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Developing a Compliance Monitoring Framework for Conservation Easements: Case Study – North Irvine Ranch

A Group Project submitted in partial satisfaction of the requirements for the degree
of
Master's in Environmental Science and Management
for the
Donald Bren School of Environmental Science & Management

by

Jessica Grant
Jon Peter Hardie
James Mazza
Lacrissa Rizo Patron

Committee in charge:
Bruce Kendall, Ph.D

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Jessica Grant	Jon Peter Hardie
James C. Mazza	Lacrissa Rizo Patron

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The Group Project is required of all students in the Master's of Environmental Science and Management (MESM) Program. It is a three-quarter activity in which small groups of students conduct focused, interdisciplinary research on the scientific, management, and policy dimensions of a specific environmental issue. This Final Group Project Report is authored by MESM students and has been reviewed and approved by:

Advisor: Bruce Kendall	Dean: Dennis Aigner

Date

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Abstract

Conservation easements have emerged as an important conservation tool utilized by Non-Governmental Organizations (NGOs) to try to maintain areas of ecological, biological, and/or historical importance. Typically, conservation easements purchase and retire the rights to develop a piece of land, meaning the land owner may no longer build on the property. However, a land owner may still own and/or sell other rights associated with the land, which may have competing interests with the goals of the conservation easement. Therefore, monitoring is crucial to ensuring the success of the easement. This report describes a compliance-monitoring framework for conservation easements, using the North Irvine Ranch (NIR) conservation easements in Orange County California as a template. The NIR's biological richness, open space, and connectivity make it an important asset to a relatively developed area, Orange County. The challenge is to determine compliance with the terms of the easement documents, and recommend monitoring procedures, given a limited budget. The initial step was to determine the monitoring targets per the NIR's easement Grant Deeds, Easement Documents and Resource Plans. The second step was to document baseline conditions -- including existing trails, roads, and developments -- across the easement. The third step was to develop a hierarchical method comprised of remote sensing, ground truthing, and ground assessment that can identify change and/or disturbances over time. Remote sensing addresses all levels of change and subsequent ground-truthing can be used to more accurately measure the findings associated with remote sensing. Ground assessment can be used between remote sensing sessions to provide greater temporal resolution in high-priority areas. For ground assessment, a "Threat Matrix" model was developed to prioritize areas to be monitored. Finally, the fourth step included other tools for compliance monitoring such as proactive measures for maintaining robust lines of communication with the property owner, local government and local community, which could be implemented to decrease the risk of violations occurring in the first place. The development of this framework will be directly applicable to other monitoring programs for conservation easements.

Executive Summary

One of the fastest growing land-protection tools in the United States is the "conservation easement," a voluntary legal agreement that places restrictions on how land can be used in order to protect historic sites, open space, particular species, or natural communities. Recently, The Nature Conservancy (TNC) secured easements on over 11,500 acres of land in Orange County, California. This land, known as the North Irvine Ranch (NIR) conservation easements, is one of the last undeveloped areas in Orange County which possesses natural, ecological, scenic, open space, recreational and education values (collectively stated as "Conservation Values" in the easement agreements). The natural and ecological Conservation Values include open space, habitat, and habitat linkages essential to preserving various natural communities. Many sensitive, rare, and endangered plant and animal species are dependent on such natural communities. The easement lands also provide open space and protection for scenic qualities unique to the

area, providing public access and venues for appropriate educational and recreational activities, and providing venues and targets for scientific study.

Also stated within the easement agreements are specific targets relative to monitoring the conservation values of the site. The NIR's monitoring targets included: residential and other buildings; roads and trails; fences, gates and walls; electric power lines, pipelines, wells and tanks; fuel modification areas; arterial highways; grazing and farm areas; educational and recreational areas; mining and drilling; exotic vegetation, and features of surrounding properties. Compliance monitoring assures all stakeholders that the landowner is adhering to the terms of the easement agreements and preserving the conservation values the easement was established to protect.

A conceptual compliance monitoring framework was designed that would preserve the goals of an easement agreement; determine changes across an easement; qualify and quantify those changes; compile and organize relevant data; and provide preemptive measures to deter future violations from occurring. This conceptual framework includes:

- Conservation Easement Documentation – defining the goals of the conservation easement agreements
- Baseline Data Acquisition and Documentation – compile and document the initial condition of features which are relative to the goals of the easement agreements
- Data Management – organize easement features, and baseline conditions, with statistical properties in a relational database for storage and analysis (MS Access®)
- Remote Sensing – use multispectral and multitemporal images to perform image differentiation to detect areas of change across the easement (Utilizing high resolution ADAR imagery)
- Ground Truthing – qualify and quantify remotely sensed areas detected for change
- Ground Assessment – monitor in between remote sensing sessions those areas flagged by the "threat matrix" model as having a high potential for change
- Other Tools – create robust lines of communication with stakeholders as a preemptive measure to prevent violations

This conceptual framework was applied to the NIR to determine compliance with the terms of TNC easement documents, and recommend monitoring procedures, given a limited budget. Key recommendations were given based on factors such as cost, effort, and best available technology. The following are the key recommendations and procedures specified for compliance monitoring of the NIR easements:

- Baseline Data Acquisition and Documentation – Extrapolate the NIR's monitoring targets from its easement agreements, this included: residential and other buildings; roads and trails; fences, gates and walls; electric power lines, pipelines, wells and tanks; fuel modification areas; arterial highways; grazing and farm areas; educational and recreational areas; mining and drilling; exotic vegetation, and features of surrounding properties.

- Data Management – Develop a Microsoft Access relational database to support the TNC easement baseline, documentation, and data management for the monitoring targets listed above.
- Remote Sensing – Specify Airborne Data Acquisition and Registration (ADAR) as the sensor for image acquisition. Images should be multispectral, one meter resolution, and shot using GPS triggers on the order of once every three years. Basic difference imaging software such ERDAS, ENVI, or GRID should be utilized for change detection and newly acquired data added to the database.
- Ground Truthing – Use a differential GPS and digital camera to better quantify and qualify changes highlighted during the change detection procedure, all data should be updated into the database.
- Ground Assessment – Develop a "threat matrix" model to prioritize areas for ground assessment, based on their potential for future development. Ground assessment should be performed in these flagged areas over an annual basis, with new data updating the database and subsequently feeding back to the threat matrix and updating the following year's assessment areas.
- Other Tools – Introduce proactive measures, such as, establishing a good rapport with the property owner, local government, and community, which are an invaluable component of a compliance monitoring program. These are not "monitoring" tools per se, rather tools for maintaining lines of communication to prevent problems from arising.

Aspects of the NIR's compliance monitoring program could also be applicable to other easements of various size and type, as well as to biological monitoring issues. The conceptual framework gives options for a land manager to choose which tools and variables best fit the needs of each easement, therefore these are simply procedural outlines with room for the discretion of different land managers.

Objectives

Develop a compliance-monitoring framework for conservation easements using the North Irvine Ranch as a case study, with potential applications for other easements. The analysis will include:

- Analysis of the resource plans and easement document reports
- Identification of the easement's conservation values
- Identification of compliance monitoring targets
- Compilation and analysis of the existing GIS/remote sensing data for recent-past and current extent of land uses, fire history, development, infrastructure, and exotic plants
- Develop a baseline database for the property with respect to the easements' conservation values and monitoring targets, which are pertinent in the monitoring protocol
- Develop a remote sensing protocol with respect to cost and best available technology, to determine land changes in association with use or "take"
- Develop a ground truthing protocol to validate remote sensing findings

- Develop a ground assessment protocol and model to choose survey grids for sampling to determine change in between remote sensing sessions
- Develop proactive measures in compliance monitoring by establishing relationships with the property owner, stakeholders and local community
- Generate recommendations for best practice compliance monitoring on conservation easements

Significance

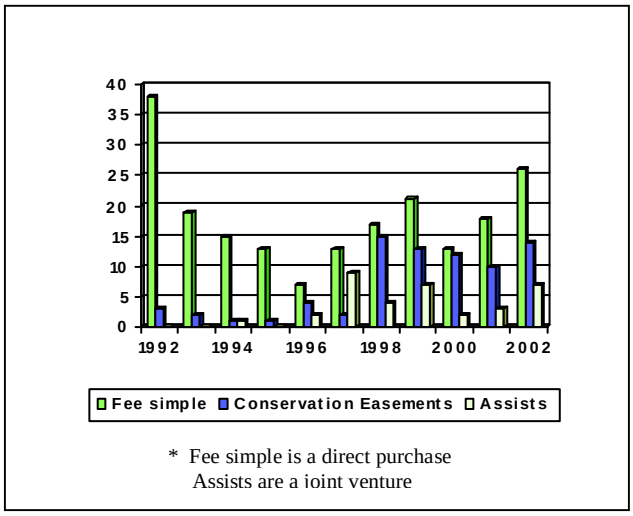
This project outlines a protocol to determine compliance with the terms of The Nature Conservancy's conservation easement agreements that govern the North Irvine Ranch (NIR) of Orange County, California. This area is significant for conservation due to its large size, connectivity with other important areas, relatively pristine condition, high biological diversity, diverse physical features, and sensitive species. Conservation easements, like NIR, are a new tool used in the repertoire of conservation. Currently the "strength of an easement program lies in the diligence of the conservation organization's monitoring activities," (Hahn 2000) as well as the ability for the conservation entity (grantee) to maintain the terms of the easement. An aggressive compliance-monitoring framework is needed to judge whether the restrictions associated with the easements are adhered to. Recognizing that property rights for the easement still lie with the land owner and not solely to the grantee, and that the property may still have developable rights, a monitoring framework should be employed to ensure that the grantor is adhering to the terms of the conservation easement. This project proposes to create a compliance-monitoring framework that can be utilized in the NIR and in other Nature Conservancy conservation easements[*] throughout California. Given the general scarcity of conservation resources, it is imperative that this compliance-monitoring framework ensures that easements serve their intended purpose, and that compliance monitoring of easements be done in a cost effective manner.

Background

Conservation easements are amongst the latest methods of land preservation employed by environmentally oriented NGO's and other conservation entities. Over the past ten years the use of conservation easements by NGOs, such as The Nature Conservancy (TNC), has more than doubled as a way of conserving privately owned lands (See **Figure 1**). Conservation easements purchase and retire certain rights allocated to a piece of land, meaning the land owner may no longer exercise those rights once an easement has been made. However, a land owner may still own and/or sell other rights associated with the land, which may have competing interests with the goals of the conservation easement. In essence, easements place restrictions upon the types of use that an individual property owner can undertake on his or her property.

[*] Easements of comparable size. For easement of smaller size easements only portions of this protocol may apply or be necessary.

Figure 1: Types of TNC Conservation Transactions in California Since 1992



The term "conservation easement" applies to a number of different types of easements. Agricultural, open space, and historic easements are some of the different distinctions that fall within the conservation easement classification. An agricultural easement, for instance, is set up to preserve land from development and assure that land will remain in agricultural use in the future. Historic and open space easements are fashioned in the same manner as agricultural easements, to maintain areas of historic significance or open space. "Conservation easement" serves as an all encompassing term to signify the protection of an area that is meant for conservation.

Economic incentives also prove to be a driving force in the increasing trend towards developing conservation easements. While creating a regime of long-term protection to the benefit of the conservation entity, the easement can be used as a tax-deductible write-off for the owner of the land. This is accomplished by an agreement on behalf of all relevant parties who have ownership of the land (i.e. landowners, mortgage holders, entities with joint ownership), and the donation or sale of the parcel in question for less than its fair market value. Conservation easements are generally set in perpetuity. Therefore, if the landowner or the "grantor" of the easement decides to sell the easement land, the new owner will have to abide by the easement constraints as well.

The Irvine Ranch comprises 93,000 acres or $1/5^{th}$ of Orange County. Of these 93,000 acres, the Irvine Company has pledged 50,000 acres to open space. Comprising 11,500 acres, the North Irvine Ranch (NIR) easements are located in the foothills of the Santa Ana Mountains and represent one of the last contiguous tracts of wild lands in Orange County. The site is characterized by a diverse landscape of rugged terrain ranging from narrow deep wooded canyons, to accentuated ridgelines. The NIR area provides a glimpse of Southern California prior to being intensively developed. Spanning 14.8 square miles and bordered on its eastern front by the Cleveland National Forest, the site overlooks Irvine Lake, Santiago Creek, Fremont Canyon to the north, and Wier Canyon to the west.

Conservation Easement Documentation

A conservation easement document is made up of a collection of restrictions and obligations. The easement document restricts the activities that may occur on the property and imposes obligations on both the landowner (Grantor) and easement holder (Grantee).

Baseline Documentation

Baseline documentation of existing features across an easement creates a picture and record of existing conditions over the property that is used to compare, catalogue, and track future changes.

Data Management

The form of baseline documentation and data storage can be critical to the success of tracking change across an easement, as these property and land types may have multiple owners and/or stakeholders with various dimensions of property boundaries or land use rights. It is imperative that easement managers develop thorough measures for storing information regarding the status of land use and easement features for perpetuity.

Remote Sensing

Remote sensing has emerged as a powerful tool to determine changes over large areas of land. The ability to view large areas of land with respect to their spectral characteristics over time has far reaching implications in terms of changes related to seasonal variation, habitat monitoring, and human related changes. Remote sensing can be accomplished by a number of different apparatus, ranging from satellite-based platforms to low flying aircraft. Each of these different types of remote sensing distinctions has different associated costs, abilities, (such as spatial and spectral resolution), and limitations. Differentiating which of these types of remote sensing will allow for the greatest amount of associated data is an important factor in determining compliance with easement terms.

Ground Truthing

Ground truthing is used to visually qualify and quantify the nature of changes suggested by remotely sensed data. Visual verification of the suggested change is aided by different technologies such as GPS tracking and photo documentation, and thus increases the reliability of remote sensing.

Ground Assessment

Ground assessment entails regularly scheduled surveys/patrols of the property to detect and measure human related disturbances that may occur between remote sensing sessions. In-field regular scheduled investigations of the property help reveal land use changes that could otherwise go undetected and potentially expand in size between remote sensing sessions. Quantification of detected changes, either allowable developments or unannounced human related disturbances to habitat, could be performed during these visits prior to subsequent remote sensing sessions.

Other Tools for Compliance Monitoring (Stakeholder Communication)

Other tools for compliance monitoring such as proactive measures for maintaining robust lines of communication with the property owner, local government and community, can be implemented to decrease the risk of a violation from occurring in the first place.

Approach

The main goal of a conservation easement is to preserve and maintain areas of ecological, biological and/or historical significance. Stated within easement agreements are specific attributes of the site that can be monitored to help achieve this goal. In order to know whether a landowner is complying with the terms of the easement agreements easement holders should monitor the landowner's actions on the easement property. Compliance monitoring assures all stakeholders that the landowner is adhering to the terms of the easement agreements. In order to develop a monitoring framework that could detect when 1) an allowable change in land use had occurred, or 2) a landowner is not in compliance, baseline conditions of the property need to be documented.

Baseline data should express the current conditions of features targeted in the conservation goals listed in the easement agreements. Data relevant to these features are often researched and stored independent of each other, such was the case for the baseline data covering the NIR. To better analyze and track data pertaining to multiple site characteristics, it is necessary to gather, compile, and organize it into a single location. To fit the data within the context of a monitoring framework for the NIR that could be used to detect and keep a tally of changes in land use, all relevant information was entered into a single MS Access® relational database. This centralized mechanism is useful for storing and tracking changes as they occur over time. Once a baseline database was set up and available for queries, the next step was to develop a protocol for collecting data in the future that would be able to give a visual representation of change in land use cover.

Remote sensing was chosen as the primary mechanism for detecting change in land use for the NIR conservation easements due to its ability to survey large parcels of land in a relatively short amount of time and provide imagery that could be measured against a baseline for change detection (*i.e.* image differentiation). Information retrieved through remote sensing sessions can be translated into quantitative measurements and entered into a database for further analysis. To verify whether changes in land use identified through image differentiation are accurate, ground truthing of detected changes will be employed. Ground truthing serves as a complement to remote sensing and allows for verification of changes detected through the comparison of past and baseline images.

Being that remote sensing is set on a specific time frame, a ground assessment protocol was set up to monitor conditions between remote sensing sessions. A ground assessment framework was developed to ensure that areas identified as having a relatively high risk of disturbance or change will be monitored to assure compliance. As a tool to help identify areas of high risk a "Threat Matrix" model was developed.

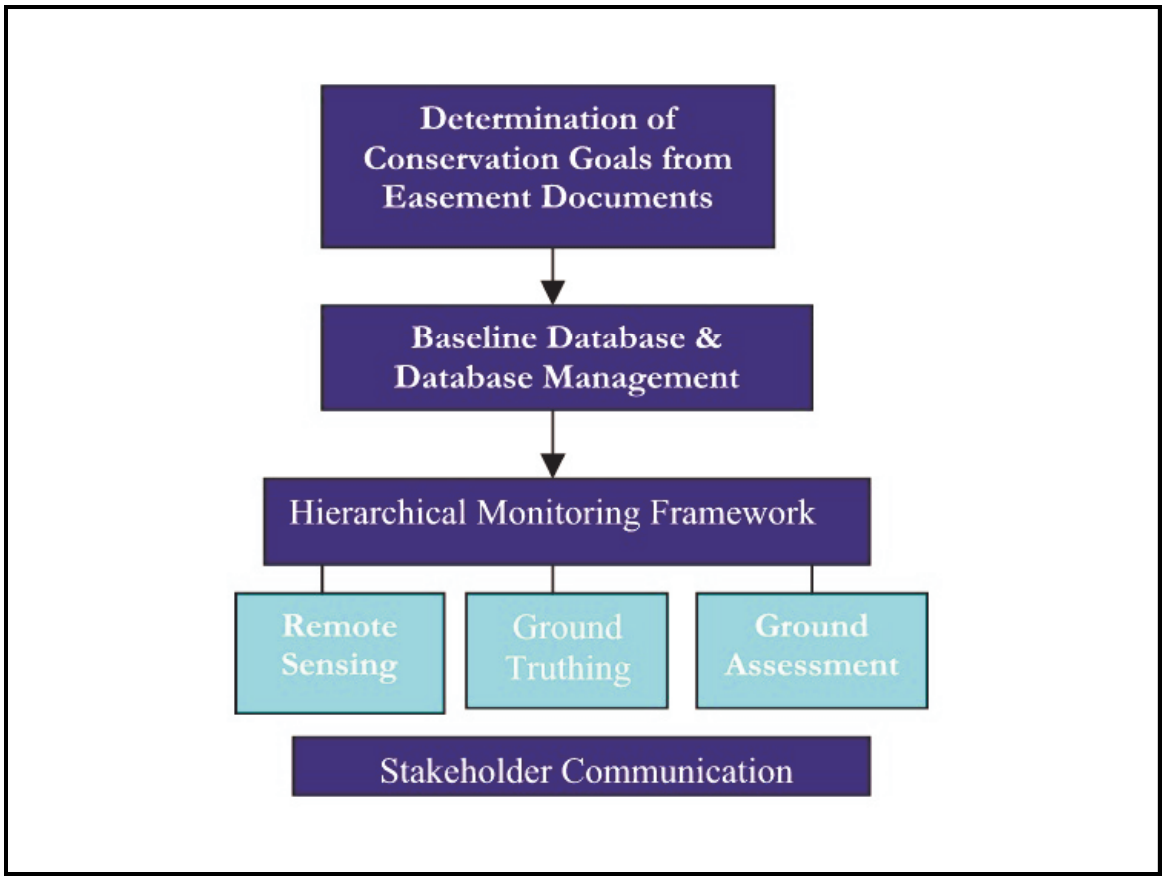
The "Threat Matrix" is an explicit framework that helps to prioritize areas of concern within an easement property. This was developed to help simplify the problem of determining where to conduct compliance monitoring in between remote sensing sessions. By assigning weights to certain portions of a property based on their relative risk of disturbance, such as existing roads, structures, or trails, and then prioritizing based

on sites with the greatest risk, a conservation entity can essentially focus their monitoring via ground assessment in these areas.

Above represents an approach for detecting change in land use cover after the change has occurred. In developing a framework for compliance monitoring it was also recognized that the inclusion of proactive measures could help to further a conservation entity's goal of having the landowner comply with the terms of the easement agreements. Such proactive measures may include maintaining robust lines of communication with the property owner, local government and local community, and would be implemented to increase the likelihood of compliance with the easement agreements.

A visual representation of the approach is presented below:

Figure 2: Conceptual Framework



Conservation Easement Documentation

A conservation easement document is made up of a collection of restrictions and obligations. The easement document restricts the activities that may occur on the property and imposes obligations on both the landowner (Grantor) and easement holder

(Grantee). According to *The Conservation Easement in California*, a conservation easement document should contain the following information (Barrett & Livermore, 1983):

- Identification of who the grantor and grantee are;
- A legal and qualitative description of the easement;
- A generalized statement of the type and purpose of the easement;
- A statement of intent of why the grantor is creating an easement in perpetuity for the protection of specified conservation values and why grantee is honoring the easement;
- Reference to documentation of the specific conservation values of the land involved that is intended to be preserved;
- A list of the rights to the grantee which give the grantee the power to monitor and enforce compliance with the terms of the easement and to fulfill the grantee's role as guardian of the conservation values involved;
- A list of restrictions or prohibitions on all activities foreseeably harmful to the conservation values of the easement;
- A list of permitted uses and reservations that are consistent with the intent and purpose of the easement as well as any uses that might be reasonably anticipated as necessary adjunct to the grantor's main permitted uses of the land;
- Allocation of costs born by the grantor such as, maintenance, insurance, taxes, assessments, liability and enforcement costs;
- A Habendum Clause, which makes the granter or the successors of the easement hold the easement's terms, conditions, restrictions and purposes in perpetuity;
- Dates, signatures and acknowledgement of the easement;
- Exhibits containing maps, plan, surveys, photographs, reports and scientific information.

The Fremont, Blind, Silmod and Anaheim Easements, which make up the North Irvine Ranch (NIR), each contain its own Grant Deed of Conservation Easement, which documents the above information in detail (Appendix 1: Grant Deed). In addition to the Grant Deed, each easement contains an Easement Document Report and a Resource Plan. The Easement Document Report is an accurate representation of such natural, ecological and other attributes of the easement at the time the Grant Deed was recorded and it is intended to serve as the baseline for monitoring compliance with the terms of the easement. The Resource Plan discusses certain specific uses and practices permitted upon the easement at the time the Grant Deed was approved. The Resource Plan may be updated in writing by mutual agreement of the grantor and grantee.

Generally, the purpose of NIR's easement lands is to be used for open space and conservation purposes. The specific conservation values of the lands are natural, ecological, scenic, open space, recreational and education values (this is known as "Conservation Values" in the Grant Deed). More specifically, the natural and ecological Conservation Values include open space land, habitat, and habitat linkages essential to preserving various natural communities. Many sensitive, rare and endangered plants and animal species are dependent on such natural communities. The easement lands also provide open space and protection for scenic qualities unique to the area, providing public access and venues for appropriate educational and recreational activities, and providing venues and targets for scientific study.

What to Monitor on the North Irvine Ranch Easement Lands

The effectiveness of a conservation easement document is largely dependent on the commitment of the easement holder's willingness to monitor and ability to enforce the easement (Gustanski & Squires, 2000). In the North Irvine Ranch (NIR) Easement Area, Fremont and Blind Easements total 7,584 acres, Silmod easement totals 1,389 acres and Anaheim Easement totals 911 acres. As discussed in the NIR's easement Grant Deeds, Easement Documents and Resource Plans, the following is what should be monitored for compliance: residential and other buildings; roads and trails; fences, gates and walls; electric power lines, pipelines, wells and tanks; fuel modification areas; arterial highways; grazing and farm areas; educational and recreational areas; mining and drilling; and surrounding properties. Each of these monitoring targets is considered to pose its own potential threat to the preservation of the conservation values stated in the easement agreements. Below in Table 1 is a brief overview of the monitoring targets for the NIR and the specific threat concerns they pose:

Table 1: NIR Monitoring Targets

Monitoring Target	Perceived threats to conservation values
Residences and other buildings	Loss of plant species and communities; loss of wildlife and wildlife habitat; loss of other natural Resources (air and water quality); soil erosion; proliferation of exotic species; greater chance of new development
Roads and trails	Loss of plant species and communities; loss of wildlife and wildlife habitat; loss of other natural Resources (air and water quality); soil erosion; proliferation of exotic species; greater chance of permitted and/or illegal trails and from main roads/trails; greater chance of existing roads being widened; impacts to wildlife corridors; increase of fragmented landscape; alterations in surface and groundwater hydrology
Fences, gates and walls	Impediment of wildlife; proliferation of exotic species
Electric power lines, pipelines, wells and tanks	Loss of plant species and communities; loss of wildlife and wildlife habitat; loss of other natural resources (air and water quality); soil erosion; proliferation of exotic species; greater chance of new development; alterations in surface and groundwater hydrology
Fuel modification	Proliferation of exotic species; loss of habitat (native vegetation and wildlife)
Arterial highways	Loss of plant species and communities; loss of wildlife and wildlife habitat; loss of other natural Resources (air and water quality); soil erosion; proliferation of exotic species; greater chance of permitted and/or illegal trails and from main roads/trails; greater chance of existing roads being widened; impacts to wildlife corridors; increase of fragmented landscape; alterations in surface and groundwater hydrology
Educational and recreational areas	Loss of plant species and communities; loss of wildlife and wildlife habitat; loss of other natural resources (air and water quality); soil erosion; proliferation of exotic species; greater chance of area expansion into biologically sensitive resources.
Grazing areas	Loss of habitat (native vegetation and wildlife); loss of other natural resources (water quality); proliferation of exotic species
Farm areas	Loss of habitat (native vegetation and wildlife), proliferation of exotic species
Mining and drilling areas	Loss of plant species and communities; loss of wildlife and wildlife habitat; loss of other natural Resources (air and water quality); soil erosion; proliferation of exotic species; alterations in surface and groundwater hydrology
Surrounding properties	Loss of other natural Resources (air and water quality); greater chance of trespassing, illegal dumping, non-native species (i.e. pets) and new and/or illegal roads and trails near surrounding properties; impacts to wildlife corridors; increase of fragmented landscape; alterations in surface and groundwater hydrology

Below is a description of each attribute that should be monitored; the applicable sections of the Grant Deed, Easement Document or Resource Plan for the attribute; a summary of the attribute's conditions set forth in the Grant Deed or Resource Plan; and a description of the existing or baseline condition for that attribute. Please note that the majority of the text below is taken verbatim from the applicable sections of the Grant Deeds, Easement Documents and Resource Plans of the NIR Easement lands so as not to misinterpret the legal language of these documents. At the conclusion section of the report are the recommended monitoring procedures for each attribute. The monitoring format below was modeled after the Stewardship Protocol for the Pingree Forest Conservation Easement (Reed & Sader, 2004).

Attribute 1: Residences and Other Buildings

Applicable Sections:
Easement Document Section 3.1; Grant Deed – Schedule 4, #2 and 3

Condition(s):

1. Grant Deed - Grantor shall be entitled to maintain, repair, replace and use all existing structures and improvements on the property; provided that no such structure or improvement shall be materially expanded in size, nor shall the use of such structure or improvement be materially changed, except as provided in the Resource Plan.

Existing Conditions (i.e. Baseline Data) per Easement Document:
Fremont/Blind
No residential buildings located on property. Public infrastructure structures located on the property are limited to Metropolitan Water District's water towers and the Orange County Fire Authority's Remote Access Weather Station.
Silmod
No residential buildings located on property. An abandoned trailer occurs north of Silverado Canyon Creek, at the National Forest Boundary. In lower Baker Canyon, an abandoned homestead, former site of the "Axelrod Camp" for blind children. An abandoned house site with a domestic well occurs in Santiago Canyon.
Anaheim
No residential buildings located on property. Remnants of a former commercial/industrial ground lease tenant exist on the northern portion of Parcel 1: one single story structure, asphalt paving, several smaller structures, concrete slabs and other facilities remain on the lease area.

Attribute 2: Roads and Trails

Applicable Sections: Easement Document Section 3.2; Grant Deed – Schedule 4, #4 and 9; Resource Document IV.A.3 and IV.D.1
Condition(s):

1. Grant Deed - Grantor shall be entitled to maintain, repair, replace and use all existing roads and trails located on the property, provided that no such road or trail shall be materially expanded in size, nor shall the use of such road or trail be materially changed, except as provided in the Resource Plan. The construction, maintenance, repair, replacement and use of new roads and trails shall be

permissible only as explicitly permitted to any other paragraph in Section 4 or as provided in the Resource Plan.

2. Grant Deed – The continued use of existing easements and other possessory rights of record granted prior to the easement is permitted, including without limitation such rights of record, if any, to construct, maintain, replace and use new roads or trails.
3. Resource Plan - Orange County Fire Authority (OCFA) may continue with maintenance of existing dirt truck trails consistent with existing practices. Grantor shall review maintenance of existing dirt truck trails with Grantee on an annual basis.
4. Resource Plan – Trail routes for guided hiking, mountain cycling and equestrian tours have been already been selected and tours will be restricted to those trails. Grantor and Grantee will review the locations, timing, and frequency of guided tours from time to time.

Existing Conditions (i.e. Baseline Data) per Easement Document:

Fremont/Blind

There are no paved roads on this property. The dirt roads on the property provide access to the property primarily for the Metropolitan Water District and Southern California Edison and are maintained annually by MWD and SCE.

Silmod

There are four paved public roads on the property: Santiago Canyon Road (south of Irvine Mesa), Black Star Road, Silverado Canyon Road and Baker Canyon Road. Dirt roads provide access to the interior of the property. The Orange County Fire Authority under contract with Southern California Edison maintains the dirt roads annually.

Anaheim

One partially paved road bisects the northerly portion of Easement Parcel 3 from Santa Ana Canyon to an adjoining property. One main dirt road is located in Parcel 1, which runs adjacent to Gysum Canyon Wash. Off this dirt road there are several short and dead end roads into tributary canyons in Parcel 1 and one construction road leading to the Eastern Transportation Corridor wildlife under-crossing.

Attribute 3: Fences, Gates and Walls

Applicable Sections: Easement Document Section 3.3; Grant Deed – Schedule 4, #1; Resource Plan Section IV.E.

Condition(s):

1. Grant Deed - Grantor shall be entitled to maintain, repair and (where necessary) replace all existing fences on the property. Grantor shall maintain, repair and (where necessary) replace all existing perimeter fences. New fences may be erected by Grantor at the perimeter of the property and otherwise only as provided in the Resource Plan. All new fences erected by Grantor shall also be maintained, repaired and (where necessary) replaced by Grantor.
2. Resource Plan - Grantor must give consideration to replacement of barbed wire fencing with smooth-wire fencing, reduction in number of strands, and other fencing modifications (including fence removal) so as to diminish impediment to wildlife movement.

Existing Conditions (i.e. Baseline Data) per Easement Document:

Fremont/Blind

Five-strand barbed wire fencing and various access gates occur in several locations on the property. The entire length of both the east and west slopes of the Eastern Transportation Corridor (ETC) is lined with 7 foot high wire fencing. The property can be accessed from the ETC through two Caltrans gates along the northbound lanes. Two barbed wire entry gates are located on the western and eastern sides of the ETC near the over crossing.

Silmod

Five-strand barbed-wire fencing and various access gates occur in several locations on the property. Much of the perimeter fencing on the Irvine Mesa portion of the property is in disrepair or non-existent.

Anaheim

Fence lines are found on the perimeter of the easement property where it borders other ownership or the ETC. 7 foot combination barbed wire and chain link fencing is found on Parcels 1 and 2 where they border or are near the ETC. Five-strand barbed wire fencing is found along the northeastern border of Parcel 2 where it adjoins Chino Hills State Park. A six-foot high combination wrought iron and concrete block wall borders the western edge of Parcel 3.

Attribute 4: Electric Power Lines, Pipelines, Wells and Tanks

Applicable Sections: Easement Document Section 3.4; Grant Deed – Schedule 4, #3 and 9

Condition(s):

1. Grant Deed - Grantor shall be entitled to construct, develop, improve, undertake, maintain, repair, replace and use on, under and/or across the property utility facilities and lines, water drainage and treatment facilities, water tanks, access roads, slope stabilization and other grading activities, and any other improvements and activities (collectively, "Infrastructure Facilities"), as needed or desired to support development of other portions of the Irvine Ranch, such to provisions in Grant Deed, Schedule 4, #3 (see this section for more applicable text).
2. Grant Deed - Grantor shall consult with Grantee concerning construction of Infrastructure Facilities. Grantor shall also provide copies of (or allow Grantee to review) any and all applications for permits filed by Grantor for the Infrastructure Facilities.
3. Grant Deed – The continued use of existing easements and other possessory rights of record granted prior to the easement is permitted, including without limitation such rights of record, if any, to construct, maintain, replace and use new roads or trails.

Allowable Facilities Area:

Infrastructure Facilities cannot occupy more than 78 acres of the Fremont/Blind Easement, 28 acres of the Silmod Easement and 30 acres of the Anaheim Easement. (Note: It is our understanding that the existing facilities count toward this total).

Existing Conditions (i.e. Baseline Data) per Easement Document:

Fremont/Blind

Southern California Edison Company (SCE) maintains two power transmission lines along the northeasterly property boundary of Fremont 2. Metropolitan Water District

(MWD) maintains a water pipeline through the westerly and southerly portion of Blind 2, also pursuant to an easement. The Municipal Water District of Orange County Facilities Corporation maintains a system of water transmission pipelines known as the Santiago Aqueduct in the southerly and westerly portions of Blind 2, also pursuant to an easement.

