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Abstract

The University of California Information Center for the Environment (ICE) and the California Department of Transportation (Caltrans) are developing a GIS-based analytical framework to improve the effectiveness of biological mitigation throughout California. Goals include incorporating the best available sets of mapped natural resource data into the early project planning and preliminary environmental assessments for single and multiple projects. Incorporation of these data will facilitate early and more strategic identification of mitigation requirements and op¬portunities, for both single-project and regional mitigation efforts.

The cost of delays and over-runs due to late and fragmented project-by-project environmental planning and mitigation in California is estimated at $75 million per year. Developing systematic GIS-based decision-support tools to identify important species and habitats, both those impacted directly by Caltrans activities and those that might contribute to effective mitigation in the same locale or watershed will permit Caltrans, counties, and environmental regulators to incorporate the results of biological impact assessments earlier in the planning process, and identify opportunities mitigating the combined biological impacts of many projects in a given area. By building upon previous efforts and using tools known to be effective for integrated analyses, this project will help Caltrans improve planning results, decrease costs, improve project delivery schedules and provide greater environmental protection in the long-term.

To accomplish these goals, Geographic Information Systems (GIS) analysis and conservation planning principles are being applied to develop multi-scale long-range (10-year) mitigation need forecasts for each Caltrans district, county, and watershed in the State of California. These will be used to determine the cumulative mitigation needs for early biological mitigation planning of multiple projects in a given area. Available statewide biological data have been integrated into a database that can be queried by Caltrans district, county, or any of six levels of watershed classification. For a queried geographic area, the database returns the biological resources expected to exist in the area based on the available data, as well as the potential impacts to these resources from

Caltrans projects that are currently funded to be constructed in the area over the next 10 years. The type of project programmed to occur was then used to estimate the impact zone of each project (e.g. road repaving, road widening, new road, etc.). Then, by querying the database for a given geographic region, the area, habitats and species potentially affected by cumulative biological impacts from all programmed highway projects in that region can be estimated. From this, estimates of area and types of lands that would need to be acquired for mitigation can be determined.

This project provides a framework for analyzing and estimating biological mitigation needs that could be generalized for use in transportation planning in other geographic areas, as well as for other types of planning. The database schema developed here could easily be adapted to analyze the potential impacts and mitigation needs for urban growth planning efforts, and other development projects with biological impacts that require biological mitigation planning. Overall, by integrating available data into a useful database format, this project has developed a system for assessing long-term biological mitigation needs that will assist in the implementation of early biological mitigation planning

A Multi-Scale and Context Sensitive State-Wide Environmental Mitigation Planning Tool for Transportation Projects in California

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Abstract: The University of California Information Center for the Environment (ICE) and the California Department of Transportation (Caltrans) are developing a GIS-based analytical framework to improve the effectiveness of biological mitigation throughout California. Goals include incorporating the best available sets of mapped natural resource data into the early project planning and preliminary environmental assessments for single and multiple projects. Incorporation of these data will facilitate early and more strategic identification of mitigation requirements and opportunities, for both single-project and regional mitigation efforts.

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Introduction

Late incorporation of environmental assessment into road development projects is inefficient and can lead to costly delays. The primary problem is that considerable resources have already been committed to a road design by the time the environmental review occurs. California, like many other States, does not review potentially significant environmental impacts of a proposed project until the project receives funding authority, at which point, for the purposes of the National Environmental Policy Act and most State acts, it is then a potential "project" subject to environmental review. However, in order to have reached the stage of program funding, a project must be fairly well developed in terms of its engineering requirements. This means significant investment has been made in siting and design and the flexibility to avoid or minimize environmental impacts is substantially reduced. Mitigation becomes the tool of choice and is often a costly and time consuming procedure. Besides foregoing the flexibility to practice avoidance and minimization of impacts at the early planning stage the current practice is prone to rush environmental scoping in the haste to produce projects once their funding is programmed. It is estimated that errors in environmental mitigation scoping costs the State of California $75 million per year in direct costs not including the time cost of delays.

