# A Feasibility Study On Possible Uses For Common Area Greenbelts In A Southern California Residential Development

A Senior Project

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by

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**Abstract**

Common greenbelt areas within residential neighborhoods are capable of existing as multi-function zones. ‘The Village’ in Southern Orange County, California, envisions its greenbelts as benefiting the homeowners, both in cost and esthetics, all beneficial insect and plant species, and the surrounding micro-climate. Research was conducted on three different systems, aimed at improving the areas of ‘The Village’ both economically and environmentally; the areas of focus were vineyard installation, fire resistant landscaping, and low impact development installations. The process began with evaluating the sites physical and judicial restraints. Soils tests, topography calculations, climate records, and preexisting species identifications were conducted; documents regarding water rights, installation restrictions, site history, and zone regulations were also collected. Interviews were conducted with all relatable parties, including local fire authority, board members from the Homeowners Association, vineyard lesser and lessee, and LID specialists. All potential benefits and drawbacks of each installation were compared and contrasted between the three areas of focus, on levels ranging from maintenance costs to long run ecological factors. This research will be used in moving forward to improvements within the greenbelt areas of ‘The Village,’ and can be further applied to similar residential development areas in future projects.

**Acknowledgements**

I would like to acknowledge the Homeowners Association of ‘The Village’ for their guidance and cooperation throughout my study.

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## Introduction

The purpose of this feasibility study is to compare and contrast possible uses for the common areas found between houses in a gated community of Southern California. The common area is currently in the form of a green belt and lacks beneficial usage and aesthetics. There are three points of exploration for installation possibilities: vineyards, fire resistant landscaping, and low impact development.

### The Village and Its History

The Village is a custom-built home entity of a larger guard-gated private community known as Coto de Caza. According to the 2010 United States Census, Coto de Caza is 8.0 square miles and has a population of 14,866. The Village contains 428 of the 3,977 homes within Coto de Caza (Atkins, 2013). The community is located within the northern portion of Wagon Wheel Canyon in southeast Orange County, California. The Village is nestled near the foothill portions of Saddleback Mountain Range

Prior to its initial development in 1964, the land was used occupied by the Shoshonean Native Americans, more commonly known as the Acagchemen. In 1843, roughly 5,000 acres of the Acagchemen land was purchased by Juan Forster. With Forster came the transformation of the land into "La Victoria Ranch." The ranch allowed sheep to graze amongst the native California species such as *Danthonia californica* (California oatgrass) and *Nassella pulchra* (purple needle grass). Sheep grazing provided weed control and animal stock, both beneficial to Forster financially and ecologically to the health of the land (Fischer, 2013). In 1864, the land was sold to James C. Flood and Richard O'Neill, who began a search for a more profitable use for the now 230,000 acre ranch that included Rancho Santa Margarita and two other counties

(Atkins, 2013). Barley was planted in the portions of La Victoria that are now categorized as The Village. The barley was primarily used for malting, with a large quantity also harvested for grain and cereal products. Barley remained present in the landscape until the 1950s, whene it became gradually surrounded by hunting grounds and hiking trails (Merrit, 2013). In 1968, the corporations of Chevron and Arvida initiated the development of a hunting lodge and a community of custom built homes (Fischer, 2013). Within the decade, the barley had been removed and the landscape returned to a native coastal sage scrub and native grass weeds. In 1995 the Homeowners Association implemented a law allowing homeowners to extend personal landscaping 50 feet beyond the edge of their property; this is known as greenbelt encroachment (Blaul, 2011). The remaining acres of flat land were to receive a biannual mow to 4 inches with the hillsides left untouched; all areas go without irrigation or frequent maintenance (Blaul, 2013). The sole use for the common area greenbelt land today provides a handful of equestrian and pedestrian trails that lead into Cleveland Nation Forest.

**The Village and Its Physical Facts**

According to The Village HOA document entitled 'Coto- Greenbelt Acquisition Documentation #42289687,' the community is broken down into lots categorized as residential, streets (private), clubhouse and recreational facilities, guest units, commercial, and common area-pedestrian-equestrian-utilities access. This portion of The Village is under tract number #6970 in an unincorporated territory of Orange County. The attached document provides a breakdown of these numbers. In reference to this feasibility study, lots 427, 428, 432, 429, 426, and 430 will be under examination for the proposed landscape improvements. The Village is documented on paper using a scale of 1"=300'. The acreage of the lots listed above is as

respectively follows: 11.56, 9.83, 2.63, 2.82, 6.34, 3.93. Both combinations of lots rest on either side of Via Coyote and are northeast facing. Lot 429 backs up to houses resting at an average of 731 feet with a slope of 831 feet at its highest point. Lot 426 raises houses to 804 feet above sea level, with a slope point of 899 feet. Lot 430 homes rest at 838 feet with the slope at 905 feet. Lots 427, 428, and 432 possess a consistent slope elevation of 921 feet above sea level, with the majority of houses at 806 feet (Church, 1969). Soil samples from the plot reveal a clay-loam composition, with an average pH of 6.1; neutral levels of aluminum, iron, and manganese were determined with the test (Doherty, 2013).

