Wilson Creek Wildlife Corridor Project: Application of GIS for Conservation and Development in Riverside County California

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Wilson Creek Wildlife Corridor Project: Application of GIS for Conservation and Development in Riverside County California

A Major Individual Project submitted in partial satisfaction of the requirements for the degree of Master of Science Geographic Information Systems

by

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August 2008
I thank all the Professors from whom I have had the pleasure of learning GIS from. A special thank you must go to Karen Kemp, who was a constant encouragement throughout the Major Individual Project and the MS GIS University of Redlands program. Mark Kumler, Tim Krantz and Bob Owens have each made a significant and indispensable contribution to the successful completion of this project and I thank each one sincerely as well. Grateful acknowledgement must also go to Jordan Henk, thank you kindly. Throughout the many project months a continual source of insight and inspiration is Felix Rogers Jones III and I thank him for it. The beneficent impact Peter Vander Kooy has had on the furtherance of this project and my life is myriad and my gratitude is profuse. Most of all I thank the Lord for the enriching experience and successful completion of the MS GIS Program at the University of Redlands.
Preface

All the datasets used in the Wilson Creek Wildlife Corridor Project were provided by Kenneth Althiser of the Redlands Institute and Michael Dangermond of the Dangermond Group. Their considerable contributions during the initial phases of the project have made the Wilson Creek Wildlife Corridor Project possible and are greatly appreciated. The recommendations made by Paul Burgess proved very useful, and so I thank you. Also a thank you is due to Nathan Strout whose prodigious geoprocessing expertise was essential to the completion of the project. Thank you to Tom Baker and many others that have made direct and indirect contributions, large and small, towards the completion of this project and yet remain unmentioned. However, their significance is prominent and appreciated.
ABSTRACT

Major Individual Project
Master of Science Geographic Information Systems
By Carl McCaughey

Wilson Creek Wildlife Corridor Project: Application of GIS for Conservation and Development in Riverside County California

Situated in Western Riverside County, the Wilson Creek/Sage/Aguanga area is experiencing rapid growth as urban development extends eastward from the communities of Temecula and Murrieta. The Wilson Creek area contains many unique biological resources and the opportunity exists to establish an important natural open space Wildlife corridor between the San Jacinto Mountains and the Agua Tibia Wilderness Area of the Cleveland National Forest. Through conservation endeavors, coupled with the cooperation of environmentally conscientious and responsive developers, the goals for both human population expansion and the protection of threatened and endangered species habitats can be simultaneously accommodated.

Many factors have contributed to the need for a Geographic Information System (GIS) model to identify areas most suited for development and to prioritize others for conservation. This report introduces a methodology based on a series of GIS geoprocessing models that produces both suitability maps for achieving immediate conservation goals to protect threatened and endangered species habitat, and long range objectives of maintaining species population and habitat health through sustainable practices. In addition, geoprocessing models are created to delineate a best use, cost-effective approach to development requirements that both preserve and protect precious biological resources while enhancing the quality of life for humans by incorporating recreational, educational, and aesthetic provisions in identifying more readily developable areas.
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1. Introduction

The Wilson Creek, California, area (see Figure 1-1) located approximately 7 miles east of Temecula, is a unique biological setting situated where a number of ecosystems meet, providing a natural location for building a wildlife corridor. Wildlife corridors are necessary because they are required to maintain genetic diversity among a large number of wildlife species through the preservation of several different types of habitat, as well as, allowing communication between already preserved areas, including those designated as critical for threatened and endangered species. Maintaining connectivity between wildlife populations, otherwise located in these ‘islands’ of natural habitat, is critical to achieving this goal of bridging separated populations. The Western Riverside County Environmental Programs Department’s Multiple Species Habitat Conservation Plan (MSHCP) recognizes the importance of maintaining habitat connectivity and thereby conserving wildlife biodiversity, and seeks to establish a policy that will encourage the preservation of a natural open space corridor between the San Jacinto Mountains and the Agua Tibia Wilderness Area of the Cleveland National Forest.

Figure 1-1 Wilson Creek, California Preserve (CNLM 2004 & 2008)

This document provides an overview of a GIS application and companion methodologies to fulfill the intent of the MSHCP implementation, as well as, providing a way to represent or model the corresponding criteria and datasets considered most advantageous to achieving the area plan’s seemingly juxtaposed goals of conservation and development. Also presented are the essential user interfaces for supporting the selection of conservation acquisitions while making smart growth development decisions and tracking the changes of values and priorities over time.

1.1. Wilson Creek MSHCP Wildlife Corridor

The Wilson Creek area contains many unique biological resources and provides an opportunity to establish an important natural open space corridor for target resources between the San Jacinto Mountains and the Agua Tibia Wilderness Area of the Cleveland National Forest. “The Area is experiencing rapid growth as urban development extends eastwards from the communities of Temecula and Murrieta. ‘Smart Growth’ planning
principles (providing incentives for infill and transfer of density into urban core areas) that form the basis for the MSHCP need to be formulated and programs defined to accommodate urban development, while conserving sensitive resources. The proposed GIS and implementation plan will promote the principles of conservation biogeography with regard to special status species regulated by the California Department of Fish and Game, as well as the United States Fish and Wildlife Service.

1.1.1. Purpose

This project will focus on designing and establishing the mechanisms and methodologies by which lands can be conserved through the MSHCP process, including developing a transactional database system to track conservation acquisitions and identify areas more suitable for development, to encourage development where appropriate and yet to conserve critical lands. This GIS mechanism can also become a component for maintaining open space values within the conserved lands long after the transfers and development are complete, through the construction of a system of annual inspections by an outside entity to insure that conservational values have been maintained.

The intended audiences of this Wilson Creek Wildlife Corridor Project document are the Riverside Land Conservancy (RLC), to enhance the decision making process for current and future land acquisitions for conservation, and Dr. Timothy Krantz, Director of the Environmental Studies Program at the University of Redlands, who was interested in assisting Riverside County in building a system to implement and enforce the MSHCP program. Dr. Krantz initiated the Wilson Creek Wildlife Corridor Project and acted as the principal liaison between the various stakeholders. Dr. Krantz has participated in a number of local projects that have facilitated the building of wildlife corridors to connect various habitat “islands.”

1.1.2. Scope

This GIS application will create a detailed methodology for implementation of the Multiple Species Habitat Conservation Plan (MSHCP), with a particular focus on the Vail Lake-Wilson Creek area. Using a GIS to analyze and define areas suitable for development and others more suitable for conservation, the Wilson Creek MSHCP Wildlife Corridor pilot project will assist in establishing priorities for land acquisition for conservation, while also directing growth to areas better suited for development. This system must remain sensitive to changes in conservation values in that the scores for parcels adjacent to lands acquired for conservation will also become more desirable for acquisition due simply to proximity; areas surrounded on two, three or four sides will become progressively more suitable for conservation as the surrounding lands are conserved. Conservation will also take many forms, including conservation easements, parcel splits for donations, etc. This system may provide a template for implementation in other Area Plans within the Western Riverside County MSHCP regional planning district, as well as other areas of Riverside County.
This MSHCP is one of the most complex habitat conservation plans ever attempted. It preserves and protects 146 species by acquiring lands for a habitat reserve system. The permit for the Western MSHCP has a life of 75 years and guides future growth within the County of Riverside that provides open space for habitat and recreation.

The Western Riverside County MSHCP Plan is comprised of an interlocking network of Plan Areas. Each Plan Area has an associated set of specific conservation criteria unique unto that particular Bioregion along with permissible development density percentages. The overarching guidelines of the MSHCP Plan represent conservation and development target goals throughout Western Riverside County.

Although most of the MSHCP Conservation Area is comprised of relatively few generalized vegetation types, it does represent the distribution of generalized vegetation types within the entire Plan Area… of the relative percent distribution in the MSHCP Conservation Area and the relative percent distribution in the Plan Area. For example, the relative distribution of chaparral in the MSHCP Conservation Area is 55% of the total acreage in the area, whereas it comprises only 42% of the Plan Area. On the other hand, grassland comprises 15% of the Plan Area, but only 9% of the MSHCP Conservation Area. Thus, if a conservation goal is to provide a typical representation of a vegetation type in the MSHCP Conservation Area (i.e., representativeness) as an index of diversity, chaparral is "over-represented" by approximately 12% and grassland is under-represented by more than 6%. It is important to understand that the relative percentages are arithmetically dependent.

All through the MSHCP a primary objective is to conserve representative percentages of native vegetation within each of the plan areas. These percentages are uniquely varied to the MSHCP goals for that plan area.

1.1.3. Client

The Riverside Land Conservancy

Riverside Land Conservancy is a nonprofit land trust that works with landowners who would like to see their lands preserved. By facilitating the transfer of land from willing private landowners to public ownership, RLC helps to ensure that natural lands, wildlife habitat and working farm lands are preserved for future generations.

The Dangermond Group

The Riverside Land Conservancy (RLC) was established in 1988 to help conserve and protect land in Southern California. The Dangermond Group has been working with RLC since 2000, with Pete Dangermond acting as
Executive Director. During this time, The Dangermond Group has helped RLC to acquire nearly 3,000 acres of land, have helped to develop a vision for a new State Park, San Timoteo State Park, which we are in the process of realizing.

Dr. Krantz guided this project through its inception and much of the shape and direction of the project has ensued from his knowledge of geography and biogeography, previous experience with many conservation related projects, and expert suggestions. He has acted as an essential facilitator between the various parties involved, including the Riverside Land Conservancy, the Dangermond Group, the Endangered Habitats League, and the Redlands Institute to acquire access to data, and to organize and launch the project.

1.2. The Objectives

The primary objective of the Wilson Creek Wildlife Corridor Project is to create two derivative overlay maps for analysis and then compare them to evaluate the criteria used in the project, and to gain insights into potential effectiveness of the strategies in making choices for parcel purchases for either conservation or development purposes. This will set the stage for additional enhancements. According to Dennis Beck’s popular “Common GIS Mistakes” article, “As project manager you should etch your goals into your forehead and be prepared to say no to anything that's contrary to those goals.”

The goals for the current project will be accomplished by creating a GIS using ArcGIS ModelBuilder to perform geoprocessing that will allow the modeling using a variety of criteria weights and values according to client case-specific needs. The GIS can then be used to produce maps for decision support of the conservationists or developers in prioritizing lands for acquisition. The consequent goal of the GIS is to give conservationists the capability to produce a derivative map for decision support clarifying to receptive developers those lands that are suitable for development which would not block or impede conservation and habitat preservation efforts.

The final goal is to compare the two overlay derivative maps, one for Conservation Priority, the other for Development Suitability, creating a further echelon of map analysis revealing any conflict or inconsistency between the two primary derivative maps.
1.2.1. Conservation Priority Model

In order to clarify the concepts of the foremost goal and act as a guideline for creating the Conservation Priority Model in ArcGIS ModelBuilder, the following Data Flow Diagram was created. The conceptual model brings the selected criteria into the data flow. Then conservation appropriate rankings are applied to each criteria dataset. Next the intermediate output can be weighted to test specific scenarios. Lastly, the results are then combined via an overlay process to produce a value map for display and analysis.

Figure 1-2 Conservation Priority Conceptual Data Flow
1.2.2. Development Suitability Model

Additionally, in order to clarify the concepts of the goal and act as a guideline for creating the Development Suitability Model in ArcGIS ModelBuilder, the following Data Flow Diagram was created. The conceptual model brings the selected criteria into the data flow. Then development appropriate rankings are applied to each criteria dataset. Next the intermediate output can be weighted to test specific scenarios. The results are then combined using overlay processing to produce a value map for display and analysis.

![Data Flow Diagram](image)

Figure 1-3 Development Suitability Conceptual Data Flow
1.2.3. Fixed Point Scoring

In both of the previous conceptual data flow diagrams, there is a category titled **Weighted Total Must = 1**. This refers to the weighting technique that was selected for the Wilson Creek Wildlife Corridor Project and is known as Fixed Point Scoring.

In this technique the decision maker is required to distribute a fixed number of points amongst the criteria. A higher point score indicates that the criterion has greater importance. Often percentages are used as this is a measure with which many decision makers are familiar. The key advantage of fixed point scoring is that it forces decision makers to make trade-offs in a decision problem. Through fixed point scoring it is only possible to ascribe higher importance to one criterion by lowering the importance of another. This presents a difficult task to the decision maker which requires careful consideration of the relative importance of each criterion. Fixed point scoring is the most direct means of obtaining weighting information from the decision maker. It requires the least amount of operations to transform information supplied by the decision maker into a weights vector satisfying the requirements…

Through whatever discipline of group communication preferred by the Conservation and Development decision makers, whether it be the Delphi, quantitative, unstructured or subjective methods, fixed point scoring may then be applied to achieve appropriate criteria weighting.

Ideally, weighting processes in Natural Resource Management decision settings will allow the decision makers to specify interactively the complexity and nature of the weighting tasks. Computerized and interactive Methods of Decision Support models will have much to offer in this regard. These models provide decision makers with a dynamic interface that allows them to explore the consequences of a particular criteria weighting scenario. Through this approach a decision maker can receive instant feedback on how criteria weights will influence the subsequent ranking of alternatives. Computerized models can also provide decision makers with optional layers of complexity in the weighting tasks. This will allow decision makers to adapt weighting tasks to suit their particular needs and constraints.