In addition, biological solutions for effective mitigation derived under these planning conditions do not necessarily represent the optimum, in part due to the fact that solutions must be identified late in the life time of the project. Much mitigation is done on a project-by-project basis, which ignores the cumulative impacts of multiple projects in a region. Regional mitigation analysis and planning has been recognized by the Environmental Protection Agency (EPA) and Federal Highway Administration (FHWA) as an objective in the regulatory and transportation planning sectors, as a way to attempt to deal with the problems of cumulative impacts. Regional assessments that quantify impacts from multiple projects are one way to address such problems, and are starting to be incorporated into the planning practices of transportation departments. Some state-wide examples of mitigation assessments include projects in Florida (Florida Department of Transportation 2001, Hoctor et al 2000) and initiatives listed in Brown (2006); while regional examples include Thorne et al. (2006a) who modeled the distribution of 12 species of concern along a 100 km stretch of highway in the San Joaquin Valley and looked at the expected impact from future urban growth along that transportation corridor.

Some of the issues that arise when considering multiple-site assessments include determining the pros and cons of on-site versus off-site mitigation, identifying the appropriate scale of analysis, and quantifying the expected impacts before they occur. Timing also becomes an issue because the long time required for major capital projects means that off-site mitigation locations available at the beginning of a project may either no longer exist or be affordable by the end of a project. Because single projects may affect only one watershed, but multiple projects in a county or district may impact the same habitat types in several watersheds, the scale of analysis needs to be flexible. Watershed-level analyses present an ecologically meaningful way to look at regions in a scaled manner due their nested capacity. Watershed-level analyses are also becoming the standard used by regulatory agencies, such as the EPA which has adopted Total Maximum Daily Load (TMDL). The FHWA has also adopted a watershed-based operational paradigm through its 'Eco-logical' program (Brown 2006), which identifies integrated planning as the first step towards an ecosystem-based approach. Other groups moving to watershed-based approaches include the United States Forest Service and National Parks Service.

However, much planning is done through human-defined areas such as counties or transportation districts. So, a multi-scale framework needs to be able to report cumulative impacts for both watershed units and administrative units (e.g., transportation planning districts and municipal counties). This multi-scale watershed and administrative boundary framework will to permit transparent cross-tabulation of potential biological impacts due to multiple project planning blueprints.

The California Department of Transportation (Caltrans) has recognized these limitations and called for the development of early mitigation assessment capacity. This capacity would need to be able to address mitigation assessments for any location in the state, for a minimum of a 10-year planning horizon, and would permit the earlier incorporation of estimates of the level mitigation needs that could be associated with any given project. In particular, Caltrans needs the capacity to assess the overall mitigation needs of its transportation planning districts. There is a desire to know if impacted habitat types are rare or not, both locally and state-wide. Finally, the resulting tool needs to be flexible enough that it can be used by a wide variety of users, who do not necessarily have enough GIS training to conduct the spatial analyses themselves.

Potential Solutions

We developed a database tool that permits multi-scale advanced assessment capacity of mitigation needs for single or multiple highway improvements. The database consists of eight spatial scales that cover the entire 410,000 km2 of California in a spatial framework consisting of: Caltrans districts, county boundaries, and six nested views of watershed boundaries. Into each of these spatial templates, we intersected the best available state-wide landcover data, outlines of species ranges, and human impacts including road and population density. Finally, programmed highway projects were also incorporated in to the database to allow for the assessment of biological impact due to these projects. The resulting database permits non-GIS users to query by project or spatial region and determine the potential impacts to habitat types, the known presence and the potential presence of federally or State listed threatened and endangered plants and animals.

This paper presents four summary analyses to demonstrate the capacities of this approach. First, we report the projected impacts of a single project; second, the projected cumulative impacts from four planned projects along California State Highway 132; third, we report the projected impacts for all 94 programmed projects in Caltrans District 5; and fourth we report the project impacts of 21 projects occurring in an intermediate-size watershed within District 5, the Elkhorn Slough watershed.

