May 24, 2011

0 0.25 0.5 1 Miles
1 in = 1 miles



Appendix G: Caged Trees near Residential Areas

A close up view of the caged trees near residential areas depicts where the majority of caged oaks will be found. This may also be used for residents who wish to participate in the Adopt-an-Oak program.

Caged Trees Near Homes- Varian Ranch



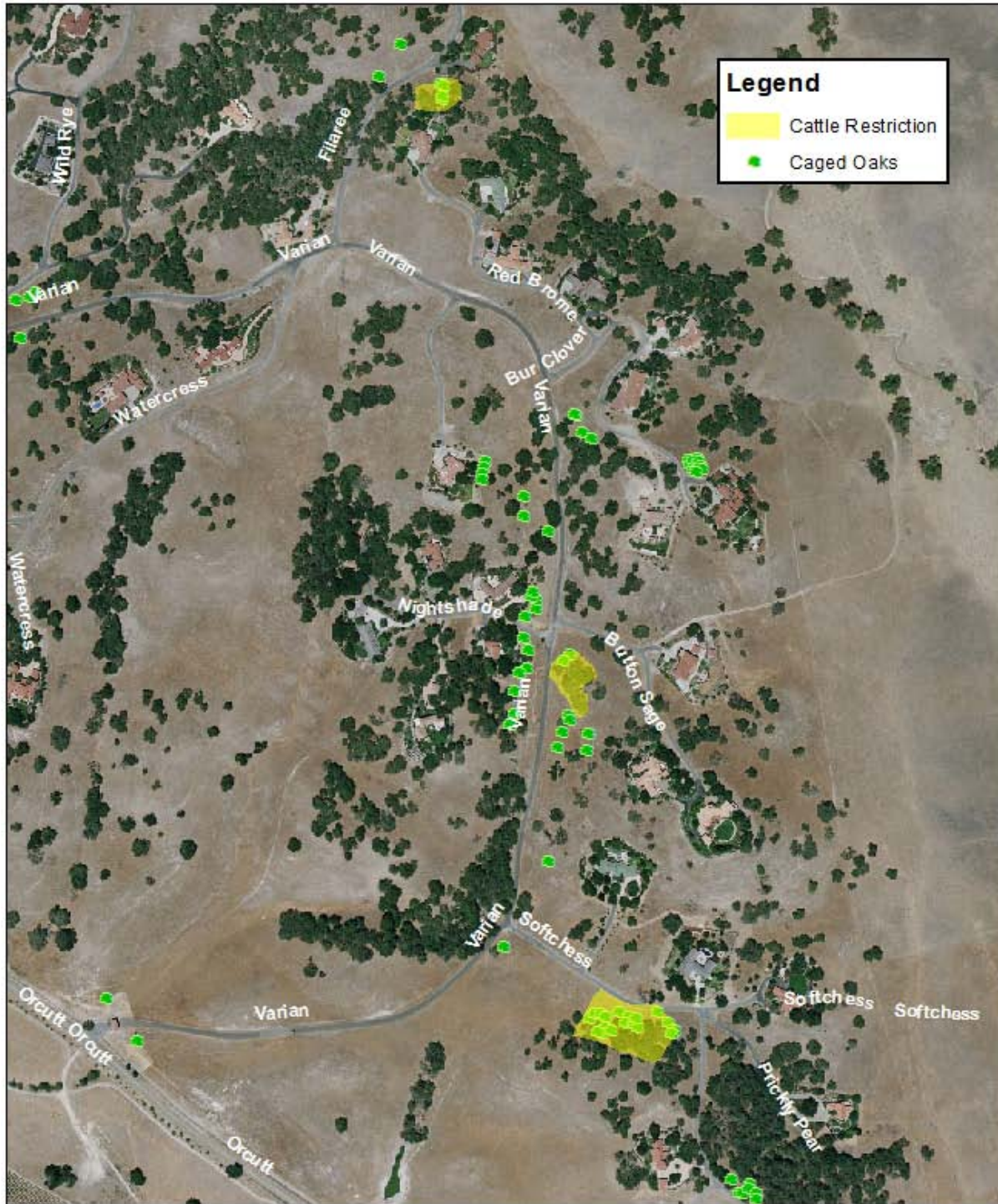
Legend
VR unofficial boundary
Caged Oaks

Created By: Tiffany Lappinga and Ivy Ku
Created For: Dr. Wally Mark
Created On: May 24, 2011