This entire range of computer modeling functionality is found in ArcGIS and its ModelBuilder interface for geoprocessing. The geoprocessing tools in ModelBuilder are designed to readily accept fixed point scoring for criteria weighting. Therefore, the Wilson Creek Wildlife Corridor Project will utilize both ESRI ArcGIS ModelBuilder and fixed point scoring.
1.3. The Documentation

This document includes a description of the inputs (stimuli) into the Wilson Creek Wildlife Corridor Project implementation application, and outputs (responses) from the application as well as, the functions performed by the application. The following principles apply:

- The Database is designed to allow for storage of all required datasets;
  - Parcels, government conserved lands, privately conserved lands, threatened and endangered species, critical habitat, MSHCP Policy cells, vegetation classes, slope, roads, parcels of willing sellers, various administrative boundaries, Wilson Creek waterway, etc.
- The application allows the development of both conservation and development suitability models;
  - Representation of logic flow to assemble datasets and set criteria for analysis
- The application permits the creation of weighted overlay base-maps for both the conservation and development models;
  - Datasets were selected by the stakeholders, weighted, analyzed and thematically overlaid as part of the processing
- The application results in the generation of complete and printable maps;
  - Maps replete with legend, north arrow, and scale bar to be used in the office or field for implementation and/or presentation of decisions
- The application will produce a consistent decision model;
  - To aid the stakeholders in determining conservation and development suitability in a uniform manner.

1.4. Project Definition

For the Wilson Creek Wildlife Corridor Project, a project is defined as:

A temporary and one-time endeavor undertaken to create a unique product or service, which brings about beneficial change or added value. This property of being a temporary and one-time undertaking contrasts with processes, or operations, which are permanent or semi-permanent ongoing functional work to create the same product or service over and over again.\textsuperscript{ix}

The Wilson Creek Wildlife Corridor Project is a unique endeavor to create a methodology of benefit to conservationists in prioritizing land parcels for acquisition. The ultimate function is intended as an ongoing process by which the work of parcel prioritization for conservation and acquisition can become a regularized operation with varying user-defined input parameters. To fulfill the need of parcel prioritization for conservation purposes, the project will be formed as a complete GIS using both ArcGIS and ModelBuilder. The project will be further characterized by progressive elaboration where the understanding of the methods gained through the steps of parcel prioritization are applied to a second project stage for identifying parcels more suitable for
development, which is a critical step in achieving a workable compromise and consensus involving both developers and conservers.

Lastly, the project will involve a comparison between the models developed in each of the two Project phases (conservation and development), resulting in a supplementary analysis to identify areas of conflict between the two models.

1.4.1. Project Deliverables

- Wilson Creek Wildlife Corridor Project Geodatabase
- Conservation Priority and Development Suitability Models
- Conservation Priority and Development Suitability Maps
- Intelligent GIS for Conservation & Smart Growth Development Decision Support
- Wilson Creek Wildlife Corridor Project Report

1.4.2. Project Stages

Documentation will be carried out before, during, and after all project phases.

The Wilson Creek Wildlife Corridor Project phases are:

**Phase 1** Build a functional model in ModelBuilder to do the geoprocessing work in prioritizing land acquisition for conservation purposes on a parcel-specific basis.

**Phase 2** Build a functional model in ModelBuilder to do the geoprocessing work for determining suitability of land for development purposes on a parcel-specific basis.

**Phase 3** Compare the overlay derivative maps produced in Phase 1 and Phase 2.

1.4.3. Project Datasets

- Crucial Vegetation Communities
- Threatened & Endangered Species Critical Habitat Areas
- Government Conserved Lands
- Privately Conserved Lands
- Parcel Proximity to Roads & Highways
- Area Digital Elevation Model
- Initial Willing Sellers Parcels
- Wilson Creek Water Course & Proximity Buffers
- Parcel Boundaries
- MSHCP Cell Boundaries

1.4.4. Project Study Area

The study area is located in western Riverside County, California, generally in the Wilson Creek area, with a focus on parcels in and near the Wilson Creek stream bed. Wilson Creek courses roughly southwest beginning near the southernmost portion of the San Bernardino National Forest and emptying into Vail Lake just north of the Cleveland
National Forest (see Figure 1-4). Development along the route of this creek is sparse and intermittent. However, urban encroachment is mounting from both the Lake Riverside community to the east and the cities of Temecula and Murrieta to the west. Presently an opportunity still remains to establish a natural-condition wildlife corridor between the two National Forests into perpetuity. A natural wildlife corridor will help diminish the “island” effect engendered around the habitat of the indigenous plant and animal species when the interceding wilderness areas are eradicated by urban sprawl.

![Figure 1-4 Wilson Creek Wildlife Corridor Project Study Area](image)

**Figure 1-4 Wilson Creek Wildlife Corridor Project Study Area**

The conservation focus for the wildlife corridor is Wilson Creek from the point where several small tributary streams flow out of the national forest and join the creek north west of Lake Riverside to the point where Wilson Creek empties into Vail Lake. The creek, the parcels through which the creek passes, and the immediate neighboring parcels are of primary interest for conservation acquisition and therefore constitute the focus of the project study area.
2. Biological Communities of the Wilson Creek Area

Conservation efforts along Wilson Creek will preserve one of the most diverse areas of pristine natural vegetation found in California with a thriving mixture of chaparral, coastal sage scrub, desert scrub, grassland, Riversidean alluvial fan sage scrub, riparian scrub, woodland, and forest.

![Figure 2-1 Wilson Creek Area a Biologic Transition Zone](image)

The Wilson Creek… supports an exceptionally diverse community. This diversity stems from the position of the preserve in a transition zone between coast, mountains and desert. An unusual variant of sage scrub that contains desert species such as jojoba, Mojave yucca, and hedgehog cactus, as well as more typical sage scrub species, predominates. Patches of chamise chaparral and redshank chaparral grow along the ridges, and cottonwood woodlands and southwestern willow scrub are found along Wilson Creek.⁵
2.1. Wilson Creek Riparian Zones

A riparian zone is typically desirable as the core of a wildlife corridor due to the presence of food and shelter needed to support the area fauna. A discussion of riparian zones is given in the following.

A riparian zone is the interface between land and a flowing surface water body. Plant communities along the river margins are called riparian vegetation, characterized by hydrophilic plants. Riparian zones are significant in ecology, environmental management, and civil engineering due to their role in soil conservation, their biodiversity, and the influence they have on aquatic ecosystems. Riparian zones occur in many forms including grassland, woodland, wetland or even non-vegetative. In some regions the terms riparian woodland, riparian forest, riparian buffer zone or riparian strip are used to characterize a riparian zone. The word "riparian" is derived from Latin ripa, meaning river bank. Riparian zones may be natural or engineered for soil stabilization or restoration. These zones are important natural biofilters, protecting aquatic environments from excessive sedimentation, polluted surface runoff and erosion. They supply shelter and food for many aquatic animals and shade that is an important part of stream temperature regulation. When riparian zones are damaged by construction, agriculture or silviculture, biological restoration can take place, usually by human intervention in erosion control and revegetation… Because of their prominent role in supporting a diversity of species, riparian zones are often the subject of national protection in a Biodiversity Action Plan.
Wilson Creek is home to several riparian zones along its course. The protection of these vital riparian zones is part of the intent and benefit of creating a wildlife corridor along Wilson Creek, and is currently the focal point of conservation efforts in the area. The significance of this particular habitat to maintain the stability of the entire local ecosystem and associated microclimates along the wildlife corridor merits special consideration and focus to capture for enclosure these riparian zones to institute “functional connectivity”\textsuperscript{xii} for a sustainable living passageway.

2.2. Threatened and Endangered Species

Many species like the California Gnatcher, Slender-horned Spineflower and Quino Checkerspot Butterfly are on State and Federal Threatened and Endangered lists. Other listed species include the Stephens' Kangaroo Rat and the San Bernardino Kangaroo Rat. Some species are unique and are found only in or near the Wilson Creek area, including the Nevin’s Barberry, Rainbow Manzanita, Round Leaved Boykinia and Vail Lake Caenothus. Referring to the Center for Natural Lands Management Website, Wilson Creek supports many additional species besides the threatened and endangered ones. “In addition to the listed species... the site also supports San Diego horned lizard, orange-throated whiptail, mountain lion, Bell's sage sparrow, loggerhead shrike, rufous-crowned sparrow, and other sensitive species.”\textsuperscript{xiii}

\begin{figure}[h]
\centering
\includegraphics[width=0.7\textwidth]{Slender-horned_Spineflower_and_Nevin’s_Barberry.png}
\caption{Slender-horned Spineflower and Nevin’s Barberry\textsuperscript{xiv}}
\end{figure}

2.3. Creation of a Wildlife Corridor

According to the Australian Environmental Protection Agency, “Wildlife need to move across large areas of bush searching for food, nesting sites and mates. Corridors of vegetation linking areas of bushland are valuable as they allow movement of wildlife and also provide useful habitat in themselves.”\textsuperscript{xv}
There are many compelling reasons for the creation of the Wilson Creek Wildlife Corridor. A number of parcels in or near the creek bed are already managed by the California Department of Parks and Recreation, or by federal agencies, including the Bureau of Land Management, Fish and Wildlife Service, Forest Service, and National Park Service. The Wilson Creek and Wilson Valley Preserves that are maintained by the Center for Natural Lands Management have already been established near Vail Lake. Many land owners are also making significant contributions of their privately conserved lands to the wildlife corridor conservation effort.

**Figure 2-4 Wilson Creek & Wilson Valley Mitigation Banks (CNLM 2008)**

The Western Riverside County Multiple Species Habitat Conservation Plan calls for the conservation of up to 40,000 acres of wildlife habitat surrounding the Wilson Creek Mitigation Bank. The Wilson Creek Mitigation Bank was created to hold mitigation credits to be used to compensate for the incidental take of habitat of the federally listed threatened California Gnatcatcher and endangered Quino Checkerspot. Biological studies continue in and around the preserve to locate other threatened and endangered species.\textsuperscript{xvi}
3. Wilson Creek Geodatabase Design

The organization of any GIS project, including the Wilson Creek Wildlife Corridor, requires defining a workspace for the physical storage of both the collected project data and the resulting derivative data generated for project analysis. A geodatabase can contain nearly everything needed for a GIS project and has the advantage of being centrally administered, making it easy to maintain and to share the project data with stakeholders, and other interested parties.

A geodatabase can contain four representations of geographic data:
- Vector data for representing features
- Raster data for representing images, gridded thematic data, and surfaces
- Triangulated Irregular Networks (TINs) for representing surfaces
- Addresses and locators for finding a geographic position

A Geodatabase stores all of these representations of geographic data in a commercial relational database.\textsuperscript{xvii}

Designing a Geodatabase for the Wilson Creek Wildlife Corridor Project will help define the initial project datasets. It gives flexibility in handling many data types for future growth of additional feature data classes, custom tools, toolboxes, and scripts.

![Figure 3-1 Contents of an ArcGIS Geodatabase (ESRI 2004)](image)

A geodatabase can hold all of your project data as well as custom toolboxes. Scripts are stored in a separate system folder.

Figure 3-1 Contents of an ArcGIS Geodatabase (ESRI 2004)

A key characteristic of successful geoprocessing is organization. Knowing ahead of time where the input data is stored and where the new output datasets will be located will help expedite your workflow. You can organize your data input and output locations by using or creating workspaces, or containers for geographic data. A workspace can be a system folder, a geodatabase, or a feature dataset.\textsuperscript{xviii}
To increase efficient storage and guarantee the integrity of project and derivative data, the Wilson Creek Wildlife Corridor Project will utilize the System Folders approach. Each of the project and derived datasets are deposited in an individual Geodatabase located in its own folder. “You can work with any number of geodatabases in ArcInfo, but in certain situations grouping or splitting sets of features by geodatabase is better.” Figure 3-2 illustrates an upper level folder subdivided into a series of subfolders designed to accommodate project associated toolboxes and scripts along with the source data and derived datasets.

System folders can be used to organize multiple geodatabases, custom toolboxes, and scripts.

Figure 3-2 ArcGIS Geodatabase Storage System (ESRI 2004)

“Everything you need for your project is stored either in a system folder or a geodatabase. In this way, you can easily share either the whole project or individual pieces of it.”

3.1. Specific Requirements

This section of the current project documentation sets forth the various system interfaces (external, hardware, software, and communications) to show overall the specific requirements of the Wilson Creek Wildlife Corridor Project as a Decision Support System for both land conservation and development. Each section includes several subsections of application specific requirement details.

3.1.1. External Interface Requirements

In the future it may become necessary to assemble and host a collection of many very large land-use and land-cover datasets, requiring access to a Data Server. To collect data and disseminate information Wireless and LAN communication interfaces will be required.
3.1.2. User Interfaces

The ArcGIS 9 graphical user interfaces are not expected to require any customization for the current project. However, a custom Toolset or Toolkit may become advantageous to facilitate the decision making process.

ESRI ArcGIS 9 Graphical User Interfaces:

Interface 1. ArcCatalog for viewing and managing Geodatabases, spatial databases contain data sets that represent geographic information in terms of features, rasters, topologies, and networks. In addition the Geodatabase includes traditional attribute tables that describe the geographic objects. Many tables can be linked to the geographic objects by a common thread of key fields.

Interface 2. ArcMap is for working with maps and other views of geographic information including interactive maps, 3D scenes, summary charts and tables, time-based views, and schematic views of network relationships. Various map views of the underlying geographic information can be constructed and used as "windows into the database" to support queries, analysis, and editing of the information.