Methods

Overview

We developed a relational spatial database framework which permitted the integration of biological, cultural, and infrastructure data. The database was developed using spatial overlays in a geographic information system (GIS, ESRI 2006), that were subsequently output to a Microsoft Access relational database (Microsoft 2006). The spatial framework for the database consists of a combination of two nested administrative boundary delineations and six nested levels of watershed boundary delineations for the entire state of California (figure 1). The administrative boundaries used are Caltrans districts (12 units), and counties (58 units). The six nested levels of watersheds, listed from largest to smallest size are: river basins (RB, 9 units), hydrologic units (HU, 189 units), hydrologic areas (HA, 578 units), hydrologic sub-area (HAS, 1040 units), super planning watersheds (SPWS, 2309 units), and planning watersheds (PWS, 6998 units). All of these boundary delineations were intersected together to create a combined planning unit map layer that contains 8058 unique combinations of district, county, and watersheds.

Highways and proposed projects buffered on each side of their centerline by 500 meters were intersected with these combined planning units in order to allow for watershed specific analyses of the biological resources potentially impacted by highways and proposed future highway projects. This combined planning unit layer was used to summarize available biological, physical, and cultural information that was input into a relational database for assessing the biological mitigation needs of Caltrans districts, counties, and watersheds in the State of California.

Biological Database

The biological components of the state-wide database currently comprise four main elements: landcover derived from aerial imagery, point locations of known occurrences, listed plant species range maps, and vertebrate animal range maps.

We included a landcover map to be able to assess the extent of impact of proposed projects on different habitat types. The landcover map used for this exercise was the California Department of Fish and Game's Fire and Resource Assessment Program (FRAP, 2003) digital multi-source landcover of California map, which is a composite map is based on the best available landcover information. It identifies approximately 50 different landcover types, termed Wildlife Habitat Relationship (WHR) classes, for the state of California.

We incorporated two sets of information about species: known occurrences and potential occurrences as measured by range maps. The known occurrences were derived from the state's California Natural Diversity Database (CNDDB, California Department Fish and Game, Wildlife & Habitat Data Analysis Branch 2006), a current collection of the reported locations of listed species. The terrestrial vertebrate range maps used are the same as those used by California Department of Fish and Game (CWHR 2005). Each species range map was intersected with each of the spatial configurations mentioned above. Vascular plant range maps were derived from the CalJep database (Viers et al 2006). Plant ranges in this database are defined as a plant's presence or absence in each of 228 mapping units in California. We took the definitions for each listed plant, and intersected that range map with the estimated elevational distribution as listed in the most recent flora of California (Hickman 1993), resulting in a more conservative estimate of the distribution of each species.