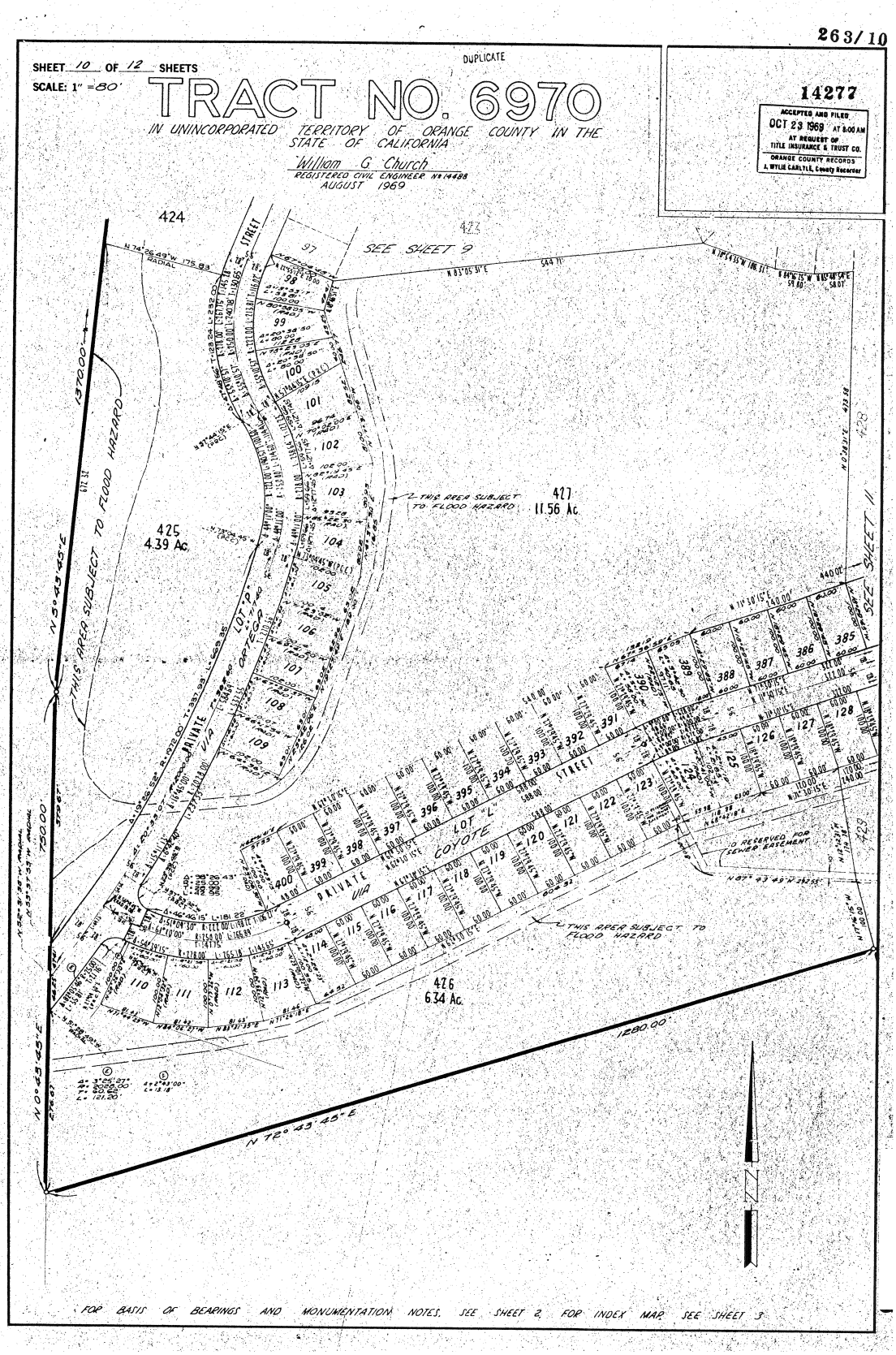


Figure 1. Records of lots 426 and 427 in reference to specific location and topographical measurements.