Interface 3. The ModelBuilder Toolbox is a collection of geoprocessing tools (operators) used on information objects such as datasets, attribute fields, and cartographic elements for printed maps. GIS tools are the building blocks for assembling multistep operations. A tool applies an operation to existing data to derive new data. Geoprocessing is used in virtually all phases in the development of a GIS for data automation, compilation, and data management; analysis; modeling and for advanced cartography.

All three are critical parts of an intelligent GIS and are used at varying levels in all GIS applications.
3.1.3. Hardware Interfaces

The hardware interface and platform, chosen and required by the MS GIS University of Redlands Program for the Wilson Creek Wildlife Corridor Project GIS, is the Dell Precision M60 Mobile Workstation, and includes:

- Microsoft® Windows® XP Professional Operating System
- Intel® Pentium® M Processor 714 (1.40 GHz, 2MB L2 Cache)
- Intel Centrino™ mobile technology
- NVIDIA® Quadro™ FX Go1000 graphics card with 128MB of DDR memory
- 15.4” UltraSharp™ Wide Aspect display
- Communications include 56 Kbps V.92 modem (integrated), 10/100/1000 Ethernet (integrated) LAN Dell Wireless LAN (standard) and Intel® PRO Wireless LAN
- Integrated SmartCard Reader
- Dell Tri-Metal™ Chassis
- A/C adapters.
3.1.4. Software Interfaces

ArcGIS 9 software requires a Microsoft Windows operating system. Windows XP, Windows 2000, Windows NT (Service Pack 6a) are compatible versions. Criterion Decision Plus (CDP) analysis software may also be incorporated in a future enhancement of this application as an immediate decision feedback mechanism for proposed criteria values and weighting. Output from ArcGIS 9 and Model Builder can be input into CDP and readjusted to support consideration of various scenarios, allowing the user to progressively select more favorable weight and values sets, and generate additional iterations of the Wilson Creek Wildlife Corridor Project application to further refine suitability model outputs both to test acquisition scenarios and to track suitability changes over time. See chapter 9 Future Enhancements for more information on CDP.

3.1.5. Communications Interfaces

Although the Wilson Creek Wildlife Corridor Project will be capable of full functionality on a standalone desktop or laptop computer, access to a file server is advantageous, due to the large size of many of the datasets and the need to maintain updated records of the various weighting schemes used in the decision model. A few of the most relevant decision criteria datasets may contain sensitive information requiring password protection. Security for decision support modeling may prove crucial in conducting actual negotiations for land purchases. It is also preferable that the computer has wireless and LAN communication interface network hardware cards.

3.2. Functional Requirement Specifications

This subdivision is organized into several sections to illustrate the major participants in building the wildlife corridor and some of their primary functions as an Overall Conceptual Description of the GIS. Each section holds several subsections of functional requirements for the application.
Figure 3-4 Functional Requirements Overall Conceptual Description
<table>
<thead>
<tr>
<th>Use Case</th>
<th>Wilson Creek Multiple Species Habitat Conservation Plan Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>High-level</td>
</tr>
<tr>
<td>Summary</td>
<td>Numerous issues motivate the need for an implementation model in the Wilson Creek area of southwestern Riverside County. The model will provide a comprehensive methodology for implementation of the MSHCP, with a special focus on Wilson Creek natural resources.</td>
</tr>
<tr>
<td>Participants</td>
<td>County Board, Conservator, Developer, Protector/Monitor</td>
</tr>
<tr>
<td>Preconditions</td>
<td>The area is experiencing rapid growth as urban development extends eastwards from the communities of Temecula and Murrieta. The Wilson Creek area contains many unique Biological resources.</td>
</tr>
<tr>
<td>Post-conditions</td>
<td>Smart growth planning principles have formed the basis for the MSHCP to formulate programs to define and accommodate urban development while conserving sensitive resources.</td>
</tr>
<tr>
<td>Description</td>
<td>Using a Geographic Information System to analyze areas most suited for development and prioritize other areas for conservation feasibility. The Wilson Creek MSHCP Implementation Model will also be used as a guideline for implementation throughout the Western Riverside County Environmental Programs Department MSHCP.</td>
</tr>
</tbody>
</table>

**Figure 3-5 Functional Requirements High Level Use Case Description**
3.2.1. User Class 1

A person, organization, or group acting as Protector/Monitor for the Wilson Creek Wildlife Corridor will be able to share information derived from the GIS application with County Board members and others (see Figure 3-6) to safeguard and/or enhance conservation intents and purposes.

<table>
<thead>
<tr>
<th>Use Case</th>
<th>Monitor Habitat and Density Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Business level</td>
</tr>
<tr>
<td>Summary</td>
<td>Will provide the basis for further refinement of cell criteria detailed on the MSHCP, and generate a suite of planning tools and options for developers, conservationists, and other stakeholders in the plan area.</td>
</tr>
<tr>
<td>Participants</td>
<td>Protector/Monitor, County Board</td>
</tr>
<tr>
<td>Preconditions</td>
<td>Conservation Priority Model and Development Suitability Model must already exist</td>
</tr>
<tr>
<td>Post-conditions</td>
<td>MSHCP appropriate decisions are implemented for conservation acquisitions and land development</td>
</tr>
</tbody>
</table>

**Figure 3-6 User Class 1 Functional Requirements**

- Overlay Conservation Priority Model with Development Suitability Model;
- Acquire weighted values from participants, implement selected modeling scenarios;
- Create a poster depicting model design;
- Present enhanced decision support model to planners and other stakeholders;
- Present enhanced decision support model to the Riverside County MSHCP Board;
- Ensure proper project documentation.
3.2.2. User Class 2

Conservationists will use the GIS application to consider multiple criteria essential for building a wildlife corridor, vary the significance of each, determine appropriate priorities of action and parcel acquisition (see Figure 3-7) to preserve targeted species and resources.

<table>
<thead>
<tr>
<th>Use Case</th>
<th>Identify Conservation Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Business level</td>
</tr>
<tr>
<td>Summary</td>
<td>Emergent GIS technology will promote the principles of conservation biogeography with regard to special status species regulated by the State of California.</td>
</tr>
<tr>
<td>Participants</td>
<td>Conservator</td>
</tr>
<tr>
<td>Preconditions</td>
<td>The Wilson Creek area contains many unique biological resources and the opportunity exists to establish an important natural open space corridor for target resources.</td>
</tr>
<tr>
<td>Post-conditions</td>
<td>Habitat is established for protecting multiple endangered species in perpetuity</td>
</tr>
</tbody>
</table>

Figure 3-7 User Class 2 Functional requirements

- Assess data needs;
- Acquire needed datasets;
- Compile acquired datasets;
- Apply planning values;
- Construct GIS application;
- Present conservation priority model to planners and other stakeholders;
- Ensure proper project documentation.
### 3.2.3. User Class 3

Conservationists may use the GIS application to consider area parcels suitable for development that do not hinder creation of a wildlife corridor or serve other conservation purposes (see Figure 3-8), and then share this information with conservation-friendly developers.

<table>
<thead>
<tr>
<th>Use Case</th>
<th>Demonstrate Development Suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Business level</td>
</tr>
<tr>
<td>Summary</td>
<td>A development suitability model will be constructed in a GIS, using planning criteria, such as slope, access to roads and infrastructure, availability of water, existing parcels, and compatibility with local and county plans.</td>
</tr>
<tr>
<td>Participants</td>
<td>Conservator, Developer</td>
</tr>
<tr>
<td>Preconditions</td>
<td>The area is experiencing rapid growth as urban development extends eastwards from the communities of Temecula and Murrieta.</td>
</tr>
<tr>
<td>Post-conditions</td>
<td>Implementation of the MSHCP by offering incentives for directing growth and development of communities in question, while streamlining the environmental review process.</td>
</tr>
</tbody>
</table>

**Figure 3-8 User Class 3 Functional Requirements**

- Assess data needs;
- Acquire needed datasets;
- Compile acquired datasets;
- Apply planning values;
- Construct GIS application;
- Present development suitability model to planners and other stakeholders;
- Ensure proper project documentation.
3.2.4. User Class 4

When parcel acquisitions are made for conservation, the immediately adjacent parcels become more appropriate as potential additions to the Wilson Creek Wildlife Corridor. This necessitates a reevaluation of the area’s biological resources to prioritize further acquisitions (see Figure 3-9).

<table>
<thead>
<tr>
<th>Use Case</th>
<th>Change of Land Ownership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Business level</td>
</tr>
<tr>
<td>Summary</td>
<td>As conservation and development decisions are implemented iteratively, Parcel Ownership transfers and MSHCP cell values change dynamically. Density transfers change potential values.</td>
</tr>
<tr>
<td>Participants</td>
<td>County Board, Conservator, Developer</td>
</tr>
<tr>
<td>Preconditions</td>
<td>MSHCP cell criteria and density values are maintained in the current iteration.</td>
</tr>
<tr>
<td>Post-conditions</td>
<td>Changes to parcels MSHCP cell criteria and density values are stored in the system and made available for further scenario modeling and decision support.</td>
</tr>
</tbody>
</table>

**Figure 3-9 User Class 4 Functional Requirements**

- Update conservation acquisitions MSHCP Cell criteria;
- Update development density MSHCP Cell values;
- Feedback updates are applied to data, models and the application;
- Ensure proper project documentation.

3.3. Performance Requirements

The static and the dynamic numerical requirements for the Wilson Creek Wildlife Corridor GIS DSS application for the user interface include:

(a) One terminal initially with the possibility of expanding to several additional server terminals;
(b) One user to be supported during the design and development of the project, with possibility for additional users being added at a later date;
(c) Information that might include feature classes, rasters, topologies, networks, attribute tables, survey data, and other datasets that are supported by the ESRI Geodatabase interface;
(d) Numerous data sets provided by many different organizations.

Therefore, it is important for GIS data sets to be:

- Simple to use and easy to understand;
- Compatible with other geographic data sets;
- Effectively compiled and validated;
- Clearly documented for content, intended uses, and purposes.
Dynamic numerical requirements may include:

(a) The number of transactions and tasks;
(b) The amount of data to be processed within certain time periods;
(c) The normal and peak workload conditions.

All of these dynamic numerical requirements are yet to be determined in measurable terms. Volume should increase dramatically with acceptance of the methodology by a diverse user community.

3.4. Design Constraints

Application development will be in ArcGIS 9; ArcGIS extensions may be added. The Model Builder environment will be used in conjunction with ArcCatalog and ArcMap for a broad range of support for the Wilson Creek Wildlife Corridor Project decision models. Several ArcGIS extensions are available, including Spatial Analyst and Tracking Analyst that may potentially augment the Wilson Creek Wildlife Corridor GIS capabilities. However, no ArcGIS extensions will be integrated into the present project plan. ArcGIS 9 requires a Microsoft Windows Operating System and a minimum 800 MHz Processor.

3.5 Additional Requirements

There are no additional requirements at this time, however, when other requirements are recognized as necessary, they will be added to this section of the Wilson Creek Wildlife Corridor Project documentation.
4. The Overall Description

The Wilson Creek Wildlife Corridor Project is a pilot application designed to serve as a decision support system for conservationists to prioritize land conservation acquisitions in establishing a wildlife corridor along Wilson Creek. After successful implementation, the system will become available to conservationists for future use throughout Western Riverside County and eventually throughout all of Riverside County. The project system will work equally well to identify lands suitable for development that do not infringe upon or compromise conservation goals for cooperative environmentally-aware developers and prioritize parcels for acquisition in building a wildlife corridor for conservationists. The project will be divided into a two-part work plan to minimize risk. The GIS application will accumulate functionality, sophistication and complexity as progress is made through the project life cycle and the models grow and change over time.

4.1. The Project Description

This project is being conducted in two iterations for overlay and rectification. This overarching approach is intended to identify and resolve conflicts that the project system may have uncovered. The successive iterations incorporate the lessons, skills, and technology developed in the preceding stage. Ultimately, future projects involving two or even more iterations may be found to be advantageous.

4.2. Product Perspective

For planning purposes, the two parts of the Wilson Creek Wildlife Corridor Project are:

1. Completion of the development suitability and conservation priority models.
2. Presentation and demonstration of Model viability in setting priorities for land acquisition for either conservation or development purposes.

4.2.1. Product Prospective

For future project purposes, several prospective enhancements to the Wilson Creek GIS project are:

1. Create decision support system for evaluating density transfer deals and constructing alternative options.
2. Construct a system for periodic monitoring of conserved land values.
3. Package a Transaction Processing System with the GIS-based DSS to allow evolution of values, and to track changes while conducting density transfers as individual parcels are developed or conserved over time.

4.2.1.1. System Interfaces

The Wilson Creek Wildlife Corridor Application will be developed in the ESRI ArcGIS 9 Graphical User Interface (GUI) environment, comprised of three distinct GUls:
- ArcCatalog for viewing and managing geodatabases;
- ArcMap for exploring geographical information and generating cartographic products;
- Model Builder and ArcToolbox for performing all geoprocessing and modeling.

4.2.1.2. Other Interfaces

No other interfaces are incorporated into the project plan at this time. However, several ArcGIS Extensions are available from ESRI that can and most likely will be recommended for use in concert with the Wilson Creek Wildlife Corridor Project in ArcGIS 9 in the near future, such as the Spatial Analyst, 3-D Analyst, and Tracking Analyst Extensions to ArcGIS.