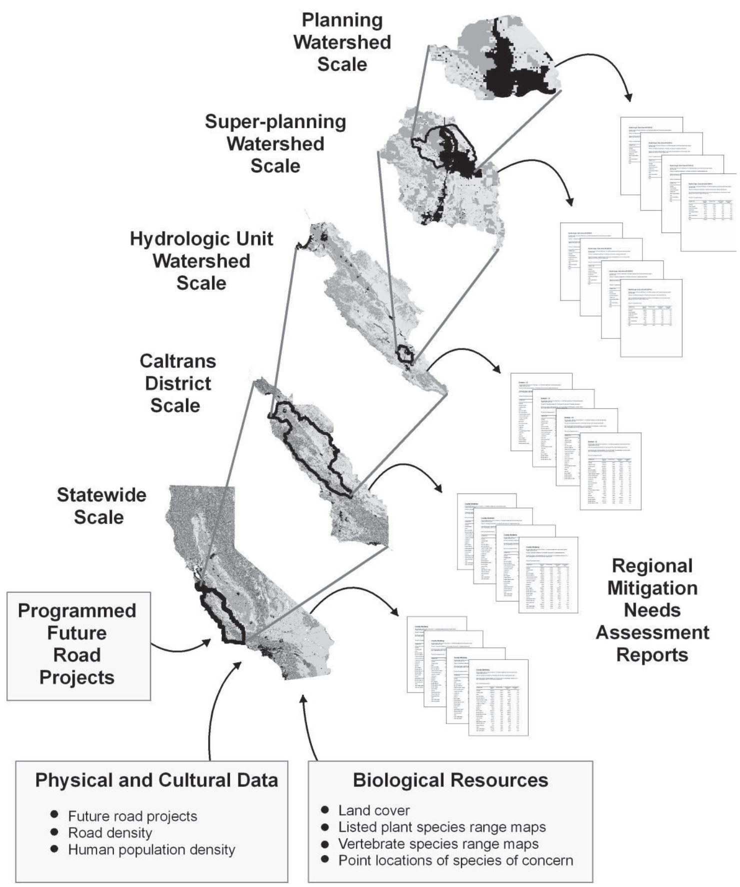

Figure 1. The state of California was cut into 8 spatial frameworks. Each spatial framework was contained the same data- four datasets representing biological data, and four representing human activities.

Impacts Database

Cultural Impacts

For each unique combination of Caltrans district, county, and watershed, a set of summary statistics were calculated that indicate the level of human impact already present on the landscape, including road and population density in that planning unit. The roads layer (from Geographic Data Technologies, GDT, 2006) was intersected with the combined planning unit layer to calculate the road density in each spatial unit. Similarly, block level population density was broken into each spatial unit.

Future Transportation Project Impacts

A GIS of future programmed transportation projects was obtained from the California Transportation Investment System (CTIS) and used to estimate the potential biological impacts due to each project within each county, district, and watershed (figure 2). The CTIS GIS database shows the stretches of roads along which projects have been identified and funded, and has a description of each project. Based on the project description and consultation with Caltrans, we estimated the linear distance from the center of the road that would be impacted by different types of projects (table 1). The distance impacted ranged from 500 feet for a highway being build on an new alignment to 5 feet for median replacement or traffic operation systems. Then to estimate the types of habitat impacted by the programmed projects, we buffered each project 500 meters out from the road on either side and intersected it with the land cover map. This analysis provided a relative estimate of the amount of each habitat type that might be impacted by that particular project. Then to estimate the actual area that would need to be mitigated for, the total area of each habitat type within the buffered area was divided by 500 and multiplied by the distance out from the center of the road estimated to be impacted (table 1).

The CTIS projects buffered by 500 m within the combined planning units were also intersected with the point and polygon observations of rare and endangered species from the CNDDB database. For each CTIS project, the vertebrate and listed plant species ranges were identified that intersected with any of the planning watersheds the project touches.

Database Assembly

Once the spatial processing was completed, the tables representing the results were imported into a relational Microsoft Access database. All of the biological data were linked to each highway and programmed project within each of the combined planning units. A graphical user interface (GUI) was developed to allow for queries to be run easily, and a report generating function was created to output standardized reports from the custom queries (figure 3). Using the GUI, any combination of district, county, watershed, highway, and project can be queried and potential biological impacts due to future transportation projects will be returned in a standardized report format. The four types of standardized reports available for any given queried area are: (1) area of different land cover types and estimated area impacted by all programmed future transportation projects based on the project type in the given queried area; (2) a list of the known species occurrences including listing status (from the CNDDB database) that are located in the queried area, as well as those that are located within 500 meters of a programmed project; (3) a list of the vertebrate species range maps, including listing status, that overlap with the queried area (from the CWHR database); and (4) a list of the state and federally listed plant range maps that overlap with the queried area (from CalJep database). All the reports include a header proving background summary information about queried area that includes the density of the different types of roads, human population density, and the number of programmed projects.