Silmod

SCE maintains several power lines and facilities through the property, all on easements. These easements include a 100 foot-wide transmission easement, a 270 foot-wide transmission easement and a 100 foot-wide transmission easement, all long the northeasterly property line. There are also two distribution easements 10 feet in width. Pacific Bell, also on an easement, maintains a microwave tower and related facilities on a knoll behind the school on Santiago Canyon Road. There is an easement for a water well and pipeline near the southeasterly property boundary, in favor of the Orange Unified School District. The County of Orange has easements along portions of the right of way of Santiago Canyon Road for various existing utility franchises, sewers and storm drains. There are also existing water lines to homes and ranches in adjacent Baker Canyon.

Anaheim

In the northern portion of Parcel 1 there are: abandoned electrical poles and lines and an approximately two inch steel above ground water line, all of which serviced the facilities of the former ground lease tenant; thirteen ground water monitoring wells; and the possibility of an underground fuel storage tank. In Parcel 3, Pacific Telephone and SCE hold easements.

Attribute 5: Fuel Modification

Applicable Sections: Easement Document Section 3.5; Grant Deed – Schedule 4, #12; Resource Plan IV.D.2

Condition(s):

1. Grant Deed - Grantor shall be entitled to undertake those activities necessary to prevent the risk of wildlife as and when required by Applicable Law or as provided in the Resource Plan.
2. Resource Plan – Grantor may continue with maintenance of existing fuel breaks consistent with existing practices. The need to maintain existing fuel breaks will be reviewed by Grantee and Grantor on an annual basis prior to implementation.
3. Resource Plan – Fire suppression practice shall be in accordance with those established for the easement property in the Nature Reserve of Orange County's Tactical Suppression Plan (Part II of the NCCP/HCP Wildland Fire Management Plan – Central/Coastal Subregional Reserves) dated March 15, 2002.

Existing Conditions (i.e. Baseline Data) per Easement Document:

Fremont/Blind

A 20-foot wide fuel break was constructed through a patch of young Tecate cypress in Fremont 2 during the Green Fire of February 2002.

Silmod

There are four known fuel breaks on the easement property. There is an approximately five foot wide break on either side of Baker Canyon Road. There is an approximately 10 to 15 foot wide fuel break on either side of Black Star Canyon Road.

Anaheim

The number of fuel breaks on the easement property has not been quantified yet but aerial photographs have been taken of them.

Attribute 6: Arterial Highways

Applicable Sections: Easement Document Section 3.5; Grant Deed – Schedule 4, #5; Resource Plan

Condition(s):

1. Grant Deed – A depiction of the existing Orange County Transportation Authority (OCTA) Master Plan of Arterial Highways effective as of December 11, 2000 (the "MPAH") is included in the Easement Document Report. Grantor shall be entitled to cooperate with the appropriate federal, state, and local authorities with respect to, and undertake in all respects, the development, construction, improvement, maintenance, repair, replacement, relocation and use of all roads as shown and described on such existing MPAH, together with all utilities and other facilities ordinarily constructed or installed within or adjacent to such roads, and all improvements related thereto (collectively, the "MPAH Roads") in the relevant area, subject to the following conditions that are further outlined in the Grand Deed.

Existing Conditions (i.e. Baseline Data) per Easement Document:

None, however, map of the MPAH is included as an attachment to the Easement Document. According to the map it appears the Blind easement may be effected by new highway arteries in the future.

Attribute 7: Grazing areas

Applicable Sections (Note: only applies to Fremont, Blind and Silmod Easements): Grant Deed – Schedule 4, #15, Resource Plan 5.4

Condition(s):

1. Grant Deed – For so long as The Irvine Company is the owner of any portion of the Property and there has been no deemed transfer of such portion of the property, Grantor shall be entitled to use such portion of the property for cattle grazing if and to the extent provided in the Resource Plan, and then only in compliance with the following:
    a. Grazing may only take place seasonally, between the months of November and June.
    b. All grazing activities shall be consistent with a written grazing management plan developed and revised annually as part of the Resource Plan.
    c. Salt licks and artificial watering sources for cattle shall not be located within 1000 feet of any water source, and shall be located where there is ample grazing material.
    d. No grazing shall be allowed in any pasture which leaves in that pasture, at the conclusion of grazing within any grazing year, an average of pounds per acre of residual herbaceous dry matter ("RDM") which is less than 1,000. Grantee may conduct monitoring and quantitatively measure RDM in order to determine compliance with the RDM standards established above. Areas which, if left ungrazed, would not in any case provide at least the minimum target RDM due to rockiness, soil quality, or other

natural cause, shall not be considered, and no pasture made up largely of such areas shall be grazed.

2. Resource Plan – Grazing is subject to the Grazing Management Plan prepared by NativeScape in 1996.

Existing Conditions (i.e. Baseline Data) per Easement Document:

Fremont/Blind

No existing grazing conditions were given, however there has been grazing in this easement in the past.

Silmod

No existing grazing conditions were given, however there has been grazing in this easement in the past.

Attribute 8: Farm areas

Applicable Sections (Note: only applies to Silmod Easement): Grant Deed – Schedule 4, #16; Resource Plan IV.G

Condition(s):

1. Grant Deed – Grantor shall be entitled to use a portion of the property for pumpkin and Christmas tree farming, subject to the following conditions.
    a. Total area to be used for farming and new access roads (together, the "Farm") cannot exceed 20 acres.
    b. Grantee shall have approved the location or relocation of the Farm and the size and location of any improvements permitted with respect to any proposed sales facility, any storage buildings, and any proposed fencing. For purposes of such approval, the parties agree that it shall be reasonable for Grantee to withhold its consent to a location due to the existence of substantial intact, functioning, native habitat in such location or any fencing, which is not wildlife friendly. In the event of a relocation of the Farm, Grantor shall return the site being vacated as much as reasonable possible to at least its condition prior to the installation of the Farm.
    c. The operation of the Farm may only include the growing of pumpkins and/or Christmas trees entirely within the permitted area of the Farm, the retail sale of pumpkins and/or Christmas trees grown at the Farm, the retail sale of items reasonably connected to the sale of such pumpkins and/or Christmas trees, and reasonable access for employees of the operator and the public to the Farm for such purposes.
    d. There shall be no paving of any portion of the property in connection with the Farm. There shall be no erection of any structures or other improvements in connection with the Farm, other than structures reasonable necessary at the site for carrying on the activities, which are permitted above.
2. Resource Plan – A portion of the easement property may be used for a pumpkin and Christmas Tree farm, such to the Grant Deed.

Allowable Farm Area: Total area to be used for farming and new access roads (together, the "Farm") cannot exceed 20 acres.

Existing Conditions (i.e. Baseline Data) per Easement Document:

Silmod
No existing farm conditions were given, but such farm described above does currently exist in the Silmod Easement.

Attribute 9: Farm areas

Applicable Sections: Grant Deed – Schedule 4, #6; Resource Plan IV.A and F (Silmod, Fremont and Blind Easements)
Condition(s):

1. Grand deed – Grantor shall be entitled to use and develop the property to provide for recreational and educational use of the property by the general public; provided, however, that all recreational and education uses of the property and the facilities therefore shall be planned mutually by Grantor and Grantee pursuant to, and shall only be installed as provide in the Resource Plan, taking into account (a) the desire of the parties to provide substantial and regular use of the property by the public through recreational and educational uses as permitted under this Deed, (b) the recreational and education uses and facilities provided on other portions of the Irvine Ranch, and (c) the need to preserve and protect the other Conservation Values of the Property. Without meaning to address all possible uses or facilities in advance, the parties anticipate that trails for hiking, cycling and equestrian, picnicking and picnic areas, viewpoints and overlooks, staging areas, access roads, interpretive centers and related facilities, and an equestrian center and similar recreational and/or education uses or activities will be appropriate on the property, but that motorized recreation, paved or landscaped playing fields or areas and similar recreational uses or activities will not be appropriate on the property.
2. Resource Plan (Silmod, Fremont and Blind Easements) – Public access to the easement property will be provided through docent led or supervised tours for hikers, mountain cyclists and equestrians. Such tours shall be allowed only by either a TNC Staff Person or two or more docents selected in a manner approved by TNC and Irvine. Tour participants will meet at the Blackstar Canyon Staging Area. A maximum of twenty (20) persons (excluding docents or staff) will be permitted per tour.
3. Resource Plan (Fremont and Blind Easements) – No public access will be permitted in the bottom of Fremont Canyon beyond the designated trail.
4. Resource Plan (Silmod, Fremont and Blind Easements) – Public access will not occur during OCFA Red Flag days.
5. Resource Plan (Silmod, Fremont and Blind Easements) - Public access will not occur within three (3) days of a rainfall event exceeding 1 inch.
6. Resource Plan (Silmod Easement) - The existing Blackstar Canyon Staging area, located at the corner of Blackstar Canyon and Silverado Canyon Road will serve as the primary parking/staging area for visitors participating in guided tours of the area, including tours nearby Limestone Canyon.
7. Resource Plan (Silmod, Fremont and Blind Easements) - OCFA and US Army conduct helicopter-training exercises, including practice landing and touch-and-go activities, in a cleared area containing approximately 15.6 acres in Black Star Canyon (Silmod Easement) and in a cleared area adjacent to Lakeview Road (Fremont – Parcel 1). For OCFA, use of this facility for helicopter training shall

not be permitted during the avian nesting season (February 15 – June 15). Prior to the re-issuance of an entry permit for OCFA or Department of the Army, Grantor and Grantee will review the activity as to its compatibility with easement purposes and, if deemed compatible, may establish limits in the renewal entry permit for 1) the size, location and maintenance of helicopter landing areas, 2) the number and timing of training events, and 3) the placement and maintenance of other related facilities to support the activity.

8. Resource Plan – (Silmod Easement) The Orange County Astronomers may use the site for their purposes until their current entry permit expires on March 31, 2002. Prior to the re-issuance of an entry permit for Orange County Fire Authority (OCFA) or Department of the Army, Grantor and Grantee will review the activity as to its compatibility with easement purposes and, if deemed compatible, may establish limits in the renewal entry permit for 1) the size, location and maintenance of parking/staging areas, 2) the number and timing of events, and 3) the placement and maintenance of other related facilities to support the activity (i.e. portable toilets).
9. Resource Plan – (Silmod Easement) OCFA may use the site only as a temporary waste collection/storage site for non-hazardous waste collected during the annual "Canyon Cleansweep." OCFA shall be responsible for disposing of the waste in a timely and legal manner. The use of this site for this activity shall be reviewed by Grantor and Grantee on an annual basis to determine its compatibility with easement purposes and uses of the property.

Existing Conditions (i.e. Baseline Data) per Easement Document:
Refer to applicable Resource Plan sections above for information on Silmod, Fremont and Blind Easements.

Attribute 10: Mining and Drilling

Applicable Sections: Easement Document Report Section 5.4; Grant Deed – Schedule 4, #8

Condition(s):

1. Grant Deed - Grantor shall have the right to enter the subsurface of the property for the extraction or removal of oil, gas, hydrocarbon substances, minerals, and/or any other material or resources (collectively "minerals") below the surface of the property, subject to further conditions outlined in the Grant Deed.
2. Grand Deed – Granter shall give Grantee written notice at least forty-five (450 days prior to commencement of any such operations affecting the property by Grantor or by anyone acting for or by authority of Grantor, describing the proposed location and nature of such operations.

Existing Conditions (i.e. Baseline Data) per Easement Document:
Fremont/Blind
Portions of the site were mined for coal in the late 1800's and early 1900's, as evidenced by mine tailings and surface disturbances along Coal Mine Road in Fremont 1.
Silmod
There were historic gravel mining activities in Silverado Canyon.
Anaheim
None mentioned.

Attribute 11: Surrounding Property Concerns

Applicable Sections (Anaheim Easement only): Easement Document Report Section 2.3 (refers to every easement); Grant Deed – Schedule 4, #15; Resource Plan 3.6

Condition(s):

1. Grant Deed (Anaheim Easement only) – Grantee acknowledges that development of the area(s) adjoining the property may require that the boundary of the property be adjusted minimally in order to free one or more portions of the initial property from the easement for use in the adjoining property. Grantee shall cooperate with Grantor as reasonably requested from time to time in amending this Deed and the Easement, in order to make such adjustments, provided that (a) the amendment shall provide that, in exchange for the portion of the property released from the easement, one or more other portions of the Irvine Ranch contiguous with the remaining portion of the property shall be added to the property governed by the easement; (b) such added area shall be of equal or more conservation and dollar value to that which is released from the easement (though it need not necessarily be exactly the same in area); and (c) in no event shall the alteration as to any portion of the property in the aggregate for the entire property exceed ten (10) acres.
2. Resource Plan (Anaheim Easement only) - The homeowners' association adjacent to Parcel 3 holds an easement for, among other things, maintenance of landscaping and slopes in a portion of Parcel 3.

Existing Conditions (i.e. Baseline Data) per Easement Document:

Fremont/Blind

Much of the land surrounding the property is in open space. Weir Canyon NCCP lands border the property to the west; Coal Canyon/Gypsum Canyon NCCP Lands border the property to the north; while the Cleveland National Forest borders the entire eastern boundary of the property. West of the ETC, Irvine Regional Park borders the property to the south. East of the Eastern Transportation Corridor, Santiago Creek NCCP lands border most of the property to the south. Southern California Edison owns a 500 foot-wide swath of land on which transmission facilities are located, bisecting the property between Fremont 1 and 2 and Blind 1 and 2. Another out parcel owned by a third party borders the property to the south.

Silmod

Much of the land surrounding the property to the west and south is open space. Grantee NCCP lands that border the property include Santiago Creek to the west and the Limestone Canyon Dedication Area to the south. The Grantee's Fremont Conservation Easement property borders the property to the north and west.

Anaheim

Much of the land to the east and south of Easement Parcels 1 and 2 is open space. Open space to the east includes Coal Canyon Ecological Reserve, which represents the southern extent of Chino Hills State Park. Open space to the south consists of the Weir/Gypsum Canyon NCCP lands, currently owned by the Grantor and managed by the Grantee, and the Fremont/Blind Conservation Easement Area. Parcel 1 to the north is adjacent to a development area and to the west is bounded by the Eastern Transportation Corridor. Parcel 2 to the west is bounded by an operating sand and gravel mine with a concrete batch plant and an asphalt batch plant. Parcels 2 and 3 are bordered by the 91

Freeway on the north. Parcel 3 is bounded by residential development to the west and the Eastern Transportation Corridor to the east.

Table 2 provides a list of what to monitor for the NIR and how to monitor each item or target. Remote sensing, ground assessment and permit notification are discussed in detail in the following sections of the report.

Table 2: What and How to Monitor on the NIR

What to Monitor	How to Monitor		
	Remote Sensing	Ground Assessment	Permit Notification
Residences and other buildings	X	X	X
Roads and trails	X	X	X
Fences, gates and walls	X	X	X
Electric power lines, pipelines, wells and tanks	X	X	X
Fuel modification	X	X	X
Arterial highways	X		X
Educational and recreational areas	X	X	X
Grazing areas		X	X
Farm areas	X	X	X
Mining and drilling areas	X	X	X
Surrounding properties	X	X	X

Baseline Data Acquisition and Documentation

Introduction

In order to measure any type of change it is necessary to form a baseline, an outline of current conditions, from which future measurements can be compared. As conservation easements are often in perpetuity, this requires a baseline that is comprehensive enough to be useful as technological capabilities and systems continue to advance and new forms of measurement are forced onto older forms of data. According to Lind (1991) a comprehensive baseline "should document in detail the condition of all ecological, scenic, historic, geologic, land use, and other property features that are protected or affected by the easement terms." Baseline data for the items above, however, can be very expensive and difficult to acquire, composite, and maintain. Therefore, easement holders should structure baseline documentation, and data management based on the goals of the easement agreement.

In contrast, Hamilton (2003) defines the contents of a baseline as having "to explain, in words and pictures, why the property is being protected; what particular values are being protected and why are these values important; what improvements exist on the property at the time of the easement; and include any material that will help future land trust staff, board members or volunteers know if the easement has been violated or not." She then provides a list of what should be included in a baseline.

- Donor acknowledgment – required by Treas. Regs.
- Table of Contents
- Summary Information

1. Owner's name and contact info; property manager
2. Directions to property and address
3. Zoning
4. Surrounding land use summary; names of neighbors and address/telephone
5. Date of easement and recording information
6. Acreage

- Description of conservation values – read easement to understand what values are protected and what activities are restricted and document these items.
- Description of improvements
- Description of current land use
- Management, timber harvest, mineral development, grazing plans
- Photos (signed by the landowner) and photo point map
- Maps and surveys
- Appraisal or Form 8283
- Preparer qualifications
- References
- Conservation Easement
- Title Commitment and exceptions

The following is an example Hamilton gives for a typical baseline documentation.

- Wildlife habitat mapping from local wildlife agencies, Natural Heritage Program Studies, etc.
- Soils maps (NRCS, local soils districts)
- Wetlands and riparian areas mapping (USGS or state wildlife agencies)
- Aerial photographs
- Topographic maps (USGS)
- Ecological inventory; inventory of T&E species; description of distinct natural features.
- Information to support scenic qualities; buffer qualities.
- Archaeological or historical information
- Mineral remoteness letter
- Press articles

It is important to differentiate here between a written baseline and an electronic baseline. Hamilton (2003) outlines important baseline contents for a written baseline, which would be reviewed by hand on an item by item basis. An electronic baseline, as proposed below, is designed to not only harbor data, but to serve as a tool which allows analysis of that very same data, but on an aggregate scale. Therefore, a complete baseline should contain all relevant elements of Hamilton's list, but data that will not be utilized in analyses can be listed and stored simply as written easement documentation (for example: the original easement documentation reports). This written record would house information such as the donor acknowledgements, a table of contents, driving directions to the site, the date of easement and recording information, description of conservation values, etc (See *Conservation Easement Documentation Section*). Other data that may be analyzed, or that may change with time, should be entered into a database so that it may be queried and easily updated. Data, such as maps and photos, that may also be stored in a digital format, can be linked to the electronic database. This subset of Hamilton's list

as chosen for the NIR is listed on the following page as the NIR Baseline Contents. Those items that were excluded from this list are recorded in detail in the Easement Documentation Reports, which serve as a supplement to the electronic baseline and database described below.

Other Considerations

In addition to the formal outline of baseline contents listed by Hamilton (2003), there are a number of other factors that managers should consider when beginning to compile data. The first point of consideration should be to what scale or detail should the easement features be scrutinized, in other words how much information is necessary. The baseline data should be tailored to the conservation values of the easement and the restrictions in the easement agreement (Diehl & Barrett 1988, Hamilton 2003). Hamilton (2003) further argues that including beyond that directly relevant to the conservation agreement "can lead to future confusion about the easement's provisions and intent." Therefore it is important to gather information with consideration to external or surrounding property effects such as human traffic, dumping, fires, etcetera, while keeping in mind that all of the information should reflect the values of the easement terms and should not overstate irrelevant features.

A second consideration for data acquisition and documentation is the potential for future threats and changes that may not be apparent yet. For example, an easement negotiated for its biodiversity value may be quite removed from urban development, however, when designing the baseline for the property it is important to capture elements just beyond the property boundaries as outside development may become a threat within the next 50 years or more, and could create significant edge effects, thus greatly compromising the biodiversity or "conservation values" of the easement. Compliance issues could be an increase in illegal trails, development, road use, etcetera. It is impossible to imagine all that could occur within the future, so it is in the easement holder's best interest to gather more information, rather than less, regarding the property and its concurrent boundary areas during the early years of the easement's existence, thus safeguarding a higher capability of detecting change or causality in the future.

North Irvine Ranch

In order to track changes in development, data was gathered regarding most all current, and future, permitted or proposed developments on and around the NIR.[*] Specifically, scenic, historic, land use, and developed features, with consideration to some ecological and geological features, were documented for the property's compliance monitoring framework. This data was gathered from public records available on the world wide web, from local governing agencies, and from private records released by the landowner, The Irvine Company. The data was generally in a digital format, either ArcView or ArcGIS, Excel, or Access.

The following is a list of the baseline contents gathered "to explain, in words and pictures, why the property is being protected; what particular values are being protected

[*] Data was gathered to the extent possible given the time and resources limitation for the scope of this project. Therefore, this is not a complete database as some data was unavailable during the data acquisition phase of the project.

and why are these values important; what improvements exist on the property at the time of the easement; and … material that will help future land trust staff, board members or volunteers know if the easement has been violated or not" (Hamilton, 2003). These data were then normalized and entered into a relational database and mapped in ArcGIS. Again, the data below is the electronic baseline data contents, any items not listed from Hamilton's list are covered in the Easement Documentation Reports; were unavailable during the data acquisition phase; or were deemed unnecessary for inclusion in the electronic database.

NIR Baseline Contents

- **Summary Information**
  1. Land and Easement Ownership (For the property and neighboring areas)
  2. Surrounding Land Use Summary
  3. Date of Easement and Recording Information
  4. Acreage and Boundary Coordinates
- **Description of Current Land Use**
  1. Roads (Primary Class 1 Hwy, Secondary Class 2 Hwy, Light Duty, CL3 Light Dirt Road, Unimproved Road Class 4, Railroad, Standard Gauge, Fuel Breaks)
  2. Trails (Regional Class I Bike, City Class I Bike, Regional Riding and Hiking, Hiking, Bikeways, Multi-Use, Wilderness Trails)
  3. Power Lines
  4. Water Lines (pipeline, underground, canal, aqueduct, or ditch, Canal /Aqua/ Ditch - Intermittent, aqueduct pipeline or penstock)
  5. Mining (Land Grant, Mining Claim, pit-large, Land Subject to Inundation, Land Grant/Mining Claim/DLC, mining permits)
  6. Infrastructure and Development (large building, large tank/tower, levee, dike, or diversion dam, reservoir, natural shoreline, land subject to inundation, spillway, masonry, built up area, recreational areas, farming areas, grazing areas, windmills, gates, helicopter landing pads, runways)
  7. Water Sources (streams, rivers, wells, springs, reservoirs, dams, canals, ditches)
  8. Fire History (historic fires and burn areas)
  9. Fire Compartments (Orange County Fire Compartments and units)
  10. Fences (gates were not included)
  11. Exotic Plants (List of all exotic plants and geographical locations across or along property boundaries)
  12. Other Potential Onsite Threats
  13. Potential Offsite Threats
- **Photos** (These can be linked directly to the electronic database)
- **Topographical Feature Maps (Slope, Aspect, and Elevation)** (These can be linked directly to the electronic database)
- **Maps and Surveys** (These can be linked directly to the electronic database)

There are limitations to data availability, so these map layers and data tables do not include information for all of the monitoring targets listed in Table 1: NIR Monitoring Targets. However, there should be sufficient information in these captured data to infer most of the potential threats and changes across the easements and thus ensure compliance with the terms of the agreement.

Data Management

Introduction

After gathering what is deemed the most pertinent information for monitoring change across an easement, it is critical to store that data in a format that is durable, functional, and compatible with other software and programs. Designing how these different types of data will be stored and inter-linked is critical to the utility of the data that has been gathered. Without clear relationships between these various arrays of data it becomes increasingly more difficult and inefficient to determine true changes across the easement. It is recommended that a relational database be used for storing and analyzing such large amounts of data.

The relational database serves as a single repository for all easement attributes with statistical (quantitative) properties. The baseline data forms the body of the database. In subsequent years, new data is imported into the database into separate tables from the baseline data. For example, after a remote sensing or ground assessment session, data from areas that are flagged as having exhibited change will be entered into specific tables (observation tables) within the database. These observation tables can then be queried with the baseline data, to analyze the question of how much the development feature has changed. In this way, the database not only serves to store data, as the traditional easement documents would do, but the database also allows analysis of its contents. It is this fundamental power of analysis, as well as the organization of data, storage of large amounts of data, and the provision for sharing information across networks that makes the relational database an ideal monitoring tool for easements.

Microsoft Access® was chosen as the relational database for the NIR because the program is a readily available one and inexpensive (~ $300 or less). There are, however, various and more complex databases such as Oracle® ($1,000–$15,000) or SQL Server® ($4,100-$20,000) that could also be utilized. SQL Server and Oracle were not given consideration for the NIR because of their high costs, steep learning curve for advanced capabilities, and project staff's inexperience with these programs. Access is preferable as it is readily available and is usually included with Microsoft Office Suite®. Access has both a simple user interface of button commands and wizard tools, and the more formal programming interface of SQL. This allows users to have a more diverse background, in which most tasks can be performed by novices, but users who have a visual basic or query language background will be able to perform considerably more complex tasks. SQL server, on the other hand, requires experience or training in SQL while Oracle would also be difficult for the novice. See the comparison table below for the strengths and weaknesses of each different program.

Table 3: Database Features and Price Comparisons

Feature Pricing

Database	Access	Oracle	SQL Server
Basic individual level use	**$229**	**$400**	**$4,999**
Basic office level use	**$229**	**$15,000**	**$4,999**
Extra Features office level use	**$229**	**$21,000**	**$4,999**

Competitive Features

Database	Access	Oracle	SQL Server
Trademark Features	Use the Stored Procedure Designer to create and modify simple procedures stored in SQL Server without having to learn Transact-SQL. Link tables so that you can access data from multiple databases at one time in Access 2003 forms, reports, and data-access pages. Link tables from other Microsoft Access databases, Microsoft Excel spreadsheets, ODBC data sources, Microsoft SQL Server™ databases, and other data sources.	Only Oracle offers the benefits of **clustering**--high availability and scale out on-demand--with Oracle Real Application Clusters.High performance business intelligence services such as ETL, data warehousing, OLAP, and data mining. Continuous availability despite system failures, site failures, and disasters, human errors, and planned maintenance. Spatial analysis that performs optimization functions on spatial data.	Online analytical processing (OLAP) mixes and matches algorithms and tools from Microsoft and third parties to customize analysis applications. Performs rapid, sophisticated analysis on large and complex data sets using multi-dimensional storage. This is more technology intensive set-up, requires a lot of SQL and visual basic language skills. The intent in this is to provide a more user friendly end-product, whereby the users are not the administrators who designed the DB. This would be difficult to utilize unless one had an advance background in SQL or visual basic.Microsoft SQL Server 2000 Meta Data Services are a set of services that allows the user to manage meta data. Meta data describes the structure and meaning of data, as well as the structure and meaning of applications and processes. It is important to remember that Meta data is abstract, has a context, and can be leveraged in a development environment.
Additional Cost	**$0**	**$60 - $15,000**	**$0**

Assistance

Database	Access	Oracle	SQL Server
Minimal to Extensive Assistance Options	Minimal Assistance: Email assistance desk and receive same day help, Online Help Desk, available books.	Extensive Support: Online help desks, person-to-person consultation, consulting/outsourcing IT support (Oracle has several support options ranging from free online support to 24/7 real-time availability)	Extensive Support: Online help desks, person-to-person consultation, consulting/outsourcing IT support (SQL server has several support options ranging from free online support to 24/7 real-time availability)
Additional Cost	**$0**	**$0 - $750**	**NA**

Outside Consulting

Database	Access	Oracle	SQL Server
Consulting Options and Sources	Readily available DB administrators for hire, these are generally private companies that are paid by the hour or can be hired for continual work	Oracle provides consulting and outsourcing, available over the web. They have several options for tailoring their services to your needs, for an additional cost of $10 to $150 a month.	The Microsoft website lists dozens of IT and DBA (database administrator) support consulting firms. The website provides contact information for systems related support. The website does not give prices for these support services.

Security

Database	Access	Oracle	SQL Server
Security Options	Minimal Security: Online Downloads, security bulletins and updates	Extensive security measures: Available online and through web	Security administration is improved and simplified through better integration with Windows NT security and new server and SQL Server roles. Windows NT integration includes authentication, support for multiple groups, grant/revoke/deny model and dynamic use of groups.
Additional Cost	**$0**	**$0**	**$0**

Training

Database	Access	Oracle	SQL Server
Training Options	Online Training available	Extensive online Oracle University with nearly 50 different classes available online or in-class.	Extensive online training, seminars, books and training related materials.
Additional Cost	**$0**	**$500 per day**	**NA**

Minimal System Requirements

Database	Access	Oracle	SQL Server
Computer Processor	At least 233-megahertz (MHz)	At least 2.0 GHz	At least 166-megahertz (MHz)
Memory	128 MB of RAM or greater	At least 2.0 GB RAM	64 to 128 MB RAM or greater
Hard Disk	180 MB		95–270 MB
Drive	CD-ROM or DVD drive	CD-ROM or DVD drive	CD-ROM drive
Operating System	Recommended: Microsoft Windows® 2000 with Service Pack 3 (SP3), Windows XP, or later. Older Access versions are compatible with previous Windows® Applications.	Linux, Oracle and Java, Windows®,	Windows® 1998, 2000, 2003, NT 4.0, ME, or XP Server. Operating systems listed above for Enterprise, Standard, Evaluation, and Developer Editions.
Compatibility	Microsoft Excel spreadsheets, ODBC data sources, Microsoft SQL Server™ databases, and other data sources	Grid, Java, Linux, Web Services, HTML, XML	Visual Basic Scripting Edition, Java scripting, Windows NT commands and custom ODBC and OLE DB programs, and Unicode APIs.
Data Formats	Extensible Markup Language (XML), OLE, Open Database Connectivity (ODBC), and Microsoft Windows® SharePoint™ Services	Comprehensive, open access to Web Services through SQL, Java, XML and standard Web interfaces.	SQL, XML

http://www.microsoft.com/sql/evaluation/compare/pricecomparison.asp
http://www.oracle.com/
http://office.microsoft.com/home/office.aspx?assetid=FX01085791
**All of the above pricing quotes are subject to change, and are ranges which may fluctuate. These numbers should serve as estimates and approximations only, exact amounts vary for each specific purchase.

Other things to consider when selecting a database are whether or not the database will be accessed by more than one user, placed on a network, loaded over the web, and what type of security is necessary to protect the data. Considerations may be financial, the size of the data, the expertise and abilities of staff, legal needs, program compatibility, and future applications. Generally a small database such as Access will suffice for most easement needs, however, if a database is serving several large easements or operating through multiple offices and for multiple users it becomes more beneficial to look at the more complex systems such as Oracle. It is important to note that although the NIR easements total over 11,000 acres, the database needs, in modern standards, are relatively small.

After a database has been selected, it is necessary to outline the basic setup, entities and relationships that will govern how data is entered, stored, and retrieved in the database. This is achieved by reviewing the list of baseline contents outlined in *the Introduction to Baseline Data Acquisition and Documentation* or in the *Conservation Easement Documentation Section* as the directives for data search and acquisition. Each item from this list should represent a unique entity, or a distinct grouping of information. For example, trails and roads are both linear features with similar descriptive attributes. However, they are different objects (entities) and are therefore treated as separate tables within a relational database. Each entity is then described using attributes. So the road entity (table) would be described using attributes such as its name, type, geographical location (relative grid cell), data type, length, access points (intersecting roads or areas of entry), related permit numbers, governing agencies, ownership, maintenance updates, surface type, and related fire compartments and easements that the road falls within. It is important to layout this type of structural design in order to then clearly define existing relationships and to access what types of information may be necessary in order to create linkages between entities within the database. Refer to Appendix B for an example of the structural design of the NIR database.

Choosing the attributes that will form the core of the database is very important. It is beneficial to include attributes that will form a database that is geographically referenced and capable of representing physical data either with or without secondary or supplemental files in programs such as ArcGIS. With current technological capabilities it is beneficial to maximize compatible programs in order to create a more multidimensional analysis of the property. The NIR database was designed so that it can stand alone as a geographically referenced entity as well as serve as a data source to multiple mapping programs. This was accomplished by interconnecting data with remote sensing, mapping programs, and the Microsoft Access database, but by incorporating spatial information into the database rather than depending on AcrGIS for the sole geographical component of the monitoring plan.

North Irvine Ranch

The NIR database looks at linear features and point attributes for changes in ownership, size, use, maintenance, access, relative permits, or status. These all work together so that if an attribute exhibits some type of change in aerial photography or during ground assessments, then the database allows managers to quantify the amount of change that has occurred over that temporal scale. In this way the database serves as a template by which all future suppositions of change may be weighed. Aerial photography and ground assessment may reveal small transitions in the landscape, the database can then relate

those changes to other features allowing managers to better assess and monitor those changes. By interlinking systems across the easement (roads to developments) managers are better able to discover changes before they grow too large.

What makes the NIR database highly efficient and a departure from the norm, or traditional easement baseline data "checklist," (Diehl & Barrett, 1988) is that it is much more comprehensive, inter-linked, and highly compatible with other computer programs and tools. This database was designed to interact with several other programs (ArcGIS, ArcView, Microsoft Excel®, Systat and other Stats Programs). Therefore, data from many different formats may be harbored in this central location. For example, whenever the NIR is flown for remotely sensed images, this data is registered and then entered into the database as a new observation. Whenever docents or TNC staff perform ground assessments or ground truthing activities, waypoints taken by GPS (global positioning satellites) and survey data taken by hand or PDA will be entered into the database with other pertinent observations. Record keeping of local government permitting or contacts may also be stored in the database. The database interacts with many data formats which allows it to serve as a starting point for centralizing data, building queries, asking questions, and performing analyses that can in themselves provide insight into the physical relationships that correspond to changes in the field.