4.2.1.3. Hardware Interfaces

ArcGIS 9 software on a Desktop PC or Laptop requires an 800 MHz Processor and 256 MB RAM, 800 MB hard disk space, including 50 MB on the Operating System drive. More hard disk space may be needed if generating raster data is required.

4.2.1.4. Software Interfaces

The Wilson Creek Wildlife Corridor Application will require the following compatible software interfaces to perform data analysis:

- Microsoft Windows XP Professional;
- ESRI ArcGIS 9.

4.2.1.5. Communications Interfaces

It is preferable that the desktop or laptop computer running the Wilson Creek MSHCP application have a LAN communication interface network hardware card to access a data server for large and protected datasets. Occasionally, wireless access may prove sufficient and convenient.

4.2.1.6. Memory Constraints

The minimum required RAM for operating the required software and associated applications is 256 MB, but an increase to 1 GB will improve operating time and efficiency, particularly for raster processing. Likewise, the minimum hard disk space of approximately 1 GB should be increased to 4 or 5 GB. Many of the datasets are quite large due to their land-use and land-cover nature, while others can be small point data files.
4.2.1.7. Operations

The Application operations will supply effective and efficient Conservation and Development decision information. Decision makers will be able to access several types of land, infrastructure, and habitat datasets. Selected datasets can be assigned values and weighted according to spatial location and conditional factors. Variables can be adjusted for consequent iterations and the resulting suitability information can be either hardcopy or electronically formatted (softcopy).

4.2.1.8. Site Adaptation Requirements

No site adaptation requirements are anticipated at this time. However, a wireless and/or LAN Network can be added, if necessary.

4.2.2. Product Functions

The Wilson Creek MSHCP decision implementation application will carry out the following tasks:

1. Manage selected datasets;
2. Accept user defined criteria for input;
3. Overlay weighted data;
4. Run and validate ModelBuilder scenarios;
5. Accommodate ArcGIS 9 Extensions for wide-ranging supplementary decision modeling;
6. Output data in tabular format, both electronic and hardcopy;
7. Output data in map format, both electronically and hardcopy.

4.2.3. User Characteristics

The users have expert experience with environmental administration, threatened and endangered species, habitat, land conservation, development, and management. They will select datasets for analysis and postulate criteria, values, and theme weights, then view results to determine the need and course for further evaluation or action. The system allows users to save specific scenarios and create associated maps depicting those scenarios. Users are not required to possess extensive GIS skills. An analyst with GIS knowledge will be required to track, update and maintain changes to the input datasets, especially with a possible future integrated TPS support package. The users have expressed interest in acquiring and being trained in the use of ESRI ArcExplorer, a GIS Data Viewer which would allow for both online and Web-based remote access and usage.
4.2.4. Constraints

Following is a brief excerpt describing software project constraints from SoftwareProjects.org.

**Project Constraints**

Whatever you have to create, whatever the reason for the project may be, there will always be constraints set for the project. These conditions determine the space in which the project organization may operate…

Project constraints consist of the following elements:

- **Cost**: This includes everything that costs money, like people and equipment.
- **Time**: What is the time frame in which every activity should take place?
- **Quality**: What is the level of quality the project has to reach?

Constraints are not independent from each other. Reaching a higher level of quality will cost you more money. If you want to use less time, you need more people… The point I’m trying to make is that **constraints are interdependent**.

A classic way to show this interdependence is through use of the Project Constraints Triangle, or Iron Triangle. Imagine a 3-D space where the x-axis represents the amount of cost, the y-axis the amount of time, and the z-axis the level of quality for the project.

The project is represented by a triangle within this 3-D space. The size of a project is displayed as the square of the triangle. The size is determined by complexity and the amount of the product to realize. As you might understand, quality is a product requirement, and size can be viewed as the scope of the project.
A project with a constant size can have altering constraints. However, altering one constraint has influence on the others because the square of the triangle stays the same. The constraints are reflections of the stakes of the customer, but keep in mind that regardless of how boldly the constraints are stated by the customer, they are requirements, not stakes, so there is room for some negotiation. Playing with the aspects of the project triangle (including size) may also satisfy the stakes of the customer and therefore are more likely to be accepted.\textsuperscript{xxii}

The doctrine described in the previously mentioned software project constraints demonstrate that cost, time, and money are interdependent, requiring adept and practical management skills.

4.2.5. Assumptions and Dependencies

The primary project dependency is the data availability from the archives of the Redlands Institute, and to a lesser degree, the Dangermond Group, especially for the early phase of the project. There is a secondary dependency on the membership of the Wilson Creek conservation implementation planning and development group to provide the initial criteria, review the progress of the GIS DSS for the project area, and participate in Delphi weighting surveys if deemed desirable. The survey results can then be readily converted to the Fixed Point Scoring percentages of 1 for adjustments to model weighting.
5. Project Datasets and Selection Criteria

The following datasets have been selected for the Wilson Creek Wildlife Corridor Project based on the interests of both conservationists and developers, representatives of both sets of stakeholder being present during the original organizational meetings. Other available datasets are excluded because they were of interest to only one party. These unused datasets can be utilized in the future to tailor individual models to suit a particular client. The same data will be used for the Wilson Creek Wildlife Corridor Project as a base set of inputs for both the Conservation Priority ModelBuilder model and the Development Suitability ModelBuilder model so as to not skew the results towards one side or the other. The differences between conservation and development values represented by land characteristics plus the degree of significance for the information are applied to each model. This creates a variety of ranking values in the datasets for each model. The weighting formula of the models was also varied depending on the conservation or development need to be fulfilled. The use of identical datasets for both models is intended to allow the use of a single Geodatabase to store the project data. Another Geodatabase can be maintained to store the derivative data, thus simplifying the data management aspect and enhancing the overall manageability of the project.

5.1. The Wilson Creek Area Land Cover

At this point in the Wilson Creek Wildlife Corridor Project, the only land cover of special interest is the Riversidean Sage Scrub, since it is the favored habitat of the California Gnatcatcher and Quino Checkerspot Butterfly. The California Gnatcatcher has been selected to represent threatened and endangered species for the project. However, the Quino Checkerspot Butterfly critical habitat and other important land cover types can be added at client request to the project to make the models more representative of the entire MSHCP program.

5.1.1. Crucial Vegetation Communities

The importance of vegetation is a primary consideration as stated by the Center for Natural Lands Management, “The primary management goal on the Wilson Creek Mitigation Bank is to support viable populations of the California Gnatcatcher and Quino Checkerspot. Since Riversidean Sage Scrub is the preferred habitat of these species, a healthy sage scrub community must be maintained.”

Figure 5-1 California Gnatcatcher and Quino Checkerspot Butterfly

Figure 5-1 California Gnatcatcher and Quino Checkerspot Butterfly

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5.1.2. Threatened and Endangered Species Zones

The California Gnatcatcher (Figure 5-2) dataset represents one of many threatened and endangered species well documented throughout the Wilson Creek Wildlife Corridor Project study area. Protection and preservation of Gnatcatcher habitat is a priority for conservationists. Development can eliminate this critical habitat; the loss of habitat is a serious and potentially costly concern for developers and conservationists alike. Conservationists are concerned due to likely species loss; developers are concerned, on the other hand, for potential constraints on construction on other lands desirable for development that would now be prohibited by MSHCP constraints. The Wilson Creek Wildlife Corridor will aid conservationists in safeguarding a portion of the California Gnatcatcher and Quino Checkerspot habitat for posterity and potentially assist with mitigating the loss of habitat through development.

![Figure 5-2 Wilson Creek Area California Gnatcatcher Habitat](image)
5.1.3. Government Conserved Lands

This dataset represents the Government Managed Lands in the Wilson Creek Wildlife Corridor study area. The two national Forests provide anchor points for the creation of a wildlife corridor, and are displayed in relation to Wilson Creek (see Diagram 5-3). Eventual linking of the San Bernardino National Forest and the Cleveland National Forest is the prime objective in developing this wildlife corridor.

Figure 5-3 Wilson Creek Area Government Managed Lands
5.1.4. Privately Conserved Lands

Several parcels are already privately conserved in the Wilson Creek area, and are important in building the Wilson Creek Wildlife Corridor (see Figure 5-4). Together with the government managed lands in the study area, these publicly and privately conserved parcels form a basis for constructing the wildlife corridor.

Figure 5-4 Wilson Creek Area Privately Conserved Parcels
5.1.5. Parcel Proximity to Roads and Highways

Proximity to nearby roads reduces the development cost of a parcel. Few and/or no roads near a parcel may indicate land in a more pristine, natural condition, which is preferred for conservation (see Figure 5-5). The actual condition will require verification by other means, such as an onsite inspection or validation through use of aerial imagery. The proximity to road, therefore, depending on whether they are to be used for conservation or development purposes, sets up a wide disparity in the values and weights applied to this dataset for the corresponding ModelBuilder models. Roads also provide additional landmarks for orientation and feature recognition in using the map. The significance of roads for both conservation and development necessitates the inclusion of a roads and highways data layer in the current project.

Figure 5-5 Wilson Creek Area Roads and Highways
5.1.6. Area Digital Elevation Model

The DEM for the Wilson Creek study area is not essential to conservation decisions at this time, but can be important for development purposes. The natural slope on a parcel is a development consideration and this dataset can be applied to future development models (see Figure 5-6). In general, development on lands with greater than 25% slope are considered undesirable, due both to general planning prohibitions against constructions on a steep slope and to increased cost during development that is required to “terraform” an area prior to construction both to make roads and build structures.

Elevations may also prove useful for recreational improvements, such as a nature center or ranger station once the land is conserved. This dataset is included in the project for visual enhancement of the basemap, allowing the user to determine the direction of water flow.

Figure 5-6 Wilson Creek Area Digital Elevation Model
5.1.7. Initial Willing Sellers Parcels

Knowing which parcels are owned by willing sellers is advantageous to conservators and developers (see Figure 5-7). A brief list of Wilson Creek study area parcels held by owners willing to sell at the time of project inception is included in the Wilson Creek Wildlife Corridor Project for consideration of use when combined with parcel geometry.

Figure 5-7 Wilson Creek Area Parcels of Willing Sellers
5.1.8. Wilson Creek Water Course and Buffers

The water course of Wilson Creek acts as a centerline and a focus for the Wilson Creek Wildlife Corridor Project. This dataset provides a visual reference for the spatial relationship of the creek to the surrounding parcels under consideration. "Everything is related to everything else, but near things are more related than distant things." In this case, parcels near the creek are more appropriate for conservation in building a Wildlife corridor than distant parcels. To that end, 500m, 1000m, and 1500m buffers are displayed along with Wilson Creek (see Figure 5-8) to assist in identifying parcels with favorable proximity to the watercourse.

Figure 5-8 Wilson Creek Study Area Buffers
5.2. The Wilson Creek Area Administrative Boundaries

Two administrative boundaries, both applicable to conservation and development, are incorporated in the initial datasets of the Wilson Creek Wildlife Corridor Project. One is the boundary of the Multiple Species Habitat Conservation Plan (MSHCP) and the other administrative boundary dataset is of the Wilson Creek area parcels.

5.2.1. Area Parcel Boundaries

The Wilson Creek Area Parcel Boundaries will be used to determine if a given parcel is favorably adjacent to already conserved lands and to indicate changes in adjacency once additional parcels are conserved (see Figure 5-9). The Assessors Parcel Number (APN) is also associated with each parcel to identify selected parcels and facilitate acquisition proceedings. The geographic extent of any Wilson Creek area parcel can easily be accessed for consideration.

Figure 5-9 Wilson Creek Area Parcel Boundaries
5.2.2. MSHCP Cell Boundaries

The Wilson Creek MSHCP Plan Area cell grid is included for identifying in what MSHCP cell or cells a selected parcel lies within. Each MSHCP cell has been given its own development density and conservation value in accordance with the Western Riverside County Multiple Species Habitat Conservation Plan developed and applied by the County of Riverside Environmental Programs Department (EPD). The potential exists for the creation of a custom toolset specifically to track changes in the development density and conservation values as they are brokered over time. The MSHCP is a broad-reaching action plan designed to mitigate the damage done to critical habitats for species on state and federal threatened and endangered lists by development throughout Riverside County (see Figure 5-10).

The MSHCP cells correspond to certain Public Land Survey System (PLSS) quarter sections. Not all PLSS quarter sections have designated MSHCP values. Only those with assigned values are included as cells in the MSHCP data layer. The labels in Figure 5-10 are the PLSS Township and Range identification for each quarter section in the study area.

The focus of the Wilson Creek Wildlife Corridor Project is to prioritize parcels for potential conservation acquisition and presently has no direct relationship to the Western Riverside County MSHCP. The MSHCP Cell Grid is included for the convenience of conservationists to overlay a derivative parcel map. Identifying the Cell in which a high priority parcel is located has been used to facilitate obtaining related MSHCP policy information for that parcel.
6. Wilson Creek Wildlife Corridor ModelBuilder Models

The models for the Wilson Creek Wildlife Corridor Project are primarily intended to assist land conservation decision makers and wildlife ecosystem managers to prioritize parcels for acquisition and conservation in establishing a protected wildlife corridor along Wilson Creek. A similar model will serve conservationists working with developers to demonstrate alternative Wilson Creek area parcels suitable for development that do not impede these conservation goals. This cooperation may encourage other land developers to more fully comply with Riverside County MSHCP conservation goals, rather than trying to legally circumvent them in their development proposals.