Table 1: Estimated footprint width of highway project types in California

Project Type	Estimated Footprint Width (feet)
New alignment	500
Reconstruct interchange and access ramps	200
Construct expressway	200
Construct new bridge	150
Widen roadway	100
Remove rail trestle	100
Realign curve	100
Grade separation improvements	100
Construct expressway existing alignment	100
Truck climbing lanes	50
Slow vehicles lane	50
Passing lanes	50
construct lane	50
High occupancy lanes	40
Stabilize slope	30
Rehabilitate roadway	30
Construct noise barrier	30
Slope erosion control	30
Construct left turn lane	30
Construct bike path	30
Construct retaining wall	20
Rehabilitate other	20
Other project	20
Install median barrier	20
Repair landslide	20
Roadside rest areas	10
Rehabilitate pavement	10
Install warning devices	5
Install message signs/traffic operation systems	5
Install ramp metering	5
Operational improvements	5

Results

There are many ways to query the database presented here. The following results present four examples of how the database may be useful for assessing biological mitigation needs for future transportation projects: (1) by a single project, (2) by all the projects along a specific highway, (3) by a specific transportation district, and (4) by a specific watershed.

Mitigation Needs Reports

Single Project

Selecting a single CTIS programmed project at random, ID #0A4000, is a roadway rehabilitation (see inset of figure 3 for location). The work is along 5 miles of highway and is estimated to traverse 54.6 acres; with 52% of that going through Agriculture and 34.6% through annual grasslands, both types that are extensive within the state and for which mitigation requirements are generally low. The project may cross blue oak woodland (0.25 acres), a valuable type for the wildlife that uses it, and might impact 0.8 acres of critical coastal Scrub habitat, which houses several endangered species and is a recognized conservation concern.

There are 13 listed vertebrate species whose range maps intersect the watershed that the project occurs in. These species are therefore possibly present within the footprint of the project, and the list serves to alert the biologists who would do the field survey to their potential presence. Similarly, there are nine listed plant species whose range maps intersect the watershed the project occurs in. The actual geographic location of sightings of five listed species are recorded for the watershed the project occurs in, and of those four are found within the footprint of the programmed project: *Caulanthus californicus* (California jewel-flower), *Dipodomys ingens* (giant kangaroo rat), *Gambelia sila* (blunt-nosed leopard lizard) , and *Vulpes macrotis mutica* (San Joaquin kit fox). It took approximately three minutes to retrieve this information from the database.

Specific Highway

Highway 132 is an east-west highway running between Modesto and Freemont in California's San Joaquin Valley (figure 3 inset). There are four highway improvements projects programmed to occur along the highway over the next 10 years. The habitat map identifies 16 landcover types, covering 30,030 acres, of which 168.9 acres that would be impacted (table 2), along a highway that measures 76 miles. The type that will be most impacted is agriculture, at 40.8 acres. Three natural vegetation types would be impacted, including 2.2 acres of Annual Grasslands. Sensitive habitats, including Valley foothill riparian and Freshwater emergent wetlands are projected to be impacted by 1.6 and 0.3 acres, respectively. The database also includes the overall extent of each landcover type in the state- e.g. freshwater emergent wetlands cover 456,952 acres, of which 79,422 acres are currently protected. Three of the four projects programmed on this highway are along the edges of urban regions, leading to the high level of urban impacts.

There are 14 listed terrestrial vertebrates and 21 listed vascular plants whose species ranges fall in watersheds that intersect this highway. Sixteen listed species have georeferenced sightings within the project's watersheds, and of those and one is already known to be within the footprint of the programmed projects along the highway.