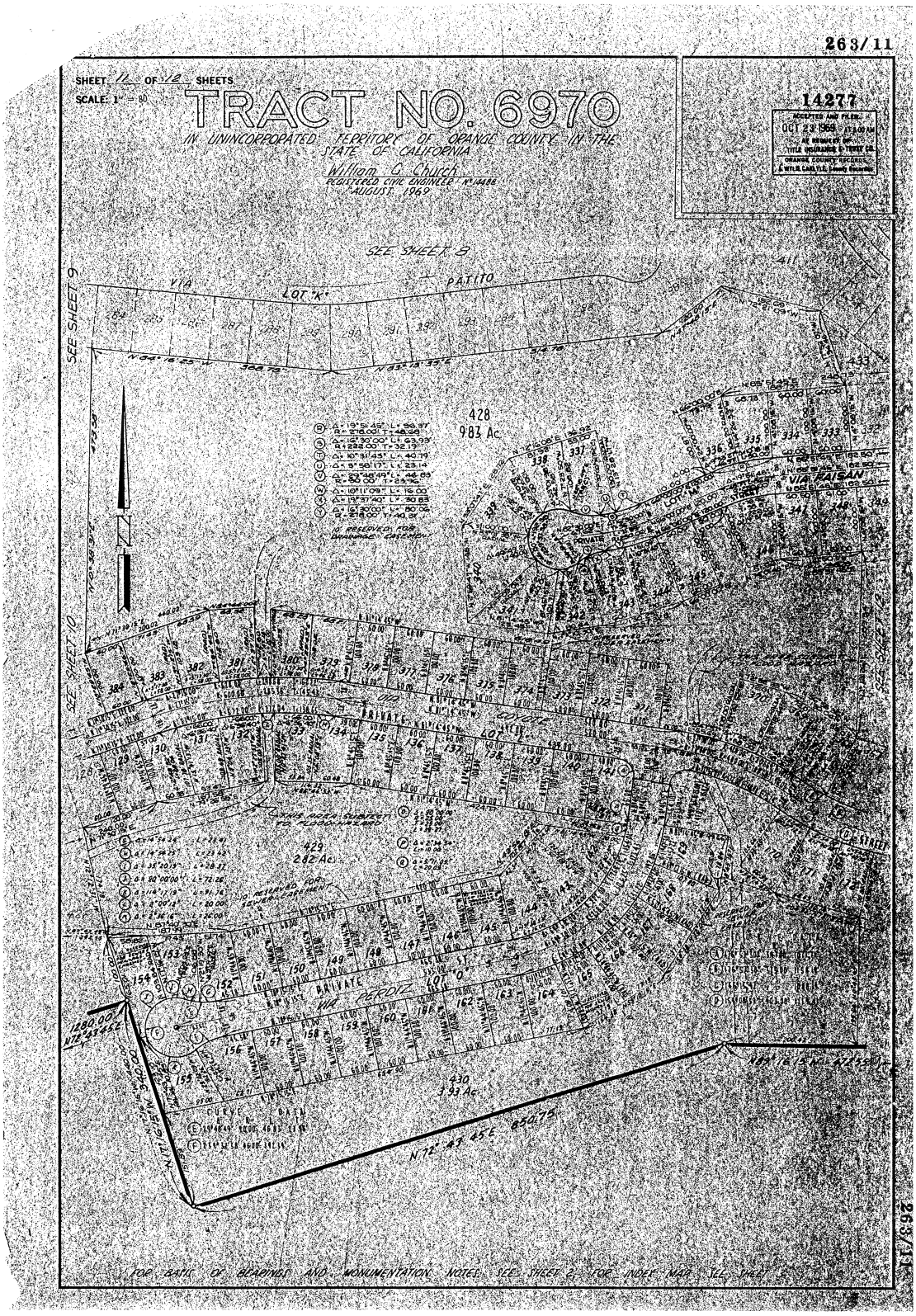


Figure 2. Records of lots 428, 429, and 430 in reference to specific location and topographical measurements.

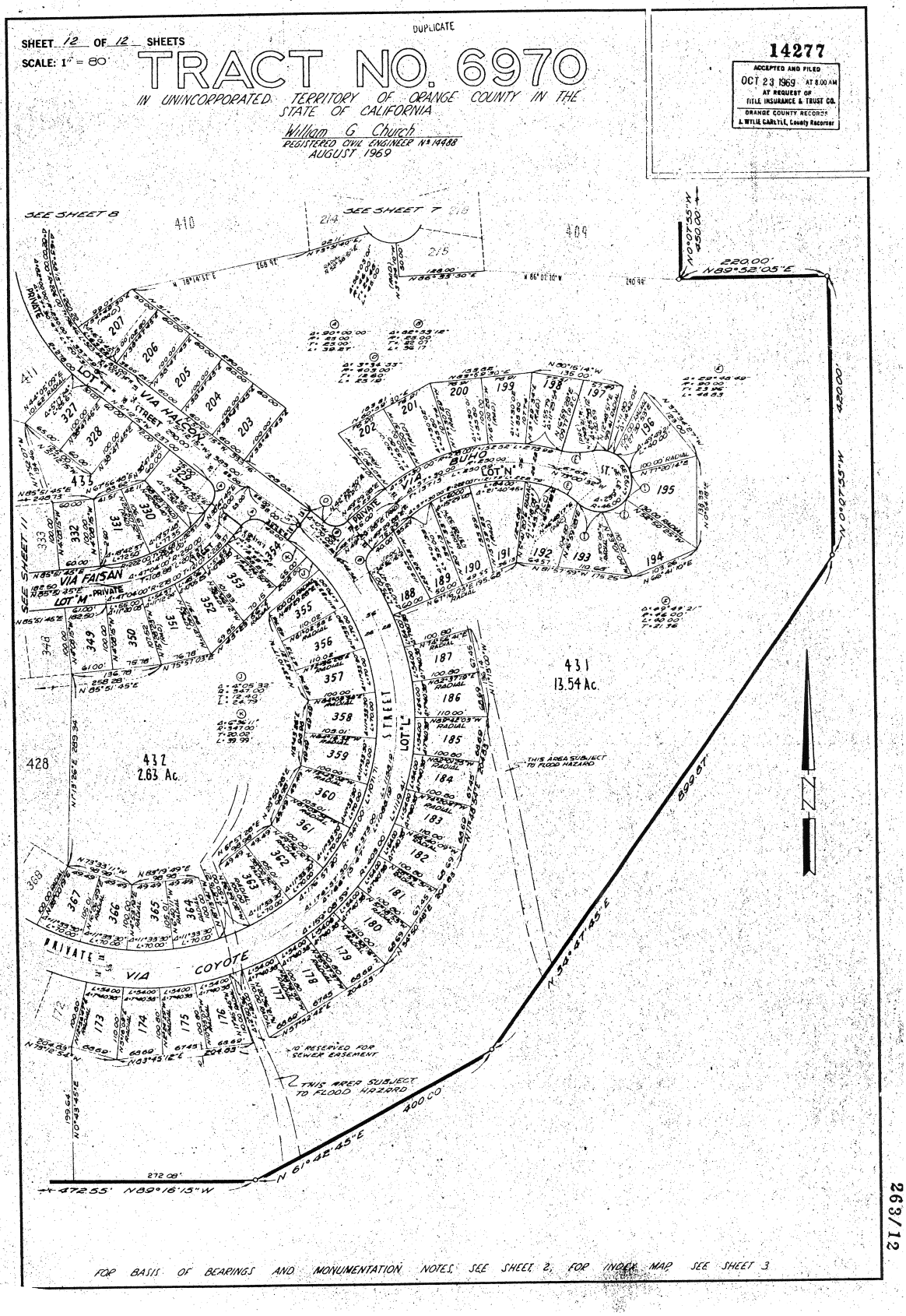


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Figure 3. Records of lot 432 in reference to specific location and topographical measurements.