Managers make decisions...Good managers make good decisions, but what constitutes a good decision-making process?...Decisions affect the future...This is where modeling enters the decision process. A wildlife manager can no more make a defensible decision without a formal model than somebody in the business world can make a deal without “running the numbers.”

There are two prevailing approaches to the creation of models and the purpose for which models are created. The first is an assumption that a model is a representation of scientific truth or a precise depiction of reality. The other paradigm presents the model as an experimental tool for solving a specific problem. The models for the Wilson Creek Wildlife Corridor Project will be designed as problem-solving tools for both the Conservation Priority and the Development Suitability models to achieve a purposeful representation. “It is more useful to think of a model as a hypothesis, an experiment or even a problem-solving tool. A good definition of a model in these terms is ‘a purposeful representation’ (Starfield et al., 1994).”

Creating small models as problem-solving tools is also a cost efficient method of processing data for analysis. Data can often be expensive to collect, especially when using an inflexible, one-of-a-kind, standalone software product which requires extensive training to obtain any useful results. “If it is worth spending the resources to collect the data, surely it is worth spending far less to build a model. One nearly always learns something from the exercise.”

Creating a wildlife corridor to preserve critical habitats for threatened and endangered species along several miles of creek requires extensive data holdings covering a large area over a long period of time. Modeling is perhaps the best tool available to fulfill the purposes of conservation and development decision makers alike. “Ecosystem management is usually concerned with large spatial areas and long time periods. Obviously, there is no way to begin to understand the likely consequences of management actions on these spatial and temporal scales without modeling.”

The following sections of this chapter describe the project models that were created with the ModelBuilder tools of ArcGIS.
6.1. ModelBuilder Geoprocessing Advantages

ModelBuilder is an efficient tool for managing large geoprocessing tasks that does not require extensive programming skill.

What is a model?
In general terms, a model is a representation of reality. A model represents only those factors that are important to your work flow and creates a simplified, manageable view of the real world. In ArcGIS, a model is displayed as a model diagram. You automate your work flow by stringing processes together in the model diagram that will execute in sequence when the model is run.xxxii

ModelBuilder was designed to be a more user-friendly geoprocessing interface by creating task-specific model diagrams using symbols for data and geoprocessing tools. The symbols are linked together and the model is run to create new derivative data. Creating model diagrams in ModelBuilder provides the GIS user with extensive geoprocessing capability without using scripts or command line code, which can mandate that the user possess additional programming skills. The Model’s geoprocessing tasks can be readily repeated and the model, including its data and tools, easily shared.

The ModelBuilder interface, new to ArcGIS at version 9, provides a graphical framework for designing and using geoprocessing models that can include tools, scripts, and data. Models are process flow diagrams that link together tools and data to create advanced procedures and work flows. ModelBuilder also provides a mechanism for sharing methods and procedures with other GIS users. The complete model (excluding input data) is saved as a single XML file. The entire model—model diagram, properties, and model metadata—can be shared with other users.xxxiii

Once a ModelBuilder model is created, it can then be easily modified, updated, or otherwise adapted to meet changing geoprocessing needs.

Why build models?

Building a model helps you manage and automate your geoprocessing work flow. Managing processes and their supporting data can be difficult without the aid of a model. A sophisticated model contains a number of interrelated processes. At any time, you may add new processes, delete existing processes, or change the relationships between processes. You may also change assumptions or parameter values, for example, replace old datasets with newer ones, or consider alternative scenarios in which input factors are prioritized differently. Building a model helps you manage this complexity in a number of ways:
• It makes processes and the relationships between processes explicit, and the model you create is dynamically updated whenever a change is made.

• It lets you set values for the parameters of each tool, and it records this information, making the model output easily reproducible.

• It lets you edit the structure of the model by adding and deleting processes or changing the relationships between the processes.

• It lets you edit the parameter values defined for tools to experiment with alternative outcomes.  

ModelBuilder also is able to incorporate preexisting methods of geoprocessing into the ModelBuilder model diagram format for extending the life of older models and improving the likelihood of greater distribution and sharing.

ArcInfo has undergone significant interface and data management changes. AML has been replaced as the main programming language for tool development with other languages such as Visual Basic or Python. Consequently, new GIS users are not familiar with AML, which has limited its use…The advantages of using ModelBuilder are many. Like in AML and other programming languages, ModelBuilder automates processes. However, it does not require programming. Models are easily created in ArcToolbox, and existing models can be customized by any user. In addition, ModelBuilder works with both vector and raster data files. Users can create documentation for each process and have easy access to help files.

ModelBuilder allows access to data and software from previous versions of ArcInfo for GIS users with command line expertise. Within ModelBuilder older geoprocessing models and tools can be revamped, customized and updated for current needs and changing uses. The diagrams and help files provided with ModelBuilder also improve user understanding of the models and the results.

6.2. Models for Data Preparation

Several of the datasets selected for use in the conservation and development models require some degree of preparation for the geoprocessing tools to accept them and function properly. The data preparation is accomplished through use of small, focused models following the concepts clarified by Anthony M. Starfield in “A Pragmatic Approach to Modeling.” This has the additional benefit of keeping the primary conservation and development models accessible to all levels of users. The data preparation models are described in this chapter of the project report; they have also been included in the Wilson Creek Geodatabase for reference when future supplementary datasets will be added. As Starfield adroitly declared in 1997, “One can safely predict that software will make it easier to develop and to implement models. One can also safely
predict that small, pragmatic models will become part of the everyday experience of wildlife professionals.}

6.2.1. Wilson Creek Study Area 2000 Meter Buffer

The user dialogue box of the model for creating a 2000 meter study area around Wilson Creek is displayed in Figure 6-1 below.

![Wilson Creek Study Area 2000 Meter Buffer User Dialogue Box](image)

**Figure 6-1 Wilson Creek Study Area 2000 Meter Buffer User Dialogue Box**

The Wilson Creek study area buffer model (see Figure 6-2) was initially intended to identify parcels within 1500 meters of Wilson Creek. However, many aspects of the study benefit from expanding the region of parcels considered to include all within a 2000 meter buffer. A 2000 meter buffer of Wilson Creek actually overlaps the northern end of the planned anchor point at the San Bernardino National Forest for the wildlife corridor by more than 200 meters. It also extends approximately 500 meters beyond the Cleveland National Forest as the expected southern anchor, providing continuity in parcel coverage while attempting to build a wildlife corridor.
The study area remained clear of the influences of California State Highway 371 (Cahuilla Road) and California State Highway 79 by more than 50 meters at any point (see Figure 6-3). The need for an onsite field study for the best locations for wildlife to cross Highway 79 became apparent in the early stages of the project. The parcels south of Wilson Creek near Vail Lake are separated from the Cleveland National Forest by California State Highway 79. The northern edge of the Cleveland National Forest extends to State Highway 79.
Parcels located within a 2000 meter buffer area will be considered for conservation acquisition (see Figure 6-3). The project datasets will be clipped to the Wilson Creek study area 2000 meter buffer to better focus geoprocessing to parcels in the immediate vicinity of the projected wildlife corridor along Wilson Creek.

Figure 6-3 Wilson Creek with 2000 Meter Buffer
6.2.2. Wilson Creek California Gnatcatcher Habitat

The user dialogue box of the model for creating the union between California Gnatcatcher habitat and Wilson Creek study area parcels is displayed in Figure 6-4.

![Figure 6-4 Wilson Creek Parcels with California Gnatcatcher Habitat User Dialogue Box](image)

In order to create a dataset of Wilson Creek parcels designated to also be part of the California Gnatcatcher critical habitat, the project data is clipped by the previously created Wilson Creek study area buffer in the Gnatcatcher habitat model (see Figure 6-5).
The intermediate datasets are then brought together using the Union Tool, which results in a study area-specific layer of Wilson Creek parcels with associated Riversidean Scrub Sage, preferred for its Gnatcatcher Habitat-favoring characteristics (see Figure 6-6). This dataset can now be utilized in the conservation and development models and given values accordingly. A high value is assigned to the conservation model for these parcels that favor the Gnatcatcher by targeting the parcels as highly recommended for acquisition, and a low value provided to the development model in order to avoid further destruction of threatened and endangered species critical habitat and to avoid the MSHCP-required mitigation costs.
6.2.3. Wilson Creek Study Area Parcels Proximity to Roads

A model was produced to prepare a dataset of Wilson Creek parcels that identifies the distance to the nearest major road. This model clips the Wilson Creek parcels to the study area as well (see Figure 6-8). The model then generates a “centroid” for each parcel in the study area. After the centroids have been generated, the distance to the nearest road from each study area parcel centroid is measured. The intermediate data table with near distance to road attributes is next joined to the Wilson Creek study area parcels. The derived dataset can now be accordingly valued for either conservation or development purposes. Proximity to roads is desirable for development, but not desirable for conservation. Roads serve to fragment critical habitat, which leads to habitat degradation and species loss.

Generating a centroid for each parcel in the Wilson Creek Wildlife Corridor Project study area will provide a single point of reference to represent the parcel so that a Euclidean distance to the nearest point of the creek or a road may be obtained, measured and ranked for proximity by the model. Polygon centroids are often used in GIS for analytical purposes such as distance measurements to other features. “The effect
of such assignment is to assume that the variable of interest is well approximated by assigning values to a single point”.

The user dialogue box of the model for adding the attribute of distance from the nearest road to each of the Wilson Creek study area parcels is displayed in Figure 6-7 below.

![Figure 6-7 Wilson Creek Parcels Distance to Roads User Dialogue Box](image)

![Figure 6-8 Wilson Creek Parcels Road Distance Model](image)
The newly acquired relationship between the Wilson Creek study area roads and the distance to the centroid of the study area parcels is apparent in Figure 6-9 below.

Figure 6-9 Wilson Creek Study Area Parcels Proximity to Roads
6.2.4. Wilson Creek Parcels Distance from Creek

The user dialogue box of the model for adding an attribute identifying the distance of the parcel from Wilson Creek to each of the study area parcels is displayed in Figure 6-10 below.

![Figure 6-10 Wilson Creek Parcels Distance to Creek Dialogue Box](image)

A model was produced to prepare a dataset of Wilson Creek parcels that identify the proximity or distance to the creek bed (see Figure 6-11). This model also clips the Wilson Creek parcels to the study area. The model then generates a centroid for each parcel in the study area. After the centroids have been generated, the distance to the creek from each study area parcel center point is measured, similar to what was done versus the roads.
The intermediate data table with the distance to the creek attributes is next joined to the Wilson Creek study area parcels. The derived dataset can now be accordingly assigned values for either conservation or development purposes. The correlation between Wilson Creek and the distance to the centroid of the study area parcels is evident in Figure 6-12.
6.2.5. Wilson Creek Parcels Adjacent to Privately Conserved and Gov. Lands

The user dialogue box of the model for clipping the Privately Conserved and Government Lands dataset to the Wilson Creek study area is displayed in Figure 6-13 below.

![Figure 6-13 WC Adjacent to Privately Conserved and Gov. Lands Dialogue Box](image)

The project data for the Wilson Creek parcels adjacent to privately conserved and government lands required clipping to the study area in preparation for use in the conservation and development models. To perform this geoprocessing task, a model was created (see Figure 6-14). The conservation and development models will yield planning values for the parcels, which are consequent to either conservation or development ranking purposes, as outlined previously for the other models. Different weighting schemes can then be applied and tested.
Figure 6-14 Wilson Creek Parcels Adjacent to Conserved and Gov. Lands Model

Parcels adjacent to privately conserved and government lands are shown clipped to the study area boundary in Figure 6-15.

Figure 6-15 WC Study Area Parcels Adjacent to Conserved and Government Lands
6.3. Model for Conservation Priority

The user dialogue box of the Conservation Priority model for the Wilson Creek Wildlife Corridor study area is displayed in Figure 6-16 below.

![Figure 6-16 Wilson Creek Conservation Priority User Dialogue Box](image)

Each section of the Wilson Creek Conservation Priority model ranks the prepared conservation criteria datasets of Wilson Creek California Gnatcatcher habitat, parcel proximity to roads, parcel proximity to the creek, and parcels adjacent to privately conserved and government lands with a priority planning value scale ranging from 1 to 9 (see Figure 6-17).
Figure 6-17 Wilson Creek Conservation Priority Model
The model then performs a weighted overlay of the four ranked conservation criteria to prioritize parcels most suitable for conservation acquisition. These weights can be readily adjusted to meet various conservationist criteria and purposes.

The Wilson Creek Conservation Priority Model was created at the ArcInfo License level. The Union Tool in the ModelBuilder Geoprocessing Interface at the ArcInfo License level has the capability of handling multiple inputs. The Union Tool at the lower ArcEditor and ArcView License levels can only accept two inputs, which can be inconvenient. This varied capability of the Union Tool at different License levels was taken into consideration in the current project. The Wilson Creek Conservation Priority Model and Development Suitability Model have been designed to facilitate information sharing and will function properly at all ArcGIS ArcLicense levels.

6.3.1. Model Section for Conservation Ranking California Gnatcatcher Habitat

This section, which details the Conservation Priority model, ranks the Wilson Creek study area parcels for California Gnatcatcher habitat (see Figure 6-18). Parcels that are part of the critical habitat for the threatened and endangered Gnatcatcher are considered of primary concern for preservation. Parcels that are part of the Gnatcatcher critical habitat are given a ranking value of High-high = 9. The Parcels without a critical habitat designation are given a ranking value of Low-low = 1.
This section of the Conservation Priority model ranks the Wilson Creek study area Parcels for California Gnatcatcher Habitat. Parcels with Habitat are given a ranking value of High-High = 9. The Parcels without Habitat are given a ranking value of Low-Low = 1.