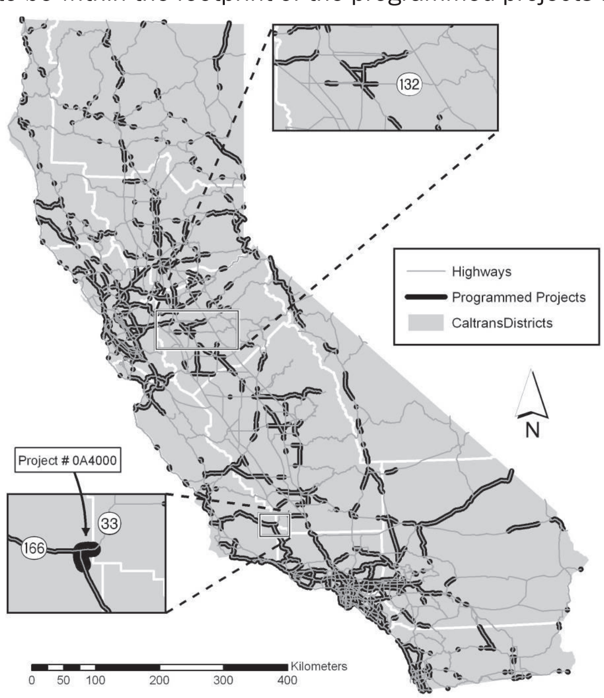

Figure 2. The 967 programmed projects in California, as derived from the CTIS database. The impacts of each of these were assessed separately and the data complied for report generation from a number of perspectives.

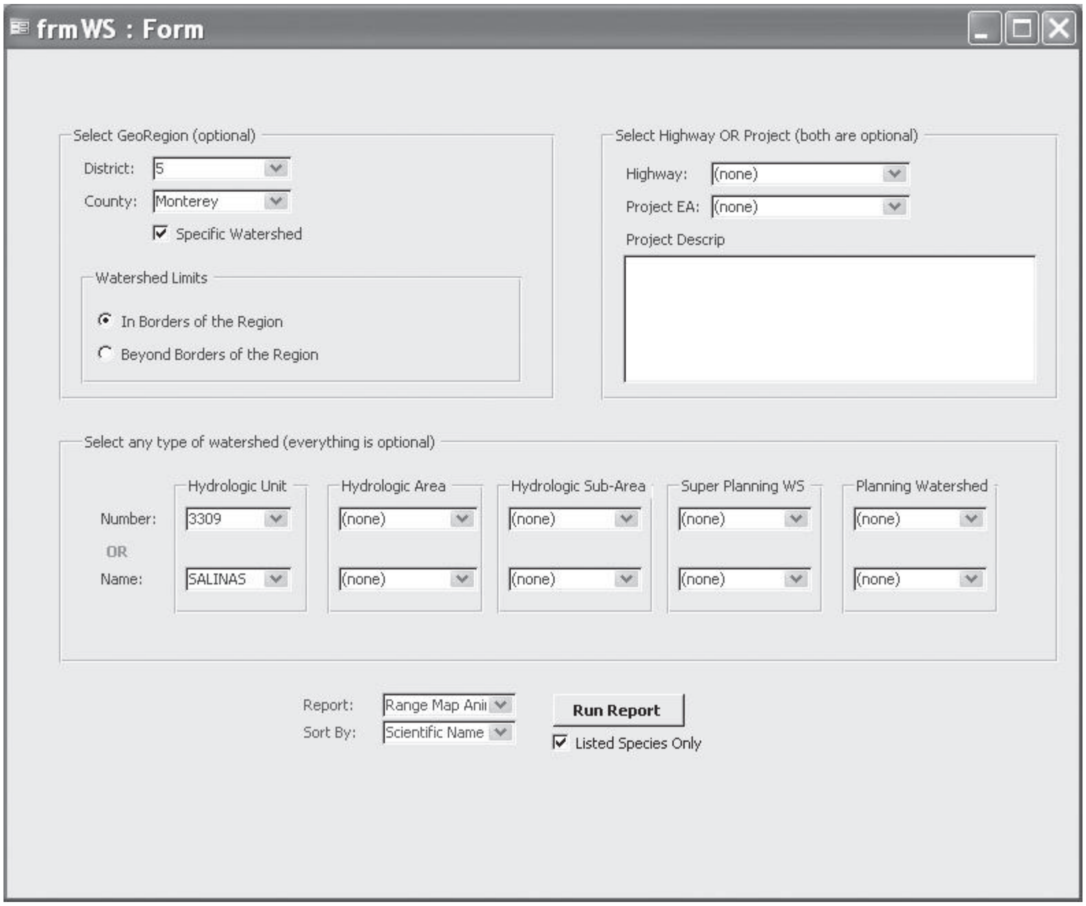

Figure 3. The interface of the California state biomitigation needs database. The coarsest scale watershed units (Hydrologic Region) are not shown.