**Legal Rights Associated**

*Fire Restrictions*

According to California state wide law, properties subject to wildfire risk must adopt protective management practices. Coto de Caza is declared an at risk zone (Blaul, 2011). The Village began its development in 1968 and the majority of the current homes are infrastructures built in the 1968-1975 construction phase (Fischer, 2013). Orange County Fire Authority implemented a provision in local fire codes in 1979 requiring the practice of Fuel Modification Zones; structures built prior to 1979 fall under Defensible Space legal requirements (Blaul, 2013). Under Defensible Space jurisdiction, homeowners must abide to predetermined horizontal and vertical separation requirements . The Village's provision to these OCFA requirements include any developed landscape within the fifty extended feet from the property line as the homeowners Defensible Space responsibility (Blaul, 2013). The requirements are as follows:

I. Horizontal Separation

a. All shrubs greater than 2 feet in height shall be in a maximum grouping of 3 plants and separated by a distance of 3 times the height of the tallest shrub in the group, or 15 feet, whichever is greater (Blaul, 2011).
b. Shrubs greater than 2 feet in height shall be no closer than 15 feet from the edge of the tree canopy(s) measured horizontally (Blaul, 2011).
c. All trees shall be in a maximum grouping of 3 and shall be separated by a distance of 30 feet (Blaul, 2011).

II. Vertical Separation

a. Trees and shrubs more than 10 feet in height require vertical separation of 4 feet between the plant material and the lowest branch of the tree or shrub (Blaul, 2011).
b. Trees and shrubs less than 10 feet in height, and are located within 30 feet of the home, require vertical separation of 2 feet between the plant material below and the lowest branch of the tree of shrub (Blaul, 2011).
c. No vertical separation is required between the plant material below when trees or shrubs are located more than 30 feet from the home and they are less than 10 feet in height (Blaul, 2011).

While the common space zones of The Village existed within its development prior to the Fuel Modification Zone provision of 1979, any amendments of the space must adhere to FMZ restrictions (OCFA, 2013). Currently, the Homeowners Association is responsible for the maintenance and property management of this land. As defined by the OCFA Guideline C-05, "a fuel modification zone is a strip of land where combustible vegetation has been removed and/or modified and partially or totally replaced with more adequately spaced, drought-tolerant, fire resistant plants in order to provide a reasonable level of protection to structures from wild-land and vegetation fires" (Blaul, 2011). The HOA currently mows the chaparral to a maximum of four inches biannually; this fulfills the C-05 requirement stating "development adjoining grass-covered, brush-covered or chaparral covered land, canyons, foothills, mountains, non-irrigated former farming areas, and other lands containing combustible vegetation requires modification of natural vegetation at the urban interface" (Blaul 2011).

In modifying the maintenance plan or implementing a differing landscape use, OCFA will implement regulations based on Zones A-D (OCFA, 2013). The zone breakdown is as follows:

Zone A- A 20-foot structure setback zone to be located on a level, graded area at the top of base of any potential slope (Blaul, 2011).

Zone B- A minimum 50-foot irrigated zone with existing vegetation removed and replanted with adequately spaced plant material previous approved by OCFA (Blaul, 2011).

Zone C & D- An additional 100-foot minimum of vegetation thinning zones (Blaul, 2011).

Because The Village greenbelts are deemed public space, emergency and maintenance access easements must be maintained or implemented (OCFA, 2013). These easements must fulfill the following criteria:

I. The easements shall have a minimum 10-foot width

a. Alternatively, 5-foot wide easements may be provided every 250-feet (Blaul, 2011).

II. Gates shall be installed into the fuel modification ares and shall be a minimum of 36 inches wide (Blaul, 2011).

III. The easements shall be maintained free of vegetation or any structures greater than 5-inches in height (Blaul, 2011).

In implementing a fuel modification zone, the HOA is restricted to the plant palette provided by the OCFA, unless otherwise approved via proposition and inspection.

*Water Rights*

The subject common areas of The Village are currently non irrigated; water is received solely through runoff and natural rainfall. However, if an alternative use were to be implemented, the HOA possess the water rights to the land (Fischer, 2013). Any non-passive, unnatural water supply would be provided by the Orange County Water District; the associated fees would be handled by the HOA and would be included in The Village homeowners' annual dues (Fischer, 2013). If the land was contracted out, water usage would be the responsibility of the developer, physically and financially.

*HOA Restrictions*

According to The Village HOA Code of Conduct, they must not act or implement any modification or improvement to common areas without providing adequate opportunity for approval by the homeowner. Homeowners must be given due notice and substantial information regarding the proposal. Each homeowner has the right to the information, along with the right to vote for or against the proposal at a determined meeting of the Board; the time and place of the meeting must be public knowledge. Without majority homeowner approval, the HOA may not move forward with the implementation of the proposal (Fischer, 2013).

**Vineyard Installation**

The concept of using property as a small scale vineyard installation has been growing in popularity over the past decade, with more adaptable grape species and growing techniques being introduced. Small scale 'backyard' vineyards can increase the aesthetics of a property, the value of the given property, and can provide a source of income to its owner. The type of vine utilized is dependent on the size of the land, water availability, soil properties, macro and micro

climates.  (Fisk, 2008). Local fire authority, homeowners associations, U.S. Fish and Wildlife services, and establishments alike may place restrictions on vines that are allowed in a residential setting. The idea behind using the common greenbelt areas within The Village for a vineyard installation would involve contracting the land out to a developer whose focus is in implementing small scale vineyards (Firstenfeld, 2006). The revenue generated from contracting the land out would assist in lowering, or at a minimum maintaining, the association dues of the homeowners in The Village. Added benefits to the homeowner would be aimed to parallel those of a personal, residential, 'backyard' vineyard, without the cost and maintenance requirements to the homeowner; in essence, the aesthetic improvement, and property value increase without the burdens associated with ownership.

*Types of Wine Grapes and Ideal Environmental Characteristics*

Cabernet, Sauvignon, and Chardonnay are the most commonly produced wines in California, as they thrive in its warm, dry climate (Fisk, 2008). The average temperature of Coto de Caza is 64.7˚F, with a temperature above 70˚F six months of the year (USA Weather, 2013). The annual average precipitation is 12.58 inches, nearly half of the average of the entire state of California at 22.97 inches (USA Weather, 2013). The Muscadine grapevine is a species native to the American South, and has been cultivated to be the most adapted to Southern California climates (Firstenfeld, 2006). Muscadine vines require a pH of 5.5 to 7.5 for optimal growth (Firstenfeld, 2006). A less fertile soil with sandy-loam texture is ideal for most wine grapes, as it allows proper drainage and nutrient holding capacity, and commonly lies within the preferred pH range (Firstenfeld, 2006). While nutrients are necessary for vine survival, many grape species perform best on rocky hillsides with less fertile soil, with the limited resources producing small

grapes. A reduced grape size generally allows for a better ratio of juice to skin in wine making (Firstendfeld, 2006).