Figure 6-18 Wilson Creek Conservation Priority Gnatcatcher Habitat Model Sec.
6.3.2. Model Section for Conservation Ranking Parcels Proximity to Roads

This section of the Wilson Creek Conservation Priority model ranks the Wilson Creek study area parcels for distance from the system-calculated parcel centroid to the nearest road. Parcels with fewer roads to fragment the land or that are farther from roads are considered more likely to be in a pristine condition. Actual use and condition of any parcel will require verification by onsite inspection prior to acquisition. The parcel proximity to road rankings are here chosen arbitrarily and can be adjusted to accommodate any preferred criteria. Parcel proximity to roads rankings are for the model (see Figure 6-19) as follows: greater than 500 meters from a road is High-high = 9; 400 to 500 meters to road is High-medium = 8; 300 to 400 meters to road is High-low = 7; 250 to 300 meters to road is Medium-high = 6; 200 to 250 meters is Medium-medium = 5; 150 to 200 meters is Medium-low = 4; 100 to 150 meters is Low-high = 3; 50 to 100 meters is Low-medium = 2 and less than 50 meters is Low-low = 1.
This section of the Wilson Creek Conservation Priority model ranks the Wilson Creek study area Parcels for distance from parcel center point to the nearest road. Greater than 500 meters from a road is High-high = 0, 400 to 500 meters to road is High-medium = 8, 300 to 400 meters to road is High-low = 7, 250 to 300 meters to road is Medium-high = 6, 200 to 250 meters in Medium-medium = 5, 150 to 200 meters in Medium-low = 4, 100 to 150 meters in Low-high = 3, 50 to 100 meters in Low-medium = 2, and less than 50 meters in Low-low = 1.
6.3.3. Model Section for Conservation Ranking Parcels Proximity to Creek

This section of the Wilson Creek model ranks the Wilson Creek study area parcels for distance from parcel centroid to the creek. Parcels containing the creek may have important riparian vegetation present, and parcels nearer the creek will allow easier access for creatures following the waterway as a natural corridor in a typically dry environment. The parcel proximity to Wilson Creek rankings are assigned as follows (see Figure 6-20): within 100 meters of the creek is High-high = 9, 100 to 250 meters of the creek is High-medium = 8, 250 to 500 meters of the creek is High-low = 7, 500 to 750 meters of the creek is Medium-high = 6, 750 to 1000 meters is Medium-medium = 5, 1000 to 1250 meters is Medium-low = 4, 1250 to 1500 meters is Low-high = 3, 1500 to 1750 meters is Low-medium = 2 and farther than 1750 meters is Low-low = 1.
6.3.4. Sec. for Conservation Ranking Adj. to Previously Conserved and Gov. Lands

This section of the Wilson Creek model ranks the parcels in the study area for adjacency to parcels already conserved by private organizations or lands under governmental agency management. Parcels with at least one common side to an already conserved or government managed area are given key consideration. The parcel adjacency rankings are (see Figure 6-21) as follows: adjacent to government lands is High-high = 9; adjacent to privately conserved parcels is High-medium = 8; study area parcels not adjacent to conserved or government lands is Medium-medium = 5; parcels privately conserved is Low-high = 3; government lands is Low-medium = 2.
This section of the Wilson Creek model ranks the Wilson Creek study area Parcels for adjacency to parcels already Conserved by private organizations or lands under Governmental agency management.
Adjacent to Government Lands is High-high = 9,
Adjacent to Privately Conserved parcels is High-medium = 8,
Study Area Parcels not adjacent to Conserved or Government Lands is Medium-medium = 5,
Parcels Privately Conserved is Low-high = 3,
Government Lands is Low-medium = 2.

Figure 6-21 Wilson Creek Conservation Priority Adjacency Model Section
6.3.5. Model Section for Conservation Weighted Overlay Map Layer Output

This section of the Wilson Creek Conservation Priority model performs a weighted overlay of the four ranked conservation criteria to prioritize parcels most suitable for conservation acquisition. A model parameter (indicated by P in the model diagram) is assigned values via the Calculate Field Weighting Tool (see Figure 6-22) to allow the percentage weighting to be adjusted in the WC Conservation Priority Weights Text Box of the Conservation Priority Model Dialogue Box (see Figure 6-16). The weights can be adjusted and optimized to meet various conservationist needs and purposes. The output is then added to the ArcMap display as a map layer. The output Conservation Priority Map Layer is also designated as a model parameter (also indicated by P in the model diagram) in readiness for use as input data to other ModelBuilder models for additional geoprocessing and analysis.

Figure 6-22 Wilson Creek Conservation Priority Weighted Overlay Model Section
6.4. Model for Development Suitability

The user dialogue box of the Development Suitability model for the Wilson Creek Wildlife Corridor study area is displayed in Figure 6-23 below.

![Development Suitability User Dialogue Box](image)

Figure 6-23 Wilson Creek Development Suitability User Dialogue Box

Each section of the Wilson Creek Development Suitability model uses a value scale of 1-9 to rank the preprocessed development criteria datasets based on parcels in the Wilson Creek area, including California Gnatcatcher critical habitat, proximity to roads, proximity to creek and adjacency to privately conserved and government lands. The model then performs a weighted overlay of the four ranked conservation criteria to prioritize parcels most suitable for development. The weights can be readily adjusted to meet various land developer requirements as well (see Figure 6-24).
Figure 6-24 Wilson Creek Development Suitability Model

This section of the Wilson Creek Development Suitability model shows the Wilson Creek floodplain. The model incorporates various factors in the floodplain zone, including flood depth, area, and distance from flood stage. The model uses a weighted average of these factors to determine the suitability of the area for development.

The model includes the following criteria:
- Distance from flood stage
- Flood depth
- Area

The model is based on a grid with a resolution of 250 meters x 250 meters. The suitability score is calculated for each grid cell based on the criteria mentioned above.

The Wilson Creek Development Suitability Model by Carl McCurdy
The Wilson Creek Development Suitability Model was created at the ArcInfo License level. The Union Tool in the ModelBuilder Geoprocessing Interface at the ArcInfo License level has the capability of handling multiple inputs (more than two). The Union Tool at the lower ArcEditor and ArcView License levels can only accept two inputs, which can be inconvenient, because the user is then obligated to daisy-chain multiple union processes in order to bring all the criteria together. This variation in the capability of the Union Tool based on different License levels was taken into consideration in developing the models for this project. The Wilson Creek Conservation Priority Model and Development Suitability Model have been designed to facilitate information sharing and will continue to function properly at all ArcGIS ArcLicense levels. It is recommended, however, that users have the ArcInfo license level available.

6.4.1. Model Section for Development Ranking California Gnatcatcher Habitat

This section of the Development Suitability model ranks the Wilson Creek study area parcels overlapping with California Gnatcatcher Critical Habitat. Parcels with habitat for any threatened and endangered species have an associated MSHCP mitigation cost, due to expected species loss that accompanies degradation of the habitat during development. Therefore, study area parcels without threatened and endangered species critical habitat associated costs are preferred for development (see Figure 6-25). Parcels without critical habitat designation are given a ranking value of High-high = 9. The Parcels with critical habitat designation are given a ranking value of Low-low = 1.
This section of the Development Suitability model ranks the Wilson Creek study area Parcels for California Gnatcatcher Habitat. Parcels without Habitat are given a ranking value of High-high = 9. The Parcels with Habitat are given a ranking value of Low-low = 1.

This section of the Wilson Creek model ranks the Wilson Creek study area Parcels for distance from parcel center point to the Creek. Further than 1750 meters of the Creek is High-high = 9. 1500 to 1750 meters of the Creek is High-medium = 8. 1250 to 1500 meters of the Creek is High-low = 7. 1000 to 1250 meters of the Creek is Medium-high = 6.

Figure 6-25 Wilson Creek Development Suitability Gnatcatcher Habitat Model Sec.
6.4.2. Model Section for Development Ranking Parcels Proximity to Roads

This section of the Wilson Creek Development Suitability model ranks the Wilson Creek study area parcels for distance of the parcel centroid from the nearest road. Parcels nearer to existing roads are more accessible and the costs for adding infrastructure to access the parcel is less (see Figure 6-26). The parcel proximity to road rankings are as follows: less than 50 meters from a road is High-high = 9; 50 to 100 meters to road is High-medium = 8; 100 to 150 meters to road is High-low = 7; 150 to 200 meters to road is Medium-high = 6; 200 to 250 meters is Medium-medium = 5; 250 to 300 meters is Medium-low = 4; 300 to 400 meters is Low-high = 3; 400 to 500 meters is Low-medium = 2, and greater than 500 meters is Low-low = 1.
This section of the Wilson Creek Development Suitability model ranks the Wilson Creek study area Parcels for distance from parcel center point to the nearest road.  
Less than 50 meters from a road is High-high = 9,  
50 to 100 meters to road is High-medium = 8,  
100 to 200 meters from road is High-low = 7,  
200 to 300 meters from road is Medium-high = 6,  
300 to 500 meters from road is Medium-medium = 5,  
500 to 1000 meters from road is Medium-low = 4,  
1000 to 2000 meters from road is Low-high = 3,  
2000 to 5000 meters from road is Low-medium = 2,  
and greater than 5000 meters is Low-low = 1.

Figure 6-26 Wilson Creek Development Suitability Proximity to Roads Model Sec.
6.4.3. Model Section for Development Ranking Parcels Proximity to Creek

This section of the Wilson Creek model ranks the study area parcels for distance from parcel centroid to the creek. Until the wildlife corridor is established, parcels containing the creek and those nearer to Wilson Creek, if developed, will hinder its creation. Parcels farther from the creek will likely receive less resistance to development and mitigation costs from County MSHCP Management, allowing for a least cost path to accommodate both Wilson Creek area conservation and development plans (see Figure 6-27). The rankings for parcel proximity to Wilson Creek are: beyond 1750 meters from the creek is High-high = 9; 1500 to 1750 meters from the creek is High-medium = 8; 1250 to 1500 meters is High-low = 7; 1000 to 1250 meters is Medium-high = 6; 750 to 1000 meters is Medium-medium = 5; 500 to 750 meters is Medium-low = 4; 250 to 500 meters is Low-high = 3; 100 to 250 meters is Low-medium = 2, and within 100 meters is Low-low = 1.
This section of the Wilson Creek model ranks the Wilson Creek study area Parcels for distance from parcel center point to the Creek.
Further than 1750 meters of the Creek is High-high = 9,
1500 to 1750 meters of the Creek is High medium = 8,
1250 to 1500 meters of the Creek is High low = 7,
1000 to 1250 meters of the Creek is Medium high = 6,
750 to 1000 meters is Medium medium = 5,
500 to 750 meters is Medium low = 4,
250 to 500 meters is Low high = 3,
100 to 250 meters is Low medium = 2,
and within 100 meters is Low low = 1.

Figure 6-27 Wilson Creek Development Suitability Proximity to Creek Model Sec.
6.4.4. Model Section for Development Ranking Adjacent to Conserved and Gov.

This section of the Wilson Creek model ranks the study area parcels for adjacency to lands already conserved by private organizations or under governmental agency management. Parcels not located adjacent to already conserved or government managed lands may have fewer restrictions and encumbrances to development and are therefore given preference. Parcels located adjacent to already conserved lands are considered less valuable for development. Development values will likely further decline for parcels adjacent to the wildlife corridor once its boundaries are established (see figure 6-28). Study area parcels not adjacent to conserved or government lands is High-high = 9; adjacent to privately conserved parcels is High-low = 7; adjacent to government lands is Medium-medium = 5; parcels privately conserved is Low-high = 3; government lands is Low-low = 1.
This section of the Wilson Creek model ranks the Wilson Creek study area Parcels for adjacency to parcels already Conserved by private organizations or lands under Governmental agency management. Study Area Parcels not adjacent to Conserved or Government Lands is High-high = 9, Adjacent to Privately Conserved parcels in High-low = 7, Adjacent to Government Lands is Medium-medium = 5, Parcels Privately Conserved in Low-high = 3, Government Lands is Low-low = 1.
6.4.5. Model Section for Development Weighted Overlay Map Layer Output

This section of the Wilson Creek Development Suitability model performs a weighted overlay of the four ranked development criteria to prioritize parcels most suitable for development. A model parameter (indicated by “P” in the model diagram) is assigned from the Calculate Field Weighting Tool (see Figure 6-29) to allow the weighting percentages to be adjusted in the WC Development Weights Text Box of the WC Development Suitability Model Dialogue Box (see Figure 6-23). The weights can be readily adjusted to meet various land developer needs and purposes. The output is then added to the ArcMap display as a map layer. The output Development Suitability Map Layer is also designated as a model parameter (indicated once again by a “P” in the model diagram) in readiness for use as input data to other ModelBuilder models for additional geoprocessing and analysis.

Figure 6-29 Wilson Creek Development Suitability Weighted Overlay Model Section
6.5. Data for Wilson Creek Models Origination, Errors and Anomalies

As mentioned in the preface, all of the original datasets for the Wilson Creek Wildlife Corridor Project were provided by Kenneth Althiser of the Redlands Institute and Michael Dangermond of the Dangermond Group. No errors have been found within the original datasets. It has been found that some of the geoprocessing tools available in the ModelBuilder interface of ArcGIS 9 will allow null value fields to be created in the attribute tables of data. However, certain other geoprocessing tools will not allow processing of null values, and will therefore function incorrectly. When datasets based on new criteria are added to the models, all null values must be eliminated from the data and further, the creation of null values avoided to prevent error propagation during geoprocessing.