Single Transportation District

Caltrans district five is located along the central coast of California, shown as in figure 1 termed 'Caltrans district'. By querying the district, the following summary information is developed. The total area of the district covers 7,054,287 acres. As of 2000 the population was 1.34 million and the area contained 480,427 housing units. The district contains 0 miles of interstate highways, 275 miles of federal highways, and 903 miles of state highways. There are 94 programmed projects in the district. Examples of the first page of outputs from each of the categories available are shown in appendix 1.

Range maps of 132 listed plant species and 73 listed vertebrates intersected the footprint of the programmed projects in district 5, and therefore should be the focus of field surveys to confirm presence or absence as projects move forward. Actual occurrence data is available for 371 species in the district, of which 98 are state or federally listed. Within the programmed area footprints, there are 157 recorded occurrences of plants and animals, of which 49 are listed. These represent recorded populations of state or federally listed species that are in locations that are currently planned for highway improvements. There are 38 landcover types recorded for the region, of which Annual grasslands will be the most impacted by programmed projects, and 1174 acres. Coastal Scrub, a critical habitat for several endangered species is projected to lose 64 acres, and extremely rare saline and fresh water emergent wetlands to lose 6.6 acres and 0.03 acres, respectively. For each landcover type, the amount impacted, the amount of the type in the state, and the percentage of the impacted over the state, and the amount protected as of January 2007 was listed.

Table 2: The extent of landcover types along Highway 132, California, and the extent of each type projected to be impacted by the four programmed projects on the highway

Landcover Type	Total Acres Along Highway of Type	Acres of Type Affected
Agriculture	12,295.7	40.8
Annual Grassland	7,153.6	2.2
Barren	101.3	0.0
Blue Oak Woodland	2,248.6	0.0
Blue Oak-Foothill Pine	180.4	0.0
Chamise-Redshank Chaparral	736.4	0.0
Douglas-Fir	12.4	0.0
Freshwater Emergent Wetland	158.1	0.3
Mixed Chaparral	175.4	0.0
Montane Hardwood	988.4	0.0
Montane Hardwood-Conifer	625.2	0.0
Unknown Conifer Type	143.3	0.0
Unknown Shrub Type	395.4	0.0
Urban	4,089.5	123.9
Valley Foothill Riparian	573.3	1.6
Water	153.2	0.1
Total	30,030.1	168.9

Specific Watershed

The Salinas River occupies one of the largest watersheds in district five. Of the 94 programmed projects in district five, 21 of them occur in the Salinas watershed. An estimated 402 acres will be impacted, including 2.5 acres of coastal scrub, 20.4 acres of coast live oak woodland, and 0.15 acres of Saline emergent wetland. Over 350 acres of the total is in urban areas, on agricultural lands or on annual grasslands. There are 59 federally or state-listed threatened, endangered, sensitive or candidate vertebrate species whose range maps intersect the watershed (out of 368 vertebrates in the region). There are 74 plant species of concern (64 listed as state or federally rare, threatened or endangered) whose range maps intersect the valley. There were 176 recorded sighting of species (plants and vertebrates) of concern in the watershed, of which 72 are state or federally listed. Of those recorded sightings, 45 are in the footprint of the programmed projects, and of those 13 are federally listed.