For instance, a land manager may be interested in knowing what areas have high indexes of development/ infrastructure, because these are areas that are most likely to have human impacts such as road use, trail use, development of new or illegal trails, infrastructure maintenance, and possibly new or illegal infrastructure. Using the database, a land manager could write a simple query to ask the computer what grid areas have the greatest number of development features. This simple query would look like **Figure 3** below.

The query shows all tables relevant to the question at hand. **Figure 3** shows tables for trails, roads, grid cells, development/infrastructure, and power lines. Each of these tables is linked through their related grid cells (handle). A land manager need only enter an identifying attribute, such as a name or ID number, for each of the related tables and the main source of the link that relates them all (handle). Once all of the attributes are entered into the query the RUN function calculates an output that is presented in a spreadsheet like **Figure 4**.

Figure 3: Simple Developments Query Input

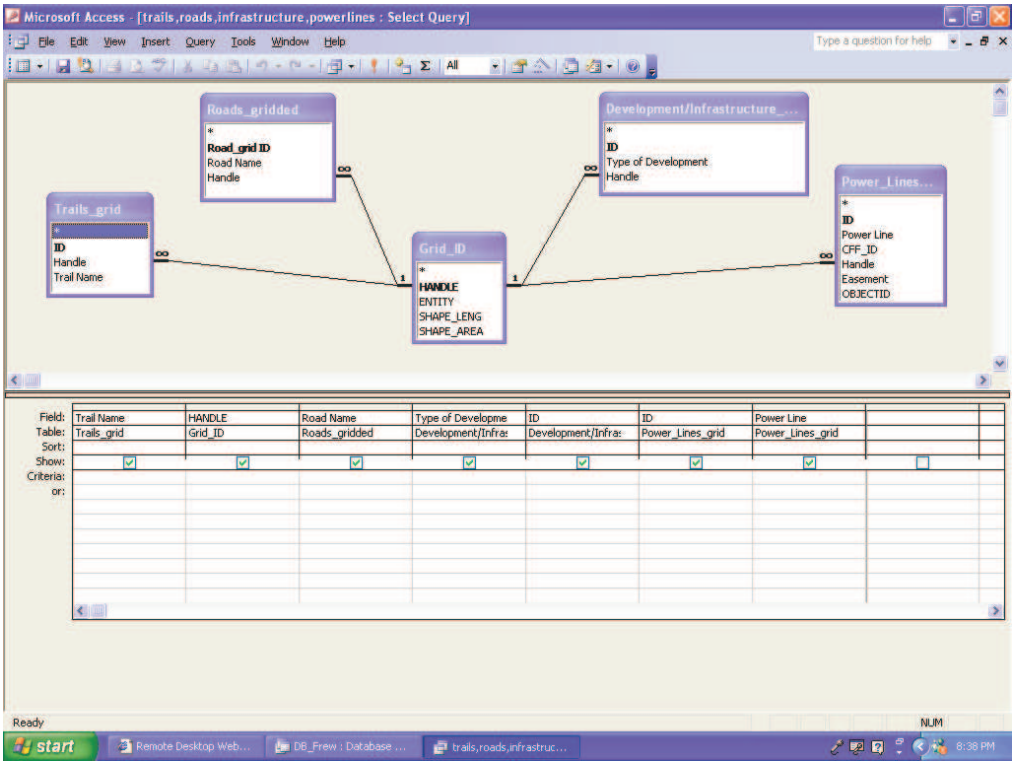
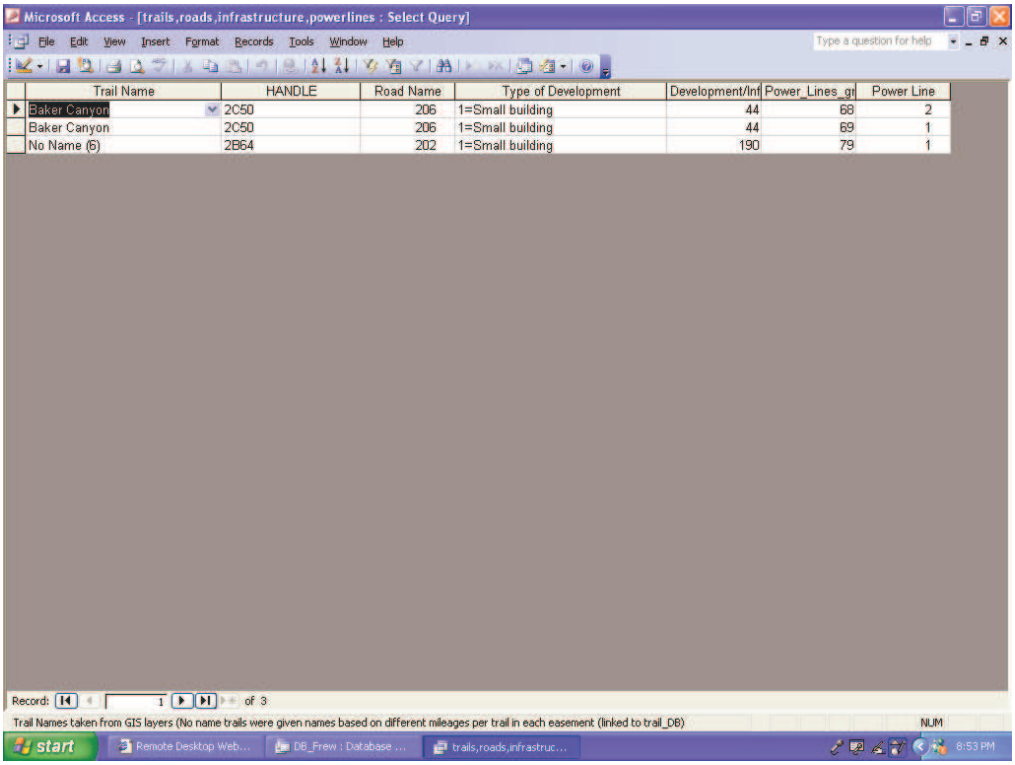


Figure 4: Development Query Output



The output for this query only produces three matching results. This means that there are three grid cells with at least one attribute from each of the tables queried, so a trail, a road, a development feature, and a power line. The query works from left to right with an "AND" function so that the results are cumulative. The results would read that grid cell 2C50 includes Baker Canyon Trail, "AND" Road 206, "AND" building #44, "AND" Power Line #2. This function could be adjusted to read "OR" instead of "AND." Access allows much more complicated queries and will even perform calculations on results. A land manager could not only produce a list of related features, but could also ask for summary analysis of the related attributes. The point of this example is to demonstrate that there are many options and utilities within a relational database, many of which could facilitate a land manager in organizing and analyzing vast amounts of data relative to a specific piece of land. Searches such as this one can be done in seconds and require no statistical work up, and yet they may provide managers with important clues as to changes across large landscapes.

These queries also serve other functions, such as a work up for producing data sets that are ready for analysis in statistical programs, allowing managers to assess correlations between land use and biological effects (such as exotic plant intrusion or loss of biodiversity) or illegal "take" (illegal trails or new developments). These powerful tools are convenient and practical, given that the data has been structured and maintained properly. For instance, change that has been identified through remotely sensed images, can be quantified based on difference imaging and entered into the database. In other words, images taken from satellites or aircraft can be used to detect areas of change on the ground. These areas have data associated with them, which can be lifted into the relational database. Once in the database the geographical data can be extrapolated in a query. A query may ask what is the difference in the width or length of a development feature as seen in new remotely sensed data versus the measurements for that attribute taken for the baseline, or over subsequent years of monitoring. Other, less centralized, forms of change such as erosion could be queried to show the number or distance of local roads from the impacted area. This data could then be further examined by transferring the query results into a statistical package. Managers could examine whether or not the erosion is related to local land uses such as roads or fire breaks.

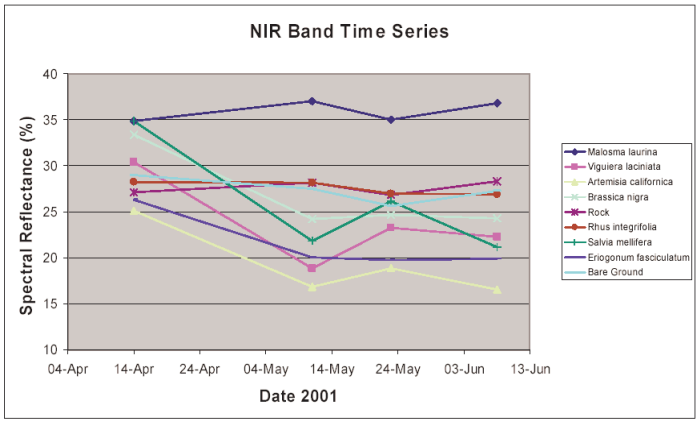
For the NIR, several queries were designed to identify those grid cells which contain a high number of development features. These outputs were then used in a model, to determine what areas have the highest future potential for experiencing change or impacts (Refer to *Threat Matrix* Section). Areas pinpointed for having a high threat of potential development or change, can then be assessed by ground, which might prevent what would have otherwise been future land use change. The following sections outline in more detail how these systems interact and how a well designed and maintained data source can provide more robust results, with less effort, and greater efficiency, than a less thought out and more spuriously designed data management system.

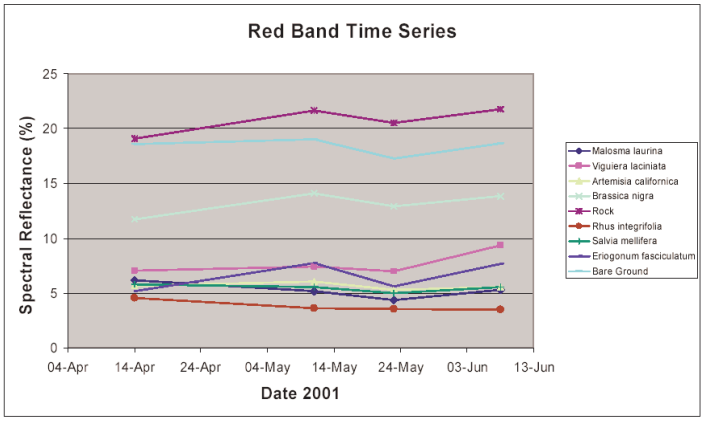
Determining Compliance via Remote Sensing

Introduction

Remote sensing is the science of acquiring information about the Earth's surface from a remote location. This is done by sensing and recording reflected or emitted energy and processing, analyzing, and applying that information. Remote sensing has become an invaluable tool for monitoring as it provides a unique perspective from which to observe areas of land ranging from 1km^2 to 1000 km^2 for fewer dollars and with less manpower than traditional ground monitoring techniques. Remote sensing can be done via satellite imagery or by low-level aerial remote imaging. Satellite remote sensing is generally used to measure or obtain information about relatively large areas such as large weather systems or county to continental-scale images and maps. Aerial photography and other airborne sensors are generally used to map and measure relatively small areas in greater detail. Both technologies allow land managers to see a *multispectral* and *multitemporal* perspective, which enhances data quality and analysis. Different groundcovers reflect different spectra of light (**Figure 5**). Multispectral images (a combination of both visible and infrared wavelengths) capture and represent these different reflectance in a manner that allows specialists to measure important habitat quality indicators such as vegetation abundances and densities, photosynthetic vegetation indexes, reflectance or plant health, etc, as well as important structural attributes such as road, trail, and development sizes, etcetera. . Multitemporal images are simply images taken over time (**Figure 6**) which can help land managers determine the extent of change across a property over a predetermined timeframe.

Figure 5: Comparison of Spectral Reflectance





Shows the comparison between the different types of ground cover and the amount of red and near infrared light is reflected. There is a significant amount of the red waveband reflected by rock and bare ground while the majority of the vegetation species absorb this waveband. The near infrared waveband shows a significant difference, with the vegetation species reflecting a much larger quantity of this waveband. This comparison shows how spectral reflectance can aid in determining vegetation cover over ground cover. This factor can aid in the determination of when a vegetated area has been stripped to bare ground.

Image courtesy Coulter, L. & Stow, D; NASA Food and Fiber Applications of Remote Sensing (2003)

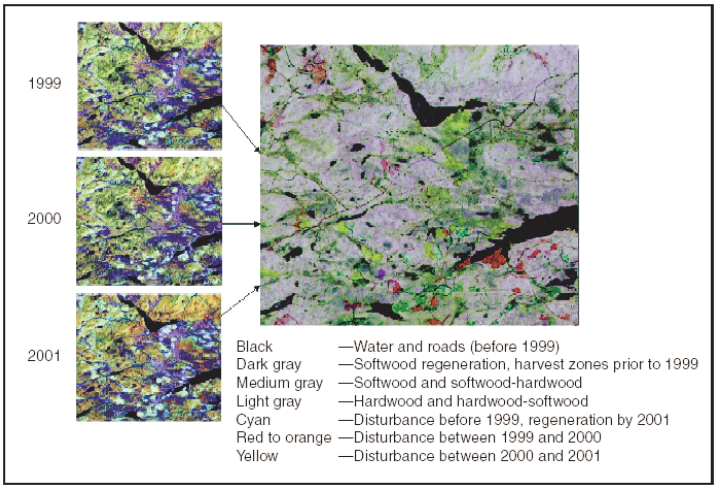


Figure 6: Multitemporal Images

Example of multitemporal remote sensing data shot in three different years (1999, 2000, 2001). The images are of Normalized Difference Vegetation Index (NDVI) set to different color schemes and overlaid. When overlaid the changes that have occurred over the relevant time period are revealed by different colors (Sader et al., 2000).

Conceptual outline

1. Determine remote sensing platform to be used for remote sensing sessions and create baseline images of property
    a. Images should incorporate all spectral wavebands as these are indicators of habitat change, as well as true color and possibly NDVI
2. Correct images for errors associated with topography and radiometry (discussed later)
3. Enter extents and conditions of monitoring targets into database and create GIS layers for targets
4. Determine timeframe for remote sensing sessions and fly remote sensing sessions using the same platform
5. Correct images for errors as in number (2) and also correct images for discrepancies associated with multitemporal remote sensing (discussed later)
6. Use a software package that allows for the creation of change maps.

The North Irvine Ranch (NIR), which is approximately 46km^2 in size, is a prime location to use high resolution remote sensing to determine change. This section focuses on how remote sensing can be used to determine and document compliance with easement restrictions over the NIR. Topics of discussion include types of remote sensors, timing of remote sensing sessions, processing of data and change detection. Although this section focuses on monitoring the lands for compliance with the easement terms, remote sensing could also be helpful for land managers to determine areas where sensitive biological species may exist, and where to undertake biological monitoring.

General types of remote sensors

Remote sensing can be accomplished using satellite or airborne platforms. These two sensors have many different characteristics ranging from different spatial to spectral resolutions. Satellite sensors range in resolution from very coarse instruments such as Advanced Very High Resolution Radiometry (AVHRR) to very fine spatial resolution platforms such as Space Imaging IKONOS or Digital Globe Quickbird (**Figures 7&8**).

Figure 7: Quickbird Infrared Image

Infrared Quickbird images of 2003 southern California fires: Images taken from Digital Globe website. Source: Digital Globe Website

Digital Globe Quickbird

Launch date	October-18-2001.
Revisit time	1-3.5 days
Spatial resolution	.61 Meters panchromatic[1] 2.44 Meters multispectral[1]
Image bands	Panchromatic 450-900 NM Blue 450-520 NM Green 520-600 NM Red 600-690 NM Near IR 760-900 NM
CE90[2]	4.1 Meters at Orthorectified 1:4800 processing level, and variable at custom orthorectified processing level

[1] On nadir: angle of image acquisition
[2]CE90 is circular error 90. This is a measure of the distance from true location of which 90% of all objects are.

Figure 8: Ikonos Infrared Image

Two meter infrared Ikonos image of 2003 southern California fires: Images taken from Space Imaging website. Source: **Space Imaging Website**

Space Imaging Ikonos

Launch date	September-24-1999
Revisit time	3 days
Spatial resolution	.82 Meters panchromatic[1] 3.2 Meters multispectral[1]
Image bands	Panchromatic 450-900 NM Blue 450-520 NM Green 510-600 NM Red 630-700 NM Near IR 760-850 NM
CE90[2]	2 Meters at precision plus processing level

[1]-On nadir: angle of image acquisition
[2]CE90 is circular error 90. This is a measure of the distance from true location of which 90% of all objects are.

These different resolutions are beneficial in attempting to decipher various types of change. For instance, to determine change of roads or trails would require remote sensing with at least five meter resolution. Exposing unauthorized trails would require at least two meter resolution or finer. For larger targets, such as fires or development, a coarse resolution (≥10 meters) could be used.

Satellite platforms have different image acquisition periods and abilities based on their orbital patterns in proximity/angle (nadir angle) to the target. Since timing of repetitive shots is such an important factor, and satellite platforms are on specific orbital patterns, this may restrain the ability to get a shot on a specific date. The nadir angle of satellite

platforms will change the resolution of the image. When the satellite's nadir angle is "0°" the platform is directly above the target. However, as the satellite orbits, the nadir angle will change, and the spatial resolution will decrease. This decrease in spatial resolution can be of sufficient magnitude to preclude the identification of some of the smaller features, possibly to the point of making it difficult to determine the creation or enlargement of trails. For instance, the posted revisit time for the Digital Globe Quickbird satellite platform is 1-3.5 days. However this is dependent on the latitude of the target to be sensed. For instance a target which is located at 33° latitude would have a near nadir (0-15°) revisit time of between 9 and 10 days in order to get a shot. Quickbird is a satellite which is in a "walking" or moveable orbit. Therefore, it has the ability to move to a different orbit, which makes it superior to fixed orbit satellites. However based on atmospheric makeup the time period between acquiring a "near nadir" image may be variable due to the orbit of the satellite. Satellite sensors may be hindered by physical obstructions such as clouds in-between the satellite and the target, these hindrances can obstruct image acquisition or reduce image clarity. In addition, sun sensor geometry, the angle of the sun with respect to the sensor and target, (**Figure 9**), coupled with high cloud coverage, will obscure other parts of an area through the shadow which they cast.

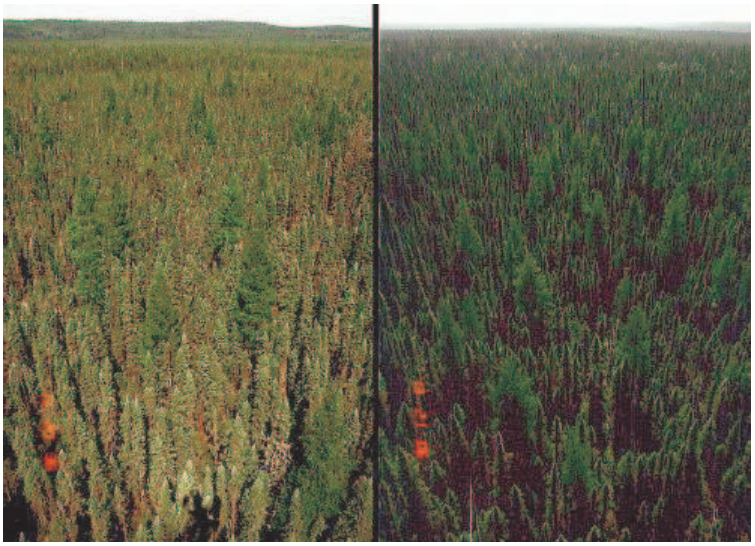


Figure 9: Effects of Sun Sensor Geometry

These figures show a black spruce forest from different vantage points. The illumination of the trees is clearly different due to the sun sensor geometry. The picture on the left shows the forest with the sun directly behind the sensor. The picture on the right shows the forest with the sensor facing the sun.

Wolfgang, L., Geography and Center for Remote Sensing Bidirectional Reflectance Distribution Function (BRDF) and Albedo Research Website
Image courtesy of Don Deering

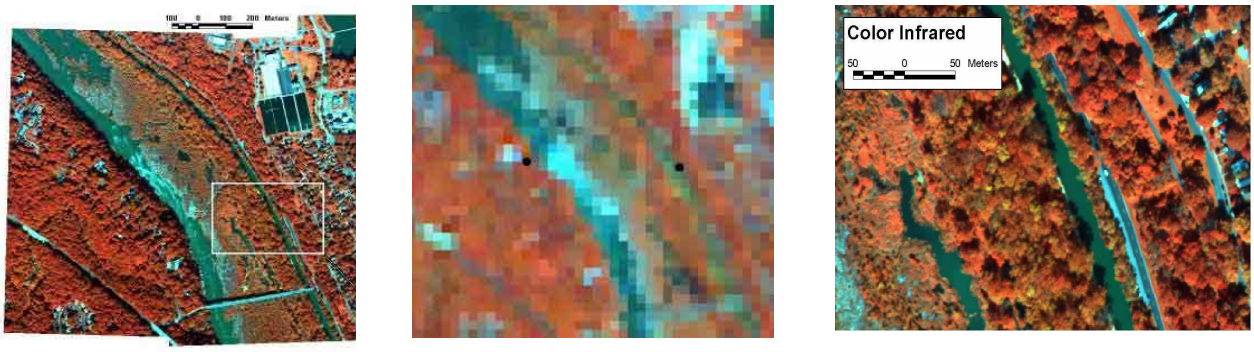
Another drawback of satellite data acquisition is the age of the sensor. Satellite sensors wear out over time, requiring a great deal of preprocessing to correct for the decrease in sensitivity. These constraints of flight/imaging scheduling, interference potential, and degradation create an element of uncertainty when organizing temporal satellite based remote sensing data acquisition schemes. There are a number of different correction techniques that can help to compensate for some of these drawbacks, which are discussed later.

Remote sensing with aerial flyovers can achieve even finer resolution capabilities than their satellite counterparts. Airborne data acquisition involves a low altitude aircraft, which flies a site while a camera shoots images from the bottom or the wing of a plane. The advantages of low flying aircraft are that the plane is closer to the target, allowing for

finer spatial resolution; planes are not subject to orbital patterns which limit satellites; and weather/cloud cover can more easily be compensated for, avoiding potential delays.

One example of an aerial sensor is Airborne Data Acquisition and Registration (ADAR), which has a spatial resolution of <1 meter. Fine scale spatial resolution of this nature could be utilized for monitoring existing trails as well as detection of new or unauthorized trails. "Trails wider than 0.25 meters can be detected with 0.5 meter resolution images" (Coulter et al., 2004). However, there are several limitations to airborne remote sensing. ADAR would require the plane to fly at lower altitudes, which means the site will have to be flown in a number of flight patterns. This number of repetitions will require more intricate mosaic processing to align the images, as well as a great deal of image rectification to correct for the movement of the plane. In addition, the plane will move in accordance with wind shear and gravity, which further complicates the georectification process. This increases the cost of image acquisition and image correction. However, with respect to a temporal scale, airborne imagery can be flown more often and at any specific time, and is not subject to degradation like satellite sensors.

Figure 10: Comparison of ADAR images and Thematic Mapper satellite images



Comparison of high-resolution infrared color imagery ADAR 1M (left) and medium resolution infrared color imagery Thematic mapper TM 30M (middle). The spatial extent of the two images are the same. However, the more the image is scaled in upon , the more apparent the effects of high spatial resolution are (right) Note the scale bar on the two two ADAR photographs. Source: Mid-Atlantic Regional Earth Science Applications Center **http://www.geog.umd.edu/resac/adar.htm**

Table 4: Attribute Monitoring Requirements

Object to Monitor over the NIR	Resolution required to view	Requires spectral reflectance to determine existence	Change detection technique	ADAR	Quickbird	IKONOS
Residences and other buildings	>10 meters*	No	Visual identification or Change detection technique	Yes	Yes	Yes
Road	<5 meters	Probable	Visual identification or Change detection technique	Yes	Yes	Yes
Trails (authorized)	<2 meters	Yes	Change detection required	Yes	Yes	Yes
Trails (unauthorized)	<1 meter	Yes	Change detection required	Yes	Probable	Doubtful
Fences, gates, and walls	<1 meter	Probable	Change detection required	Yes	Probable	Doubtful
Electric power lines, pipelines, wells, and tanks	>10 meters*	Yes	Visual identification or Change detection technique	Yes	Yes	Yes
Fuel modification areas	>10 meters*	No	Visual identification or Change detection technique	Yes	Yes	Yes
Farm areas	>10 meters*	No	Visual identification or Change detection technique	Yes	Yes	Yes
Educational and recreational areas	>10 meters*	No	Visual identification or Change detection technique	Yes	Yes	Yes
Mining and drilling	>10 meters*	No	Visual identification or Change detection technique	Yes	Yes	Yes
Surrounding property	<5 meters*,**	Yes	Change detection required	Yes	Yes	Yes

* To determine exact extent of possible change, finer resolution may be needed.

** Resolution for this is not necessarily to determine change outside of the easement boundaries, but to determine the change associated with the surrounding property, such as vegetation clearing at the edge of the property.

Type of remote sensing for the NIR

The cost for ADAR remote sensing is approximately "$25,000" (T. Smith, personal communication, 2003) This cost includes flying of the property, image acquisition, processing (radiometric correction, topographic correction, and geographic referencing) and mosaicing of the images. The associated costs for Digital Globe Quickbird remote sensing is roughly $8,000, and roughly $7,000 for Space Imaging IKONOS. The approximate prices quoted above may be more or less depending on applicable taxes, rush delivery fees, or the type of support information supplied by TNC.

The best candidate for remote sensing over the NIR easements is ADAR, with Quickbird and Ikonos being strong alternative sensors. These three sensors are offered by Positive Systems, Inc., Digital Globe, and Space Imaging respectively. Although ADAR is the most expensive of these three different types of remote sensing, its high spatial resolution make it the most excellent candidate for measuring change over the NIR property.

ADAR has more utility in identifying change than its satellite counterparts for several reasons:

1. ADAR has finer spatial resolution than both Quickbird or IKONOS, which allows more sensitive analysis, including trails. Trails (one of the smallest features of interest) will be one of the most important disturbances to keep track of, as they are likely to be the most utilized aspect of the property.
2. ADAR has the greatest potential for identifying the creation of authorized or unauthorized trails. Trail features smaller than one meter require finer resolution than Ikonos sensors can offer. In Coulter et. al. both Ikonos and ADAR imaging sensors were used to look at trails over NCCP lands in southern California and determine that "nearly all existing and developing man-made trails approximately 0.25 meters wide or greater are detected with 0.5 meter resolution" (Coulter et. al., 2004).
3. The timing for image acquisition using ADAR is more easily controlled.

Please note that with any remotely sensed technology there is the potential for errors. Because of this, it is recommended that the changes be ground truthed to quantify and validate changes outlined through remote sensing (See *Ground Truthing* section for further details).

Timing of remote sensing sessions

Timing of remote sensing sessions is an important factor when determining change. Seasonal variation in vegetation can make change detection processes difficult to interpret. For instance, spectral signatures in the red wavelength will be less noticeable when larger quantities of photosynthetic vegetation are present. Comparing seasonal images can introduce errors into the change detection processes. Sun sensor geometry will also make change detection processes more difficult through the reflectance of the target (See **Figure 9**). Illumination of the target will depend on the angle of the sun with respect to the location of the sensor, a change in the angle will result in an image with a different appearance or illumination. Ideally timing of remote sensing should be done

during the same season and as close to the same day as the sensor allows or possibly when the vegetative phenology is closely related to that of the baseline shot. This point is worthy of noting due to variable amounts of rainfall that are associated with the southern California climate. Also, the time of day in which the images are acquired should be controlled to reduce the effects of sun sensor geometry.

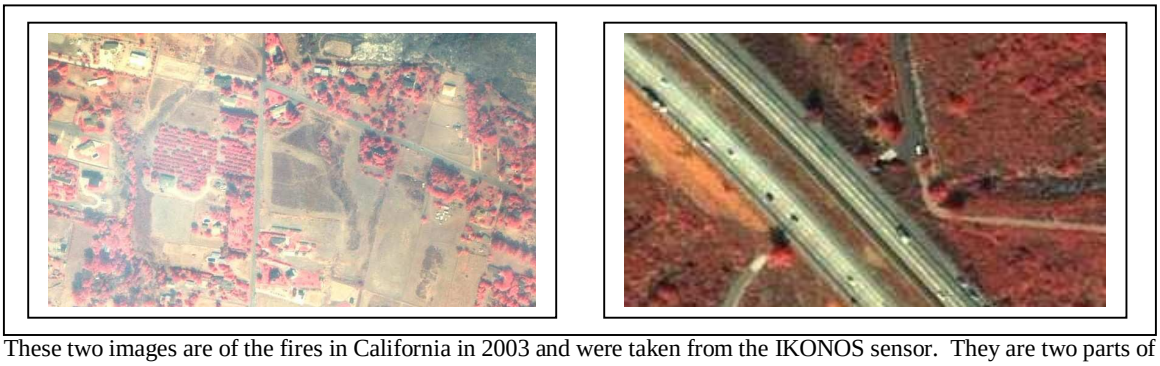
Timing of remote sensing sessions the NIR

The primary use of remote sensing is to determine the amount, type, location of change, not necessarily view a specific event at a specific point in time. Therefore given the potential changes associated with the easements over the NIR, the extent of time which institution of these changes will occur, and the budget of ~$200,000 per year, the recommended frequency for remote sensing is every three years. Development and institution of new roads will take long periods, of time (on the order of months to years) to complete, and can also be identified through ground assessments. Remote sensing can be used to quantify there existence and extent subsequent to their creation. Trails, unauthorized and authorized, can be established on a smaller time scale. However, their existence can be determined during the remote sensing sessions. Therefore it is unnecessary to utilize remote sensing more frequently than the temporal scale of the change.

Processing of Remote Sensing Data

Remotely sensed images have a number of processing requirements in order to correct for errors associated with image acquisition. To detect change the "imagery must be radiometrically corrected and co-registered" (Levien et al, 1999). Corrections for remotely sensed images include radiometric correction for spectral distortions introduced by sensors, sun angle, and atmospheric interference. Remotely sensed images also require topographic correction for errors associated with changes in elevation, as well as geographic registration, aligning images to known features. Radiometric correction involves correction for sun sensor differences (**Figure 9**), any form of brightness related differentiation, sensitivity of the sensor over time, and/or atmospheric composition (**Figure 11**).

Figure 11: An Example of Atmospheric Interference



These two images are of the fires in California in 2003 and were taken from the IKONOS sensor. They are two parts of the same image. (Left) Smoke has obscured the image, making it less clear with respect to its spectral reflectance. (Right) An area devoid of smoke, which shows up much clearer. Image acquired from: Space Imaging website

If images are to be analyzed quantitatively, "as in the case of multi-date analysis for detecting surface changes, the [need] to be adjusted to compensate for radiometric divergences" is paramount (Mas et al., 1999). There are several means for performing radiometric correction. One method of correction may compare reflectance values of two images to determine areas of relatively constant reflectance (invariant features), which are then used in a regressional analysis to determine the overall change in reflectance between the two images. Invariant features could be rock outcroppings, structures, or water bodies. However, this process can introduce error if invariant features do not show a wide range of reflectance values or do show poor quality reflectance values. A certain amount of radiometric calibration can be removed through the use of low-level aerial photography, as the camera is closer to the target, and the timing of the photograph can be controlled.

Topographic correction is required to account for areas of variable relief. "In mountainous areas, in addition to all other factors, topography and land cover type also affect the global irradiance of each pixel" (Dozier & Frew, 1981). These errors are caused by changes in elevation and can be corrected for, by incorporating Digital Elevation Model data (DEMs). DEMs are digital models that have elevation data within their attributes. DEMs take into account vertical exaggerations which are created though changes in ground elevation. DEM data can be incorporated into remote sensing images and used to correct for reflectance discrepancies associated with elevation. The remote sensing image has a known irradiance value associated with each pixel. By incorporating the elevation data and dividing the irradiance value by the Cosine of solar zenith angle, this attempts to remove the error associated with topography. It is worthy of noting that the higher the resolution of the DEM, the more accurate the topographic correction will be. The reason this correction is necessary is that the sun sensor reflectance angle changes in areas of high relief.

Finally, geographic registration is necessary to geographically align images. "Accurate georeferencing and registering of multidate, high spatial resolution imagery acquired from aerial (and satellite) platforms over areas of extreme relief is critical to change detection" (Coulter et. al. 2003). Geographic registration is important during image acquisition, as the final product is generally a compilation of several images as opposed to a single image. Therefore, images must be mosaiced into a single image, and geographically registered.

During change detection processes, precise image coregistration and radiometric normalization are vital. If the images are not coregistered, false changes, or misregistration, (See **Figure 12**) will be associated with other features (such as road or trails) not lining up. These changes may suggest that a road or trail has increased in width, when no change has actually occurred. Image coregistration of the two temporal images involves aligning the images to known fixed points. Examples of these points could be roads, or buildings. Coregistration ensures that there is little or no pixiallary misregistration. Pixiallary misregistration is where a pixel's position is associated with two attributes within the same image, such as when a road, trail, or development do not line up due to poor image coregistration. This will cause false changes to show up due to

the misalignment of the images. (**Figure 12**). The more known positions that are incorporated into coregistration, the more confidence land managers will have that features of change identified are actual change. However, all features of change will have to be determined through subsequent ground truthing analyses.