*Installation and Maintenance Requirements*

Many of the commercial cultivars selected for growth in Southern California, such as Muscadine, Noble, and Carlos, require specific installation and maintenance practices for optimal yields and survival (Sommer, 2012). The Village's soil has an average pH of 6.1; dolomitic liming would be needed to bring the level up to an ideal pH of 6.5 (Doherty, 2013). The proposed site must be scouted for potential hardpans and possible obstructions to drainage. Multiple trellising systems are available for backyard vineyard installations, however most practical systems implement a wire structure that allows for the establishment of permanent cordons (arm-limbs) that are easily accessible during annual pruning (Sommer, 2012). Pruning is to be done in late winter, post harvest (Fisk, 2008). The cordons are to be trained to single strands of No. 9 wire, placed approximately 5 to 6 feet above the ground (Fisk 2008). Wires are connected and secured using 2x6 pressure treated lumber, spaced to allow the vine to be placed 18 inches from the post on either end. Row spacing is generally selected based on desired yields, aesthetics, cost allowances, water allowances, etc. However, rows should be spaced at a minimum of 4 feet (Fisk, 2008).

Cultivars selected for Southern California are generally drought tolerant; however, adequate amounts water are necessary during the first two growing seasons for proper establishment. Once established, vines can survive on natural rainfall during the Fall and Spring seasons. Occasional water applications may be needed during the warmest months of the Summer, if air moisture content is low. Leaves and tendril droop are common symptoms of low

water supply (Sommer, 2012). Muscadine vines are generally resistant to many of the common wine grape pests and pathogens; a citrus tree planted at the edge of the vineyard allows for symptom observance prior to vine infection (Fisk, 2008). Pierce's Disease and Grown Gall are the most common pathogens affecting wine crops, while Glassy Winged Sharpshooters and Japanese Beetles are the most common pests. All vineyards should be monitored weekly for potential threats, including weeds.

*Contracting Out*

The wine industry has been increasing in popularity and yield over the past century throughout California. Thousands of acres have the potential for vineyard installation and production, with the possibility of millions of dollars worth of profit. However, the field is impacted by a small number of growers who have dominated the industry. Many believe it is too risky to purchase land and build a vineyard from scratch that will be able to successfully compete with the already established 'old-timers.' A solution to these apprehensions has been found- land leasing. The concept of land leasing involves the owner of property that has vineyard potential allowing an outside grower to utilize the land at a set rate. The party leasing the land is generally responsible for paying rent, taxes, operating expenses, crop insurance, and maintenance, and in return, they are able to experience the benefits of ownership without large capital outlay. The lessee is able to grow grapes and produce wine without having to purchase land and commit further than the contract states. The benefits for those leasing the land is rent income, a possible percentage of crop yield and wine revenue, and improved aesthetics and utility of their land. The practice of land leasing has been done on small scale privately owned properties, as well as large scale acreage of an even larger, previously established vineyard. The characteristics of the

operation, as well as the potential of the land, rest in the hands of the lesser-lessee relationship (Firstenfeld, 2006).

*Success Stories*

Stephen R. Dooley, a viticulturist from California, began Stephen Ross Wine Cellars in 2001 under a 25-year lease of 9 acres of land from Talley Vineyards of San Luis Obispo. Dooley did not have the financial stability to purchase and sustain his own property at the beginning of this endeavor, but had a knowledge of grape growing that he felt would lead him to success. Talley Vineyards maintains their portion of the property, with 165 acres devoted to more than 16 varieties of specialized wine grapes, while enjoying an added income from Dooley's renting of his 9 acres. Dooley was given permission to start his production from the ground up, selecting his own trellis system, vine material, irrigation system, and bird netting. The two vineyards have successfully formed a symbiotic and mutually beneficial relationship (Talley Vineyards, 2013).

While Jeff Graves vineyard is not leased, but rather owned as part of his property, his production is a prime example of the potential success of growing wine grapes in Coto de Caza. Jeff owns 6.57 acres in a section of Coto de Caza located a quarter mile east of The Village borders. He found that the land behind his home, which he primarily intended to build a barn on, possessed a slope ideal for grapevines. In 2008 Graves removed the existing chaparral and implemented a 1,600 plant vineyard, which is projected to produce 1,200 bottles of his Jumping Vines label at the end of 2013. The vineyard is a low maintenance operation, with a tangelo tree used for disease and pest watch, bee hives for cross pollination of the vines with nearby lavender plants, and an occasional watering schedule; the vineyard was started on a drip-system and once established, routine water application was removed (Merrit, 2013).

*Fire Resistance Issues*

Orange County Fire Authority is currently researching the efficacy of using crops as a potential fire break in a Fuel Modification Zone or Defensible Space setting. Presently, however, small scale vineyards within the area have been approved with the requirement of a surrounding border of fire resistant landscaping chosen from the list provided by OCFA. Due to The Village common area greenbelts being public space, all installations must still meet the Zone A-D standards discussed previously in regards to fire authority restrictions of the subject land (OCFA, 2013).