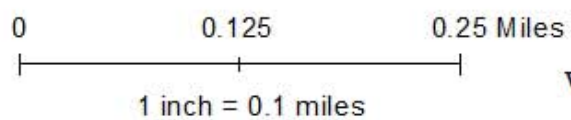
Appendix H: Proposed Limited Cattle Restriction Areas

On the following map, sensitive areas containing a number of volunteer oaks can be observed by yellow shading. These areas of natural regeneration are rare throughout the ranch and the absence, or limited access of cattle, in such areas is strongly encouraged. With decreased cattle activity, oak sprouts will have an increased chance of establishment due to the lack of browsing and compaction caused by the presence of cattle. If it is not feasible to restrict cattle access in such areas, the placement of cages surrounding such sprouts is encouraged.

Proposed Limited Cattle Restriction Areas Due to Presence of Volunteers



Created By: Tiffany Lappinga and Ivy Ku
Created For: Dr. Wally Mark
Created On: May 24, 2011



Appendix I: Priority of Attention Needed for Caged Trees

The next three maps are representations of prioritized caged oak trees on Varian Ranch, split up into North, Central, and South sectors. Three separate maps were generated to provide a more detailed view.

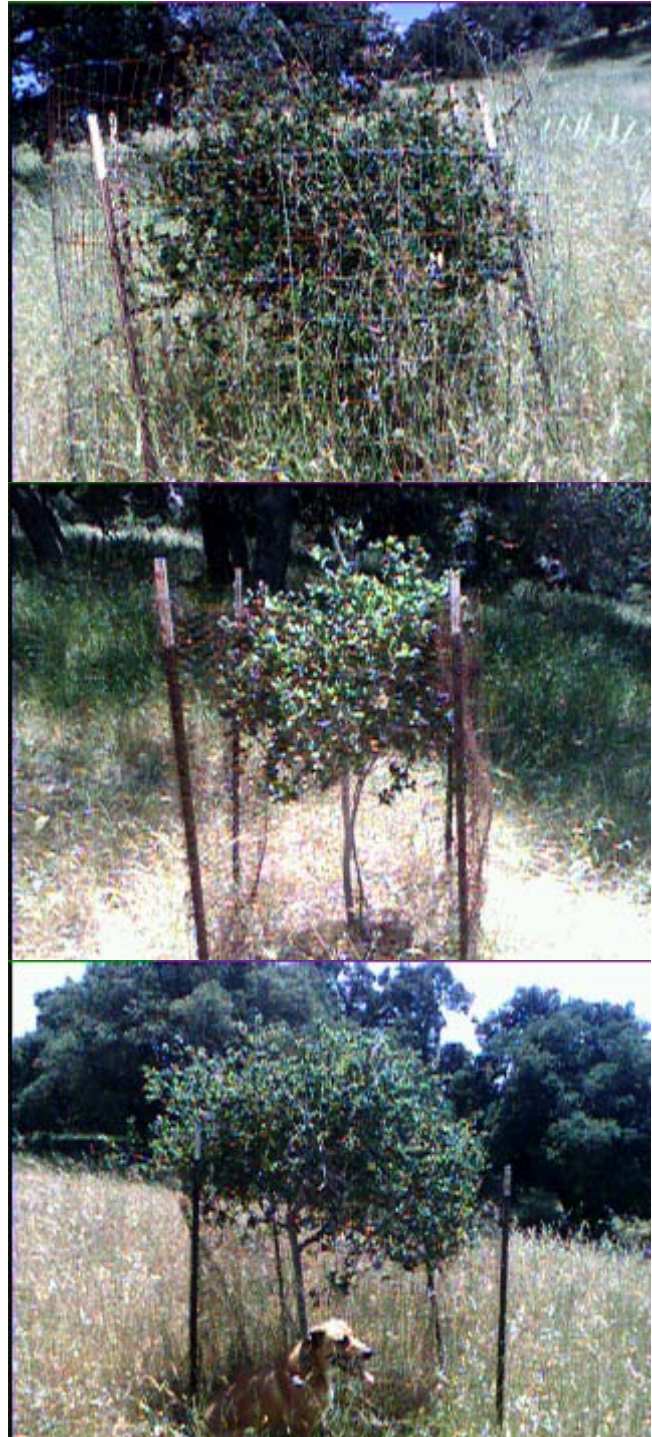
Priority one trees are those whose growth is being significantly restricted by the current placement of their cages and would significantly benefit from the immediate widening or removal of them (see Figure 6).



Figure 6: Four oaks classified as Priority 1

Priority two trees are those who are beginning to outgrow their current cages but can survive one to two more years without such cages causing significant restriction of growth. Images can be viewed below.