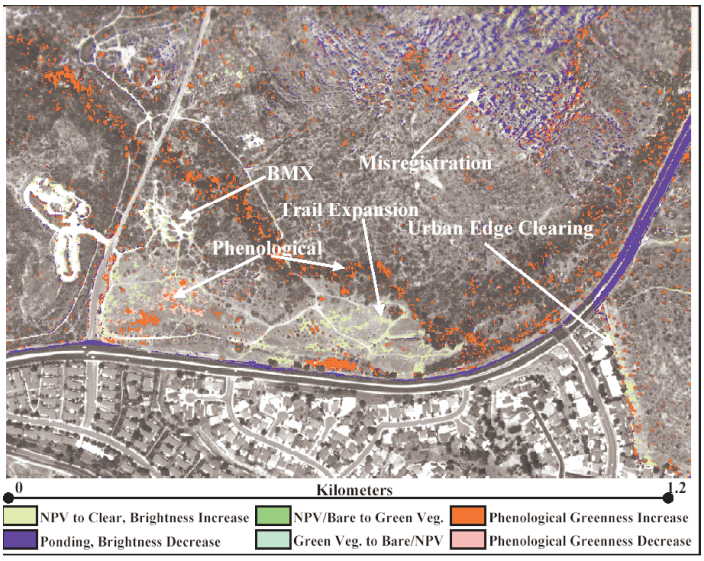


Figure 12: Misregistration of Multitemporal Images

This is an example of misregistration of multitemporal images. The two temporal images have been color coded and overlaid on top of one another. Due to errors in the coregistration process certain attributes (such as bare ground or possibly vegetation) do not line up causing a misregistration. During change detection processes this misregistration would show up as a detected false change.
Image courtesy of Coulter, L. & Stow, D; NASA Food and Fiber Applications of Remote Sensing (2003)

Radiometric normalization of multitemporal images is required to normalize reflectance values of different temporal images. A common way of processing images is using pseudo-invariant features. These are features which have relatively constant reflectance that can be referenced to the baseline image. The other reflectance values can be assigned with a linear regression based on changes from the baseline. Another processing technique is the histogram matching technique, which is a more robust technique for multitemporal normalization. Areas of relatively small development may not have a large range of pseudo-invariant features, therefore by adjusting one of the image's statistical distribution of radiance across pixels to match the other image's distribution, the images can be normalized to determine reflectance changes. This is referred to as "histogram matching" which looks to match the mean and the standard deviation of the images. The global statistics (mean and standard deviation) are calculated and set as a reference image. Then the image with the smallest standard deviation is adjusted so that it matches the standard deviation of the reference image, the result being similar radiance over areas of unchanged location. This technique relies on a couple of underlying assumptions:

1) The land cover change is relatively small
2) The atmospheric make up of the two images (*i.e.* cloud cover or smoke) is relatively constant

Frame center matching is a way of reducing error associated with geographic coregistration. Frame center matching can be used during ADAR remote sensing sessions. This is a process by which images are shot in association with known variables

(such as known GPS coordinates). This process removes a certain amount of the mosaic process. Frame center matching can be done in one of two ways. By incorporating GPS triggers on the cameras positional accuracy of images can be accomplished as the aircraft flies over a target. Or, another more crude manner of frame center matching is done by following a known trajectory of a specified flight path and maintaining a known velocity while shooting images over the flight path. An image acquisition interval is also important in this equation. The timing between the image shots must be known as well and controlled for.

Processing of remote sensing for NIR

Lloyd Coulter and Doug Stowe of San Diego State University used ADAR imaging to determine change over NCCP lands in northern San Diego county. These areas are very similar topographically, as well as in their vegetative makeup, to the NIR. The radiometric image correction processing steps required were anisotropic reflectance correction and multitemporal radiometric normalization to calibrate multitemporal ADAR remotely sensed data. "Anisotropic reflectance describes a condition where materials imaged within a scene exhibit different radiometric values when sensed from different view directions, because their reflectance varies as a function of view and solar angle." (Coulter et al., 2003) This is another example of radiometric correction required to correct for sun sensor geometry. The study was done using ERDAS Imagine software and was found to remove the majority of the anisotropic reflectance as well as the existence of "hot spots" (areas of high spectral reflectance which are artifacts of remote sensing).

Change Detection Through Remote Sensing

Remote sensing can be used as a quantitative and qualitative tool to determine the extent of human related change. Using baseline images of the easement property, future images can be compared or overlaid on the baseline images to produce an output that identifies areas of change. There are a number of ways to accomplish change detection: true color air photos or more automated techniques such as multidate overlay composite imaging, difference imaging, or change vector analysis. These automated procedures can be accomplished with a number of different software packages that are commercially available including IDL/ENVI, ERDAS, or GRID.

The most inexpensive way to view changes is by visual comparison of aerial flyover images. This manual comparison reveals large-scale changes, relative to the resolution of the image. Examples of evident changes are grading of new roads, developments, or fire. Other smaller features may be noticeable, such as large walls or large fences (depending on the spatial resolution). Although visual interpretation of images is inexpensive, quantifying the extent of change is not possible. Small changes such as unauthorized trails will be difficult to determine as well. Spectral reflectance change detection procedures are more successful at revealing these attributes.

Multidate overlay composite imaging is a procedure that highlights land transitions across a parcel of land. For example, two images acquired from the same type of remote sensor, but on different dates, can be color coded in red and blue-green tints. These two

images are then overlaid on top of one another. The result is an image that outlines areas where change has not occurred with a gray tint. Where a change has occurred, a red or cyan hue will appear indicating changes in ground cover.

Another change detection mechanism that can be incorporated to determine change in relevant ground cover is difference imaging. Difference imaging as a change detection tool is very similar to multidate overlay. Values (such as reflectance) of respective images are subtracted from each other to express the direction of change. Using difference imaging, "displaying the red, near-infrared, and NDVI images in the blue, green, and red color guns, respectively, yielded the best qualitative results for enhancing land cover changes of interest to habitat managers" (Stow, 2004). Difference imaging will create a change map that projects changes in land cover based on the presence or absence of change. **Figure 13** is an example of difference imaging using NDVI, red and near-infrared spectral characteristics.

Change vector analysis is a method of change detection, which quantifies change in a specific direction. The images are radiometrically corrected, with areas of urban extent and no change removed. Using the NDVI, NIR, and red wavebands, the images are processed and color-coded for increases and decreases in the NIR and red wavebands. "This is the case because changes in vegetation cover have an inverse effect on the two wavebands; e.g., if vegetation cover increases, the near-infrared waveband values increase(s) while red waveband values decrease(s)" (Stow, 2004). Again, change vector analysis is more of a directional way of viewing change. It points out the presence of change and its resultant direction (*i.e.* an increase or decrease in green vegetation cover), where as, other forms of change detection (multidate overlay and difference imaging) simply point out the existence of change.

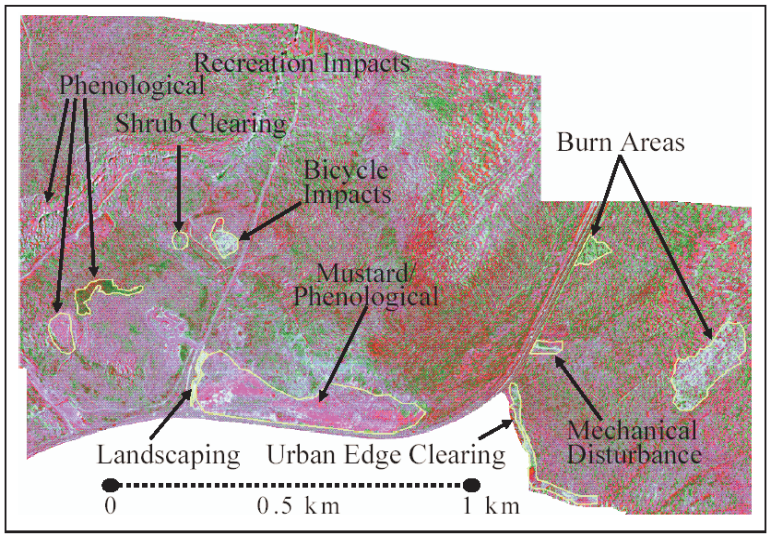


Figure 13: Difference Imaging

An example of difference imaging and an output layer that shows different spectral attribute in red, blue, and green color guns. The image shows areas of change associated with different uses, or seasonal/natural transition as well as areas of misregistration of the images. The difference images are NDVI, red, and near infrared images expressed in red, blue and green color codes. Note specifically the mechanical disturbance, urban edge clearing, and bicycle impacts annotations on the image. The red and green color guns are absent from these areas of the image. Only the blue color code is present, implying that the red wavelength is the dominant spectral waveband present. This implies that green vegetation (which reflects more of the near infrared spectra and absorbs the red wavelength) has been removed from the image. This is consistent with these types of disturbances, as BMX riding for instance removes the dominant vegetation in order to create jumps.
Image courtesy of Coulter, L. & Stow, D. **NASA Food and Fiber Applications of Remote Sensing** (2003)

Change Dectection for the NIR

The change detection tool for the NIR should consist of a software package such as ERDAS Imagine of ENVI software. This software is capable of doing basic difference imaging. ERDAS will identify change with the creation of a new data layer that conveys change associated with land transitions such as development, widening of roads, trails, and erosion due to the removal of native vegetation by fires or mechanical means. All of these values make the package ideal for monitoring as its ultimate product is a quantification change.

Proposed Conceptual Outline for Monitoring the NIR with Remote Sensing

1) Baseline

A baseline image should be established using ADAR remote sensing. Image processing for the baseline image should be done as discussed above to remove potential errors associated with remote sensing images. Once the images have been processed and the monitoring targets[*] (*i.e.* trails, roads, developments, etc) identified in the images, these features should be digitized in individual GIS layers, and their extents entered into a baseline database (see *Baseline Data Acquisition and Documentation*) to document spatial extent for future comparison.

2) Future Images

Future images from remote sensing sessions should be used to perform change detection. These images will require the same type of radiometric correction as the baseline image, as well as multitemporal radiometric normalization. Normalization procedures should be accomplished using a histogram matching approach. Subsequently, coregistration of the images will have to be performed to assure that features are in the exact location necessary for change detection procedures. Frame center matching is a good way to reduce error associated with coregistration, and should be incorporated in the acquisition of multitemporal imaging.

3) Change Detection

These different images will be uploaded into change detection software (ERDAS Imagine for instance) and change detection processes will be used. The map will be areas of change that have occurred over the three year time period. The majority of the change that shows up will be due to seasonal variation. Seasonal variation will be represented by patchy areas of change. However, change which is associated with human disturbance (*i.e.* grading of roads, new trails, developments) will be more linear features and have more "structure" (See **Figure 13**).

Conclusion

Remote sensing provides the capacity to quantify and qualify changes over large areas of land. Whether ADAR or satellite imagery, remote sensing can help deduce ground cover change and accurately quantify those changes. For the purposes of the NIR property and the terms of the easements, deducing these changes is only the first step in determining

[*] All features identified need to be ground truthed to determine their precise nature.

compliance. Once these changes have been identified, the findings must be entered into a database that catalogues changes and keeps a cumulative total of the relative acreage associated with the past and present take. This database will be capable of telling the land manager when the threshold for take has been reached or exceeded. With this type of high resolution remote sensing, changes should be easily quantifiable. However, ground truthing analysis is necessary to determine the validity of these remote sensing images. Subsequent ground truthing analysis will help to determine the true nature of the changes.

Ground Truthing

Ground Truthing

Ground truthing can be used as a tool to both qualitatively assess, as well as verify the spatial extent of features within landscapes that have initially been detected through remote sensing as having undergone land-use change. Though remotely sensed data, given a fine enough spatial resolution, can provide accurate results when attempting to quantify changes in land use due to a human related disturbance, on-site data acquisition is useful in determining the more qualitative aspects of a disturbed/developed site.

Remote sensing in compliance monitoring provides for the initial detection of land-use change that has occurred across an easement property. In the case of monitoring the NIR easement properties to determine whether the landowner is staying in compliance with the terms of the easement agreement, the amount of allowable land-use change and/or habitat removal is relatively small in comparison to the individual easement site (on average < 2% of total easement acreage). To assure that landowners are adhering to the defined amount of land-use change permitted in the easement agreements, precise measurements of the implemented change are necessary. Once a change in land-use cover is determined to have occurred, through the comparison of temporal remotely sensed images of a particular location, it is the role of ground truthing to help verify the of the extent of the disturbance and provide a qualitative assessment. Verification of remotely detected changes can be accomplished through field sampling using GPS units, which can be used to verify measurements of the spatial extent of a disturbance that had previously been determined remotely. Ground truthing also helps to decrease the proportion of uncertainty generated as the disturbances that are detected become smaller and smaller. This is of concern when remotely sensed measurements are unable to precisely quantify small changes. Since the amount of allowable development (*i.e.* habitat removal) or land-use change is small in proportion to the size of the easement itself, precision and verification in change detection is important. As a supplement to mere visual and digital examination of remotely sensed imagery, ground truthing can provide the interested party with a more comprehensive description of a particular location through the on-site examination and comparison of data acquired by remote sensing. The observations detailed in monitoring via ground truthing should determine whether the remotely detected land-use changes occurred as a result of natural or anthropogenic causes. Ground truthing may also reveal instances where a remotely detected change is really just an artifact of either data acquisition (e.g. shadows) or

processing (e.g. misregistration). In certain cases the additional data obtained can be translated into markers used for later detection of similar remotely sensed unidentifiable images. Through a combination of image interpretation and ground verification it is possible to accurately quantify land-use change and determine the cause of the change.

When verifying the information gathered from a remote sensing session via ground truthing, it is necessary to record the date, time and location (enter proper mapping coordinates into GPS unit or PDA) of site visits and sign any log sheets made in the field. Photo documentation is also useful when assessing a site that was determined to have undergone change after the review of remotely sensed images. In the case where the initial detection results in a false positive, a record should still be kept. This may help in future remote sensing sessions that reveal similar detections of change. Imagery where false positives are detected can be translated into a marker for use in future differentiation techniques to minimize the amount of ground truthing necessary. Records of all site visits should be entered into a database immediately after a site visit and should be reviewed prior to future visits of the same site. All detected changes should be catalogued in a database that is capable of recording a cumulative sum of all land use changes relative to the baseline conditions.

Ground Assessment

Given a variable time frame for acquisition of remotely sensed data it is imperative to find a means to detect and measure human related disturbances that may occur between remote sensing sessions or in areas across a landscape where remote sensing is blind (*i.e.* shadows). For conservation easements, at a minimum, some aspect of monitoring should be done annually (Lind, 1999). As a complement to remote sensing and ground truthing, ground assessment can be used to further verify whether the landowner is in compliance with the terms of the easement agreement during periods when the property is not being monitored remotely. Monitoring via ground assessment, in the context of change detection, is a tool by which areas are visited and inspected for alterations associated with human related disturbances. Areas that are identified as having potentially undergone change or have a greater potential for disturbance ("high priority" sites) due to site attributes such as slope, proximity to an actively traveled road, trail, etcetera, would require more frequent and precise assessment. Ground assessment serves to fill the gap in compliance monitoring protocols where the time between subsequent remote sensing sessions is such that areas identified to have higher disturbance potentials need to be inspected.

While ground assessment may be less efficient and likely a more expensive monitoring method in the detection of alterations/disturbances to a land cover compared to remote sensing when monitoring large acreages, it is useful in its ability to precisely quantify small/acute changes, provide exact geographical positions of such changes that may be qualified as inconclusive during remote sensing sessions, and give qualitative descriptions of sites visited. When using ground assessment to monitor large sites the goal is not to identify every land-use change, rather it is to provide a tool that can be used to complement remote sensing and that can be employed in the time between remote

sensing sessions. To determine the cost effectiveness of only monitoring a site via ground assessment versus using remote sensing/ground truthing, the primary considerations are the size of the property and the accuracy expected in the monitoring. If a site is small and can be assessed on the ground for less than the cost of acquiring and analyzing remotely sensed images, then ground assessment may be all that is required for compliance monitoring. To estimate the cost of ground assessment, the personnel for the job should know how many acres per hour they could investigate, given the terrain associated with the site. This information could then be entered into a worksheet, such as the one provided in Appendix C: *Costing-out Ground Assessment Monitoring*, and an annual budget could be formulated (Land Trust for Santa Barbara County, 2002).

Monitoring Planned Activity

Ground assessment is the primary monitoring technique to be employed when a planned disturbance activity is scheduled on an easement property. In the case where new infrastructure is being developed in accordance with permitted uses of the easement, frequent visits to the development location, accompanied by inspection, should be performed to ensure compliance and that the work performed does not extended beyond the approved development footprint.

Monitoring High Priority Sites

Areas within an easement that are of special concern to the conservation entity can only be appropriately monitored through repeated site visits. Such areas may include, but are not limited to, locations where the easement is adjacent to another development or populated area and trespassing is of concern, existing structures and facilities, or areas of rehabilitation/restoration/mitigation. Monitoring of high priority sites should occur on an annual basis. To assist in the prioritization of which sites should be monitored we have developed a quantitative framework, termed the "Threat Matrix" (See section on *Threat Matrix*, below).

Ground Assessment Personnel

Ground assessments can be performed by a wide variety of personnel. Depending on which attributes of an easement agreement are being investigated, personnel can range from trained docents/volunteers to highly specialized, contracted field technicians. The former is perhaps the most cost effective method assuming docents are capable of detecting impacts, while the later is typically the most expensive. A simple costing schedule can be determined once the hourly rate(s) of the selected monitor(s) is known along with the time required to cover a set acreage. Appendix C: *Costing-out Ground Assessment Monitoring*, provides accounting formulas for monitoring activities (Land Trust for Santa Barbara County, 2002). A benefit of using trained docents/volunteers is that they may offer the conservation entity local knowledge of a site and can perform the assessments, or at the very least take note of site changes, while completing routine volunteer duties. For example, while leading a hike a docent may notice an unauthorized trail or an undocumented road widening and enter the geographical position of the

disturbance into a GPS unit or on a map. Equipped and properly trained in documenting such disturbances, a docent may prove to be a value-added member in a conservation entity's compliance monitoring effort. Another benefit that may be provided by volunteers is that the potential for them to become "informed ambassadors" of the conservation entity they are working with through their duties (Zeller, 1999). However, most docents will typically only be able to provide qualitative assessments of easily accessed areas (*i.e.* roads and trails), thereby helping a conservation entity to zero in on specific locations within the easement in need of further examination. In the case of the NIR easements, it is estimated that less than 10% of property can be easily accessed through the use of existing trails and roads, making it difficult for monitoring targets to be readily identifiable to docents. A specialist in field monitoring, on the other hand, can consistently provide both qualitative and quantitative measurements of manmade disturbances to a landscape, granted, at a higher cost to the conservation entity. Trained staff may also be a monitoring option for a conservation entity, at a cost lower than an outside contractor, though higher than a docent. The fact that docents and staff tend to be on a property more regularly and often re-visit specific sites lends to their effectiveness at noticing changes or detecting violations more readily than outside visitors to the property, such as consultants. It is likely that a mixture of trained volunteers, staff and the contracting out of specialists will supply the conservation entity with the most comprehensive results. Depending upon management preferences and available budget, any of the aforementioned ground assessment monitoring techniques can be employed. **Table 5** provides a theoretical example of monitoring targets and the personnel that could be employed to effectively monitor them. The table assumes that personnel will have a wide range of abilities and training.

Table 5: Personnel Requirements for Effective Monitoring

	Personnel to Perform Ground Assessment		
Monitoring Targets	**Docent***	**Staff**	**Contracted Specialist**
Residential and Other buildings	**X**	**X**	
Roads and Trails	**X**	**X**	
Fences, gates and walls	**O**	**X**	
Power lines, pipelines, wells and tanks	**O**	**X**	**X**
Fuel modification areas		**X**	**X**
Arterial highways	**O**	**X**	
Grazing areas	**O**	**X**	
Farm areas	**O**	**X**	
Educational and recreational areas	**X**	**X**	
Mining and drilling areas		**X**	**X**
Exotic vegetation and animal management	**O**	**X**	**X**
Surrounding properties	**O**	**X**	

X = targets readily identifiable to chosen personnel along monitoring route

O = target may or may not be readily identifiable to chosen personnel along monitoring route

***** The extent of property access docents have is unknown, but presumably they could effectively monitor the targets mentioned above.

Documentation/Record keeping

It is essential that a standard set of guidelines be followed when performing fieldwork activities such as ground truthing or assessment. This will promote consistency in reporting over the long term and may aid the conservation entity should legal action ever need to be taken against the landowner. Prior to any monitoring, a review of past monitoring reports and baseline data should be performed. Familiarity with the easement site adds to the monitor's effectiveness at detecting previously undocumented disturbances. Appropriate record keeping should include the signing and dating of all recorded data including photos and accurate geographic location description(s) of the site(s) visited. Thorough documentation/record keeping while conducting a ground assessment will aid in future detection of disturbance. All data retrieved during a site visit should be entered into the appropriate database for ease of future reference. To facilitate in the consistency of reporting a data recording form should be created that can be used by all personnel when recording finding. The data recording form could be either electronic (e.g. available for entry on a personal data assistant) or hardcopy. For more discussion on relevant technologies to assist in accuracy and efficiency of data acquisition and documentation read below.

Technology for Ground Truthing and Ground Assessment

To aid in more efficient and precise data gathering while performing ground truthing and ground assessment tasks in the field, a number of electronic/hi-tech devices are available on the retail market. These devices, with proper training, could limit the amount of error associated with the conventional method of manually recording, then transferring data into a database by eliminating a step. The additional and likely higher quality data recorded through improved technologies may also aid in legitimizing work performed in the case that information were to be legally challenged. The following overview of current ground truthing and assessment support technologies is limited to those tools relevant for compliance monitoring.

GPS Units

One of the most useful tools used in field monitoring is the mobile GPS unit. Conveniently available as handheld units, or larger units requiring a backpack, these devices can be used to accurately map the position or boundaries of a disturbance on an easement property. GPS units can also be used to map the position of new photo stations installed during ground monitoring activities. The accuracy of the devices can range from approximately five-meters to less than 0.5-meters. Differential GPS (DGPS) units provide the highest degree of relative accuracy due to the integration of a known geographic position, which is equipped with a GPS receiver, when acquiring satellite signals. The absolute accuracy of GPS and DGPS units is about the same. Absolute accuracy refers to a positioning system's ability to map a point on earth without the use of a known stationary point. Relative accuracy refers to a positioning system's ability to map a point relative to a stationary point equipped with a GPS receiver. Coordinates, or waypoints, for observed features may be recorded in the field and easily downloaded into mapping programs such as TOPO! or GIS. These GPS waypoints can be easily referenced to remotely sensed images to determine the accuracy of remotely sensed data.

Personal Data Assistants (PDAs)

The personal data assistant, or "PDA," is another recent addition to the types of tools used for recording data measurements taken in the field. The PDA is a miniaturized computer that serves the same purpose as recording information longhand, only data is entered electronically. The benefit of these devices is that they increase the efficiency of data compilation by eliminating the tedious task of transferring information gathered via longhand in the field to a computer database. Instead, the information can be readily uploaded into a database, thus eliminating errors that often occur in the conventional process. Current PDA technologies use a variety of operating systems. The most popular operating systems currently installed in PDAs are Palm OS® and Microsoft Pocket PC 2003®. Depending on the amount of data to be stored, installed memory of 32MB to 64MB is recommended. PDAs can be easily programmed with low cost software packages, such as Pendragon Forms®, that are geared for field work use. This particular application has a simple user-friendly interface that facilitates data entry in the field directly into existing network databases and reduces potential error. Another PDA software package designed specifically for surveying and logging field notes is PenMap®. PenMap® combines an electronic field display, digital plane table, and mobile GIS capabilities (can connect directly to GPS units and is compatible with ArcView® and ArcInfo®) into one PDA. Of the two software packages mentioned, PenMap® and Pendragon Forms®, both function to provide simple, seamless import and export of data to a personal computer. PDAs and accompanying software packages have a large price range depending on the memory and functions desired (just like home computing systems). Knowing the approximate size of the database to be stored in a PDA intended for field use will aid in narrowing the range of compatible devices.

On-site Photo Documentation

A third technology that is a useful and powerful tool in site monitoring is digital photography or the development of permanent photo stations. Digital cameras are light, inexpensive, hold more photos than a roll of conventional film, and can be easily uploaded on a computer. When performing any on-site monitoring, a digital camera should be a standard piece of field equipment. Bringing a camera into the field and establishing defined photo stations can help establish definitive proof that a disturbance or violation has occurred at a particular site. Though often seen as providing simply a qualitative view at a distinct point in time, photo monitoring can also be used as an efficient means of collecting quantitative characteristics of a site. Incorporating a fixed backdrop as a reference, temporally distinct photos can be taken at a site and differences such as vegetation height and density can be measured relative to past photos of that same site (Van Horn & Van Horn, 1996). Once a site containing a representative view has been chosen, the photo station location can be entered into a GPS unit and re-visited on a regular basis to establish photo-documentation of a site. Currently, a set of permanent photo stations have been established in the NIR easement properties to portray a representative view of the overall site conditions (*see* Appendices D - F Photo Station Locations). However, it is anticipated that as new development occurs in accordance with allowable uses of the easement agreement, that new photo stations will need to be

established. A database should be established to store the geographic position of and each photograph taken at all currently existing photo stations, as well as any newly established stations.

The aforementioned technologies represent the present state-of-the-art in equipment currently used by individuals who engage in site monitoring and assessment. Given the continuing rapid increase in power and functionality of electronic devices, these technologies should be re-assessed every 3-5 years. It is likely that once a particular technology is chosen, a newer, updated version will be introduced is less than a year. Prior to upgrading measurement equipment, consideration should be given to the consistency with which data can be collected in comparison to previous methods and whether new devices are compatible with planned software for database entry. Calibration may also be an important consideration, as newer electronics are likely more accurately calibrated than similar devices from the past. This may require some modification to the parameters of the database or to the precision of which calculations are made. Depending on the anticipated use of any of the above mentioned technologies, it is not necessary to invest in top of the line equipment. For instance, if a PDA is to only be used to collect field measurements and not to store numerous other applications that require large memory capacities, a lower end model may sufficiently suit the needs of the monitoring entity.

Threat Matrix

Because of the difficulty in monitoring vast expanses of terrain by ground, it is important to prioritize where to conduct ground-monitoring. Using the NIR easement lands' as a case study, a ground assessment protocol was developed (the "Threat Matrix") that prioritizes areas that may pose a threat to the conservation values of the NIR. The Threat Matrix was created using Autocad (computer aided drawing program), ArcMap (GIS mapping program), Microsoft Access (database program), and Microsoft Excel (database program).

The approach taken in developing the "Threat Matrix" involved estimating the likelihood of land-use change given the current conditions of the site. With information about current site conditions and specific monitoring targets identified in the easement documents, a relative "threat" (*i.e.* potential to experience land-use change) database can be compiled to determine sites with a greater likelihood of experiencing land-use change due to current site conditions. By combining the likelihood of experiencing different types of land-use change at a particular site, an overall threat value score for that site can be determined. In order to obtain a score, weights must be assigned to the particular threat types associated with each condition to be monitored. Using the overall threat value score as a prioritization tool, land managers can then effectively focus their ground monitoring efforts in those areas exhibiting the highest overall threat value.

The first step in creating the Threat Matrix was to parcel or grid the easement properties. In Autocad, a polygon (*i.e*. parcel or grid cell) can be drawn to a specified scale. Once a polygon is drawn, the array function in AutoCad will draw the same polygon for a

specified number of columns and rows. Choosing the size and shape of the polygons depends on the size and possible geographical constraints of the conservation easement site. For the NIR, which totals approximately 11,500 acres, five acre polygons (466 by 466 linear feet) were selected because this is considered a feasible area to assess by ground for the NIR. This resulted in a total of 2,378 five-acre sites over the easement properties. After the grid was complete in Autocad, the new CAD file was transformed into a Geodatabase file using ArcToolbox. This step allowed for the assigning of spatial coordinates so the new polygon would overlay the NIR easement area in ArcMap as a new layer.

The second step in the development of the Threat Matrix was to export the grid layer, each monitoring target and its related attribute information from ArcMap and import it into a single Microsoft Excel worksheet. According to the easement documents, the NIR's monitoring targets include: residential and other buildings, roads and trails; fences, gates and walls; electric power lines, pipelines, wells and tanks; fuel modification; arterial highways; grazing and farm areas; educational and recreational areas; mining and drilling; and surrounding properties. For convenience, the monitoring targets "residential and other buildings" and "wells and tanks" were grouped together as "development." **Table 6** indicates the data obtained to date for the NIR. Because not all information on monitoring targets is in the Microsoft Access database, the table created in Excel consisted of only roads, trails and development. Lacking complete information of existing site conditions, the following steps discuss a simple example of how the conceptual framework of the Threat Matrix works. Using only roads, trails and development as monitoring targets in the Threat Matrix, sites of highest priority for ground assessment can be determined for the NIR easement properties. For the NIR's Threat Matrix output to be more accurate, everything considered a monitoring target should be mapped and recorded in the database.

Table 6: NIR's Monitoring Targets and Number of Records for Each Target

Condition ID	Monitoring Target (Condition)	# of Records under each Monitoring Target (Condition)
1	Roads	23 roads
2	Trails	12 trails
3	Development (includes buildings, tanks/towers, vertical control station, gate, reservoir, built up area)	18 small buildings; 4 tanks/towers; 1 windmill; 1 vertical control station; 1 gate; 1 reservoir; 1 built up area
4	Mining and drilling areas	18 mining/drilling areas
5	Electric power lines and waterlines	7 powerlines; 61 waterlines
6	Fuel modification areas	Need data
7	Arterial highways	Need data
8	Educational and recreational areas	Need data
9	Grazing areas	Need data
10	Farm areas	Need data
11	Exotic vegetation and animal species	Need data
12	Surrounding properties	Need data

The third step to the Threat Matrix was to add an additional column next to each monitoring target (*i.e.* roads, trails and development) in the Excel table to determine the

presence or absence of each target in a site. In the columns, a "1" was entered if the monitoring target was present in a given site and a "0" was entered if the monitoring target was not present in a certain site.

The fourth step to the Threat Matrix was to assign a threat value to each of the 2,378 sites. That is, for each site, a land manager would need to estimate the likelihood of each kind of land-use change, given the current conditions, and then combine those likelihoods to get an overall threat value score for the site. The type of land-use change, "j", in a site might be the potential threat of road widening, a new road, a new trail, development expansion, new development, or trail widening. The existing condition or conditions in a site might be roads; trails; development; roads and trails; roads and development; development and trails; road, trails and development. The threat value at a given site "i" was numerically expressed as:

$$T_j(i) = \Sigma\ \alpha_{jk} C_k(i)$$

T = **threat of land-use change j, in site i**
α = 1 if j could be effected by k and 0 if j could not be effected by k
k = type of condition
C = 1 if k is present in site i and 0 if k is not present site i
(this can be obtained from step 2)

Table 7 below shows types of land-use change, j, and whether the condition, k, may be affected by it. Note that the model is a rather arbitrary model, and as more information on the relationships between conditions and potential land-use changes becomes available, it can be refined.

Table 7: Type of Land Use Change and Condition Effecting It

	Conditions (k)			
Land-use change (j)	Road	Trail	Development	
Road widening (1)	1	0	0	= α
New road (2)	1	0	0	
Trail widening (3)	0	1	0	
New trail (4)	1	1	0	
Development expansion (5)	0	0	1	
New development (6)	1	0	1	

Once a threat value was assigned for a given site "i", the total threat value for site "i" was numerically expressed as:

$$TV(i) = \Sigma\, w_j T_j(i)$$

$\mathbf{TV_{(i)}}$	=	**total threat value of site i**
w_j	=	the threat weight associated with land-use change type j, 1= least threatening and 10= most threatening
$T_{j(i)}$	=	threat of land-use change j, in site i

Threat weight "w_j" was qualitatively determined on an arbitrary scale of 1 to 10, with 10 representing the highest threat potential and 1 the lowest. The weight of each land-use change was based on three factors: 1) affect of land-use change to conservation values of the NIR, 2) relative importance of assessing a particular type of land-use change by ground versus remote sensing, and 3) extent of a particular type of land-use change in comparison to the maximum allowable land-use change within the easement properties. The weights assigned to each type of land-use change should be left to the discretion of the land manager and changed in the future as site conditions dictate. Table 8 below shows a sample of threat weights given to each land-use change, "j", and whether the condition, "k", may be affected by it.