**Fire Resistant Landscaping**

Implementing a fire resistant landscape in The Village may have a large initial cost, however the benefits include the potential of saving millions of dollars in the event of an uncontrolled fire. The native chaparral landscape that surrounds the homes in The Village puts infrastructures and those existing within them at high risk during the fire season. While each homeowner has the right to implement his/her own fire resistant landscape within their property lines, the ratio between privately landscaped property and unimproved common areas is skewed towards a side that restricts The Village to its high fire risk status (OCFA, 2013). Creating a fire resistant landscape that homeowners may benefit from, both safety wise and potentially cost wise, is a worthwhile endeavor. The specific requirements for any fire resistant landscape implementation and maintenance according to OCFA zones A-D are as follows:

I. Zone A –

a. Automatic irrigation systems to maintain healthy vegetation with high moisture content and be regularly irrigated (Blaul, 2011).

b. Pruning of foliage to reduce fuel load, maintain vertical continuity, and removal of plant litter and dead wood (Blaul, 2011).

c. Complete removal of undesirable plant species (list is attached) There is also minimal allowance for retention of selected native vegetation (Blaul, 2011).

d. Plants in this zone shall be highly fire resistant and selected from the OCFA approved list attached (Blaul, 2011).

e. Tree species within Zone A are not allowed within 10 feet of combustible structures (measured from the edge of a full growth crown) (Blaul, 2011).

f. Maintenance includes thinning and removal of over-growth, replacement of dead/dying fire resistant plantings, and maintenance of the operation of the irrigation system (Blaul, 2011).

g. Devices that burn solid fuels are not permitted in any fuel modification zone (Blaul, 2011).

h. No combustible construction shall be allowed within Zone A (Blaul, 2011).

II. Zone B-

a. Ground cover shall be installed and maintained at a height not to exceed 2 feet.

b. In order to maintain proper coverage, native grasses shall be allowed to go to seed. Native grasses shall be cut after annual seeding. Cut heights shall be approximately 4 -inches (Blaul, 2011).

c. Apply irrigation rates to maintain healthy vegetation with high moisture content based on plant species specific needs (Blaul, 2011).

d. Groups of trees, tree-form shrubs, and shrubs that naturally exceed 2 feet in height shall be vertically pruned, and horizontally spaced in accordance with OCFA (Blaul, 2011).

e. Removal of dead and dying vegetation and undesirable plant species (Blaul, 2011).

f. Devices that burn solid fuels are not permitted in any fuel modification zone. (Blaul, 2011).

g. Combustible construction is not allowed within Zone B. range (Blaul, 2011).

III. Zones C & D-

a. Removal of dead and dying vegetation and undesirable plant species (Blaul, 2011).

b. In order to maintain proper coverage, native grasses shall be allowed to go to seed. Native grasses shall be cut after annual seeding. Cut heights shall be approximately 4 inches (Blaul, 2011).

c. Groups of trees, tree-form shrubs, and shrubs that naturally exceed 4 feet in height shall be vertically pruned, and horizontally spaced in accordance with OCFA (Blaul, 2011).

d. Plants species introduced into Zone C or D shall be selected from the attached OCFA list. Existing fuel modification maintenance programs are limited to the plants listed on the approved plans unless a revision is requested. Planting and

maintenance shall be in accordance with planting restrictions from the OCFA (Blaul, 2011).

e. Reduce fuel loading by reducing fuel in each remaining shrub or tree without substantial decrease in the canopy cover or removal of tree holding root systems. Maintain sufficient cover to prevent erosion without requiring planting. Roots of species listed in by OCFA shall be removed from the zone unless an erosion analysis has been performed by a qualified professional or Geologist indicating the need to retain the root systems. Geology reports affecting the fuel modification program shall be provided to the OCFA (Blaul, 2011).

Coto de Caza has previously experienced multiple fires that have made the risk reality. On May 21, 2011, a fire burned through 8 acres of residential land before firefighters were able to contain it. After the event, members of the community discussed the potential for a fire resistant landscape surrounding the residential lines of Coto. This portion of the study focusses solely on the potential for The Village, rather than the surrounding areas of Coto in its entirety.

*Financials and Plant Materials*

In developing a fire resistant landscape, all preexisting vegetation would be removed and new specimens would be introduced. Costs would include removal, plant materials, irrigation, maintenance, and permits. The HOA's goal with this feasibility study is to reduce or maintain current homeowner fees. Therefore, the landscaping would have to involve a grant in support of fire resistant landscaping, or an effort from the homeowners in making the project implementation and maintenance a responsibility of the community as a whole. Tree of Life Nursery, located in the hills of San Juan Capistrano, is a large wholesale provider of California

native species, many of which are deemed fire resistant by OCFA (Atkins, 2013). The nursery has previously worked with communities in an attempt to promote their business, as well as education of fire prevention. A recycled runoff irrigation system would likely be implemented, using excess water from surrounding homes and collected precipitation. Initial planting and continued maintenance would be done on a community level.

The approved list of fire resistant species is attached to this document. All selected specimens must be from this list in order for the landscape to be approved as a fire resistant fuel modification zone by the OCFA.

*Success Story*

The City of Beverly Hills began planning a community fire preventative and resistant landscape transition in 2003; the section chosen for the transition was 1.5 square miles and contained approximately 3,000 residents in a wildlife-urban interface. The residents recognized the capabilities of their local fire authority, however they felt taking a more hands on approach in prevention would be beneficial in the long term. They first developed a Firewise board with members from the community, fire department, and landscaping companies. After securing members for the Board, a wildlife-urban interface specialist was hired to assess the issues of the land and propose a landscape plan to the members of the City of Beverly Hills. USDA-Forest Service's Jack Cohen conducted this assessment, observing areas of potential risk, ignition, and exposure; the assessment was conducted May 3-4 of 2004. The proposed fire resistant landscape was implemented in early 2005, with funds provided through grants, City of Beverly Hills funds, and community volunteer hours. Beverly Hills became the third Firewise Community is the State of California and has since been fire-free (Cohen, 2013)

## Low Impact Development

Low Impact Development, commonly referred to by the acronym LID, is the practice of developing a property to incorporate storm water runoff into its landscape in an attempt to retain and treat runoff at its source (USDOT, 2012). This type of system opposes conventional storm water management and treatment, which involves carrying runoff to larger off-site facilities with limited recycling capabilities. In treating runoff in such a large scale with efficiency as priority, negative side effects occur frequently; decreased groundwater recharge, increased runoff volume, decreased water quality, erosion, excesses piping, etc., are potential degradations due to traditional treatment. LID techniques include permeable pavements, bioretention, vegetated rooftop retention, rain barrels, bioswales, etc.; some of these techniques will be defined in further detail below (Sabourin, 1999).