Figure 7: Three oaks classified as Priority 2



Empty cages are those in which contain no signs of a seedling or that the current seedling are dead and need to be removed or replanted. The immediate collection of these cages is suggested so that materials can be recycled and used for establishing seedlings.

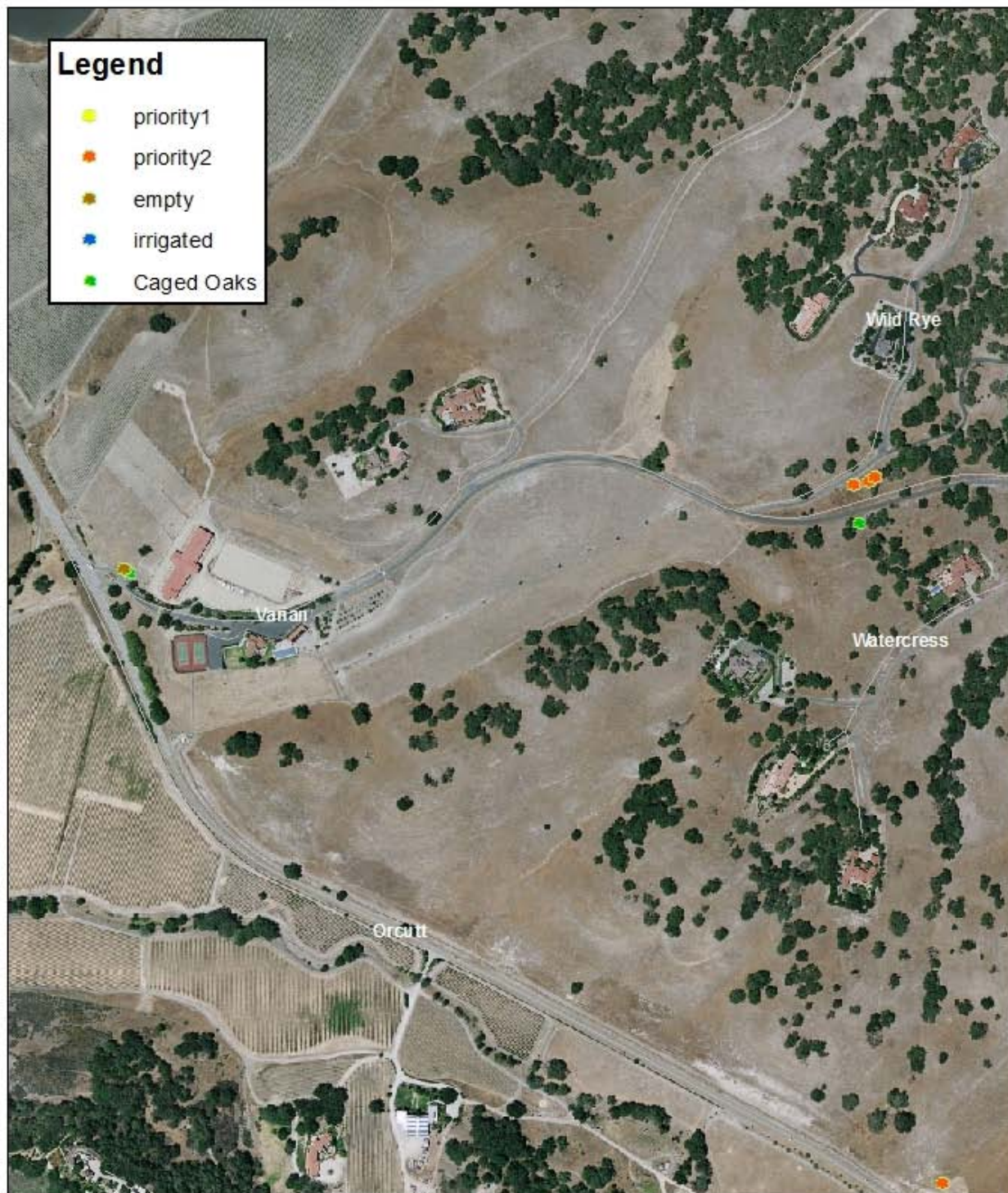


Figure 8: Dead oak classified as Empty Cage

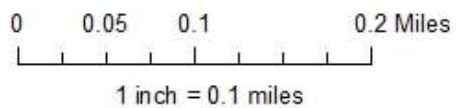
Irrigated trees are those who have been caged but have irrigation running up to them. The presence of such irrigation indicates adjacent home owners have taken responsibility for these oaks and do not have to be immediately considered for the Adopt-an-Oak Program unless otherwise notified.