Table 8: Threat Weights Given to Each Land Use Change

		Conditions (k)		
Land-use change (j)	*Threat weight (w_j)*	Road	Trail	Development
Road widening (1)	5	1	0	0
New road (2)	7	1	0	0
Trail widening (3)	4	0	1	0
New trail (4)	6	1	1	0
Development expansion (5)	5	0	0	1
New development (6)	8	1	0	1

$= \alpha$

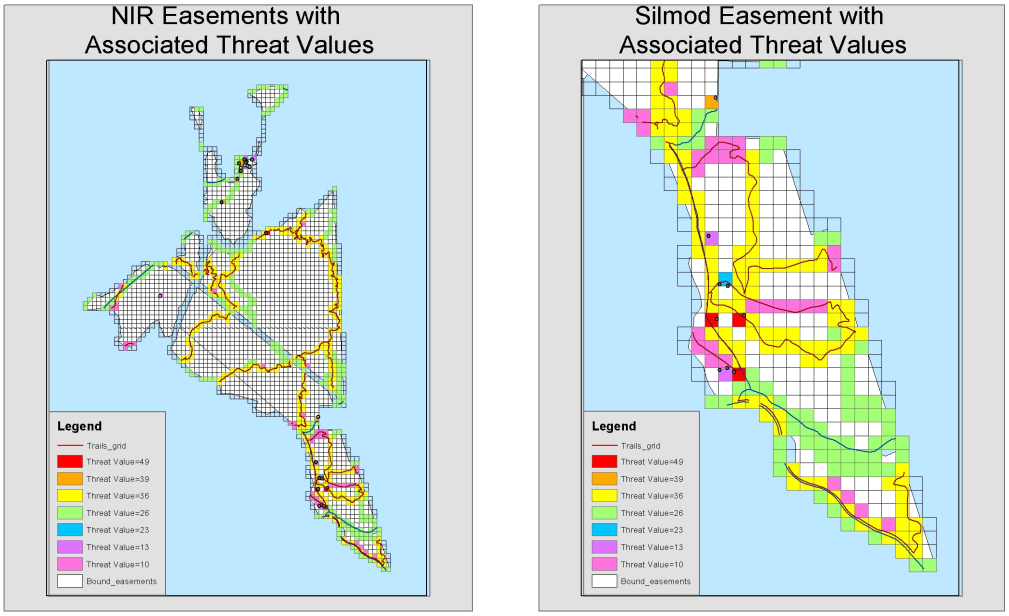
Thus, for the above "Threats" and "Conditions," the Total Threat Value ("TV") for any particular site in the easement was calculated as follows:

Table 9: Total Threat Value Calculations

Condition (k)	$TV_{(i)} = \Sigma\ w_i T_{j(i)}$
Roads only	$(w_1 + w_2 + w_4 + w_6) = 26$
Trails only	$(w_3 + w_4) = 10$
Development only	$(w_5 + w_6) = 13$
Roads and trails only	$(w_1 + w_2 + w_3 + 2w_4 + w_6) = 36$
Roads and development only	$(w_1 + w_2 + w_4 + w_5 + 2w_6) = 39$
Development and trails only	$(w_3 + w_4 + w_5 + w_6) = 23$
Roads, trails and development only	$(w_1 + w_2 + w_3 + 2w_4 + w_5 + 2w_6) = 49$

The fifth and final step to the Threat Matrix was to prioritize the areas in the NIR for assessment, based upon the total threat values, where the sites with the largest total threat value are considered as areas of highest priority for ground assessment. Ideally, of the 2,378 five-acre sites included in the Threat Matrix analysis of the NIR easement properties, the land manager would want to focus their ground assessment monitoring efforts on the sites with the highest total threat value. When summing the total threat value the land manager may come across parcels that have two or more of the same condition. In this instance it is up to the land manager to weight that occurrence appropriately. It may not be the case that simply multiplying by the a factor of occurrences is representative of the true threat the condition(s) pose. Thus, an arbitrary weighting may be appropriate for these instances. ArcMap was used to provide a visual representation of where these sites are located, **Figure 14**.

Figure 14: Threat Matrix Results - Prioritization of Threats



Other Tools for Compliance Monitoring (Stakeholder Communication)

The compliance monitoring program described in this document has focused on detecting change and potential violations of the easement conditions through remote sensing, ground truthing and ground assessment. These methods only detect violations of easement conditions after they have occurred. "Although most property owners are forthcoming with the easement holders in terms of upholding the conservation values, sometimes circumstances change. For example, lessees may assume management of the property, neighbors may trespass or participate in prohibited uses, agreements may be forgotten, and unexpected needs or events may emerge (Guenzler, 1999)." Ideally, one wants a monitoring program that deters in a cooperative manner violations before they happen. For example, in the San Francisco Bay Area there are approximately 315 conservation easements totaling 85,000 acres in size. 51% of those easements are monitored and approximately 14% of those easements in 1999 experienced violations with the easement conditions (Guenzler, 1999). The top two violations were proliferation of exotic species and construction of structures and the average expense of the easement grantee for resolving a violation was $2,500, although some cost upwards of $30,000 (Guenzler, 1999). Because violations can be costly and potentially detrimental to the easement's conservation values, proactive measures must be a component of a compliance monitoring program. These proactive measures, which take the form of active relationships between the conservation entity and the other stakeholders in the property, are aimed to reduce the negative impact of honest mistakes and understanding.

Relationship with the Property Owner

The first and most fundamental proactive measure in compliance monitoring is to establish a good rapport with the property owner. A good relationship makes it more likely that the owner will comply with the easement conditions. Before the easement is acquired, it is important that the property owner (Grantor) be made aware of what potential monitoring and enforcement may be implemented for the proposed easement (Lind, 1999). For example, the NIR easement documents contain the grant deed, which describes therein procedures to follow when the Grantor is not in compliance with the terms of the easement agreement. After acquisition, it is important for the Grantee to hold regular meetings with the Grantor in order to review technical aspects of the easement. At that time, the Grantor should be presented with baseline information of the easement, how the easement should be monitored and by whom. Monitoring forms, photo documentation procedures and maps detailing disturbance and/or change should be compiled, maintained, and provided to the Grantor. The Grantee should discuss when the Grantor should expect to hear from them before and after site visits and the Grantor should be encouraged to accompany the easement holder on monitoring site inspections (Land Trust Alliance, 2004).

For the NIR easement, the Grantor is the entitled to maintain, repair, replace, and use all existing structures, roads, trails, fences, gates, infrastructure facilities, and fuel breaks on the property. The Grantor is also allowed have educational and recreational areas,

mining, grazing and Christmas tree/pumpkin farms across some of the NIR. Although the NIR was acquired in 2002, the biological and compliance monitoring programs for the NIR will not take effect until 2005. Until then it will be important for both entities to have a clear baseline and monitoring program in place. For the NIR, it is recommended that the Grantor and Grantee hold frequent meetings, perhaps quarterly, until the baseline data and monitoring plan have been mutually agreed upon. Once the monitoring program is in place, semi-annual meetings between both parties would be appropriate to update each another of the status of the NIR easement lands. It is also recommended that the Grantor contact the Grantee prior to any scheduled maintenance activities to determine if any impacts to the conservation values of the NIR would result and whether any mitigation measures are needed to minimize the potential impacts. This is also important for allowing the Grantee the option of monitoring the activity.

Relationship with the Local Government

The second proactive measure is to establish a good relationship with the local government. Exchanging planning, monitoring and management information on a regular basis will help build a strong relationship between the government and the easement holder. An informed local government could help prevent or spot potential easement violations. For example, local ordinances often require the property owner to notify or obtain approval from the local jurisdiction for certain permits, such as construction of a road, fence or structure. If the local government is informed of the easement restrictions, the government could prevent activities that conflict with the restrictions, inform the Grantee before the Grantor embarks on such activities, or seek the Grantee's approval for the requested activity (Guenzler, 1999). The local government could also notify the Grantee of potential off-site activities that could negatively impact the easement's conservation values if it is not also monitored. For example, a new housing development adjacent to a conservation easement may be problematic and the concern of trespassing and unauthorized dumping may be more prevalent. An informed local government can also include the easement in master planning. For example, the local government can include the conservation easements on their maps and open space plans to make it known the easement area is to be preserved in perpetuity (Lind, 1999).

The NIR is located in the unincorporated lands of the County of Orange with the exception of a small portion being located within the city limits of Anaheim. The NIR is surrounded by the City of Anaheim to the north, City of Orange to the west and south, County of Orange to the south, and Cleveland National Forest, which is part of San Bernardino County and Riverside County, to the east. To establish a good rapport with the local government, it is recommended that the Grantee and Grantor provide at least the Grant Deed and Easement Document Reports to the County of Orange, City of Anaheim and City of Orange for conservation values, background, allowed uses and restrictions on the easements. Because these documents are quite lengthy, a summary of the allowed uses and restrictions are also recommended. The Grantee and Grantor should also provide this information to other governmental agencies that may have a stake in the easement lands, such as the US Fish & Wildlife Service, California Department of Fish and Game, U.S. Army Corps of Engineers, Caltrans, and the Metropolitan Water District, as well as, private entities that hold private easements over the easement lands like

Pacific Bell Telephone, Southern California Edison Company and Orange Unified School District. Because of a lot of the these stakeholders have easements across the NIR, the Grantee and Grantor should request the applicable stakeholders to be notified prior to scheduled maintenance activities to determine if any impacts to the conservation values of the NIR would result and whether any mitigation measures are needed to minimize the potential impacts. Table 10 below includes a list of contact names and their applicable departments and website address to obtain the current email and address information.

Table 10: Contact Information for NIR Stakeholders

Contact Name:	**Contact's website:**
County of Orange • Planning & Development • Public Works • Harbors, Beaches and Parks Department • Orange County Fire Authority • Orange County Transportation Authority	www.oc.ca.gov
City of Anaheim • Community Development (Building and Planning Departments) • Public Works • Fire Department	www.anaheim.net
City of Orange • Community Development (Building and Planning Departments) • Public Works	www.cityoforange.org
US Fish & Wildlife Service • Carlsbad Fish & Wildlife Office	http://carlsbad.fws.gov/
California Department of Fish and Game • Region 6 Long Beach Office	www.dfg.ca.gov
U.S. Army Corps of Engineers • Los Angeles District	www.spl.usace.army.mi
Caltrans • District 12 – Orange County	www.dot.ca.gov/dist12/
Metropolitan Water District	www.mwd.dst.ca.us
Pacific Bell Telephone	www.sbc.com
Southern California Edison Company	www.edisonx.com
Orange Unified School District	www.orangeusd.k12.ca.us

The County's Harbors, Beaches and Parks Department has already included the NIR on the County's open space plans. Grantee and Grantor should also inquire from the County of Orange, City of Anaheim and City of Orange about the surrounding County/City zoning and Comprehensive General Plan designations of the surrounding properties to have an idea of what could be developed on those properties that may pose a threat to the conservation values of the NIR. The Grantee should verify with the County's Assessor Record Department that they are shown as a co-owner of the NIR. This is important because any major project or development on and adjacent to the NIR would require public noticing. This would allow the Grantee and perhaps the Grantor to voice any

concerns about the project to the local government during the discretionary development review phase.

To date, there are two major projects proposed north of the NIR and southwest of the NIR. North of the NIR, a proposal has been submitted to the City of Anaheim to amend the Mountain Park Specific Plan to include no commercial uses and to reduce the number of homes proposed from 8,000 to 2,500. An Environmental Impact Report analyzing the potential environmental impacts of this amendment is currently under way. It is recommended for both the Grantee and Grantor to contact the City of Anaheim's Planning Department (contact can be by phone, email or letter) and request to be put on the interested party list for the Mountain Park Specific Plan Amendment project so they can be notified of upcoming public hearings. Also in the City of Anaheim, the State of California recently purchased the Cypress Specific Plan area to be used for open space and a wildlife corridor. Originally that area, which is also located north of the NIR, was slated for 1,500 homes and some commercial development. The City of Anaheim is currently in the process of terminating that specific plan and redefining that area an open space in the City's General Plan.

Southwest of the NIR, The Irvine Company, who is also the Grantor for the NIR, has submitted applications to the City of Orange for development of Santiago Hills Phase II Planned Community (SHIIPC) and the new East Orange Planned Community (EOCP). Within the 6,821-acre project area, the proposed project includes maximum development of 1,746 residential dwelling units within SHIIPC and 2,350 residential dwelling units within EOPC. The proposed project also incorporates approximately 5,172 acres of permanent open space, neighborhood parks, a 20-acre regional sports park, public trails, a new fire station, and other amenities (www.cityoforange.org). The City of Orange is currently evaluating the proposed project and will be processing a General Plan Amendment, Prezoning Application, Tentative Tract Maps, and an Annexation. It is recommended for the Grantee to contact the City of Orange's Planning Department (contact can be by phone, email or letter) and request to be put on the interested party list for the these projects so they can be notified of upcoming public hearings.

Relationship with the Local Community

The third proactive measure is to establish support of the community by involving and educating them of the easement goals and values. "Community involvement can be particularly useful in solving problems or threats to the property such as trespass by vehicles, vandalism, or dumping (Land Trust Alliance, 2004)." To date, the Grantee for NIR offers a variety of opportunities for visiting the NIR through docent-led tours. These include guided tours for hikers, bicyclists and equestrians, as well as programs for children, birders, and artists. Besides docent-led tours, the Grantee and Grantor also have informed the community about NIR by sending Orange County residents pamphlets and brochures educating them about the NIR. The Grantee and Grantor also have on their websites information about the NIR. Further community outreach may be necessary once the Grantee and Grantor finalize the NIR's public access plans, which include trail, educational and recreational areas.

Conclusion

As conservation easements continue to grow in popularity and use, it is important that easement holders and conservationists ensure that the goals of easements continue to be met. The various sizes and types of easements, and their complex arrangements of ownership, make it difficult to prescribe a single protocol that will ensure that all aspects of the easement's goals are being met. Using the North Irvine Ranch as a case study, a hierarchichal framework was designed to monitor compliance with the terms of The Nature Conservancy easement agreements for Fremont, Blind, Silmod, and Anaheim easements. The compliance monitoring framework consists of a procedural framework, that clearly defines the goals of the easement agreements; determines changes across the easement; qualifies and quantifies those changes; compiles and organizes relevant data; and provides preemptive measures to deter future violations from occurring. The following are the recommended monitoring procedures for each attribute:

- Conservation Easement Documentation – defining the goals of the conservation easement agreements
- Baseline Data Acquisition and Documentation – compile and document the initial condition of features which are relative to the goals of the easement agreements
- Data Management – organize easement features, and baseline conditions, with statistical properties in a relational database for storage and analysis (MS Access®)
- Remote Sensing – use multispectral and multitemporal images to perform image differentiation to detect areas of change across the easement (Utilizing high resolution ADAR imagery)
- Ground Truthing – qualify and quantify remotely sensed areas detected for change
- Ground Assessment – monitor in between remote sensing sessions those areas flagged by the "threat matrix" model as having a high potential for change
- Other Tools – create robust lines of communication with stakeholders as a preemptive measure to prevent violations

Although this framework focuses on compliance monitoring over the NIR, aspects of the framework could be applied to easements of various sizes, as well as to issues of biological monitoring.

Key Recommendations

The previous sections outline a framework for a monitoring program that assures that a landowner is remaining in compliance with the terms of an easement agreement. Although this framework was based on a particular region, NIR, the information presented above can be translated into recommendations that are applicable across a variety of conservation easements. Listed below are key recommendations for compliance monitoring of easement properties specific for the NIR and the attributes targeted for monitoring therein. More general recommendations for other easement properties can be deduced dependent on the size of the property and the monitoring budget. If the cost of remote sensing on the recommended timeline is greater than the cost of detecting land-use change via ground assessment annually, then it would be prudent for a land manager to disregard the recommendations to conduct remote sensing and the associated ground truthing aspects of the framework and simply adhere to all other recommendations.

Baseline Database

- Microsoft Access is the relational database recommended to fit the size, scope, budget, needs, and abilities of TNC staff on the NIR easement.
- A baseline database should include all development/compliance related easement attributes with statistical (quantative) properties. Thus the baseline would document each element of infrastructure (buildings, roads, etc.) and their descriptive features (size, location, etc.)

Database Management

- Enter all data acquired from remote sensing, ground assessment and ground truthing (including null values)
- Develop standard queries for measuring changes in the descriptive features of compliance attributes (i.e. a change in the width of a road).
- Assign security settings and regularly back up data to prevent corruption or loss of information.

Remote Sensing

- ADAR is the recommended remote sensing application, with Digital Globe's Quickbird being the best alternative for monitoring entities with smaller budgets than the NIR.
- Images (baseline and future) should be shot in their multispectral characteristics using GPS triggers for greatest positional accuracy.
- The timeline for remote sensing sessions should be every three years.
- Basic difference imaging software should be used to detect change and create maps that locate those changes.

Ground Truthing

- Ground truthing should occur when a change is detected through multitemporal aerial images.

- Detected changes should be characterized, documented via photographs and mapped using a GPS unit.
- A record of all false positives detected should be kept so that if similar changes are detected in the future via remote sensing a reference marker has already been established.

Ground Assessment

- Ground assessment should occur annually.
- Use the "Threat Matrix" model to prioritize areas for monitoring via ground assessment that are of high threat potential.
- Use GPS units when monitoring via ground assessment to allow for accurate quantification of change and characterize all changes detected.
- If change is detected, a new photo station should be set up in these areas.
- Monitoring techniques need to be adaptable so that if/when new unanticipated variables are encountered the monitoring can be altered to incorporate these variables into the protocol.

Other Tools for Compliance Monitoring

- Grantor and Grantee should conduct quarterly meetings until the monitoring plan has been agreed upon and semi-annual meetings thereafter.
- Grantor should contact Grantee prior to scheduled planned activities to determine if any impacts to the conservation values of the NIR would result and whether any mitigation measures are needed to minimize the potential impacts.
- Provide easement documents to the applicable stakeholders to educate them about the conservation values, background, allowed uses and restrictions on the NIR easements. Also, request to be notified from stakeholders of any planned activities to determine if any impacts to the conservation values of the NIR would result and whether any mitigation measures are needed to minimize the potential impacts.
- Grantee and Grantor should inquire about the surrounding County/City Zoning and General Plan designations to be informed on what could be developed there and whether any development projects are proposed on those properties. If a development is proposed that may impact the NIR's conservation values, the Grantee should notify the local government of their concerns during the project's development application and environmental review process.
- Further community outreach may be necessary once the Grantee and Grantor finalize the NIR's public access plans, which include trail, educational and recreational areas.

Recommendations for each monitoring target of the NIR

Key Recommendation 1: Residences and Other Buildings

Applicable Sections:
Easement Document Section 3.1; Grant Deed – Schedule 4, #2 and 3

Monitoring Recommendations:

1. Document location of existing structures in baseline database using GPS coordinates.
2. Check existing structures for change or expansion using multitemporal aerial images (*i.e.* remote sensing). This is to be done about every three years. If change is detected, then ground truth area documenting the site via photos and measure change using a GPS unit. Enter site measurements into database to analyze extent of change.
3. Examine remote sensing data for new or unauthorized structures. If change is detected follow step 2.
4. In years where remote sensing does not occur, ground assessment should occur annually. Priority should be given to areas indicated by the Threat Matrix model.
5. Grantor should contact Grantee prior to scheduled maintenance activities.
6. Grantor should contact Grantee prior to environmental testing and remediation work in and around the former commercial/industrial ground lease site that is located on the Anaheim easement.
7. Both grantor and grantee should contact the Metropolitan Water District and Orange County Fire Authority to request notification when the public agencies decide to repair or replace any of the existing public infrastructure structures.

Key Recommendation 2: Roads and Trails

Applicable Sections: Easement Document Section 3.2; Grant Deed – Schedule 4, #4 and 9; Resource Document IV.A.3 and IV.D.1

Monitoring Recommendations:

1. Document location of existing roads and trails (unsupervised and limited access trails) in baseline database using GPS coordinates.
2. Check existing roads and trails for change or expansion using multitemporal aerial images. This is to be done every three years when The Nature Conservancy receives remotely sensed data. If change is detected, then ground truth area documenting the site via photos and measure change using a differential GPS unit. Enter site measurements into database to analyze extent of change.
3. Examine remote sensing data for new or unauthorized roads and trails. If change is detected follow step 2.
4. In years where remote sensing does not occur, ground assessment should occur on an annual basis. Priority should be given to areas that have more frequent use, as indicated in the Threat Matrix.
5. Grantor shall review maintenance of existing dirt truck trails with Grantee on an annual basis.

6. Grantor should contact Grantee prior to scheduled maintenance activities.
7. Request written confirmation yearly from MWD, SCE and OCFA that the roads they are responsible for maintaining annually are being maintained or used.

Key Recommendation 3: Fences, Gates and Walls

Applicable Sections: Easement Document Section 3.3; Grant Deed – Schedule 4, #1; Resource Plan Section IV.E.

Monitoring Recommendations:

1. Document location of existing fences, walls and gates in baseline database using GPS coordinates.
2. Check existing fences, walls and gates for change or expansion using multitemporal aerial images. This is to be done every three years when The Nature Conservancy receives remotely sensed data. If change is detected, then ground truth area documenting the site via photos and measure change using a differential GPS unit. Enter site measurements into database to analyze extent of change.
3. Examine remote sensing data for new or unauthorized fences, walls and gates. If change is detected follow step 2.
4. In years where remote sensing does not occur, ground assessment should occur on an annual basis. Priority should be given to areas that have more frequent use, as indicated in the Threat Matrix.
5. Grantor should contact Grantee prior to scheduled maintenance activities.

Key Recommendation 4: Electric Power Lines, Pipelines, Wells and Tanks

Applicable Sections: Easement Document Section 3.4; Grant Deed – Schedule 4, #3 and 9

Monitoring Recommendations:

1. Document location of existing "Infrastructure Facilities" in baseline database using GPS coordinates.
2. Check existing "Infrastructure Facilities" for change or expansion using multitemporal aerial images. This is to be done every three years when The Nature Conservancy receives remotely sensed data. If change is detected, then ground truth area documenting the site via photos and measure change using a differential GPS unit. Enter site measurements into database to analyze extent of change.
3. Examine remote sensing data for new or unauthorized "Infrastructure Facilities". If change is detected follow step 2.
4. In years where remote sensing does not occur, ground assessment should occur on an annual basis. Priority should be given to areas that have more frequent use, as indicated in the Threat Matrix.
5. Grantor should contact Grantee prior to scheduled maintenance activities.
6. Require Grantor to provide Grantee with an annual record of the "Infrastructure Facilities," their locations and quantify extent of coverage to ensure the allowable Facilities Area has not been exceeded (i.e. Infrastructure Facilities cannot occupy

more than 78 acres of the Fremont/Blind Easement, 28 acres of the Silmod Easement and 30 acres of the Anaheim Easement).

7. Grantor and Grantee request to be notified from OUSD, PB, PT, SCE, MWD and Municipal Water District of Orange County Facilities Corporation when and if any work is ever proposed on those easements.

Key Recommendation 5: Fuel Modification

Applicable Sections: Easement Document Section 3.5; Grant Deed – Schedule 4, #12; Resource Plan IV.D.2

Monitoring Recommendations:

1. Refer to the Nature Reserve of Orange County's Tactical Suppression Plan for the location of fire management activities, policies and procedures.
2. Document location of existing fuel modification areas in baseline database using GPS coordinates.
3. Check existing fuel modification areas for change using multitemporal aerial images. This is to be done every three years when The Nature Conservancy receives remotely sensed data. If change is detected, then ground truth area documenting the site via photos and measure change using a differential GPS unit. Enter site measurements into database to analyze extent of change.
4. Examine remote sensing data for new fuel modification areas. If change is detected follow step 2.
5. In years where remote sensing does not occur, ground assessment should occur on an annual basis. Priority should be given to areas that have more frequent use, as indicated in the Threat Matrix.
6. The need to maintain existing fuel breaks shall be reviewed by Grantee and Grantor on an annual basis prior to implementation.
7. Grantor should contact Grantee prior to scheduled maintenance activities.

Key Recommendation 6: Arterial Highways

Applicable Sections: Easement Document Section 3.5; Grant Deed – Schedule 4, #5; Resource Plan

Monitoring:

1. Grantor and Grantee should contact Orange County Transportation Authority (OCTA) to be notified when highway construction will occur under the Master Plan of Arterial Highways.
2. Grantor shall contact Grantee prior to scheduled construction of highway.

Key Recommendation 7: Grazing Areas

Applicable Sections (Note: only applies to Fremont, Blind and Silmod Easements): Grant Deed – Schedule 4, #15, Resource Plan 5.4

Monitoring Recommendations:

1. Refer to the Grazing Management Plan prepared by NativeScape in 1996 for the information and compliance on grazing management activities, policies and procedures.

2. Document location of existing grazing areas in baseline database using GPS coordinates.
3. Check existing grazing areas for change or expansion using multitemporal aerial images. This is to be done every three years when The Nature Conservancy receives remotely sensed data. If change is detected, then ground truth area documenting the site via photos and measure change using a differential GPS unit. Enter site measurements into database to analyze extent of change.
4. Ground assessment should occur on a monthly basis between the months of November and June. Items to look from a biological compliance standpoint are compacted soils, loss of topsoil, infestation of exotic weeds, and degradation of the natural habitats such as coastal sage scrub and riparian areas.
5. Every June Grantee should conduct monitoring and quantitatively measure residual herbaceous dry matter (RDM) to determine that it has not exceeded its 1,000 pound limit. Grantee shall report findings to Grantor.

Key Recommendation 8: Farm areas

Applicable Sections (Note: only applies to Silmod Easement): Grant Deed – Schedule 4, #16; Resource Plan IV.G

Monitoring Recommendations:

1. Document location of existing farm areas in baseline database using GPS coordinates.
2. Check existing farm areas for change or expansion using multitemporal aerial images. This is to be done every three years when The Nature Conservancy receives remotely sensed data. If change is detected, then ground truth area documenting the site via photos and measure change using a differential GPS unit. Enter site measurements into database to analyze extent of change.
3. Examine remote sensing data for new or unauthorized farm areas. If change is detected follow step 2.
4. In years where remote sensing does not occur, ground assessment should occur on an annual basis.
5. Grantee shall have approved the location or relocation of the Farm and the size and location of any improvements permitted with respect to any proposed sales facility, any storage buildings, and any proposed fencing.

Key Recommendation 9: Educational and Recreational Areas

Applicable Sections: Grant Deed – Schedule 4, #6; Resource Plan IV.A and F (Silmod, Fremont and Blind Easements)

Monitoring Recommendations:

1. Document location of existing educational and recreational areas in baseline database using GPS coordinates.
2. Check existing educational and recreational areas for change or expansion using multitemporal aerial images. This is to be done every three years when The Nature Conservancy receives remotely sensed data. If change is detected, then ground truth area documenting the site via photos and measure change using a

differential GPS unit. Enter site measurements into database to analyze extent of change.

3. Examine remote sensing data for new educational and recreational areas. If change is detected follow step 2.
4. In years where remote sensing does not occur, ground assessment should occur on an annual basis. Recommended to give priority to the following areas below:
    a. Inspect Irvine Mesa area within the Silmod easement for clearing activities for parking and telescope viewing from the Orange County Astronomers Club. Also look for unauthorized trails in this area.
    b. Inspect helicopter landing areas in Black Star Canyon, which is located in the Silmod Easement, and in cleared area adjacent to Lakeview Road (Fremont – Parcel 1).
    c. Staging areas in Silmod easement.
5. Grantor shall post signs prohibiting motorized recreational vehicles in locations where they are most likely to trespass. Other signs pertaining to public areas shall also be posted.

Key Recommendation 10: Mining and Drilling

Applicable Sections: Easement Document Report Section 5.4; Grant Deed – Schedule 4, #8

Monitoring Recommendations:

1. Document location of existing excavation/gravel pits in baseline database using GPS coordinates.
2. Check existing excavation/gravel pits for change or expansion using multitemporal aerial images. This is to be done every three years when The Nature Conservancy receives remotely sensed data. If change is detected, then ground truth area documenting the site via photos and measure change using a differential GPS unit. Enter site measurements into database to analyze extent of change.
3. Examine remote sensing data for new or unauthorized excavation/gravel pits. If change is detected follow step 2.
4. In years where remote sensing does not occur, ground assessment should occur on an annual basis. Priority should be given to areas that have more frequent use, as indicated in the Threat Matrix.
5. Grantor should contact Grantee forty-five (45) days prior to scheduled maintenance activities.

Key Recommendation 11: Surrounding Property Concerns

Applicable Sections (Anaheim Easement only): Easement Document Report Section 2.3 (refers to every easement); Grant Deed – Schedule 4, #15; Resource Plan 3.6

Monitoring Recommendations:

1. Document adjacent properties for change in land use etc. using multitemporal aerial images. This is to be done every three years when The Nature Conservancy receives remotely sensed data. If change is detected, input into

database to analyze change in land use over time and if adjacent uses pose a significant threat to easement lands.

2. In years where remote sensing does not occur, ground assessment should occur on an annual basis. Priority should be given to easement lands, which border development. If change is detected follow step 1.
3. Grantor and Grantee request to be notified from the County of Orange, and the Cities of Orange and Anaheim when and if any work is ever proposed on the adjacent properties.
4. Grantor shall notify Grantee when and if the Grantor requests an easement boundary adjustment for the Anaheim easement.
5. The homeowner's association adjacent to Anaheim Easement Parcel 3 shall notify Grantor and Grantee prior to maintenance of landscaping and slopes in a portion of Parcel 3.

Works Cited

Barret, Livermore (1983). The Conservation Easement in California.. Island Press.

Wolfgang, L., Geography and Center for Remote Sensing Bidirectional Reflectance Distribution Function (BRDF) and Albedo Research Website. BRDF explained. Retrieved March 1, 2004 from Boston University Department of Geography: http://geography.bu.edu/brdf/brdfexpl.html

City of Orange's Website. Santiago Hills II and East Orange Planned Communities. Retrieved March 28, 2004, from www.cityoforange.org..

Coulter, L. & Stow, D. (2003) Regional Change Monitoring of Habitat Reserve Systems with Very High Resolution Remotely Sensed Data. Retrieved September 04, 2003, from NASA Food and Fiber Applications of Remote Sensing .

Digital Globe Website. Sample Imagery: California Fires, Grand Prix Fire. Retrieved January 25, 2004, From http://www.digitalglobe.com/press/imagesinthenews.shtml

Dozier, J. & Frew, J. (1981). Atmospheric Correction to Satellite Radiometric Data over Rugged Terrain. Remote Sensing of the Environment, 11, 191-205.

Fremont Resource Plan and Easement Documentation Report. Irvine Ranch Land Reserve, May, 23,2002

Guenzler, D. (1999). Ensuring the Promise of Conservation Easements. Report on the Use and Management of Conservation Easements by San Francisco Bay Area Organizations. San Francisco Bay, CA: Bay Area Open Space Council.

Gustanski, J. & Squires, R. (2000). Protecting the Land – Conservation Easements Past, Present and Future. Island Press. 2000.

Hamilton, J.E. (2003). Creating a Conservation Easement Baseline Documentation Report. National Public Land Acquisition & Management Partnership Conference. Retrieved December 8, 2003, from http://www.dep.state.fl.us/lands/conference/mateials/Hamilton%20-%20Baseline%20outline.pdf.

Harmsworth Associates & The Nature Conservancy (2002). Easement Documentation for The Irvine Company's Fremont Conservation Easement. Prepared for The Irvine Company. March 2002. Orange County, CA.

Harmsworth Associates & The Nature Conservancy (2002). Easement Documentation for The Irvine Company's SilMod Conservation Easement. Prepared for The Irvine Company. March 2002. Orange County, CA.

Land Trust Alliance (2004). Conservation Easement Stewardship - Practice 14C: Landowner Contact. Retrieved February 26, 2004, from www.ltanet.org.

Land Trust for Santa Barbara County, The (2002). Conservation and Agricultural Easement Stewardship Fund. Santa Barbara, CA.

Levien, L., et al. (1999). A Machine Learning Approach to Change Detection using Multiscale Imagery. Presented at the American Society of Photogrammetry and Remote sensing 1999 Annual Conference. Retrieved September 04, 2004, from California Fire and Resource Assessment Program: http://frap.cdf.ca.gov/projects/change_detection/pdfs/asprs99b.pdf.

Lind, Brenda (1999). The Conservation Easement Stewardship Guide – Designing, Monitoring and Enforcing Easements. Land Trust Alliance and Trust for New Hampshire Lands.

Mas; J-F (1999). Monitoring land-cover changes: A comparison of change detection techniques. International Journal of Remote Sensing, 20(1), 139-152.

Mid-Atlantic Regional Earth Science Applications Center, High Resolution Remote Sensing. Retrieved March 10, 2004 From Department of Geography, University of Maryland web site: http://www.geog.umd.edu/resac/research.htm

PCR Services Corporation & The Nature Conservancy (2002). Easement Documentation Report for The Irvine Company's Anaheim Conservation Easement Property. Prepared for The Irvine Company. December 2002. Orange County, CA.

Reed, F. & Sader, S. (2004). Developing a Stewardship Protocol for the Pingree Forest Conservation Easement: Landscape Scale Monitoring.. Retrieved February 25, 2004, from New England Forestry Foundation: http://www.newenglandforestry.org.

Sader, S., et al. (2000). Pingree Forest Partnership Monitoring Easements at Landscape Level. Journal of Forestry.

Space Imaging Website. Gallery: California Wildfires Devore Heights. Retrieved February 18, 2004 From http://www.spaceimaging.com/gallery/default.htm

Stow, D. (2003). Habitat Monitoring: Applications of Remote Sensing, Change Detection. Retrieved November 2003, from San Diego State University Web site: http://typhoon.sdsu.edu/Research/Projects/NASA_habitat/change_det.htm

Van Horn, M. & Van Horn, K. (1996). Quantitative Photomonitoring for Restoration Projects. Restoration and Management Notes. 14(1), 30-34.

Yuras, G. (2004). Advanced GIS Chapter 5: Digital Image Processing: 5.2 Radiometric Correction. Retrieved March 2, 2004, from PRFC (Regional Program of Physical Oceanography and Climate) Web site: http://www.profc.udec.cl/english/personal.html

Zeller, M. & Conservation Partners, Inc. (1999). Stewardship of the Land: An Investigation into the State of the Land. Menlo Park, CA: The INNW Fund.