Another interesting anomaly was discovered with the Near Proximity Analysis Tool when calculating the distances from the Wilson Creek study area parcels to the creek. The Near Tool will not read the last row in the data attributes table of the Wilson Creek dataset. When an extra row was added to the data attributes table, all of the rows containing essential data were then processed correctly. This work-around for the Near Proximity Analysis Tool was provided by Nathan Strout of the Redlands Institute.
7. Wilson Creek Wildlife Corridor Derivative Maps

After the Wilson Creek Wildlife Corridor Conservation Priority and Development Suitability models weighting schemes are selected and the models are generated, the derivative output layers will be added to the display. Once added the Layer Properties Dialogue Box must be accessed (see Figure 7-1). The Symbology Tab is then selected and within the “Show:” area (see Figure 7-1), under the “Quantities” heading the user can specify the “Graduated colors” option. In the “Draw quantities using color to show values” part of the display, the user may use the dropdown arrow (see Figure 7-1) to select the Development Suitability Model, WCDevelopUtil, for the “Fields Value:” option. For the Conservation Priority Model, the user should select “WCConservUtil” for the “Fields Value:” option. These are the column titles of the attribute fields added to the relational data table by the ModelBuilder models to store the attribute values produced by the preferred weighting scheme within the geodatabase. For Classification, nine classes should be entered to consistently represent the nine ranks from High-high = 9 to Low-low = 1 applied throughout the two product models. The output layer of the respective model is now ready for viewing.

![Figure 7-1 Development Suitability Layer Properties Dialogue Box Symbology Tab](image-url)
7.1. Acquisition Weighting

Three weighting schemes were applied to the Wilson Creek Wildlife Corridor models. The weighting of both models can be easily changed through the Dialogue Box to meet a variety of conservation or development purposes. The first weighting formula gives an even distribution of importance across the Wilson Creek California Gnatcatcher habitat, parcels proximity to roads, parcels proximity to creek, and parcels adjacent to privately conserved and government lands input criteria. Each of the datasets receives a 25% share of the importance weighting and is run through both the Conservation Priority and Development Suitability models. In accordance with the Fixed Point Scoring method all criteria weighting shares must total 1. The formula for the even weights scheme is:

\[(\text{AdjacentUtil} \times 0.25) + (\text{GnatcatcherUtil} \times 0.25) + (\text{RoadDistUtil} \times 0.25) + (\text{CreekDistUtil} \times 0.25)\].

For the second iteration of the Conservation Priority model, the weighting formula percentages are altered to emphasize adjacency to already conserved lands, a scenario originally discussed amongst the stakeholders:

\[(\text{AdjacentUtil} \times 0.55) + (\text{GnatcatcherUtil} \times 0.15) + (\text{RoadDistUtil} \times 0.15) + (\text{CreekDistUtil} \times 0.15)\].

Favoring the parcels adjacent to already conserved lands over the other criteria was important in early discussions with both conservators and developers. Dividing the remainder of the weighting distribution evenly serves best to extending a greater influence to parcels adjacent to already conserved lands in the derivative map.

For the second iteration of the Development Suitability Model, a formula emphasizing the importance of adjacency to existing roads was utilized:

\[(\text{AdjacentUtil} \times 0.15) + (\text{GnatcatcherUtil} \times 0.30) + (\text{RoadDistUtil} \times 0.45) + (\text{CreekDistUtil} \times 0.10)\].

The proximity of parcels to roads has been given the utmost consideration dividing the influence evenly amongst the other criteria on the model output map layer.

7.2. ModelBuilder Created Derivative Maps

The following subsections of the chapter display the Wilson Creek Wildlife Corridor Conservation Priority and Development Suitability derivative maps generated with the ESRI ArcGIS 9 ModelBuilder modeling interface.
7.2.1. Wilson Creek Value Map: Initial Conservation Priority

An even distribution of criteria weighting has been run in the Conservation Priority model using the following formula: ([AdjacentUtil] * 0.25) + ([GnatcatcherUtil] * 0.25) + ([RoadDistUtil] * 0.25) + ([CreekDistUtil] * 0.25). A series of maps will now be presented to show which parcels are deemed most important in this scenario by increasing the minimum threshold, so that a better grasp of the results calculated in the model can be obtained. Parcels with a returned value of 6.75 or greater out of 9 have been outlined in blue for added emphasis (see Figure 7-2).

Figure 7-2 Wilson Creek Conservation Priority 1st Iteration Parcels >= Value 6.75
Parcels with a returned value of 7.75 or greater out of 9 have been outlined in blue for added emphasis (see Figure 7-3).

Figure 7-3 Wilson Creek Conservation Priority 1st Iteration Parcels >= Value 7.75
Parcels with a returned value of 8.5 or greater out of 9 have been outlined in blue for added emphasis (see Figure 7-4).

Figure 7-4 Wilson Creek Conservation Priority 1st Iteration Parcels >= Value 8.5
7.2.2. Wilson Creek Value Map: Initial Development Suitability

An even distribution of criteria weighting has been run in the Development Suitability model using the following formula: \((\text{AdjacentUtil} \times 0.25) + (\text{GnatcatcherUtil} \times 0.25) + (\text{RoadDistUtil} \times 0.25) + (\text{CreekDistUtil} \times 0.25)\). Once again, a series of maps displaying a progressively higher minimum threshold are included here to help identify the parcels most appropriate for development. Parcels with a returned value of 7 or greater out of 9 have been outlined in blue for added emphasis (see Figure 7-5).

Figure 7-5 Wilson Creek Development Suitability 1st Iteration Parcels >= Value 7
Parcels with a returned value of 8 or greater out of 9 have been outlined in blue for added emphasis (see Figure 7-6).

Figure 7-6 Wilson Creek Development Suitability 1st Iteration Parcels >= Value 8
Parcels with a returned value of 9 out of 9 have been outlined in blue for added emphasis (see Figure 7-7).

Figure 7-7 Wilson Creek Conservation Priority 1st Iteration Parcels = Value 9
7.2.3. Wilson Creek Value Map: 2\textsuperscript{nd} Iteration Conservation Priority

The following formula favors parcels adjacent to already conserved lands over the other criteria, while the remainder of the weighting is evenly distributed. Conservation Priority model: ([AdjacentUtil] * 0.55) + ([GnatcatcherUtil] * 0.15) + ([RoadDistUtil] * 0.15) + ([CreekDistUtil] * 0.15). A series of three maps will be displayed to emphasize a winnowing process to reveal the parcels most appropriate for conservation. Wilson Creek study area parcels with a returned value of 6.75 or greater out of 9 have been outlined in blue for added emphasis (see Figure 7-8).

Figure 7-8 Wilson Creek Conservation Priority 2\textsuperscript{nd} Iteration Parcels $\geq$ Value 6.75
Wilson Creek study area parcels with a returned value of 7.65 or greater out of 9 have been outlined in blue for added emphasis (see Figure 7-9).

Figure 7-9 Wilson Creek Conservation Priority 2nd Iteration Parcels >= Value 7.65
Wilson Creek study area parcels with a returned value of 8.4 or greater out of 9 have been outlined in blue for added emphasis (see Figure 7-10).

Figure 7-10 Wilson Creek Conservation Priority 2nd Iteration Parcels >= Value 8.4
7.2.4. Wilson Creek Value Map: 2nd Iteration Development Suitability

In the second modeling iteration for Development Suitability, the percentages have been changed to promote development on parcels closest to or containing roads, as shown in the Development Suitability model as follows: ([AdjacentUtil] * 0.15) + ([GnatcatcherUtil] * 0.30) + ([RoadDistUtil] * 0.45) + ([CreekDistUtil] * 0.10). A series of three maps will now be displayed that show a progressively higher score from this model to emphasize the parcels most appropriate for development, given the aforementioned criteria weighting (see Figure 7-11). Parcels with a returned value of 7 or greater out of 9 have been outlined in blue for added emphasis.
Parcels with a returned value of 8 or greater out of 9 have been outlined in blue for added emphasis (see Figure 7-12).

Figure 7-12 Wilson Creek Development Suitability 2nd Iteration Parcels >= Value 8
Parcels with a returned value of 9 out of 9 have been outlined in blue for added emphasis (see Figure 7-13).

Figure 7-13 Wilson Creek Conservation Priority 2\textsuperscript{nd} Iteration Parcels = Value 9
7.2.5. Wilson Creek Value Map Comparison: Conservation 1\textsuperscript{st} and 2\textsuperscript{nd} Iterations

The first iteration of the Conservation Priority Model depicted all criteria with each being weighted evenly. The first Conservation Weighting Formula is:

\[(\text{AdjacentUtil} \times 0.25) + (\text{GnatcatcherUtil} \times 0.25) + (\text{RoadDistUtil} \times 0.25) + (\text{CreekDistUtil} \times 0.25)\] (see Figure 7-14).

Figure 7-14 Conservation 1\textsuperscript{st} Iteration Value 6.75 and 2\textsuperscript{nd} Iteration Value 6.75
In the second iteration of the Conservation Priority model, the parcels already adjacent to privately conserved and government lands are more heavily favored over the other criteria, bringing several alternate parcels into consideration (see Figure 7-15).

Figure 7-15 Conservation 1st Iteration Value 7.75 and 2nd Iteration Value 7.65
The second Conservation Weighting Formula is: 

\[ (\text{AdjacentUtil} \times 0.55) + (\text{GnatcatcherUtil} \times 0.15) + (\text{RoadDistUtil} \times 0.15) + (\text{CreekDistUtil} \times 0.15) \].

Interestingly, the same parcel returned the highest ranking in both weighting conservation schemes (Figure 7-16).

Figure 7-16 Conservation 1\textsuperscript{st} Iteration Value 8.5 and 2\textsuperscript{nd} Iteration Value 8.4
7.2.6. Wilson Creek Value Map Comparison: Development 1\textsuperscript{st} and 2\textsuperscript{nd} Iterations

The first iteration of the Development Suitability Model depicted all criteria with each receiving an even share of the weighting and is shown below (see Figure 7-17). The first Development Weighting Formula is given in the following: \([\text{AdjacentUtil}] \times 0.25 + [\text{GnatcatcherUtil}] \times 0.25 + [\text{RoadDistUtil}] \times 0.25 + [\text{CreekDistUtil}] \times 0.25\).

![Development 1\textsuperscript{st} Iteration Value Map](image1)

![Development 2\textsuperscript{nd} Iteration Value Map](image2)

Figure 7-17 Development 1\textsuperscript{st} Iteration Value 7 and 2\textsuperscript{nd} Iteration Value 7
The second iteration of the Development Suitability model depicted parcels with nearby roads and without Gnatcatcher habitat as significantly favored over other criteria (Figure 7-18). The second Development Weighting Formula follows, and the results below: 

\[(\text{AdjacentUtil} \times 0.15) + (\text{GnatcatcherUtil} \times 0.30) + (\text{RoadDistUtil} \times 0.45) + (\text{CreekDistUtil} \times 0.10)\].

Figure 7-18 Development 1st Iteration Value 8 and 2nd Iteration Value 8
Certain parcels retain a high ranking Development Suitability planning value under both weighting schemes, as shown below (see Figure 7-19).

Figure 7-19 Development 1st Iteration Value 9 and 2nd Iteration Value 9
7.2.7 Wilson Creek Value Map Comparison: Conservation and Development

In the first iteration of both the Conservation Priority model and the Development Suitability model the weighting schemes and the input criteria are the same. The first iteration Conservation and Development Weighting Formula is: ([AdjacentUtil] * 0.25) + ([GnatcatcherUtil] * 0.25) + ([RoadDistUtil] * 0.25) + ([CreekDistUtil] * 0.25) (see Figure 7-20). However, the different models’ ranking values are aligned to serve either conservation or development goals.
In the second iteration of the Wilson Creek Wildlife Corridor models, the weighting scheme was varied to represent targeted potential conservation and development interests, respectfully. The equation for the second Conservation Weighting Formula is: “([AdjacentUtil] * 0.55) + ([GnatcatcherUtil] * 0.15) + ([RoadDistUtil] * 0.15) + ([CreekDistUtil] * 0.15)” and for the second Development Weighting Formula is: “([AdjacentUtil] * 0.15) + ([GnatcatcherUtil] * 0.30) + ([RoadDistUtil] * 0.45) + ([CreekDistUtil] * 0.10).” The result is that the Conservation Priority and Development Suitability models clearly rank the Wilson Creek study area parcels according to their meaningful weighting, specified by the desired conservation and development attributes (see Figure 7-21).
7.3. Wilson Creek Proposed Acquisition Maps

In the following subsections of the chapter are maps displaying the Wilson Creek Wildlife Corridor study area parcels ranked and weighted for conservation and development purposes by their respective project models. A layer of parcels has been added from a list of Wilson Creek area owners known to the Riverside Land Conservancy who are willing to sell their property or grant conservation easements. The parcels of known willing sellers can be carefully considered for the extent of their desirability from the many conservation and development perspectives and more appropriate actions can be taken with the insight gained from the models.