Those labeled simply as caged oaks are those that are still small and establishing and are not close to outgrowing their cages. Though they are not suggested to have immediate attention, such trees should not be neglected. Particularly after this season's rain, a rapid increase in growth may be observed, and cages may need to be adjusted sooner than anticipated. It is critical that every caged oak is monitored and maintained to aid in its healthy establishment.

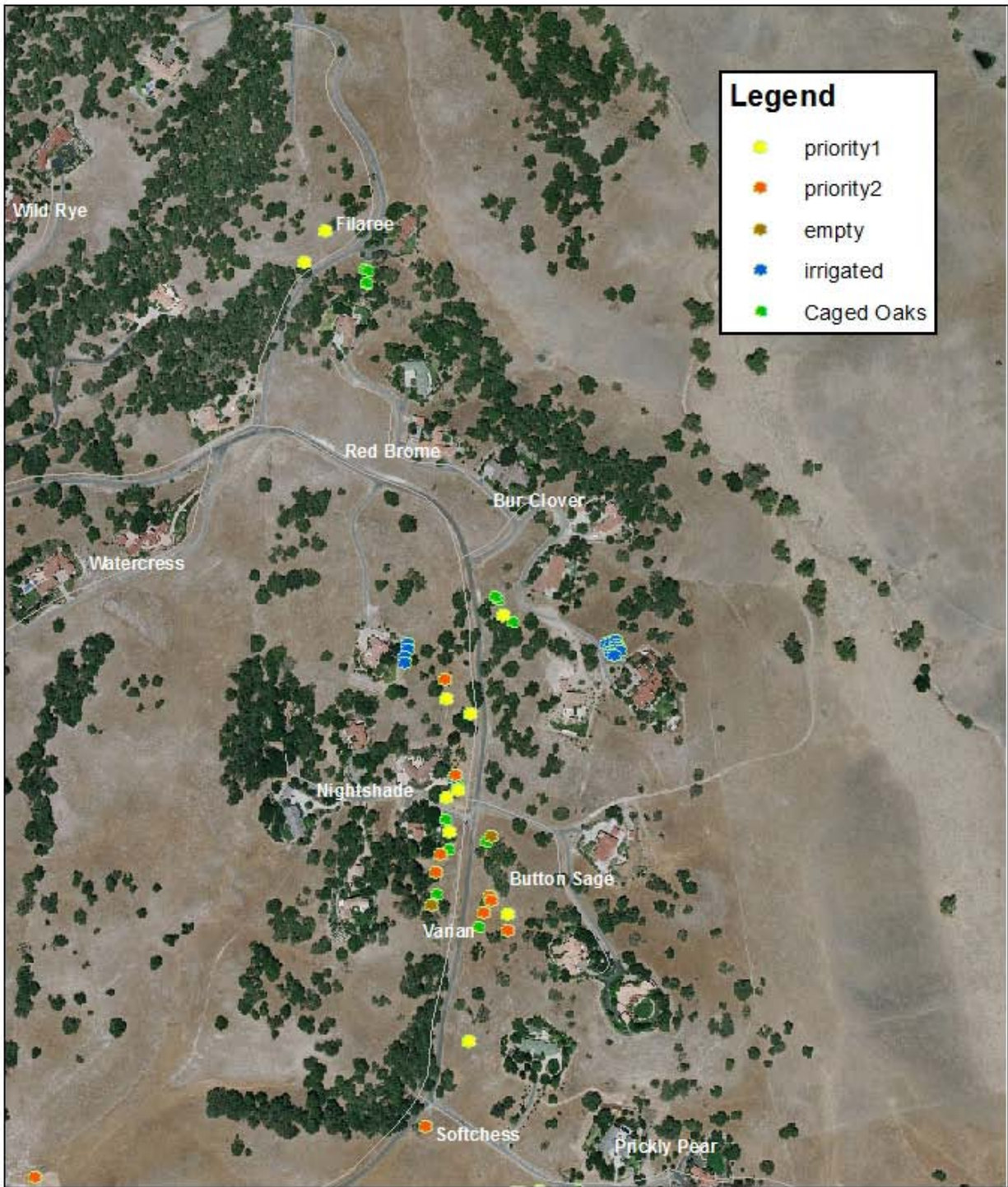
North Varian Ranch- Priority Caged Trees