Appendix 1

Grant Deed and Schedules 3,4,5
Fremont Easement

This Document was electronically recorded by First American Title

RECORDING REQUESTED BY
FIRST AMERICAN TITLE COMPANY
SUBDIVISION DEPARTMENT

Recorded in Official Records,County of Orange
Darlene Bloom, Interim Clerk-Recorder

112.00
20020500069 08:00am 06/14/02
103 15 E01 54
0.00 0.00 0.00 0.00 106.00 0.00 0.00 0.00

Recording requested by
and when recorded mail to:

The Nature Conservancy
Attn: Legal Department
201 Mission Street, 4th Floor
San Francisco, CA 94105

Space above this line reserved for Recorder's use

Grant Deed of Conservation Easement
(Irvine Ranch Land Reserve -- Fremont)

This Grant Deed of Conservation Easement (this "**Deed**"), dated for reference purposes as of May 23, 2002, is entered into by and between **The Irvine Company**, a Delaware corporation ("**Grantor**"), and **The Nature Conservancy**, a District of Columbia non-profit corporation ("**Grantee**"), on the basis of the following facts and circumstances:

A. Since 1894 Grantor has owned the vast landholdings in Orange County, California, known as the "Irvine Ranch" (the "**Irvine Ranch**"). Grantor has designated substantial portions of the Irvine Ranch for open space and conversation purposes, and Grantor wishes to ensure that significant additional areas of the Irvine Ranch are used in perpetuity for conservation purposes.

B. Grantor owns that portion of the Irvine Ranch more particularly described in **Schedule 1** attached hereto (the "**Property**") and generally depicted on the map attached hereto as **Schedule 2**.

C. The Property possesses significant natural, ecological, scenic, open space, recreational and educational values for conservation purposes (collectively, the "**Conservation Values**"), which are of importance to Grantor and Grantee, to the people of the County of Orange, and to the people of the State of California.

D. More specifically, the natural and ecological Conservation Values which the Property possesses include open space land, habitat, and habitat linkages essential to preserving various natural communities, including coastal sage scrub, chaparral, rock outcrops, native grasslands, oak woodlands, Tecate cypress forest, riparian forests, and aquatic communities. Many sensitive, rare and endangered plant and animal species are dependent on such natural communities, including but not limited to chaparral beargrass, many-stemmed dudleya, Catalina mariposa lily, Hunboldt lily, Tecate cypress, bigcone spruce, heart-leaved pitcher sage, mule deer, mountain lion, bobcat, coyote, Mexican free-tailed bat, California mastiff bat, pallid bat, San Diego mountain kingsnake, speckled rattlesnake, Bell's sage sparrow, California

gnatcatcher, black-chinned sparrow and San Diego fairy shrimp. The protection of the Property will also help support many non-listed species which are dependent on the water sources, nesting habitat and food sources found on the Property; will enhance connectivity between other nearby protected areas, parks, and/or watershed areas for wildlife; and will help ensure that this area and its existing features will continue to be conserved for its natural habitat values.

E. In addition, preservation of the Conservation Values of the Property will produce the significant public benefits of preserving open space against development pressure, providing protection for scenic qualities unique to the area, providing public access and venues for appropriate educational and recreational activities, and providing venues and targets for scientific study.

F. Grantor, as the owner of the Property, owns the right to identify, preserve, protect, and enhance the Conservation Values of the Property.

G. The State of California has recognized the public importance and validity of conservation easements by enactment of Sections 815 *et seq.* of the California Civil Code.

H. Grantee is a non-profit corporation incorporated under the laws of the District of Columbia and a tax-exempt public charity as described in Section 815.3 of the California Civil Code and the Internal Revenue Code of 1986, as amended, ("IRC") Sections 501(c)(3) and 509(a)(1); and a "qualified organization" within the meaning of that term in IRC Section 170(h), qualified to acquire and hold conservation easements.

Now, therefore, in consideration of the foregoing recitals, the respective agreements of the parties hereinafter set forth, and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, and pursuant to Sections 815 *et seq.* of the California Civil Code, the parties hereby agree as follows:

1. **Grant and Acceptance of Easement**. Grantor hereby grants in perpetuity to Grantee, and to the successors and assigns of Grantee, and Grantee hereby accepts, a conservation easement in gross on, over, and across the Property (the "**Easement**"), subject to and in accordance with the terms and conditions of this Deed. It is the intent of Grantor and Grantee, and it is the purpose of the Easement, that the Conservation Values of the Property be preserved and protected in perpetuity (the "**Easement Purposes**").

2. **Easement Documentation Report**. The parties acknowledge that certain natural, ecological and other attributes of the Property particularly relevant to the Easement are further documented in an inventory of such attributes, which is referred to hereinafter as the "**Easement Documentation Report.**" Grantor and Grantee each have a copy of the Easement Documentation Report, executed by both parties to acknowledge their approval and receipt of the Easement Documentation Report. The parties agree that the Easement Documentation Report contains an accurate representation of such natural, ecological and other attributes of the Property at the time that this Deed is recorded, and is intended to serve as an objective, though non-exclusive, information baseline for monitoring compliance with the terms of the Easement. The foregoing notwithstanding, if a dispute arises with respect to the nature and extent of the

physical or biological condition of the Property, the parties shall not be foreclosed from utilizing any and all other relevant documents, surveys, or other evidence or information to assist in the resolution of the dispute.

3. **Rights Conveyed to Grantee**. The affirmative rights conveyed to Grantee by this Deed and pursuant to the Easement are as follows:

(a) The right to identify, preserve and protect in perpetuity the Conservation Values of the Property as follows:

(i) The right to access and enter upon the Property at all reasonable times, using any and all easements and rights of way appurtenant to the Property (if any), in order to (A) inspect the Property, (B) exercise and enforce the rights which are granted to Grantee herein, and (C) determine whether the activities conducted on the Property are in compliance with the terms of this Deed; it being understood that such access and entry will be made in a manner that will not interfere unreasonably with the permitted use(s) or enjoyment of the Property by Grantor, its successors in interest, or any legally recognized occupant(s) or user(s) of the Property;

(ii) Provided Grantee shall give Grantor at least thirty (30) days prior written notice describing in reasonable detail the activity to be undertaken by Grantee under this clause (ii), the right to conduct fish, wildlife, plant, and habitat studies on the Property, as well as the right to conduct research and monitoring on the Property; it being understood and agreed that (A) such studies, research and monitoring will be made in a manner that will not interfere unreasonably with the permitted use(s) or enjoyment of the Property by Grantor, its successors in interest, or any legally recognized occupant(s) or user(s) of the Property and (B) Grantee shall carry out such studies, research and monitoring in a manner which minimizes as much as reasonably possible harm to the Conservation Values of the Property; and

(iii) The right to enjoin any activity on the Property or other use of the Property which is inconsistent with the terms of this Deed, and to enforce the restoration of such areas or features of the Property as may hereafter be damaged by Grantor by any such inconsistent activity or use, all in accordance with the provisions of **Paragraph 7** below.

(b) From and after the date that the Property (or portion thereof as applicable) has been transferred by The Irvine Company, if Grantee reasonably believes at any time that either inadequate provision has been made in the Resource Plan (defined in **Paragraph 6** below) for any specific activity listed on **Schedule 3** attached hereto (a **"Schedule 3 Activity"**) or any Schedule 3 Activity as provided for in the Resource Plan is not being carried out in accordance with the Resource Plan, then Grantee shall have the right to carry out such Schedule 3 Activity on the Property itself subject to the following conditions: (i) Grantee shall first give Grantor notice of the proposed Schedule 3 Activity in the manner provided in **Paragraph 8** below; (ii) Grantee shall carry out such Schedule 3 Activity only if no timely and reasonable objection to such Schedule 3 Activity has been made by Grantor pursuant to **Paragraph 8;** and (iii) Grantee shall carry out such Schedule 3 Activity in a manner which minimizes as much as reasonably possible harm to the Conservation Values of the Property.

For purposes of this subparagraph 3(b), the transfer, whether in one transaction or a series of transactions, of more than fifty percent (50%) of the ownership interests in The Irvine Company ("**Irvine**") shall be deemed a transfer of the Property, except that the transfer of ownership interests to the following shall not be included in such calculation: (A) any parent, subsidiary or affiliate of Irvine, (B) any individual, trust or other entity to which transfers are made for estate planning purposes and for no consideration, or (C) any heir, devisee, assignee or transferee receiving the interests upon death of the owner of such interests. As used above, "parent" shall be any person or entity who or which holds, directly or indirectly, a majority of the outstanding voting rights in or profit and loss interests in Irvine; a "subsidiary" shall be any entity as to which Irvine holds, directly or indirectly, a majority of the outstanding voting rights in or profit and loss interests; and an "affiliate" shall be any subsidiary of any parent of Irvine and any spouse, sibling or first generational lineal descendent of any parent of Irvine.

4. **Permitted Uses of the Property**. Grantor shall be entitled to use the Property for all purposes not inconsistent with the terms of this Deed. The uses of the Property set forth in **Schedule 4** attached hereto are permitted at the Property, subject to the limitations (if any) set forth in such **Schedule 4**.

5. **Prohibited Uses of the Property**. Any activity on or use of the Property which involves or permits the destruction of the Conservation Values of the Property is prohibited. The activities and uses set forth in **Schedule 4** attached hereto (subject to such restrictions as may be set forth in such **Schedule 4**, including any restrictions as to time, manner or area within which the activity is permitted) are deemed not to be destructive of the Conservation Values of the Property. The uses of the Property set forth in **Schedule 5** attached hereto are inconsistent with the terms of this Deed and, therefore, prohibited at the Property except to the extent (if any) permitted pursuant to the terms of **Schedule 5**.

6. **Resource Plan**.

(a) Certain specific uses and practices permitted upon the Property in furtherance of the Easement Purposes are described in that certain Resource Plan for the Property dated concurrent with the date of this Deed (the "**Resource Plan**"), which has been mutually prepared and agreed upon by Grantor and Grantee. The Resource Plan may be updated in writing from time to time by mutual agreement of Grantor and Grantee in furtherance of the Easement Purposes. It is the intent of the parties that the Resource Plan will demonstrate, among other things, how substantial and regular use of the Property by the public is being achieved, or will be achieved within a reasonable time of the execution of this Deed, through recreational and educational uses permitted under the terms of this Deed. To be effective for purposes of this Deed, any update, modification or addition to the Resource Plan (collectively, an "amendment" to the Resource Plan) must be in writing and must be approved or deemed approved by both Grantor and Grantee in accordance with the provisions of **Paragraph 8** below.

(b) The intent of the parties is that, for those uses of the Property addressed by the Resource Plan, the Resource Plan will determine the nature, extent and/or location of the specified uses, and such uses shall only be carried out as provided in the Resource Plan. Apart

from such determinations, which shall be consistent with the Easement Purposes, the right and obligation to manage and operate the Property shall continue to rest entirely with Grantor, except to the extent of Grantee's explicit rights set forth in this Deed. Nothing in this Deed is intended or shall be deemed to require Grantor to undertake any use or activity addressed or permitted under the Resource Plan, provided that Grantor shall undertake sufficient recreational and educational uses on the Property, as provided in the Resource Plan, to achieve substantial and regular use of the Property by the general public.

(c) If at any time the Property is divided and portions of the Property are held by different fee owners, then the Resource Plan as it exists at the time of such division of the Property shall automatically become the Resource Plan for each of the separated portions of the Property, to the extent applicable thereto, and shall thereafter be subject to amendment from time to time as to each portion of the Property by mutual agreement of Grantee and the then-fee owner of only such affected portion of the Property in furtherance of the Easement Purposes, as provided in this **Paragraph 6** above and in **Paragraph 8** below.

7. **Remedies for Violation**.

(a) The following provisions shall be applicable to Grantee's enforcement of the Easement:

(i) Notice of Violation. If Grantee becomes aware that a violation of the terms of this Deed by Grantor (a "**Violation**") has occurred or is threatened to occur, Grantee may give written notice to Grantor of the Violation (a "**Violation Notice**").

(ii) Corrective Action. Upon receipt of a Violation Notice, Grantor shall promptly commence, and thereafter diligently pursue to completion, corrective action sufficient to cure the Violation and, where the Violation involves injury to the Property resulting from any use or activity by or through Grantor in violation of the terms of this Deed, to restore the portion of the Property so injured. Grantor shall be in default under this Deed (a "**Grantor Default**") if Grantor fails to so cure the Violation within ninety (90) days after the Violation Notice is received; provided that, if more than ninety (90) days is reasonably required for the corrective action, then, if Grantor promptly begins the corrective action within such ninety (90) day period, no Grantor Default shall exist for so long thereafter as Grantor is diligently pursuing such cure to completion.

(iii) Remedies. Grantee shall have all remedies available at law or in equity to enforce the terms of this Deed. Without limiting the generality of the forgoing sentence, in the event of a Grantor Default, Grantee shall have the right to: (A) seek a temporary or permanent injunction with respect to any activity causing a Violation; (B) force the restoration of that portion of the Property affected by the Violation to a condition similar or equivalent to the condition that existed prior to the Violation, by restoring soils, replanting suitable native vegetation, or taking such other action as Grantee reasonably deems necessary to achieve such restoration; and (C) recover any additional damages arising from the Violation. The foregoing remedies shall be cumulative and shall be in addition to all other remedies existing at law or in equity with respect to a Violation.

(iv) Emergency Enforcement. The foregoing provisions notwithstanding, if Grantee reasonably determines that a Violation has occurred and circumstances require immediate action to prevent, terminate, or mitigate significant damage to or the destruction of any of the Conservation Values, or to prevent, terminate, or mitigate a significant violation of a material term of this Deed, Grantee may give a Violation Notice to Grantor (which may, however, be given orally in such cases, and then followed by written notice, if the emergency circumstances warrant doing so) and, following receipt by Grantor of such Violation Notice, Grantee may then pursue its remedies under this Deed without waiting for the period to cure the Violation which is provided for above.

(b) Costs of Enforcement. In any action, suit or other proceeding undertaken to enforce any right or obligation under this Deed, or to interpret any of the provisions of this Deed, the prevailing party shall be entitled to recover from the non-prevailing party the costs and expenses of such proceeding, including (but not limited to) the court costs and attorneys' fees and expenses incurred by the prevailing party (whether incurred at the trial, appellate, or administrative level), in such amount as the court or administrative body may judge reasonable, all of which may be incorporated into and be a part of any judgment or decision rendered in such action, suit or other proceeding.

(c) No Waiver. Enforcement of the terms and provisions of this Deed shall be at the discretion of each party hereto, and the failure of a party to discover a violation or breach of the terms of this Deed or to take action under this Deed with respect to a given violation or breach shall not be deemed or construed to be a waiver of the rights of such party under this Deed in the event of any subsequent occurrence of that or any other violation or breach.

(d) Waiver of Jury Trial. Grantor and Grantee each acknowledges that it has had the advice of counsel of its choice with respect to rights to trial by jury under the constitutions of the United States and the State of California. Each party expressly and knowingly waives and releases all such rights to trial by jury in any action, proceeding or counterclaim brought by either party against the other on any matters arising out of or in any way connected with this Deed, the Easement and/or the Property.

(e) Mediation. Except in cases where injunctive relief is being sought, or where emergency action is authorized under the terms of this Deed, if a dispute arises from or relates to the terms and provisions of this Deed, the Easement or any other matter referred to herein, which cannot be settled by direct discussions or negotiation, Grantee and Grantor agree first to try in good faith to settle the dispute by non-binding mediation administered by the American Arbitration Association under its Commercial Mediation Rules, or by such other organization or individual and under such rules as the parties may agree, before resorting to litigation or some other dispute resolution procedure.

8. **Approval Process**. Whenever the agreement or consent of either Grantor or Grantee to a proposed action or activity (a "**Proposed Activity**") is required pursuant to this Deed, including without limitation an amendment to the Resource Plan, the party seeking the approval (the "**Requesting Party**") shall give the other party (the "**Notified Party**") a written notice requesting approval and informing the Notified Party in reasonable detail of all material

aspects of the Proposed Activity (collectively, a "**Request Notice**"), and the following provisions shall then be applicable:

(a) The Notified Party shall have sixty (60) days after receipt of the Request Notice (the "**Sixty Day Period**") to respond in writing to the Requesting Party and in such writing either disapprove the Proposed Activity giving specific reasons for its disapproval or approve the Proposed Activity. The Notified Party may not unreasonably withhold its approval to the Proposed Activity.

(b) If at any time during the Sixty Day Period the Notified Party reasonably requests in writing to the Requesting Party additional specified information regarding the Proposed Activity, the Requesting Party shall promptly provide such information to the Notified Party.

(c) If the Notified Party reasonably requires more than sixty (60) days to respond to the Request Notice, the Notified Party may so notify the Requesting Party in writing during the Sixty Day Period. Such notice must specify the Notified Party's reasons for desiring the extension and must set forth the date by which the Notified Party will respond, which date may in no event exceed one hundred twenty (120) days after the original date of receipt of the Request Notice. If the extension is requested within the time period and in the manner required above, the response period within which the Notified Party must respond as set forth in subparagraph 8(a) above shall be extended to that date so requested by the Notified Party.

(d) Any disapproval of a Proposed Activity must be based upon the Notified Party's reasonable opinion that the Proposed Activity is inconsistent with the terms of this Deed. Any disapproval of an amendment to the Resource Plan may also be based upon the Notified Party's reasonable objection to the Proposed Activity based on furtherance of the Easement Purposes. Any notice of disapproval of the Proposed Activity must specify (i) the manner in which the Notified Party so believes that the Proposed Activity is inconsistent with the terms of this Deed or, with respect to an amendment to the Resource Plan, is objectionable based on furtherance of the Easement Purposes and (ii) where reasonably practical, the Notified Party's suggestions as to how the Proposed Activity could be modified to be approved by the Notified Party.

(e) If the Notified Party provides the Requesting Party with a notice of disapproval within the time period and in the manner required above, the Requesting Party shall not, and shall not have the right to, commence or conduct the Proposed Activity. If the Notified Party fails to provide the Requesting Party with a notice of disapproval within the time period and in the manner required above, the Notified Party shall be deemed to have agreed upon or consented to (as applicable) the Proposed Activity and shall have no further right to object to the Proposed Activity as described in the Request Notice (as supplemented, if applicable).

(f) The Requesting Party shall have the right to commence or conduct the Proposed Activity only upon actual agreement or consent, or deemed agreement or consent as provided above, of the Notified Party. No actual or deemed agreement or consent to, or failure to object to, any Proposed Activity shall constitute agreement or consent to any material aspect

of the Proposed Activity which was not disclosed in the Request Notice (including any supplemental information, as noted above), or to any subsequent action or activity of the same or any different nature, nor shall it alter any of the terms of this Deed.

(g) With respect to any portion of the Property, if there is at any time more than one entity or person holding undivided interests (or otherwise less than 100%) of the fee title to that portion of the Property, then it shall be the responsibility of such multiple entities and/or persons to come to an agreement among themselves as to the giving of, or response to, a Request Notice under this Deed concerning that portion of the Property. Grantee shall be entitled to rely on a Request Notice, or response thereto, given by any one of such entities or persons holding the largest (or equally largest) interest in that portion of the Property, unless Grantee shall have received written notice hereunder executed by such entities and/or persons holding at least fifty one percent (51%) of the interests in that portion of the Property, appointing one such owner as their agent for purposes of giving and responding to notices under this Deed, in which event such appointed owner shall be the "Grantor" hereunder for such purposes and Grantee shall not rely on the notice or response of any other. The entities and/or persons holding at least fifty one percent (51%) of the interests in that portion of the Property shall be entitled to change their appointed agent by notice to Grantee at any time, in the manner specified above, whereupon the newly appointed owner shall thenceforth have such role on behalf of Grantor.

9. **Notices**. Except as otherwise provided in this Deed, any notice, demand, request, consent, or approval of any kind that is required under the terms of this Deed (in each case, a "**Notice**") shall be subject to the following provisions:

(a) Each Notice shall be in writing and shall be served upon the party being addressed at the most recent address(es) which the addressed party has provided for such purposes under this Deed, by any of the following means: (i) by delivery in person; (ii) by certified U.S. mail, return receipt requested, postage prepaid; or (iii) by Federal Express or other reputable "overnight" delivery service, provided that next-business-day delivery is requested by the sender.

(b) If delivered in person, a Notice will be deemed received immediately upon delivery (or refusal of delivery or receipt). If sent by certified mail, a Notice will be deemed received on the date of actual delivery (or refusal of delivery or receipt). If sent by Federal Express or other reputable "overnight" delivery service, a Notice will be deemed received on the date of actual delivery.

(c) By written Notice to all other parties in the aforesaid manner, any party may from time to time designate a replacement for any address specified below for such party, and the replacement address shall then be substituted for the one previously in effect, provided that in no case shall any party subject to the terms of this Deed have a total number of addresses for Notices to such party in excess of two.

(d) The parties initially designate the following addresses to be used for Notices sent to them:

If to Grantor:	and to:
The Irvine Company Attn: TNC Conservation Easement Coordinator 550 Newport Center Drive Newport Beach, CA 92660	The Irvine Company Attn: General Counsel 550 Newport Center Drive Newport Beach, CA 92660
If to Grantee:	and to:
The Nature Conservancy Attn: Irvine Ranch Land Reserve Project Director 1400 Quail Street, Suite 130 Newport Beach, CA 92660	The Nature Conservancy Attn: Legal Department 201 Mission Street, 4th Floor San Francisco, CA 94105

10. **Responsibility for Operations**. Grantor shall have and retain all responsibility for, and shall bear all costs and liabilities of, the ownership of the Property, and compliance with any statutes, laws, ordinances, rules, regulations, codes, orders, guidelines, or other restrictions, or requirements applicable to the Property which have been enacted or otherwise promulgated by any federal, state, county, municipal, or other governmental or quasi-governmental agency, board, bureau, commission, court, department, panel, or other official body (whether legislative, administrative, or judicial), or by any competent official of any of the foregoing (in each case, an "**Applicable Law**"), except as expressly stated otherwise in this Deed. Without placing any limitation on the foregoing sentence, the parties agree as follows:

(a) Grantee shall have no duty or responsibility for (i) the operation or maintenance of the Property except to the extent specifically undertaken by Grantee as permitted under this Deed, (ii) the monitoring of any hazardous conditions thereon, or (iii) the protection of Grantor, the public, or any other person or entity from any risks relating to conditions on the Property, except to the extent that the risks involved are the result of the activities of Grantee on the Property. Nothing in the foregoing, however, is intended or shall be deemed in any way to override the provisions of subparagraph 11(b) below, and to that end, Grantee assumes all risk of entry on the Property by Grantee or any of Grantee's Parties (defined below).

(b) Grantor shall be solely responsible for any and all real property taxes and assessments levied by competent authority on the Property.

(c) The terms of this Deed are not intended and shall not be deemed to require or obligate Grantor, or impose on Grantor the responsibility, to prevent or stop the following, or restore, correct or otherwise remediate any injury or damage caused by the following: (i) third parties (excluding third parties who are agents or contractors acting for or under control of Grantor and within the scope of their engagement with Grantor) using the Property in a manner prohibited by the terms of this Deed, (ii) events beyond Grantor's control including, without limitation, government action, fire, flood, storm and naturally occurring earth movement, or (iii)

injury to or change in the Property resulting from prudent action taken by Grantor to prevent, abate or mitigate significant injury to the Property resulting from or anticipated to result from such third party prohibited uses or events beyond Grantor's control. Notwithstanding anything to the contrary in the foregoing sentence, if Grantee discovers any unauthorized use or activity on the Property that is destructive of the Conservation Values of the Property, and Grantee gives Grantor written notice thereof, Grantor shall use reasonable best efforts to stop or prevent any such use of the Property; provided that in no event shall the foregoing require Grantor to pursue litigation, undertake policing activities on the Property, or engage in any activity which would be detrimental to the Conservation Values of the Property.

(d) Grantor shall be responsible for maintaining real and personal property insurance related to the Property, except that Grantee shall be responsible for maintaining any property insurance it desires on its own personal property which may be located (if permitted hereunder) from time to time at the Property. Grantor shall also be responsible for maintaining liability insurance with respect to its ownership and operation of the Property. Notwithstanding anything to the contrary in the foregoing, (i) Grantee shall be responsible for maintaining insurance with respect to any and all of Grantee's activities on or relating to the Property, as well as with respect to its obligations and liabilities under this Deed, including without limitation its liabilities under subparagraph 11(b) below, and (ii) prior to any entry on the Property by Grantee or anyone acting for or under authority of Grantee, Grantee shall obtain insurance with the coverages, in the amounts, in the forms and otherwise all as reasonably required under Grantor's then current standard form entry permit. Grantee shall deliver to Grantor evidence of such insurance within fifteen (15) days of Grantor's reasonable request from time to time.

(e) Grantor shall be solely responsible for obtaining any and all applicable governmental permits and approvals for, and otherwise complying with all Applicable Laws relating to, any activity or use of the Property by Grantor which is permitted by this Deed. Grantee shall be solely responsible for obtaining any and all applicable governmental permits and approvals for, and otherwise complying with all Applicable Laws relating to, any activity or use of the Property by Grantee which is permitted by this Deed.

(f) Grantor shall keep Grantee's interest in the Easement free of any liens caused by Grantor or anyone acting for or under the authority of Grantor, including those arising out of any work performed for, materials furnished to, or obligations incurred by Grantor. Likewise, Grantee shall keep Grantor's interest in the Property free of any liens caused by Grantee or anyone acting for or under the authority of Grantee, including those arising out of any work performed for, materials furnished to, or obligations incurred by Grantee.

(g) Except to the extent (if any) due to the acts or omissions of Grantee, or any of Grantee's Parties, Grantee shall have no responsibility whatsoever with respect to any of the following which may be located at the Property at any time: wastes, materials, chemicals, or other substances (whether in the form of liquids, solids, or gases, and whether or not airborne) which are ignitable, reactive, corrosive, toxic, or radioactive, or which are deemed to be pollutants, contaminants, or hazardous or toxic substances under or pursuant to any Applicable Law, or which are to any extent regulated by, form the basis of liability under, or are otherwise under the authority of any Applicable Law (in each case, a "**Hazardous Material**"), including

(but not limited to) petroleum-based products and any material containing or producing any polychlorinated biphenyl, dioxin, or asbestos, as well as any biocide, herbicide, insecticide, or other agrichemical.

(h) Nothing in this Deed shall be construed to create in or give to Grantee: (i) the obligations or liabilities of an "owner" or "operator" as those words are defined and used in the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (42 US Code Sections 9601 *et seq.*) or any other Applicable Law concerning Hazardous Materials (in each case, a "**Hazardous Materials Law**"), including (but not limited to) the Hazardous Materials Transportation Act (49 US Code Sections 6901 *et seq.*); the Hazardous Waste Control Law (California Health & Safety Code Sections 25100 *et seq.*); the Hazardous Substance Account Act (California Health & Safety Code Sections 25300 *et seq.*); and any rule, regulation, or other promulgation adopted under any of the foregoing; (ii) the obligations or liabilities of a person described in 42 USC §9607(a)(3); (iii) the obligations of a responsible person under any applicable Hazardous Materials Law; (iv) any obligation, right or permission to investigate, remove, remediate, abate, or otherwise clean up any Hazardous Materials located at or associated with the Property; or (v) control over Grantor's ability to investigate, remove, remediate, abate, or otherwise clean up any Hazardous Materials located at or associated with the Property in compliance with any Hazardous Materials Law.

11. **Indemnification**.

(a) Indemnification by Grantor. Grantor hereby agrees to indemnify, hold harmless and defend Grantee, each of the officers, directors, employees, agents, invitees, and contractors of Grantee, and each of the heirs, successors, and assigns of such parties (collectively, "**Grantee's Parties**"), from and against any and all of the following: claims, costs, liabilities, penalties, damages, or expenses of any kind or nature whatsoever, to any person or property, and whether based on negligence, strict liability or other claim (including, but not limited to, court costs and reasonable attorneys' fees and expenses, whether incurred at the trial, appellate, or administrative level, or in connection with any required arbitration) (collectively, "**Claims**") which any of Grantee's Parties may suffer or incur, or to which any of Grantee's Parties may be subjected, to the extent such Claims are the result of or arise out of (i) any breach or violation of the terms of this Deed or the Easement by Grantor, or by anyone acting for or under the authority of Grantor, (ii) any other activity of Grantor or any of Grantor's Parties (defined below) on, at, or with respect to the Property, or (iii) the gross negligence or willful misconduct of Grantor or any of Grantor's Parties on, at or with respect to the Property.

(b) Indemnification by Grantee. Grantee agrees to indemnify, hold harmless and defend Grantor, each of Grantor's divisions, subsidiaries and affiliated entities, and each of their shareholders, officers, directors, trustees, employees, agents, invitees, and contractors, and each of the heirs, successors, and assigns of such parties (collectively, "**Grantor's Parties**"), from and against any and all Claims, which any of Grantor's Parties may suffer or incur, or to which any of Grantor's Parties may be subjected, to the extent such Claims are the result of or arise out of (i) any breach or violation of the terms of this Deed or the Easement by Grantee, or by anyone acting for or under the authority of Grantee, (ii) any entry, act, omission, or other activity upon the Property or in accessing the Property by Grantee or any of Grantee's Parties, or (iii) the gross

negligence or willful misconduct of Grantee or any of Grantee's Parties on, at or with respect to the Property.

(c) General. The term "Grantor's Parties" as used in subparagraph 11(a) above does not include, and shall not be interpreted to include, Grantee or any of Grantee's Parties, notwithstanding (i) that Grantee may be deemed to be Grantor's invitee to the Property or (ii) anything else to the contrary in this Deed. The foregoing indemnities and obligations to hold harmless and defend are intended to apply with respect to all Claims incurred directly by the indemnified party or parties, or their property, as well as by third parties or the indemnifying party. The foregoing obligation to defend Grantee and Grantee's Parties shall mean the obligation to defend with counsel reasonably approved in writing by Grantee. Likewise, the foregoing obligation to defend Grantor and Grantor's Parties shall mean the obligation to defend with counsel reasonably approved in writing by Grantor. Neither payment nor a finding of liability or of an obligation to defend shall be a condition precedent to the enforcement of any indemnity or duty to defend provision herein.

12. **Subsequent Liens on Property**. No provision of this Deed is to be construed as impairing the ability of Grantor to use the Property as collateral for any loan, provided that any lien created thereby shall be subordinate to the terms of this Deed and the Easement.

13. **Effect of Easement**. The parties acknowledge that the Easement is an easement in gross, and that, pursuant to the terms of Sections 815 *et seq.* of the California Civil Code: (a) the Property is declared to be open and natural land, and may not be converted or directed to any uses other than as permitted under this Deed and the Easement; (b) the Easement shall run with and burden the title to the Property in perpetuity, and shall bind all persons having or acquiring any right, title or interest in the Property (during their ownership of such interest), for the benefit of Grantee and the successors and permitted assigns of Grantee; and (c) the Easement shall confine the use of the Property to such activities as are not inconsistent with the terms of this Deed.

14. **Subsequent Transfers by Grantor**. Grantor shall notify Grantee, in advance of the transfer, of any deed, lease or other legal instrument by which Grantor hereafter conveys or otherwise transfers fee simple title to the Property, or any leasehold, possessory or other interest in the Property. Grantor shall use its best efforts to provide a true and complete copy of this Deed, as recorded, to each transferee of any interest in the Property. No failure by Grantor to give such notice or provide such copies shall, however, affect to any extent the enforceability of the Easement or any of the terms of this Deed.

15. **Additional Instruments**. Grantee is authorized to record or file from time to time any and all notices or instruments which may be appropriate to ensuring the perpetual enforceability of this Deed and the Easement, including (but not limited to) re-recording this Deed, or a copy thereof, for such purpose, and Grantor agrees to execute, acknowledge, and/or deliver (as applicable) any and all such notices or instruments upon reasonable request from Grantee to do so.

16. **Interpretation**. It is the intent of this Deed and the Easement to further the Easement Purposes, and Grantor and Grantee therefore acknowledge and agree as follows concerning the interpretation of this Deed and the terms of the Easement:

(a) The provisions of this Deed shall be construed liberally, in order to effectuate the Easement Purposes, while allowing Grantor to use and enjoy the Property to the extent that such use and enjoyment is not inconsistent with the terms of this Deed (including the activities expressly permitted in **Schedule 4** to this Deed). Liberal construction is expressly required for purposes of effectuating the Easement in perpetuity, notwithstanding economic or other hardship or any change in circumstances of any kind. If any provision in this Deed is found to be ambiguous, an interpretation consistent with the Easement Purposes that would render the provision valid shall be favored over any interpretation that would render it invalid.

(b) If any provision of this Deed, or the application thereof to any person(s) or circumstance(s), shall to any extent be held to be invalid, illegal, or unenforceable in any respect by any court of competent jurisdiction: (i) neither the remainder of this Deed, nor the application of such provision to any person(s) or circumstance(s), other than those as to whom or which it is held to be invalid or unenforceable, shall be affected thereby; (ii) this Deed shall be construed as though such invalid, illegal or unenforceable provision had never been contained in this Deed; and (iii) every provision of this Deed shall be valid and enforceable to the fullest extent permitted by the Applicable Laws. If any provision is so stricken from this Deed, the parties agree to negotiate in good faith any modifications that may be required to effectuate the intent of this Deed and the Easement.

(c) The parties acknowledge that each party and its counsel have reviewed, revised (where it was deemed appropriate), and approved this Deed, and that no rule of construction that ambiguities are to be resolved against the drafting party shall be employed in the interpretation of this Deed.