### *Types of LID Residential Installations*

Bioretention is a type of storm water treatment system that utilizes depressions integrated into a landscape to capture runoff from impermeable surfaces and allow infiltration and pollutant removal as the water runs through the soil profile. The water is directed to the bioretention zone where it encounters vegetation that begins the pollutant removal process; the first added benefit can be seen here, as the vegetation receives water passively without the costs associated with irrigation systems. Once percolated through the vegetation, the storm water will encounter a sand layer, which serves as a transition between the soil bed in which the plants existed and the gravel layer and underdrain pipes. The sand layer is on average 6 inches thick and allows permeability at a rate twice as fast as the previous soil bed. The following layer consists of gravel and underdrain, serving as a final filtration barrier. The water will flow through the gravel and into

perforate underdrain pipping; the pipping may lead to a larger communal storm water system or may be recycled and returned back for homeowner use (Leighton *et al.*, 2007). Bioretention installations must be frequently regulated for fertilizers, pesticides, contaminated off-site runoff, etc., that may compromise or outweigh the intended purpose of the system. In implementing bioretention zones, approximated infiltration times are calculated; if infiltration consistently exceeds the approximations regardless of the amount of water, an evaluation and possible restructuring or removal may be necessary. Biannual inspections of LID bioretention areas are recommended even in the absence of visual malfunctions (Kuo *et al.*, 1999).

If the common area land was to be converted into more housing units, LID vegetated rooftops could provide benefits to the HOA, via increased property income. Vegetated rooftops involve a similar system to bioretention zones, but possess a few added benefits as well as a few added complications. In turning a rooftop into an LID landscape, filtering plants are selected and planted atop layers of drainage material that rest on a high-quality waterproof membrane in direct contact with the building's infrastructure (E.H. Shaver *et al.*, 1997). Vegetated rooftops have the potential to assist in runoff reduction and retention, air and water quality improvement surrounding the infrastructure, improved aesthetics, and energy conservation. The rooftops are able to slow the velocity of direct runoff by allowing a large portion of it to percolate through the soil, reducing the overall quantity and extending the flow path of the unabsorbed water through the vegetation. Because the water is moving through a filtration system, existent in the plant material and soil medium layers, the excess runoff will contain less pollutants. Similarly, any water evaporating or transpiring from the vegetation will have less pollutants and will lead to improved air quality; air quality is also increased via direct atmospheric pollutant absorption of

the leaves (Davis *et al.,* 1998). Energy is conserved through the added insulation the landscaping provides for the infrastructure; the vegetation and soil medium act as insulators during the Winter months and coolers during the Summer months. If installed correctly, vegetated rooftops can extend the lifetime of the roof by providing protection from weathering, breakdown, etc. (Miller, 1998).

There are many critical factors involved in vegetated rooftop installation; weight bearing capacity is the biggest concern in terms of infrastructure safety and capability. Once the weight bearing capacity is calculated, proper filtration and plant material must be selected. Long-lasting, perforated under-drain layering is necessary at the base level of the design in order to provide proper drainage rates. Lightweight growing media can allow for little to no structural reinforcement if it falls under the weight bearing capacity; the media must promote rapid enough filtration as to prevent excess water retention that may severely increase the weight of the media. Sandy media is preferential, as it allows for more efficient percolation rates in comparison to clay. Plant material must be selected with water requirements in mind; species that are capable of survival with only natural water application (ie-rainfall) are preferred (Hsieh and Davis, 2005). In a large scale case study done at the Fencing Academy of Philadelphia, 3,000 square feet of vegetation was installed and monitored by Roofscapes, Inc. The rooftop was installed as a result of increased storm events in the area. The vegetated roof is 2.74 inches thick consisting of a base layer made from synthetic perforated piping and meadow-like perennial plant materials, including multiple *Sedum* and succulent varieties. The system allows for less than five pounds per square foot when dry and seventeen pounds when fully saturated. Water is capable of infiltrating at a rate of 3.5 inches per hour with 45 percent media volume capacity. Two years

post installation, water runoff was reduced by 54 percent; 44 inches of rainfall was recorded with an end runoff of 15.5 inches (Miller, 1998 & 2013).

*Potential Issues*

The goal of the feasibility study is to create a potential income for The Village, the HOA, and in essence, the homeowners. LID installation within the common area greenbelts would have a large initial cost, and would serve solely as an improved treatment system for storm water and potentially improve the aesthetics behind the home. If the LID installation and maintenance were to be the responsibility of the HOA, it would come as a cost rather than a revenue producer. However, urban development requirements exist in parts of Orange County that force developers to implement LID installments in conjunction with newly built or remodeled neighborhoods or complexes. In many cases, the areas within which developers are working are not suitable for LID, whether it be for reasons associated with spacing, community involvement, water laws, etc. Depending on the region within which construction is taking place, developers may participate in land banking, a practice that allows them to meet LID requirements through "leasing" land elsewhere and implementing a storm water filtration system. The Village exists within the San Diego Regional Water Quality Control Board, and therefore any developer, regardless of where his/her initial project exists, must work within the restrictions of the San Diego sector. San Diego's MS4 permit does not currently allow LID banking within the area, however plans for amendments are in place (SDRWCB, 2013).

**Side Factors Affecting Capabilities of Common Areas**

The Village currently rests atop an underground water well that predated the development of the community. Documents regarding the water rights of this well, as well as the status of the

windmill power station behind Via Coyote, are currently being pulled from the records of the HOA. To be discussed further when documents are obtained....