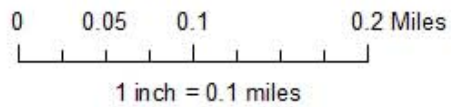
Created By: Tiffany Lappinga and Ivy Ku
Created For: Dr. Wally Mark
Created On: May 24, 2011



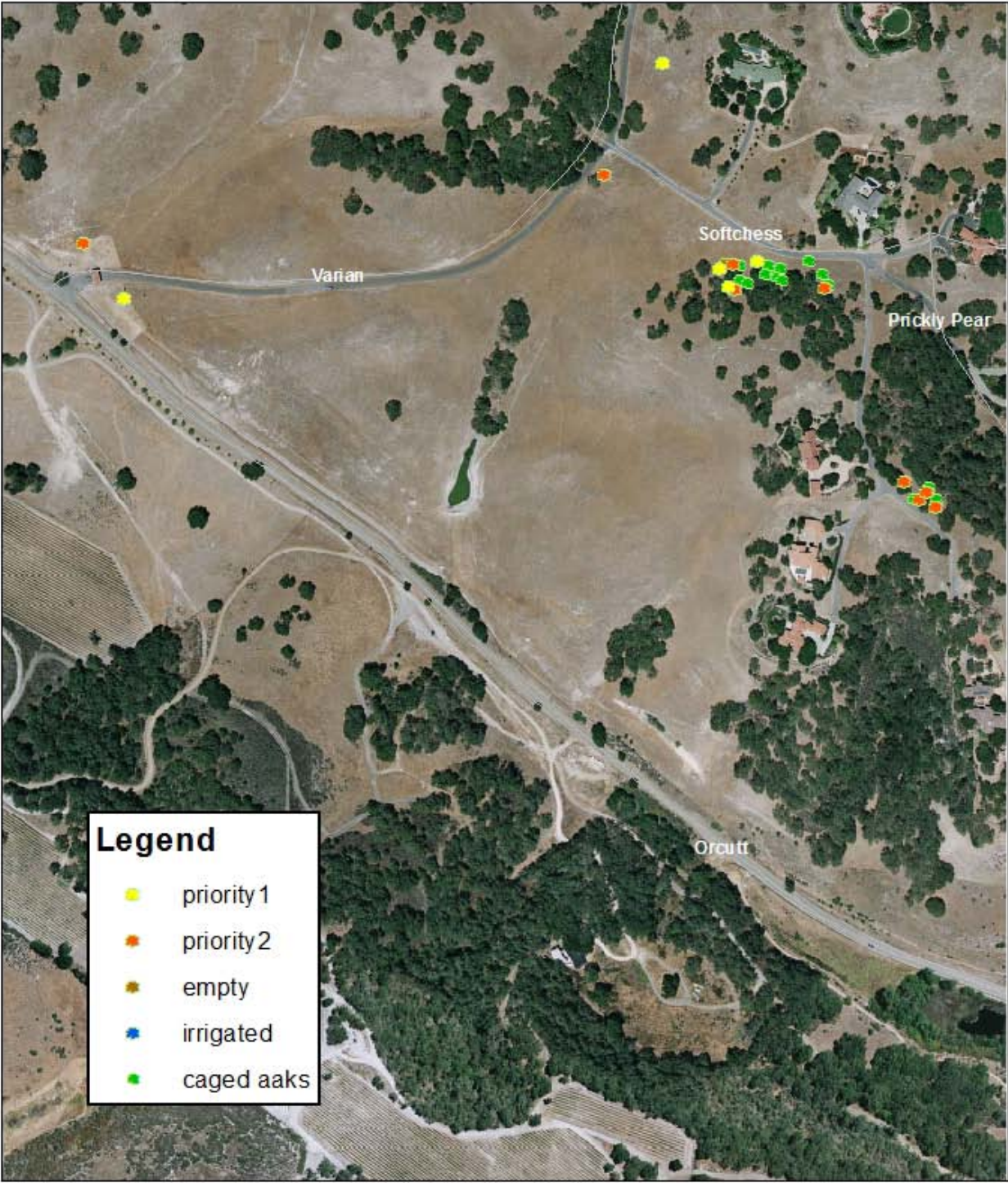
Central Varian Ranch- Priority Caged Trees



Created By: Tiffany Lappinga and Ivy Ku
Created For: Dr. Wally Mark
Created On: May 24, 2011



South Varian Ranch- Priority Caged Trees



Created By: Tiffany Lappinga and Ivy Ku
Created For: Dr. Wally Mark
Created On: May 24, 2011