(d) In the event of any conflict between the provisions of this Deed and the provisions of any use or zoning restrictions of the State of California, the County of Orange, or any other governmental entity with jurisdiction over the Property, the most restrictive provision shall apply.

(e) The terms of this Deed are intended by the parties hereto as a final expression of their agreement with respect to the subject matter hereof, and may not be contradicted by evidence of any prior or contemporaneous agreement. The parties further intend that this Deed constitute the complete and exclusive statement of its terms, and that no extrinsic evidence of any kind which contradicts the terms of this Deed may be introduced in any proceedings (judicial or otherwise) involving this Deed, except for evidence of a subsequent written amendment to this Deed. This Deed may not be modified, amended or otherwise changed in any manner, except by a written amendment executed by all of the parties hereto, or their successors in interest.

(f) In this Deed, personal pronouns shall be construed as though of the gender and number required by the context, the singular including the plural, the plural including the singular, and each gender including other genders, all as may be required by the context. Wherever in this Deed the term "and/or" is used, it shall mean: "one or the other, both, any one or more, or all" of the things, events, persons or parties in connection with which the term is used. Wherever in this Deed the term "including," "such as" or "for example" is used, or a term with similar definition is used, it shall include "without limitation" whether or not such term is also stated, it being the intent that such terms are not intended to be limiting. The headings of the various paragraphs of this Deed are intended solely for reference purposes, and are not intended for any purpose whatsoever to modify, explain, or place any construction on any of the provisions of this Deed. This Deed shall be governed by, construed in accordance with, and interpreted under, the internal law of the State of California.

(g) Any and all recitals in this Deed are agreed by the parties to be accurate and shall constitute an integral part of this Deed, and this Deed shall be construed in light of those recitals. Any and all exhibits, schedules, and addenda attached to and referred to in this Deed are hereby incorporated into this Deed as fully as if set out in their entirety herein.

(h) No remedy or election given by any provision in this Deed shall be deemed exclusive unless so indicated, and each such remedy or election shall, wherever possible, be cumulative with all other remedies at law or in equity. Grantor and Grantee hereby waive with respect to this Deed and the Easement any defense of laches, estoppel, prescription, or changed circumstances. Without placing any limitation on the foregoing provisions, Grantor and Grantee agree that no statute of limitations shall start to run and no estoppel or similar defense shall arise against any action brought to enforce or interpret this Easement, unless and until the party against whom such defense shall be used is actually or reasonably should have been aware of a violation or is aware of a dispute regarding the interpretation of the provisions of the Easement, and Grantor and Grantee hereby waive any right to assert any defense contrary to the provisions of this subparagraph.

(i) The terms "Grantor" and "Grantee," wherever used in this Deed, and any pronouns used in place thereof, shall mean and include, respectively: (i) the named Grantor and the personal representatives and assigns of such named Grantor as the owner of the relevant portion of the Property, and all other successors of such Grantor, as their interests may appear; and (ii) the named Grantee and the personal representatives and assigns of such named Grantee as the holder of the Easement with respect to the relevant portion of the Property, and all other successors of such Grantee, as their interests may appear.

(j) Each of the persons or entities making up Grantor or Grantee shall be jointly and severally liable for the obligations of such party under this Deed and with respect to the Easement.

(k) The parties may execute this Deed in two or more counterparts, all of the signature and acknowledgment pages of which shall then be combined with one of the executed counterparts by the party who will be recording the document, and the combined document shall then be recorded as the one original.

(l) If circumstances arise under which an amendment to this Deed and the Easement would be appropriate, Grantor and Grantee may jointly amend this Deed and the Easement; provided that no amendment shall be allowed that will affect the qualification of the Easement or the status of Grantee under any Applicable Law, including Sections 815 *et. seq.* of the California Civil Code, or IRC Section 170(h), and any amendment shall be consistent with the Easement Purposes. Any such amendment shall be in writing, shall refer to this Easement by reference to its recordation data, and shall be recorded in the Official Records of Orange County, California.

(m) No person or entity other than Grantor and Grantee, and their respective successors and assigns, shall be deemed to be a beneficiary hereof, and nothing in this Deed, either express or implied, is intended to confer upon any person or entity, other than Grantor and Grantee and their respective successors and assigns, any rights, remedies, obligations or liabilities under or by reason of this Deed.

17. **Estoppel Certificates**. Upon request by Grantor from time to time, which shall not be made more often than twice per calendar year, Grantee shall, in each case no later than thirty (30) days after receipt of Grantor's request therefor, execute and deliver to Grantor an estoppel certificate or similar document which: (i) certifies that, to the best knowledge of Grantee at the time of the execution of such certificate, Grantor is in compliance with the obligations of Grantor contained in this Deed, and (ii) otherwise evidences the status of the Easement, as reasonably requested by Grantor.

18. **Valuation**. Grantor and Grantee agree that the Easement gives rise to a property right, immediately vested in Grantee upon recordation of this Deed. For purposes of this Deed, the parties stipulate that the fair market value of such property right (i.e. of the Easement) shall be calculated as follows:

(a) The fair market value of the Easement on the date of recordation of this Deed (the "**Original Easement Value**") is equal to: (1) the fair market value of the Property, unencumbered by the Easement (the "**Original Property Value**"), less (2) the fair market value of the Property as encumbered by the Easement. The values at the time of this grant are those values used to calculate the deduction for federal income tax purposes allowable by reason of this grant, pursuant to IRC Section 170(h) and applicable Treasury regulations.

(b) The fair market value of the Easement on any future date shall be determined by: (1) taking the fair market value of the Property on that future date, as if it were not encumbered by the Easement; (2) deducting from that amount any increase over the Original Property Value which is attributable to improvements to the Property made by Grantor after the date of recordation of this Deed, and then (3) multiplying the result by a fraction: (i) the numerator of which is the Original Easement Value, and (ii) the denominator of which is the Original Property Value. For purposes of this Deed, such fraction shall remain constant.

19. **Condemnation**. If all or part of the Property is taken by the exercise of the power of eminent domain by public, corporate, or other authority so as to abrogate the restrictions imposed by this Deed, Grantor and Grantee shall cooperate in appropriate action(s) at

the time of such taking to recover the full value of the taking and all incidental or direct damages resulting from the taking, it being expressly agreed that the Easement constitutes a compensable property right, and the proceeds shall be divided consistent with the provisions of this Deed, based on the respective values of the interests of Grantor and Grantee, calculated in accordance with the valuation provisions set out above in **Paragraph 18**. Each party shall be responsible for its own expenses incurred in connection with such actions.

20. **Assignment**. Grantee shall have the right to transfer or assign in whole, but not in part, all of its rights under the Easement to any governmental or non-governmental entity which is qualified under the IRC and applicable California law to hold conservation easements and which agrees to enforce the terms of this Deed and which is a "qualified organization", within the meaning of IRC Section 170(h)(3), organized or operated primarily or substantially for one or more of the conservation purposes specified in IRC Section 170(h)(4)(A), provided that Grantee first obtains Grantor's consent to such assignment and such assignee, in accordance with the provisions of **Paragraph 8** above.

21. **Judicial Extinguishment**. The Easement may not be extinguished, unless a later unexpected change in the conditions surrounding the Property makes impossible or impractical its continued use for any of the Easement Purposes, and in any such event extinguishment may only be accomplished by appropriate judicial proceedings. No such extinguishment shall affect, however, the value of Grantee's interest in the Property, and if the Property, or any interest therein, is sold, exchanged, or taken by the power of eminent domain after such extinguishment, Grantee will be entitled to receive its pro-rata share (calculated in accordance with the valuation provisions set out above in **Paragraph 18**) of the proceeds of such sale, exchange, or taking, but shall apply such proceeds in a manner consistent with the Easement Purposes, or for the protection of a "relatively natural habitat of fish, wildlife, or plants or similar ecosystems," within the meaning of IRC Section 170(h)(4)(A)(ii).

22. **Access Across Adjoining Property**. Reasonable access to a portion of the Property currently does not exist from a public road, but is instead available across an adjoining part of the Irvine Ranch still owned by Grantor. Grantor agrees that, until and unless reasonable access to such portion of the Property directly from a public road is created, (a) reasonable access to such portion of the Property for Grantee shall be provided by Grantor, and (b) prior to conveying title to property with the result of cutting off Grantee's access to such portion of the Property, Grantor will ensure reasonable access to such portion of the Property for Grantee through one or more appropriate recorded easement(s) or other document(s) providing access rights running with the land.

In witness whereof, Grantor and Grantee have executed this Deed, effective as of the date first above written.

Grantor:

The Irvine Company,
a Delaware corporation

By: _____

Monica Florian
Group Senior Vice President

By: _____

Daniel C. Hedigan
Senior Vice President
General Counsel

Grantee:

The Nature Conservancy,
a District of Columbia non-profit corporation

By: _____

Graham Chisolm
Vice President

By: _____

Kevin Jewell
Assistant Secretary

State of _____)
) ss.
County of _____)

On _____ before me, _____,

a Notary Public, personally appeared _____,
personally known to me or proved to me, on the basis of satisfactory evidence, to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

WITNESS my hand and official seal.

_____
Notary Public

State of California

County of Orange

On _____ before me, _____,
a Notary Public, personally appeared MONICA FLORIAN and DANIEL C. HEDIGAN,
personally known to me or proved to me, on the basis of satisfactory evidence, to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

WITNESS my hand and official seal.

_____
Notary Public

Schedule 3

Schedule 3

Specific Rights of Grantee

Subject to and only in accordance with the terms of subparagraph 3(b) of the main body of this Deed, Grantee shall have the following rights with respect to the Property:

(a) Grantee shall have the right to plant, maintain, and/or remove native vegetation on the Property.

(b) Grantee shall have the right to control or eradicate feral and non-native animals.

(c) Grantee shall have the right to erect, maintain, and/or remove fencing on or around the Property for conservation purposes, including (but not limited to) the right to erect fencing around or along the banks of creeks, rivers, ponds, and other bodies of water on the Property.

(d) Grantee shall have the right to control or eliminate noxious weeds and non-native plant species from the Property, except that notwithstanding anything to the contrary in subparagraph 3(b) of the main body of this Deed, any use of controlled burning, pesticides, herbicides or other biocides shall be done only if and to the extent permitted in the Resource Plan.

Schedule 4

Schedule 4

Permitted Uses

The following are set forth both to list specific uses at the Property which are not inconsistent with the terms of this Deed and, therefore, are permitted under this Deed (subject to such restrictions as may be set forth in this **Schedule 4** with respect to a given use, including any restrictions as to time, manner or area within which the use is permitted), and to provide guidance in determining whether other activities are not inconsistent with the terms of this Deed.

1. Fences. Grantor shall be entitled to maintain, repair and (where necessary) replace all existing fences on the Property. Grantor shall maintain, repair and (where necessary) replace all existing perimeter fences. New fences may be erected by Grantor at the perimeter of the Property and otherwise only as provided in the Resource Plan. All new fences erected by Grantor shall also be maintained, repaired and (where necessary) replaced by Grantor.

2. Existing Structures and Improvements. Grantor shall be entitled to maintain, repair, replace and use all existing structures and improvements on the Property; provided that no such structure or improvement shall be materially expanded in size, nor shall the use of such structure or improvement be materially changed, except as provided in the Resource Plan.

3. Additional Facilities and Activities. Grantor shall be entitled to construct, develop, improve, undertake, maintain, repair, replace and use on, under and/or across the Property utility facilities and lines, water drainage and treatment facilities, water tanks, access roads, slope stabilization and other grading activities, and any other improvements and activities (collectively, "**Infrastructure Facilities**"), as needed or desired to support development of other portions of the Irvine Ranch, subject to the following provisions:

(a) Grantor shall use its reasonable best efforts to ensure that such Infrastructure Facilities are undertaken in such a manner as will minimize as much as reasonably possible the impact on the Conservation Values of the Property.

(b) The Infrastructure Facilities permitted under this Paragraph, and their installation, use, maintenance, repair and replacement, shall not affect, in the aggregate, more than **78 acres** of the total original area of the Property plus any additional area used for one electrical transmission facility as permitted in subparagraph 3(h) below (collectively, the "**Allowable Facilities Area**"). It is intended and understood that such single electrical transmission facility shall be in addition to and not subject to said stated acreage cap.

(c) Notwithstanding any other provision of this Deed to the contrary, either before or after the time that any Infrastructure Facilities permitted under this Paragraph are commenced or completed, Grantor shall have the right to transfer to any appropriate agency, entity or individual fee title, easement, license and/or other possessory interest to the Allowable Facilities Area related to such Infrastructure Facilities, in the form or manner required by the recipient (including without limitation with title acceptable to the recipient), and without

compensation to Grantor or Grantee and without requiring the recipient to resort to its powers of eminent domain (if any) or other similar legal process in such endeavor. Grantee shall cooperate with Grantor, as reasonably requested and at no out-of-pocket cost to Grantee, to ensure Grantor may exercise said right to transfer the Allowable Facilities Area. To that end, if requested, Grantee shall execute and record an amendment to this Deed releasing the Allowable Facilities Area from this Deed, provided that Grantee shall be entitled to require that any such release from this Deed explicitly confirm the provisions of subparagraph 3(f) below with respect to the released Allowable Facilities Area. In transferring title to the Allowable Facilities Area as permitted in this Paragraph 3, subject to acceptance by the recipient, Grantor shall use its reasonable best efforts to restrict use of the Allowable Facilities Area to the applicable Infrastructure Facilities in a recorded document encumbering the Allowable Facilities Area.

(d) Prior to submitting an application for a permit for the Infrastructure Facilities (or if no permit whatsoever is required for the Infrastructure Facilities, then prior to commencement of construction of the Infrastructure Facilities), Grantor shall consult with Grantee concerning its plans for the Infrastructure Facilities. Grantor shall also provide copies of (or allow Grantee to review) any and all applications for permits filed by Grantor for the Infrastructure Facilities. Nothing herein is intended or shall be deemed to require Grantee's consent or approval to any Infrastructure Facilities.

(e) It is expressly understood and agreed that the Infrastructure Facilities permitted under this Paragraph 3 are in addition to any other improvements or activities permitted under this **Schedule 4**. For example, but without limiting the foregoing sentence, the MPAH Roads permitted under Paragraph 5 below in this **Schedule 4** are in addition to the Infrastructure Facilities permitted under this Paragraph 3.

(f) For all purposes, in deriving the fair market value of the Property as encumbered by the Easement (e.g., in deriving the Original Easement Value under **Paragraph 18** of the main body of this Deed), Grantor shall be deemed to have retained the total value of all Allowable Facilities Areas permitted to be used for Infrastructure Facilities under this Paragraph 3, along with any and all potential uses or activities thereon, without regard to the terms of this Easement or the restrictions imposed by this Deed, and without regard to whether or not the total Allowable Facilities Areas will actually be so used.

(g) If at any time fee title to all or less than all of the Property is conveyed (which shall be subject to any applicable provisions of this Deed governing such conveyance) by The Irvine Company to a third party (in each case, a "**Transferred Parcel**"), the rights provided Grantor in this Paragraph 3 shall cease as to the transferee of such Transferred Parcel unless and until The Irvine Company assigns to such transferee the rights set forth in this Paragraph 3, either concurrently with conveyance of the Transferred Parcel or at anytime thereafter; in either case, as evidenced by written notice from The Irvine Company to Grantee and, to the extent practical, by a recorded assignment document executed by The Irvine Company specifically referencing this Paragraph 3 (general references to appurtenances or rights related to the acquired land will not suffice). Both such notice to Grantee and any such recorded assignment shall specifically reference the amount of acreage which may thereafter be used in the Transferred Parcel for Infrastructure Facilities, which amount together with all other acreages previously used for

Infrastructure Facilities or assigned to other Transferred Parcels may not exceed the maximum amount permitted as set forth above in subparagraph 3(b). All rights under this Paragraph 3 not so assigned by The Irvine Company shall be retained by The Irvine Company and may be used by The Irvine Company with respect to any portion of the Property whether or not owned by The Irvine Company. In no event shall any division of the Property between multiple owners, or any other event or circumstance (e.g. a release of this Deed as to an Allowable Facilities Area), create or allow any increase in the maximum Allowable Facilities Area as set forth above in subparagraph 3(b). As used in this subparagraph, the term "The Irvine Company" shall mean and refer to The Irvine Company, a Delaware corporation, its successors and any person or entity to whom The Irvine Company assigns its rights under this Paragraph 3. Any merger of The Irvine Company with or into another entity or any acquisition or transfer of all or a portion of the stock, equity or other ownership interests of The Irvine Company will not be deemed a transfer of the Property triggering the applicability of this subparagraph 3(g).

(h) As noted in subparagraph 3(b) above, the Allowable Facilities Area also includes, in addition to the number of acres indicated in that subparagraph, that amount of acreage necessary solely for electrical transmission facilities and supporting structures running from the east/west strip of land owned as of the date of this Deed by Southern California Edison which bifurcates the Property to the developments in and around the Irvine Lake area.

4. Roads and Trails. Grantor shall be entitled to maintain, repair, replace and use all existing roads and trails located on the Property, provided that no such road or trail shall be materially expanded in size, nor shall the use of such road or trail be materially changed, except as provided in the Resource Plan. The construction, maintenance, repair, replacement and use of new roads and trails shall be permissible only as explicitly permitted pursuant to any other Paragraph in this **Schedule 4** (and then subject to any restrictions set forth in such other Paragraph, including any restrictions as to the area within which the road or trail is permitted) or as provided in the Resource Plan.

5. Specific New Roads. A depiction of the existing Orange County Transportation Authority (OCTA) Master Plan of Arterial Highways effective as of December 11, 2000 (the "**MPAH**") is included in the Easement Documentation Report. Grantor shall be entitled to cooperate with the appropriate federal, state, and local authorities with respect to, and undertake in all respects, the development, construction, improvement, maintenance, repair, replacement, relocation and use of all roads as shown and described on such existing MPAH, together with all utilities and other facilities ordinarily constructed or installed within or adjacent to such roads, and all improvements related thereto (collectively, the "**MPAH Roads**") in the relevant area (the "**Allowable MPAH Area**"), subject to the following conditions:

(a) If and to the extent Grantor is undertaking the development of any MPAH Road, Grantor shall use its reasonable best efforts to ensure that such MPAH Road is undertaken in such a manner as will minimize as much as reasonably possible the impact on the Conservation Values of the Property, including (but not limited to) the incorporation into the design and construction of such MPAH Road of wildlife underpasses, where appropriate pursuant to any existing completed wildlife movement studies for the Property previously funded by Grantor. Grantee understands and acknowledges that Grantor may not be the party

undertaking development of each MPAH Road. In those instances where Grantor is nonetheless participating in the development of the MPAH Road, Grantor shall use its reasonable best efforts to provide the party undertaking the MPAH Road with the awareness of the desirability of considering the incorporation into the design and construction of such roads of wildlife underpasses and to deliver to such party copies of any existing completed wildlife movement studies for the Property previously funded by Grantor.

(b) Notwithstanding any other provision of this Deed to the contrary, either before or after the time that any MPAH Road permitted under this Paragraph is commenced or completed, Grantor shall have the right to transfer to any appropriate agency, entity or individual fee title, easement, license and/or other possessory interest to the Allowable MPAH Area related to such MPAH Road, in the form or manner required by the recipient (including without limitation with title acceptable to the recipient), and without compensation to Grantor or Grantee and without requiring the recipient to resort to its powers of eminent domain (if any) or other similar legal process in such endeavor. Grantee shall cooperate with Grantor, as reasonably requested and at no out-of-pocket cost to Grantee, to ensure Grantor may exercise said right to transfer the Allowable MPAH Area. To that end, if requested, Grantee shall execute and record an amendment to this Deed releasing the Allowable MPAH Area from this Deed, provided that Grantee shall be entitled to require that any such release from this Deed explicitly confirm the provisions of subparagraph 5(d) below with respect to the released Allowable MPAH Area. In transferring title to the Allowable MPAH Area as permitted in this Paragraph 5, subject to acceptance by the recipient, Grantor shall use its reasonable best efforts to restrict use of the Allowable MPAH Area to the applicable MPAH Road in a recorded document encumbering the Allowable MPAH Area.

(c) Again assuming Grantor is the party seeking a permit for the MPAH Road, prior to submitting an application for that permit, Grantor shall provide copies of (or allow Grantee to review) any and all applications for permits filed by Grantor for such MPAH Road. Nothing herein is intended or shall be deemed to require Grantee's consent or approval to any MPAH Road.

(d) For all purposes, in deriving the fair market value of the Property as encumbered by the Easement (e.g., in deriving the Original Easement Value under **Paragraph 18** of the main body of this Deed), Grantor shall be deemed to have retained the total value of all Allowable MPAH Areas permitted to be used for MPAH Roads under this Paragraph 5, along with any and all potential uses or activities thereon, without regard to the terms of this Easement or the restrictions imposed by this Deed, and without regard to whether or not the total Allowable MPAH Areas will actually be so used.

6. Educational and Recreational Uses. Grantor shall be entitled to use and develop the Property to provide for recreational and educational use of the Property by the general public; provided, however, that all recreational and educational uses of the Property and the facilities therefor shall be planned mutually by Grantor and Grantee pursuant to, and shall only be installed as provided in the Resource Plan, taking into account (a) the desire of the parties to provide substantial and regular use of the Property by the public through recreational and educational uses as permitted under this Deed, (b) the recreational and educational uses and

facilities provided on other portions of the Irvine Ranch, and (c) the need to preserve and protect the other Conservation Values of the Property. Without meaning to address all possible uses or facilities in advance, and on the understanding that not all uses or activities will be appropriate in all locations, the parties anticipate that trails for hiking, cycling and equestrian, picnicking and picnic areas, viewpoints and overlooks, staging areas, access roads, and similar recreational and/or educational uses or activities will be appropriate on the Property, but that motorized recreation, paved or landscaped playing fields or areas and similar recreational uses or activities will not be appropriate on the Property.

7. Environmental Enhancement Activities. Grantor and Grantee shall determine in the Resource Plan any portions of the Property that are appropriate for environmental enhancement (restoration of habitat), and what sort of enhancement activities are appropriate and will not adversely affect the ecological values of the Property. Once those determinations have been made, Grantor may carry out the approved enhancement activities from time to time, at any time thereafter, as provided in the Resource Plan.

8. Mining and Drilling. Grantor shall have the right to enter the subsurface of the Property for the extraction or removal of oil, gas, hydrocarbon substances, minerals, and/or any other material or resources (collectively for this Paragraph 8, "minerals") below the surface of the Property, subject to the following provisions:

(a) Grantor shall have the right to drill, tunnel or mine, in compliance with all Applicable Laws, from the surface of lands other than the Property, in, into, and through that portion of the subsurface of the Property lying below a depth of five hundred feet (500') measured vertically from the surface thereof, for the purposes of exploring for, extracting, and/or removing minerals.

(b) In exercising its rights under this Paragraph 8, Grantor shall conduct its activities such that the impact on the Property is limited and localized and is not irremediably destructive of the Conservation Values of the Property.

(c) Grantor shall not enter into any lease for the purposes of exploring for, extracting, or removing any minerals from the Property unless such lease specifically refers to this Deed and binds the lessee to comply with all of the relevant terms hereof.

(d) In exercising its rights under this Paragraph 8, Grantor shall not (i) pollute the surface water of the Property, (ii) pollute the subsurface water of the Property in a manner that materially, adversely affects the Conservation Values of the Property, or (iii) interfere with the surface or subsurface water of the Property in a manner that materially, adversely affects the Conservation Values of the Property.

(e) Grantor shall give Grantee written notice at least forty-five (45) days prior to commencement of any such operations affecting the Property by Grantor or by anyone acting for or by authority of Grantor, describing the proposed location and nature of such operations.

9. Existing Easements. The continued use of existing easements and other possessory rights of record granted prior to the Easement is permitted, including without limitation such rights of record, if any, to construct, maintain, replace and use new roads or trails.

10. Vegetation and Animal Management. Grantor shall be entitled to remove or control invasive, non-native plant species. Grantor shall also be entitled to remove or control feral and/or non-native animal species. Grantor shall be entitled to control problem animals (a) as provided in the Resource Plan or (b) in emergencies where an animal poses an imminent danger to human safety, but only in compliance with all Applicable Laws and using selective control techniques which are designed to be limited in their effectiveness to the specific animal which has been clearly identified as dangerous to human safety.

11. Signage. Grantor shall be entitled to place the following types of signs on the Property: (a) a sign or signs reasonably necessary for the identification of the Property or to advertise its lease or sale; (b) a sign or signs related to the open space, conservation and public access uses of the Property; (c) a sign or signs reasonably necessary to mark the boundary of the Property or to prevent trespass; and (d) a sign or signs along the perimeter of the Property reasonably necessary to provide directional or interpretive information.

12. Fuel Modification. Grantor shall be entitled to undertake those activities necessary to prevent the risk of wildfire as and when required by Applicable Law or as provided in the Resource Plan.

13. Drainage. Rainfall runoff, stormwater, urban runoff, sheet flow, receiving waters, dry weather flow, and other waters presently drain or travel within one portion of the Property to, over, onto and/or across other portions of the Property, as well as from other lands to, over, onto and/or across the Property. Portions of these waters percolate, infiltrate and otherwise are absorbed into the ground at the Property. These waters contain, and in the future will contain, water quality constituents typically associated with such flows. Grantor and Grantee acknowledge that such drainage and flows will occur in the future and that current drainage and hydrologic conditions will change in the future, for example as other lands are developed and/or for flood control purposes. Grantor retains and shall be entitled to use all drainage and flood control rights, subject to all Applicable Laws, to drain and/or route waters within and to the Property or to otherwise allow waters to reach the Property, whether in a manner similar to current conditions or in any other lawful manner; provided that nothing in this Paragraph 13 shall authorize the construction of any structures or facilities of any kind on the Property.

14. Enforcement of Right to Quiet Enjoyment. Grantor shall be entitled to prohibit entry upon the Property by unauthorized persons.

15. Grazing. For so long as The Irvine Company is the owner of any portion of the Property and there has been no deemed transfer of such portion of the Property (as provided in subparagraph 3(b) of the main body of this Deed), Grantor shall be entitled to use such portion of the Property for cattle grazing if and to the extent provided in the Resource Plan, and then only in compliance with the following:

(a) Grazing may only take place seasonally, between the months of November and June.

(b) All grazing activities shall be consistent with a written grazing management plan developed and revised annually as part of the Resource Plan.

(c) Salt licks and artificial watering sources for cattle shall not be located within 1000 feet of any water source, and shall be located where there is ample grazing material.

(d) No grazing shall be allowed in any pasture which leaves in that pasture, at the conclusion of grazing within any grazing year, an average of pounds per acre of residual herbaceous dry matter ("**RDM**") which is less than 1,000. Grantee may conduct monitoring and quantitatively measure RDM in order to determine compliance with the RDM standards established above. Areas which, if left ungrazed, would not in any case provide at least the minimum target RDM due to rockiness, soil quality, or other natural cause, shall not be considered, and no pasture made up largely of such areas shall be grazed.

Schedule 5

Schedule 5

Inconsistent Uses

The following are set forth both to list specific uses at the Property which are inconsistent with the terms of this Deed and, therefore, are prohibited under this Deed (except to the extent permitted as may be set forth in this **Schedule 5** with respect to a given use), and to provide guidance in determining whether other activities are inconsistent with the terms of this Deed. The following activities are inconsistent with the terms of this Deed and prohibited at the Property, in each case: (a) except as required to carry out, or as a normal or reasonable part of, an activity permitted under a specific Paragraph of **Schedule 3** or **Schedule 4** to this Deed, subject in each case to any and all restrictions set forth in such Paragraph, including any restrictions as to the time, manner or area within which the activity is permitted; and (b) except as required to be undertaken under any Applicable Law.

1. Improvements. There shall be no construction or placement of any structures or improvements on the Property, including (but not limited to) residential, industrial, office, or other buildings, underground or aboveground tanks, billboards, signs, advertising facilities, street lights, utility structures or lines, or sewer systems or lines.

2. Use or Transfer of Development Rights. All development rights that are now or hereafter allocated to, implied, reserved, or inherent in or to the Property are terminated and extinguished, and may not be used on or transferred to any portion of the Property as it now or hereafter may be bounded or described, or to any other property (whether adjacent or otherwise).

3. Granting of Partial Interests or Subdivision. Except to the extent otherwise permitted in Paragraph 3 or Paragraph 5 of **Schedule 4**, there shall be no legal or *de facto* sale or gift of less than the whole of the Property, nor any division, subdivision, or partitioning of the Property, without the prior written consent of Grantee, which shall not be withheld unreasonably, subject to the following provisions:

(a) Ownership of the Property may be held in the form of undivided interests as tenants in common, whether by choice or by operation of law, without any need to obtain Grantee's consent thereto, but no owner of an undivided interest in the Property shall have the right of exclusive occupancy or exclusive use of any separate portion of the Property, or any right to have the Property partitioned in kind, whether pursuant to California Code of Civil Procedure Sections 872.210 *et seq.* or otherwise.

(b) There shall be no granting of any leases, easements, licenses, or other rights to use the Property without the prior written consent of Grantee, except that Grantee's consent shall not be required for: (i) temporary or term rights to access and use the Property to provide services or carry out activities permitted at the Property, including (but not limited to) the construction, development, use, maintenance, repair, replacement, and improvement of roads, improvements and/or facilities which are permitted either in the Resource Plan or under any of the provisions of **Schedule 4**; (ii) any such conveyance permitted in **Schedule 4**; or (iii) conservation or environmental enhancement easements which are subordinate to this Easement.

(c) Fee title to less than the whole of the Property may be conveyed by Grantor to any public agency, without any need to obtain Grantee's consent thereto, but Grantor agrees to use its reasonable best efforts, in consultation with Grantee, to ensure that logical boundaries are used in such subdivision. As part of such a division of the Property, Grantor may also convey (again, without any need to obtain Grantee's consent to such transfer, but in consultation with Grantee with respect to the boundaries, in advance of the decision) less than the whole of the Property to one or more public agencies, and convey the entire remainder of the Property to one (but no more than one) non-profit entity which: (i) is organized as a corporation, limited liability company, partnership or other entity excluding an unincorporated association; (ii) is a tax-exempt public charity described in Section 815.3 of the California Civil Code and IRC Section 501(c)(3), organized to protect and conserve natural areas and ecologically significant land for scientific, ecological, scenic, charitable, recreational, and educational purposes; and (iii) has sufficient experience or expertise (or the resources to engage such experience and expertise), and sufficient resources, to hold the remainder in compliance with the Easement Purposes.

(d) In those remaining cases where Grantee's consent to conveyance of less than the whole of the Property, or subdivision of the Property, is required (e.g. conveyance to two or more owners which are not public agencies), Grantee may withhold its consent to any such conveyance or subdivision only if: (i) Grantee has reasonable grounds to doubt the ability of a proposed owner to hold its portion of the Property in compliance with the Easement Purposes; (ii) in Grantee's reasonable opinion, the administrative burden to Grantee in enforcing the Easement thereafter would be increased to an unacceptable degree due to the increase in the number of multiple owners; or (iii) in Grantee's reasonable opinion, the boundaries of such subdivision are not logical for purposes of preserving the Conservation Values of the Property.

4. Vehicles. There shall be no use of any motorized vehicles off of designated roadways on the Property except (a) vehicles used in carrying out the Easement Purposes (but not including any motorized off-road recreational use) or (b) as provided in the Resource Plan; and then in those uses permitted under clauses (a) and (b) of this Paragraph 4, the Conservation Values of the Property shall be protected as much as reasonably possible.

5. Dumping or Salvage. There shall be no dumping, storage or other disposal on the Property of soil, trash or garbage except for (a) refuse generated on the Property which may be disposed of on the Property on a temporary basis prior to its removal from the Property in areas where the Conservation Values of the Property are not adversely impacted or (b) compostable refuse generated on the Property which may be disposed of on the Property in a responsible manner which does not impair the Conservation Values of the Property. There shall be no dumping, storage or other disposal on the Property of ashes, sludge, Hazardous Materials (as defined in this Deed), or other unsightly or dangerous materials. There shall be no storage or disassembly on the Property of inoperable automobiles, trucks, or other vehicles or equipment for purposes of sale, or rental of space for that purpose.

6. Non-Native Animal Species. There shall be no release anywhere on the Property of non-native animal species.

7. Vegetation. There shall be no removal, cutting or destruction on the Property of native vegetation except (a) as provided in the Resource Plan or (b) in an emergency for purposes of disease or insect control or to prevent property damage, personal injury, or flooding. There shall be no introduction on the Property of any non-native plant.

8. Timber Harvesting and Firewood. There shall be no taking or harvesting of timber, standing or downed, on the Property (including, but not limited to, the removal of any downed wood from any waterway) except (a) as provided in the Resource Plan or (b) in an emergency for purposes of disease or insect control or to prevent property damage, personal injury, or flooding.

9. Biocides. There shall be no storage or use of fertilizers, pesticides, biocides, herbicides, or other agricultural chemicals at the Property except as provided in the Resource Plan.

10. Roads and Trails. There shall be no construction of any new roads or trails on the Property.

11. Fences and Walls. There shall be no construction of any new fences or walls on the Property.

12. Commercial Uses. There shall be no retail, office, industrial, or other commercial use of the Property.

13. Alteration of Land or Excavation. There shall be no filling, excavating, grading, draining or dredging on the Property, nor any change in the general topography of the Property.