7.3.1. Conservation Priority

Several of the Wilson Creek Wildlife Corridor study area parcels that returned with high rankings for conservation purposes are on the list of known parcel owners willing to sell and are outlined in pink for easy recognition in Figure 7-22. These parcels can be identified by accessing the parcel layer for their owner names, contact information and Assessor Parcel Numbers, and the conservation acquisition process initiated. That a field inspection of each parcel be done first is recommended to confirm the Conservation Priority model findings before making an actual offer or assuming a modeled value is valid.
7.3.2. Proposed Conservation Acquisitions

Some of the parcels given a high ranking by the Conservation Priority model are also known to have owners willing to sell. Those parcels, displayed in Figure 7-22, are proposed for further acquisition consideration. In addition, the parcels returned by the Conservation Priority model with the highest rankings, displayed in Figure 7-16, are recommended for consideration of further conservation actions, including on-site inspections, granting of conservation easements, offers for purchasing, or even performing additional adjacency scenario modeling.

![Figure 7-22 Conservation Priority 2nd Iteration Parcels with Willing Sellers](image-url)
7.3.3. Development Suitability

Several of the Wilson Creek study area parcels that returned high rankings for appropriateness for development are also on the list of known parcel owners willing to sell and are outlined in pink for easy recognition. These parcels can be identified by accessing the parcel attribute information in the GIS to acquire their owner names, contact information and Assessor Parcel Numbers, and the acquisition process for development initiated. A field inspection of the parcel is recommended to confirm the Development Suitability model findings (see Figure 7-23).

Figure 7-23 Development Suitability 2nd Iteration Parcels with Willing Sellers

7.3.4. Proposed Development Acquisitions

Several of the parcels that returned a high ranking by the Development Suitability Model are also known to have owners willing to sell. Those parcels, displayed in Figure 7-23, should be considered for acquisition. The parcels returned by the Development Suitability model with the highest rankings displayed in Figure 7-19 are recommended for consideration toward acquisition for development, including on-site inspections, and additional scenario modeling.
8. Recommendations

The Wilson Creek Wildlife Corridor Models have been deliberately designed to operate at all ArcGIS Desktop License levels and intended for nearly any ArcGIS user to be able to manipulate the weighting formulas of the primary models to produce a wide array of potential outcomes. Only Users with a measure of technical expertise in GIS and an understanding of the planning process should alter the criteria classification ranking values and regenerate the model values for either the Conservation Priority or Development Suitability models.

It is expected throughout the project that the geoprocessing and analysis offered will be updated by modification of existing models or supplemented with new datasets, with the new models fashioned to refine, enhance, and broaden the capacity and capability of the Wilson Creek Wildlife Corridor Project to meet growing and changing needs for both the conservation and development communities. Some of the anticipated new models mentioned in the conceptual phase of this report have been recognized as potential avenues to explore in the next phase of modeling. A few of these potential models, along with other enhancement suggestions encountered during the Wilson Creek Wildlife Corridor Project discussion, are included in the next chapter. These possibilities should have enough merit as a suite of tools to explore as another Major Individual Project in their own right.

The ModelBuilder Models of the Wilson Creek Wildlife Corridor GIS project have been shaped by the modeling techniques found in “A Pragmatic Approach to Modeling for Wildlife Management” by Anthony M. Starfield. This practical approach turned a seemingly monumental, complicated, and daunting task into a project with a clear path that became a joy to craft and a pleasure to work with. Therefore, it is highly recommended that Anthony Starfield’s pragmatic approach be applied to ensuing modeling efforts and any modifications to the Wilson Creek Wildlife Corridor Project, or for that matter, any other modeling project endeavors.
9. Future Enhancements

This chapter will provide suggestions for follow up measures that may expand the usefulness or advance the efficiency and effectiveness of the Wilson Creek Wildlife Corridor GIS for conservationists, their associated decision makers and other stakeholders.

The Wilson Creek Wildlife Corridor Project must be expanded to include other support modules if the added functionality necessitates the inclusion of additional data layers, interfaces, data management techniques, etc. Some of these extended capabilities might include:

- Regulate & monitor MSHCP Code with GPS and ArcPad or ArcGIS Mobile;
- Enable Online MSHCP GIS decision support with ArcIMS or ArcGIS Server;
- Extend the MSHCP decision model countywide.

9.1. Bivariate Choropleth Map of the Wilson Creek Wildlife Corridor Project

Dr. Mark Kumler has recommend that as a future enhancement to the project a Bivariate Choropleth map juxtaposing the results of the two Wilson Creek Wildlife Corridor Project models (both conservation and development) would potentially be of great use to conservators and developers alike. This graphic would likely be sufficiently intriguing and visually compelling to warrant the creation of a ModelBuilder model to support the generation of a series of Bivariate Choropleth maps.

9.2. Model for Adjacency Change Tracking

A ModelBuilder model has been conceived by Dr. Timothy Krantz which will change the status attribute of a selected parcel from its current condition to the conserved category, then appropriately change the neighboring parcels to an ‘adjacent to conserved’ attribute value class, as conservation actions have been enacted. Development suitability could be similarly affected by designating parcels as developed (not vacant) once construction occurs, and adjacent parcels are coded as “adjacent to developed.” This mutable coding in building models is useful for both tracking updates to the Wilson Creek parcels dataset after an actual acquisition, and for viewing and analyzing the impacts on future suitability assessments by anticipating a “domino effect” or cascading of scores that improve with each successive round of conservation acquisitions, or development actions all prior to actual purchase. The updated derivative datasets can be plugged back into the Wilson Creek Wildlife Corridor Conservation Priority and Development Suitability models for subsequent long range acquisition planning.
9.3. GPS & ArcPad for MSHCP Code Monitoring

With a customized ArcPad or ArcGIS Mobile application and GPS, any parcel in the Wilson Creek Wildlife Corridor and vicinity can be checked and verified through field validation on some cyclical basis, such as an annual or biannual, as to the actual condition of or landuse to which the parcel has been subjected, particularly to verify if conservation values have been maintained or compromised. Similarly, MSHCP Cell guidelines can be used to determine how well the MSHCP criteria are being met polling each of the parcels that comprise a given MSHCP cell. Additional data can be collected and uploaded to the Wilson Creek Wildlife Corridor GIS for updating, geoprocessing, recorrelation and analysis. In addition, Riverside County MSHCP records can be updated and follow up procedures implemented, as required by Riverside County policy.

9.4. Criterion Decision Plus for Supplemental Analysis

The potential for development of a Criterion Decision Plus Decision Support System for assisting stakeholders in developing a conservation or development acquisition strategy or make individual purchase decisions was recommended and demonstrated by Paul Burgess of the Redlands Institute. The definition of appropriate criteria and development of alternatives can be documented as part of the decision support system. New criteria and alternatives can be immediately reapplied to the Wilson Creek Wildlife Corridor GIS application to perform subsequent iterations for further updates to the decision support system and analysis.

InfoHarvest Criterion Decision Plus interface: After the first iteration of the decision process in ArcGIS 9, the results can be examined for alternatives in several ways. CDP provides a number of graphic aids to depict criteria, the contributions can be shown in histograms, pie charts, scatter diagrams and radar charts (Figure 9-1). One of CDP’s most useful functions is in assigning weights and making trade-offs among the criteria (Figure 9-2). There are many options for using different approaches to assigning weights and/or trade-offs.
9.5. MSHCP Cell Density Values Tracking

The Western Riverside County Multiple Species Habitat Conservation Plan is divided and referenced to an administrative grid of so-called MSHCP Cells. Each MSHCP Cell is assigned conservation guidelines that are codified as conservation and development density values. The values in the County MSHCP are static as is any legal document, but given this methodology could become dynamic and subject to change as environmental conditions evolve. A ModelBuilder model can be constructed to visually display the interplay of the conservation and development density value changes on the parcels within an individual MSHCP cell.
10. Conclusion

The models in the Wilson Creek Wildlife Corridor Project are designed from the pragmatic approach of the model serving as a problem solving tool where “the objective drives the design of small, simple models that focus relentlessly on the problem to be solved.” These practical models assist conservationists in prioritizing parcels for conservation acquisition. The models also allow conservationists to assist conservation-sensitive developers in identifying suitable parcels for development that will neither compromise the MSHCP goals for conservation nor impair the creation of the prospective Wilson Creek Wildlife Corridor. Furthermore, such models facilitate the progress towards compliance with the Western Riverside County MSHCP ‘Smart Growth’ principles.

Some of the parcels ranked high for conservation value by the Wilson Creek Wildlife Corridor Project have already been acquired by the Riverside Land Conservancy during the interim period between the collection of the datasets at the inception of the project and their use in the models of the current project. Thanks go to Michael Dangermond of The Dangermond Group for sharing a more recent map of the area (see Figure 10-1). Interestingly, the actual progress towards conservation made on the Wilson Creek Wildlife Corridor since the spring of 2004 largely reflects the output recommendations of these models in the current project. Much progress has clearly already been made to link up the sparse previously conserved and government lands with the National Forests.

The Wilson Creek Wildlife Corridor Project actually represents the foundation or starting point for many other useful projects and modeling possibilities. Some may become beneficial enhancements to the immediate project while others may prove to be worthy Major Individual Projects in their own right. The Wilson Creek Wildlife Corridor Project itself certainly has not exhausted the issues that should be considered between conservation and development suitability modeling. For example, in future iterations the color used to emphasize and outline high ranking parcels returned by the models should be darkened, widened or given a different symbol pattern to yield a more pronounced effect in printed or hardcopy media. The light blue color used for emphasis on the maps for the current project is the default value in “selecting by attribute” and it appeared quite compelling in both the map layers and report documentation when viewed on screen, but was not as conspicuous in print. Hence, the effectiveness of the hardcopy cartographic products can be improved.
The dataset for the roads must be updated to more accurately reflect changes in parcel accessibility, as well as the increase in habitat fragmentation and degradation that results from constructing miles of roads across a given parcel. All types of local roads, including all surface types (dirt, gravel and paved) should be included in the GIS data. An improved roads dataset will improve the information conveyed and improve the models for conservation and development alike.

Figure 10-1 The Dangermond Group Map for Wilson Creek Area 20 October 2006
Parcel size should be one of the major layers included in the modeling because larger parcels are preferred for acquisition by both developers and conservators. Developers prefer larger parcels because development regulations are easier to meet, and conservators get greater preservation impact when larger parcels are acquired.

While it may seem intuitive to visual analysis, a key goal for conservation is to maintain the continuity of Wilson Creek itself, to preserve the riparian vegetation communities along its course which already serve as a natural animal migration pathway. Riparian habitats are natural corridors in Southern California’s dry environment, and they provide ample food and shelter to wildlife. Parcels that contain sections of the creek should, therefore, be given an elevated significance or targeted in some specific manner through improved ranking values or weighting during production of the models.

Another technical issue was the method of how a parcel’s proximity to roads and the creek was measured. The current project yielded values based on the distance to the parcel centroid, a computer-calculated center point of the feature, which appeared to skew the results in certain instances or at least resulted in favorable values for parcels whose shape, size or orientation made them less suitable than other parcels in the vicinity. Proximity should be tested as a distance from the polygon (parcel) edge to the line (stream or road). These tests might result in improved consistency and more viable recommendations by the models.

Recently improved access of better aerial imagery for even remote areas like Wilson Creek will be useful in validating modeling results, monitoring parcel conditions and suitability for conservation or development as time goes by, and other uses as well, prior to publishing actual recommendations for onsite inspection or acquisition. Aerial imagery might serve to exclude certain parcels from consideration by observation of environmental conditions when other data sources may indicate otherwise. Aerial imagery could also prove useful in updating other datasets, like roads, vegetation types, etc.

To track changes in both conservation values and the MSHCP, a Geodatabase design accommodating parcel updates should also be considered for future enhancements to this project. As parcels are split or combined, Assessor Parcel Numbers change and the links to other attributes must be maintained. Each parcel could be attributed in some way to indicate how it falls within MSHCP cell policy, and conversely, how well the MSHCP cell policies are carried out through their member parcels also should be tracked. A reporting system could easily be grafted onto the geodatabase to allow annual status updates to be compiled and published. Originally the project envisioned a system of annual inspections, updates and maintenance. It is more likely that ongoing or at least monthly or other periodically posted updates, maintenance and regular inspections have to be instituted for the advantages they present to the decision-making process. The richness and depth of the MSHCP project, to which the Wilson Creek Wildlife Corridor Project interrelates, is such that many yet unforeseen scenarios, data layers, weighting schemes, and areas of interest are yet to be discovered.
Hopefully the Wilson Creek models will provide a basis of cooperation between conservers, developers, and the Riverside County MSHCP monitoring agency. The models may also help to implement the concepts of ‘Smart Growth’ and establish a permanent connection between the two expansive Southern California National Forests (San Bernardino and Cleveland), preserving as much of the invaluable regional biodiversity for posterity as realizable while simultaneously meeting the demands of an increasing population. Ultimately it is intended that the methods, tools, and ideas will then be applied throughout Riverside County, in support of the MSHCP, using ‘Smart Growth’ ideology, with conservationists and developers working hand in hand to achieve their essentially diverse, yet intertwined objectives for a better future for the flora, fauna and people of Riverside County.
11. References


xiv Krantz, Timothy. (December 2004). California Threatened and Endangered Species Pictures. Director Department of Environmental Studies University of Redlands.


Krantz, Timothy. (December 2004). California Threatened and Endangered Species Pictures. Director Department of Environmental Studies University of Redlands.