## Materials and Methods

### Choosing The Subject

The feasibility study involves common area greenbelts within The Village of Coto de Caza. Due to its common area characteristics, permission from the Home Owners Association was needed in order to declare the property as the subject. Prior to the monthly HOA board meeting, a written request regarding the project was submitted to the president, Jeremy Pipp. The request stated the land involved, the goals of the study, possible materials and documents needed, and contact information. The request was discussed amongst members in a closed door session, followed by a verbal request and project proposal during the public hearing session of the meeting. Permission was granted to review relevant documents regarding plots of land approved by the HOA to study. The list of available documents was retrieved following the meeting, and the necessary documents were identified; 'Coto-Greenbelt Acquisition Documentation #42289687' was requested for review and photo-copying. The request went to the board manager, Courtney Fischer. A meeting was set-up with Fischer at the HOA headquarters on October 1, 2013; the documents within #42289687 were reviewed and photo-copied under supervision. The list of board members, along with their job descriptions and contact information, was also retrieved at the meeting. Necessary members of the board were identified, and interviews were conducted to obtain the history of The Village, along with current information regarding its uses and associated rights. Bob Atkins and Bob Merrit, both members of the board, were interviewed with the aim at retrieving history and current states of the land; interviews were conducted on the 28th of September and the 13th of October respectively.

**Surveying The Land and Discovering Physical Characteristics**

Using the documents obtained from the board, the plots of land applicable to the study were identified. The plots of land were chosen based on size, homeowner interface, and available access and resources. Google Earth was used to obtain dimensions, areas, elevations, etc. The individual sites were surveyed by foot for existing plant species and observable micro-climates, pests, animals, greenbelt-homeowners interface, etc. A USA weather site was used to gather the average temperatures, precipitation rates, and humidity percentages of The Village, as well as the surrounding areas of Coto de Caza. On October 17th, 2013, soil samples were taken from the chosen plots using a hand shovel, plastic containers, and recording labels; two samples were taken per plot. An infield ribbon test was performed using a squirt bottle and fist size sample of soil; textures were recorded for each of the six plots and filed on paper. The sample testing was conducted by the HOA and results were obtained on the 23rd of October. The results included pH, soil texture, and present elemental levels.

**Vineyard Installation Aspects**

With the declaration of The Village as a Fuel Modification Zone, OCFA communication and approval was needed to allow vineyard installation as a portion of the study. Wine grapes were approved as fire resistant species by OCFA under provisions to Guideline C-05. Research was conducted in the following categories: wine grape species successful in California, vineyard installation plans, drought tolerance of vineyards, land leasing, etc. Personal communication with Talley Vineyards of San Luis Obispo occurred on October 11th, 2013. The interview covered information regarding land leasing within pre-established, large-scale vineyards. Hamilton Oaks

of San Juan Capistrano was contacted regarding vine selection and potential wholesale relations with The Village in a contracted land setting.

A draft was formed with potential grape species and installation materials, as well as a maintenance plan and initial cost breakdown. The maintenance plan included pruning, irrigation, fertilizing, spraying, and harvesting. Grape species were chosen with soil texture and pH in mind. Installation materials included specifications on treated wood selected, wire type, and disease and pest signal specimens. Crop yield and revenue projections post bottle were calculated using reference points from previous Hamilton Oaks contracts. A blueprint of the vineyard was drawn for lot #428. Mock land leasing contracts between the HOA and Hamilton Oaks, including estimated pricing on an annual projection, were written for the selected six lots of land.

**Fire Resistant Landscape Aspects**

Due to its location, The Village was deemed a fire prone region, allowing for fire resistant landscaping to exist as a portion of the study. Restrictions regarding landscape implementation within the greenbelts were discussed with the Orange County Fire Authority. The interview covered the following topics: definitions and application of Defensible Space versus Fire Modification Zone, susceptibility, rights of the land, fire resistant species, at risk species, etc. In determining the subject plots of land as Fire Modification Zones, OCFA Guideline C-05 was obtained, reviewed, and applied to the study. Research revealed successful implementations of fire resistant landscapes in differing communities within the United States. Jack Cohen, a USDA Forest Service professional, was interviewed regarding his involvement in the fire resistant landscaping project of a community in Beverly Hills, California.

An implementation plan was drafted in conjunction with the chosen greenbelt areas of The Village. Lot #428 was selected for a blueprint design of the proposed landscape. The blueprint included a plant list, hardscaping materials, and irrigation specifications. A cost analysis was drawn up, breaking down the following: cost of plant material, cost of hardscaping material, cost of irrigation material, cost of transportation, cost of road permits, cost of installation labor (if conducted on a non-volunteer basis), and cost of maintenance (if conducted on a non-volunteer basis). An installation plan, along with a maintenance plan, was compiled, including man hours, necessary tools, necessary maintenance practices, etc. In conjunction with OCFA requirements, a draft of permission requests and approval of local fire authority was constructed, with all proposed materials described above included.

**Low Impact Development Aspects**

To begin this portion of the project, the water rights associated with the subject areas were discussed and determined in an interview with Courtney Fischer. Potential water sources and estimated annual water runoff were identified and calculated. Research was conducted on two potential LID installations: bioretention zones and vegetated rooftops. The concept of LID land banking was discussed with the San Diego Regional Water Quality Control Board on September 13th, 2013. While land banking is not currently allowed within the region, mock revenue analyses were generated with the potential of a provision to banking restrictions in sight; the revenues were generated using previous banking projects within Northern Orange County.

**Presenting To Homeowners**

Once completing all three areas of the study, findings were summarized and a mock proposal to the homeowners within The Village was drafted. The proposal included a blueprint of

both the fire resistant landscape and vineyard installation, a summarized initial and continuous cost breakdown of each project, and any revenue potentials. The revenue potentials included reductions to the HOA annual dues of the homeowners. The steps following the proposal would conclude with majority homeowners approval of one of the three potential installations.

# Results

# Discussion

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# Appendix