14. Mining and Drilling. There shall be no mining, drilling, removing, or exploring for or extracting of minerals, oil, gas, coal, or other hydrocarbons, soils, sands, gravel, loam, rocks or any other material on, under, or at the Property.

15. Agriculture. There shall be no agricultural activities or operations of any kind on the Property, including (but not limited to) row crops, forage, growing of timber for harvest, orchards, vineyards, or any other agricultural activities that involve tillage of soil, removal of vegetation, planting of crops for harvest, or irrigation of such crops.

16. Grazing. There shall be no breeding, raising, pasturing or grazing of livestock of any kind, nature or description (whether for commercial purposes or otherwise) on the Property.

17. Hunting, Trapping and Fishing. There shall be no use of the Property for any hunting, trapping or fishing of any kind.

18. Water Resources. There shall be no development or other activities, action, or uses on the Property detrimental to water conservation or quality, erosion control, soil conservation, or fish and wildlife habitat preservation on the Property, and no manipulation or alteration of natural water courses, wetland, stream bank, shorelines, or bodies of water on the Property, including but not limited to:

(a) degradation or pollution of any surface or subsurface waters on the Property, or placement of revetments or rip-rapping on the Property;

(b) bank protection or any other manipulation, diversion or other alteration of natural water courses, wetlands, or other bodies of water on the Property; or

(c) any other activity on the Property which may destabilize the banks of any course or body of water on the Property; and any uses or activities on the Property which would pollute, degrade, or drain the surface or sub-surface waters of the Property.

19. Water Rights. There shall be no severance, conveyance or encumbrance of Grantor's water or water rights appurtenant to the Property, separately from Grantor's underlying title to the Property; and the Easement shall not sever any such riparian water rights appurtenant to the Property.

Appendix 2

Structural Design of the NIR Database

attribute	type	domain	required?	Examples
attribute name	**attribute type, one of: text integer real number date/time Boolean URL money**	**further restrictions on type ;e.g.: list of legal text values numbers or date/times**	**indicate whether the attribute must always have a value**	**Give an example or list of possible entries**
	Entity 1:	**Roads**		
FeatureDescription	text	50 characters	yes	Primary, Class 1, Hwy. Secondary, Class 2, Hwy. Light Duty, Comp unsp, Road, CL3 Light Dirt Road - CL3c Unimproved Road, Class 4 railroad
Name	text	50 characters	no	Weir Canyon Road
Easement(s)	text	100 characters, separate names with commas	yes	Silmod
SECoordinate	integer	must = 9 numbers	yes	334511737
CFF ID	integer	must =8 numbers	yes	12537863
CFF 1	integer		no	83-651
CFF 2	integer		no	0-652
Length	real number		yes	1200 meters
Fnode	real number		no	304
Tnode	real number		no	2688
Status	text	50 characters	yes	Open, Closed, Restricted, Unknown
RegulatoryControl/ Ownership	text	50 characters	yes	TNC, TIC, OCFD, City of Irvine, Orange Co.
Maintenance	text	yes/no	yes	
MaintenanceDate	date	mm_yyyy	yes	Give date of last known maintenance (approximate)
SurfaceType	text	50 characters	yes	paved, unpaved, plowed, unstable
Permit#	text	20 characters	no	Could be letters and #'s

Entity 2: Trails

FeatureDescription	text	50 characters	yes	Regional Class I Bike, City Class I Bike, Regional Riding and Hiking, Hiking, Bikeways, Multi-Use, Wilderness Trails
Name	text	50 characters	no	Weir Canyon Road
Easement(s)	text	100 characters, separate names with commas	yes	Silmod
SECoordinate	integer	must = 9 numbers	yes	334511737
CFF ID	integer	must =8 numbers	yes	12537863
CFF 1	integer		no	83-651
CFF 2	integer		no	0-652
Length	real number		yes	1200 meters
Fnode	real number		no	304
Tnode	real number		no	2688
Status	text	50 characters	yes	Open, Closed, Restricted, Unknown
RegulatoryControl/Ownership	text	50 characters	yes	TNC, TIC, OCFD, City of Irvine, Orange Co.
Maintenance	text	yes/no	yes	
MaintenanceDate	date	mm_yyyy	yes	Give date of last known maintenance (approximate)
SurfaceType	text	50 characters	yes	paved, unpaved, plowed, unstable
Permit#	text	20 characters	no	Could be letters and #'s

Entity 3: Power Lines

Name	text	50 characters	no	Weir Canyon Road
Easement(s)	text	100 characters, separate names with commas	yes	Silmod
SECoordinate	integer	must = 9 numbers	yes	334511737
CFF ID	integer	must =8 numbers	yes	12537863
CFF 1	integer		no	83-651
CFF 2	integer		no	0-652
Length	real number		yes	1200 meters
Fnode	real number		no	304
Tnode	real number		no	2688
Status	text	50 characters	yes	Open, Closed, Restricted, Unknown
RegulatoryControl/Ownership	text	50 characters	yes	TNC, TIC, OCFD, City of Irvine, Orange Co.
Maintenance	text	yes/no	yes	
MaintenanceDate	date	mm_yyyy	yes	Give date of last known maintenance (approximate)
Permit#	text	20 characters	no	Could be letters and #'s

Entity 4: Waterlines

FeatureDescription	text	50 characters	yes	pipeline, underground, gas or oil (excluding water), canal, aqueduct, or ditch, Canal/Aque/Ditch - Intermittant, aqueduct pipeline or penstock, underground
Name	text	50 characters	no	Weir Canyon Road
Easement(s)	text	100 characters, separate names with commas	yes	Silmod
SECoordinate	integer	must = 9 numbers	yes	334511737
CFF ID	integer	must =8 numbers	yes	12537863
CFF 1	integer		no	83-651
CFF 2	integer		no	0-652
Length	real number		yes	1200 meters
Fnode	real number		no	304
Tnode	real number		no	2688
Status	text	50 characters	yes	Open, Closed, Restricted, Unknown
RegulatoryControl/Ownership	text	50 characters	yes	TNC, TIC, OCFD, City of Irvine, Orange Co.
Maintenance	text	yes/no	yes	
MaintenanceDate	date	mm_yyyy	yes	Give date of last known maintenance (approximate)
Permit#	text	20 characters	no	Could be letters and #'s

Entity 5: Mining

FeatureDescription	text	50 characters	yes	Land Grant, Mining Claim / County/Alaska Bdy Borough, pit-large, Land Subject to Inundation, Land Grant/Mining Claim/DLC
Name	text	50 characters	no	Weir Canyon Road
Easement(s)	text	100 characters, separate names with commas	yes	Silmod
SECoordinate	integer	must = 9 numbers	yes	334511737
CFF ID	integer	must =8 numbers	yes	12537863
CFF 1	integer		no	83-651
CFF 2	integer		no	0-652
Length	real number		yes	1200 meters
Fnode	real number		no	304
Tnode	real number		no	2688
Status	text	50 characters	yes	Open, Closed, Restricted, Unknown
RegulatoryControl/Ownership	text	50 characters	yes	TNC, TIC, OCFD, Private, Orange Co.
CurrentActivity	text	yes/no	yes	
ActivityDate	date	mm_yyyy	yes	Give date of last known activity (approximate)
Permit#	text	20 characters	no	Could be letters and #'s

Appendix 3

Costing out Ground Assessment Monitoring[i]

Monitoring Rates:

Using Staff to monitor:
(overhead charges included)
Salary costs/hr ("a") + Overhead costs ("b")
Total hourly rate per staff member = a + b

Using Consultant to monitor:
Hourly fees = "a"
Total hourly rate = a

Using Volunteer to monitor:
Training costs = "a"
No hourly rate, volunteers are not paid
Total = a

Travel Rates:

Travel Costs per Site Visit:
Mileage reimbursement : (miles driven) x (reimbursement rate) = "a"
Staff or Consultant costs for travel time:
(Staff or Consultant hourly rate) x (mileage/average speed of vehicle) = "b"
Reimbursable travel expenses = "c"
Total travel costs for each site visit = a + b + c

Annual Expenses:

Annual Monitoring Expenses
Pre-monitoring staff/consultant costs: (hourly staff/consultant rate) x (time needed) = "a"
Monitoring staff/consultant costs: (hourly staff/consultant rate) x (time needed) = "b"
Monitoring: equipment costs = "c"
Post-monitoring staff/consultant costs: (hourly staff/consultant rate) x (time needed)= "d"
Travel Costs for each site visit (*see* Travel Rate formula above) = "e"
Total annual monitoring expenses = a + b + c + d + e

Annual Grantor Relations Costs
Costs of staff time: (hourly staff rate) x (time needed) = "a"
Cost of supplies = "b"
Total annual grantor relations cost = a + b

Total Annual Expenses = sum of all totals above[ii]

[i] Adapted from *Conservation and Agricultural Easement Stewardship Fund*. The Land Trust for Santa Barbara (2002).

[ii] For additional staff/consultant work, including negotiations over violations or exercising reserved rights, add [(hourly staff/consultant rate) x (time needed)].

Appendix 4

IRVINE RANCH LAND RESERVE

ANAHEIM EASEMENT
PHOTO-DOCUMENTATION STATIONS

Parcel Number	Stake Number	Photo Number	Direction	Description
1	1	A	WSW	Mixed riparian forest dominated by coast live oak, western sycamore, and tecate cypress. Photo shows a portion of the tecate cypress that burned during the Green Fire. Dense bigpod ceanothus chaparral on slopes in background.
1	1	B	SSW	Mixed riparian forest in foreground. Dense bigpod ceanothus chaparral with tecate cypress on slopes above drainage.
1	2	A	E	Coast live oak woodland in drainage. Bigpod ceanothus chaparral on slopes north of the drainage and mixed sage scrub south of the drainage.
1	2	B	WNW	Intact mixed sage scrub on slopes. Re-growth of mixed sage scrub on old road. Evidence of grazing in this area.
1	3	A	WNW	Tank on ridge. Southern cactus scrub on south-facing slope, chaparral nolina scattered throughout. Sandstone outcroppings.
1	4	A	ESE	Coast live oak woodland in drainage with rock pool complexes. South-facing slope is burned bigpod ceanothus chaparral. North-facing slope is intact bigpod ceanothus chaparral.
1	5	A	NE	Far slope shows cliff with rock outcroppings near the ridge. Chamise sage scrub with chaparral nolina on slopes below cliff. Near slope shows burned scrub-chaparral ecotone.
2	1	A	WSW	Sagebrush-buckwheat scrub in foreground. Far ridge shows toyon-sumac chaparral and oak woodland.
2	2	A	SSW	Coast live oak woodland/toyon-sumac chaparral and southern cactus scrub on slopes above drainage. Sagebrush scrub in the foreground. Castor bean within the drainage.
2	3	A	NNW	Cliff and rock outcroppings, toyon-sumac chaparral, and sumac savannah in the background. Southern cactus scrub on slopes. Non-native grasslands throughout.
2	4	A	NNE	Native grassland in foreground. Sumac savannah and power lines in the middle. Southern cactus scrub and non-native grassland on slopes in background.
2	5	A	ESE	Toyon-sumac chaparral north of firebreak/road. Burned black sage scrub and southern cactus scrub south of firebreak/road.
3	1	A	WNW	Previously cleared area. Re-growth of coastal sage scrub.
3	2	A	NW	White sage scrub on slopes. Southern cactus scrub and oak woodland below.
3	2	B	NNE	White sage scrub with intermixed laurel sumac.
3	3	A	SSW	Sagebrush scrub and rock outcrops near ridgeline. Southern cactus scrub in foreground. Note deer on game trail in the center of the picture. Coastal California gnatcatcher pair observed at this location.
3	4	A	NNE	Coast live oak woodland and white sage scrub in background. Planted fuel modification zone slopes and v-ditch drains in foreground.

Source: PCR Services Corporation & The Nature Conservancy, 2002

Appendix 5

Anaheim Easement Permanent Photo-station Points

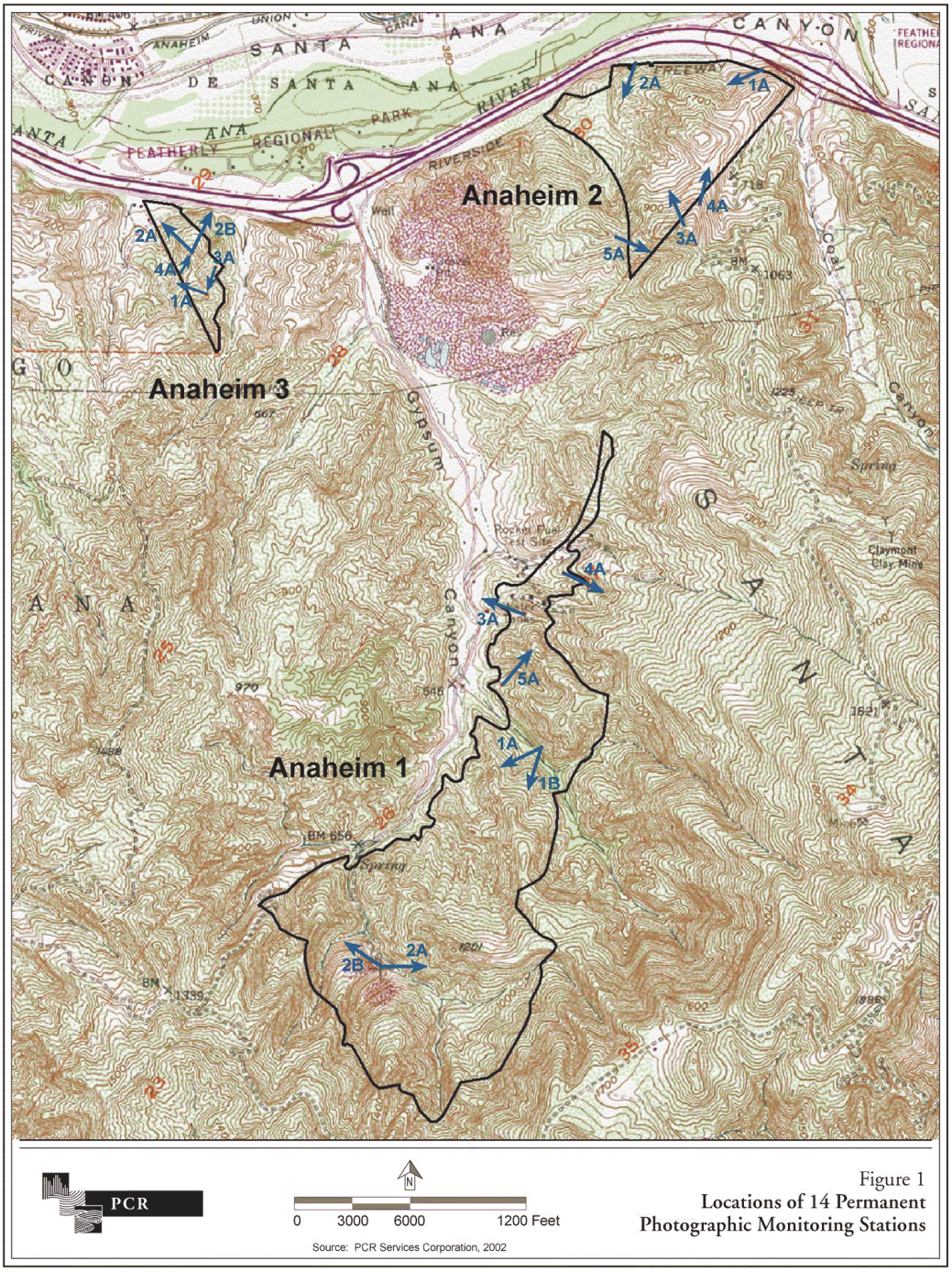


Figure 1
Locations of 14 Permanent
Photographic Monitoring Stations

Appendix 6

FREMONT EASEMENT - IRVINE RANCH LAND RESERVE

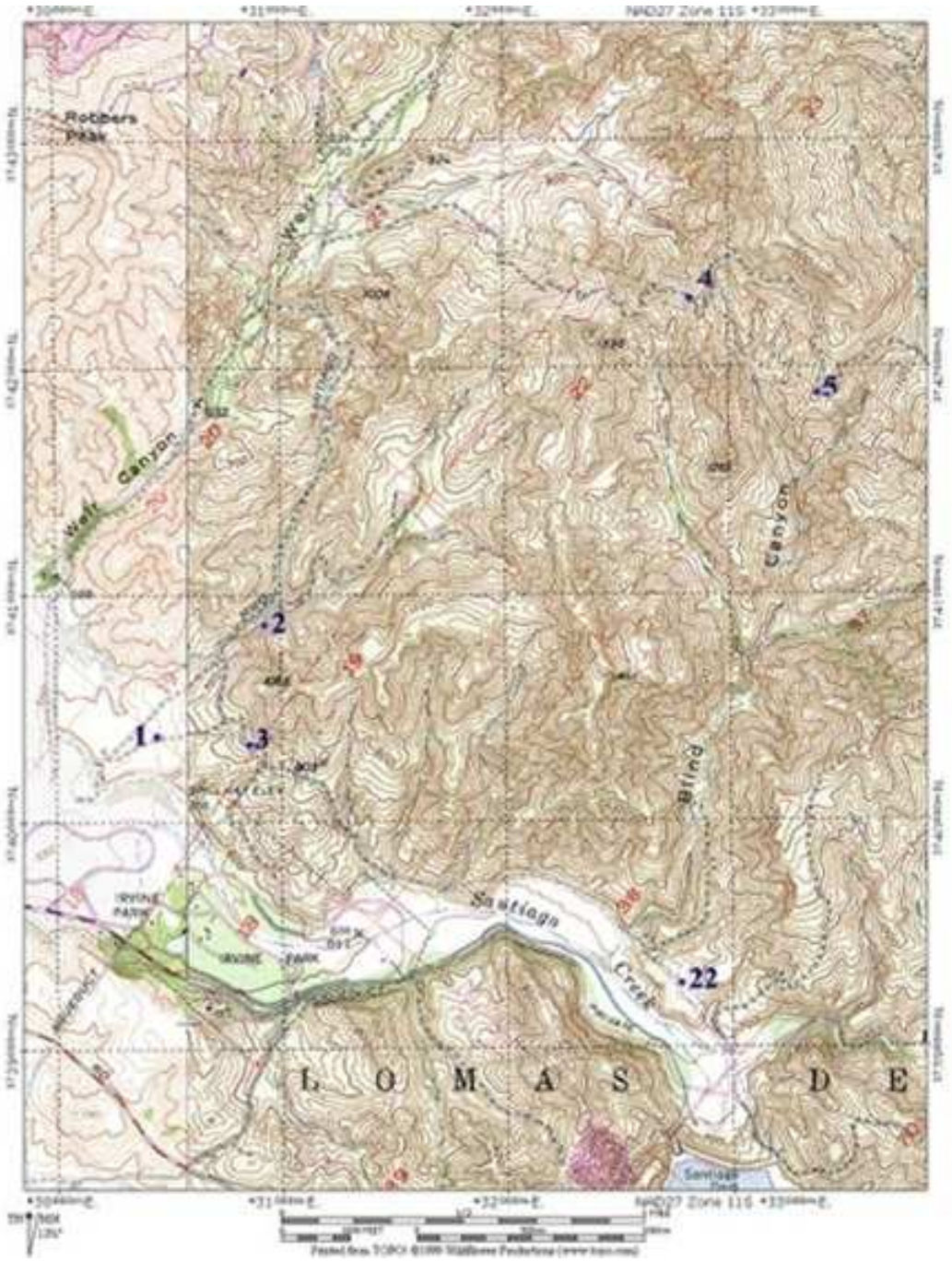
Compass Bearing, Coordinates and Elevation of the 22 Permanent Photographic Monitoring Stations.

Map ID[*]	Compass Bearing	UTM NAD 27 Zone 11S		Elevation (meters)
		Easting (mE)	Northing (mN)	
1	50	4 30 444	37 40 379	195
2	210	4 30 924	37 40 870	244
3	110	4 30 857	37 40 338	226
4	230	4 32 823	37 42 302	365
5	90	4 33 394	37 41 884	361
6	240	4 34 258	37 41 223	450
7	50	4 34 905	37 41 010	488
8	340	4 34 905	37 41 010	488
9	220	4 35 342	37 40 349	430
10	30	4 34 464	37 41 982	448
11	30	4 35 728	37 43 313	514
12	50	4 35 963	37 43 434	525
13	30	4 36 849	37 43 652	575
14	60	4 37 078	37 42 995	403
15	160	4 37 854	37 42 635	579
16	140	4 37 935	37 42 009	629
17	0	4 37 766	37 40 861	684
18	80	4 36 116	37 38 996	549
19	40	4 37 079	37 37 162	285
20	220	4 37 009	37 38 747	530
21	250	4 35 245	37 39 240	480
22	30	4 32 771	37 39 285	231

Source: Harmsworth Associates & The Nature Conservancy, 2002

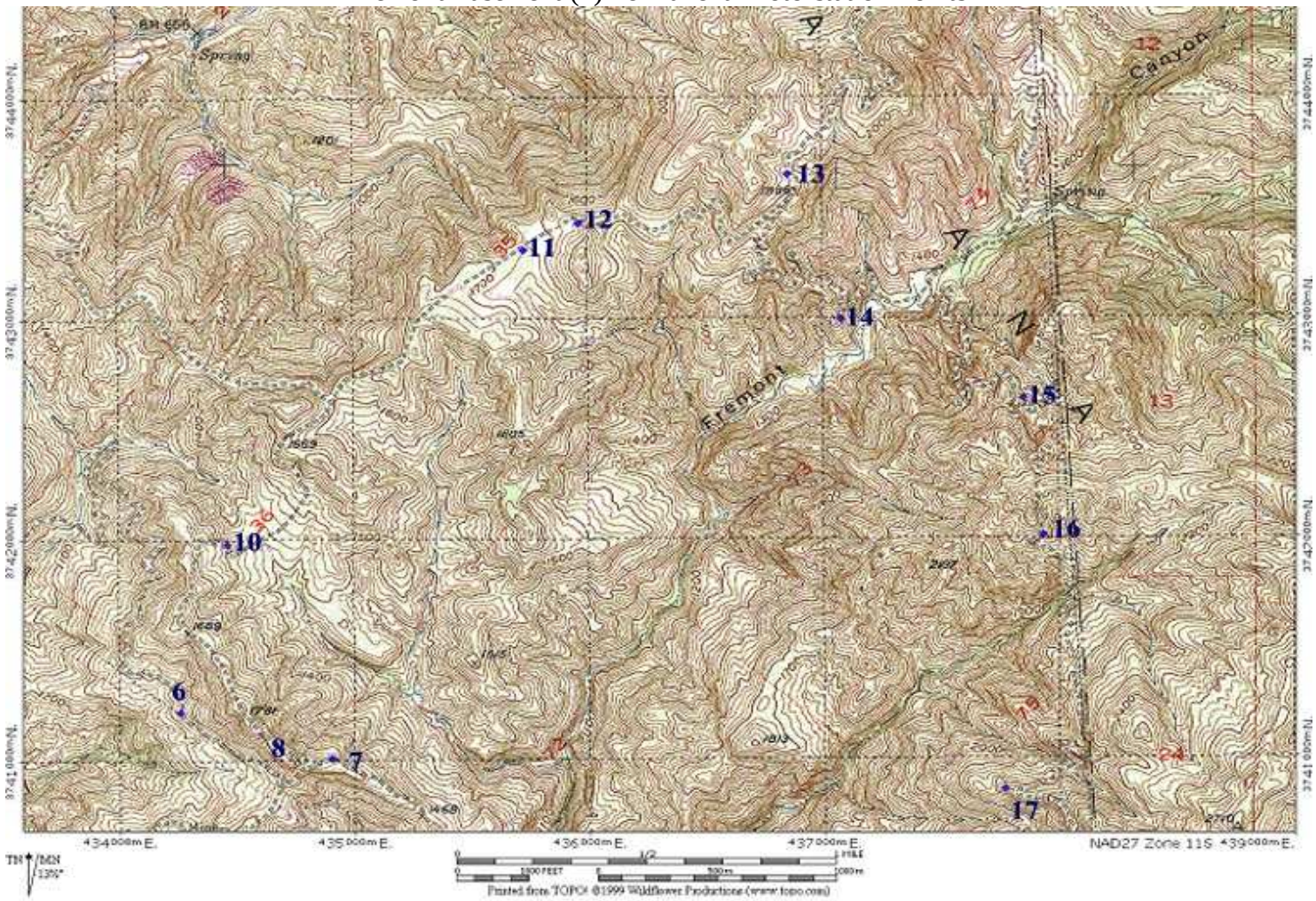
Appendix 7

Fremont Easement (1) Permanent Photo-station Points



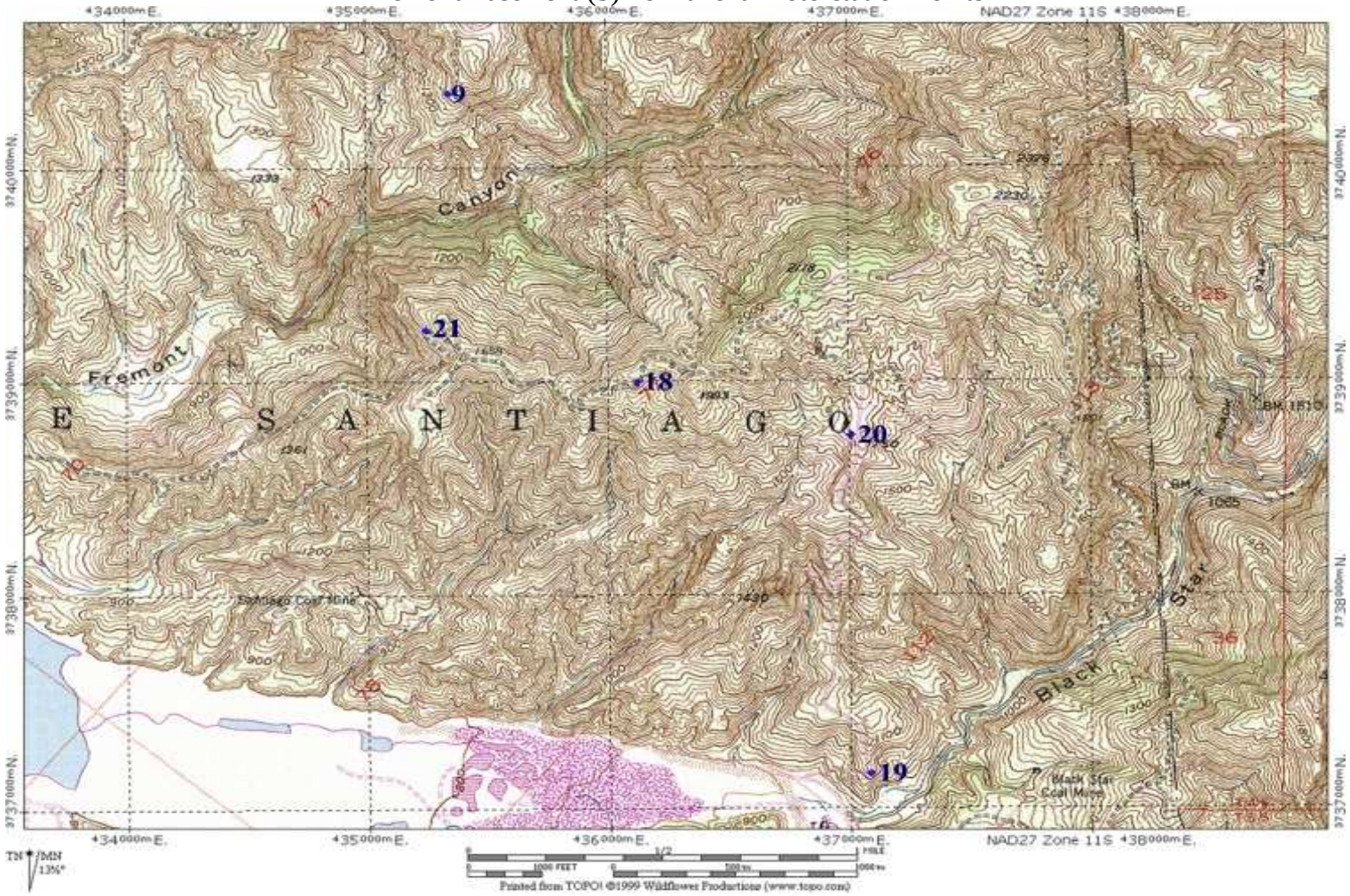
Source: Harmsworth Associates, The Nature Conservancy (2002)

Fremont Easement (2) Permanent Photo-station Points



Source: Harmsworth Associates, The Nature Conservancy (2002)

Fremont Easement (3) Permanent Photo-station Points



Source: Harmsworth Associates, The Nature Conservancy (2002)

Appendix 8

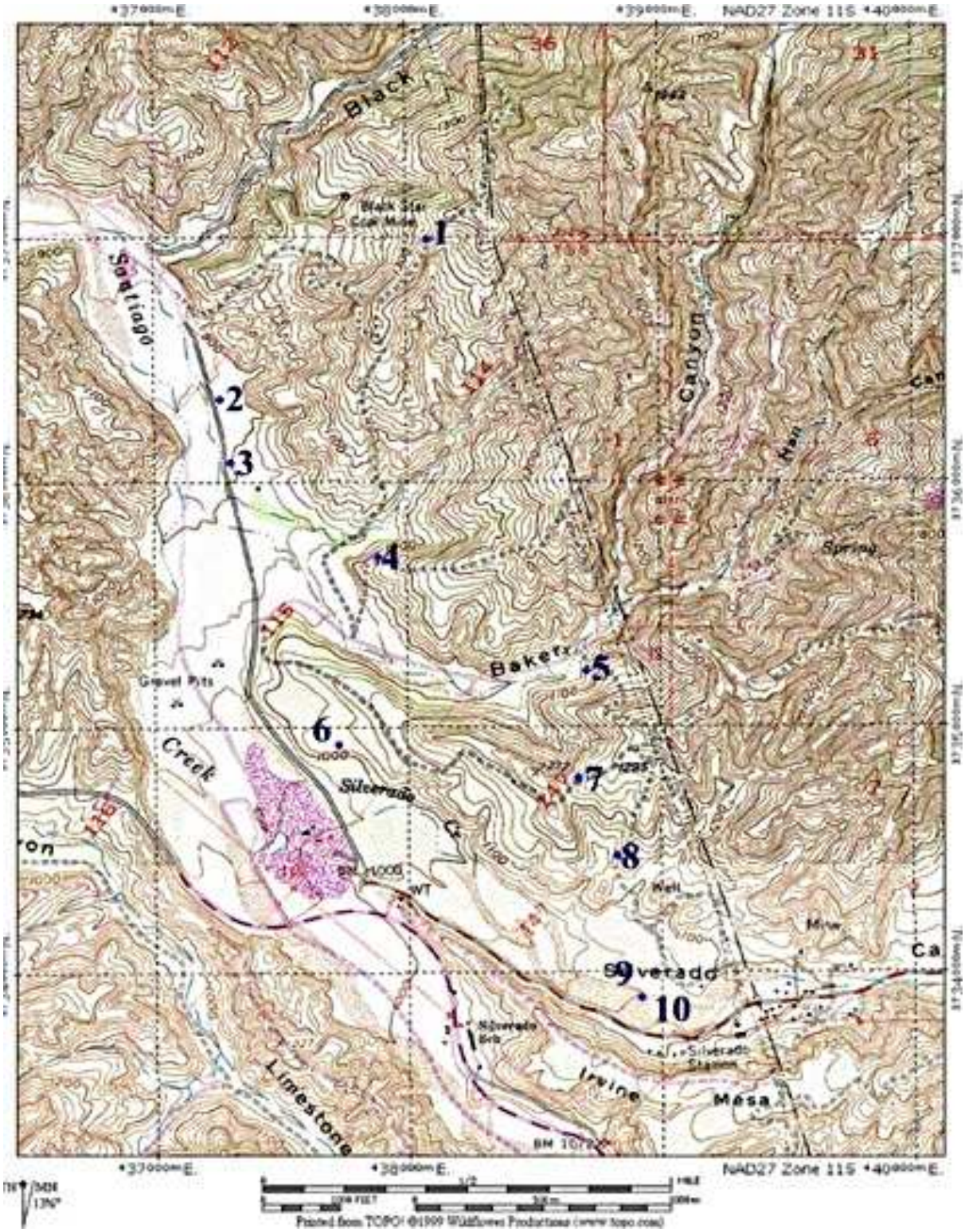
SILMOD EASEMENT - IRVINE RANCH LAND RESERVE
Compass Bearing, Coordinates and Elevation of the 10 Permanent Photographic Monitoring Stations.

Map ID	Compass Bearing	UTM NAD 27 Zone 11S		Elevation (meters)
		Easting (mE)	Northing (mN)	
1	10	4 37 260	37 36 341	271
2	50	4 37 301	37 36 082	276
3	250	4 38 080	37 36 988	403
4	10	4 37 883	37 35 693	326
5	250	4 38 707	37 35 227	343
6	120	4 37 726	37 34 929	312
7	300	4 38 674	37 34 793	388
8	320	4 38 825	37 34 474	351
9	290	4 38 916	37 33 897	317
10	80	4 38 916	37 33 897	317

Source: Harmsworth Associates & The Nature Conservancy, 2002

Appendix 9

Silmod Easement Permanent Photo-station Points



Source: Harmsworth Associates, The Nature Conservancy (2002)