Discussion

The objective of this effort was to provide a variety of transportation planners and transportation agency biologists a simple tool that allowed mitigation forecasting. We specifically wanted the end user to not have to be a GIS expert to extract the information they needed from what we compiled. Therefore, we pre-calculated the spatial relationships between natural resources defined in four ways and four measures of human activity in a geographic framework, which permitted their integration in multiple arrangements. Once all the data were integrated into the 8 spatial frameworks used to represent the state, a database could be developed that allowed the cross-querying of these items. The resulting reports permit a rough estimate of the mitigation needs that will be encountered for any or all of the 967 programmed projects that were registered to the database.

The multi-scale framework permits assessments at different scales, depending on the questions being asked. Therefore, a district biologist can use the database as a way to preview what species might be encountered when heading out to the field for a survey of a potential site. It could also be used by an environmental planner trying to assess what the overall magnitude of mitigation requirements for a transportation district might be. This type of forecasting capacity will make it easier to justify the acquisition of important habitat types at the early phase of the planning process, when acquisition of the property will be more economic. In some cases early acquisition will be the only option, because waiting could lead to no habitat remaining available for acquisition.

One of the advantages of using a defined set of spatial domains is that as other important data are developed for a region, they can be incorporated into the overall analyses. Effective mesh size (Girvetz et al. these proceedings), or wildlife connectivity models (e.g., Penrod et al. 2000, Thorne et al. 2006, Shilling et al 2002, Noss et al. 1999) could be spatially integrated into the California database presented here, so that planners would know when terrestrial connectivity was an issue in a particular watershed. Air quality and stream condition data could also be assembled, which would permit an entry into the aquatic side of mitigation planning, and an assessment of the contribution to current air pollution that new planned roads might have.

We developed an expandable database framework as a first step for mitigation forecasting in California. If this data framework proves useful, additional work will make it possible to update the database, and modifications could eventually be possible by the user, such as defining a new project area by drawing new polygons that would get incorporated into a central server where the updated GIS processing would be done to update the database. The geodatabase should at that point be able to return the updated impacts report for the user. This arrangement would mean that new biological, cultural and physical data would have to be updated at a central location, but that projects could essentially be loaded and queried remotely. Until that time arrives, the advantage to the database to date is that it can be run on a desktop computer without a GIS.

Biographical Sketches: James Thorne is a research scientist at the Information Center for the Environment, UC Davis. He received his PhD in Ecology at UC Davis in 2003, and has a masters in Geography from the UC Santa Barbara. His research interests include the integration of ecological data into planning, development and deployment of large datasets, and estimating the impacts of climate change.

Evan Girvetz is a doctoral student in the Graduate Group in Ecology at the University of California UC Davis (degree expected December 2007). His research focuses on using geographic information systems (GIS) integrated with quantitative analysis techniques to provide decision-support for answering real-world questions faced by land use planners and decision makers. He is currently a graduate student research fellow with the Road Ecology Center (UC Davis), and with the Information Center for the Environment (UC Davis).

Michael C. McCoy serves as academic administrator and principal investigator for the Information Center for the Environment. He specializes in the development, aggregation and dissemination of environmental information. In this capacity he works with a variety of agencies, committees and funding sources and works to achieve consensus on the best strategies for integrating data and implementing strategy. Projects include studies of regional environmental planning methodologies, land use and infrastructure planning policy, and the development of rule based and microeconomic land use models.

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Appendix 1

Output tables produced by querying the mitigation needs database for all programmed projects within Caltrans district 5 located on the central coast of California. The Headers and first several rows from each files are presented, as well as the total landcover assessment.

For range maps of listed plant species that intersect with watersheds that programmed projects occur in:

District # 5 Plant Range Distributions

The Area occupies 28547.69 sq.km (7054287 acres). As of 2000 the population was 1327400 people and the area contained 480427 house units.

There are 25 hydrologic unit watersheds, 70 hydrologic Sub-Areas and 870 planning watershed units.

There are 0 km (0 miles) of Interstate Highways, 443.1 km (275.33 miles) of Federal Highways, 1454.58 km (903.84 miles) of State Highways, and 125.57 km (78.03 miles) of Unknown Type

There are 94 of programmed projects.

Scientific Name	Common Name	Federal List	State List
Acanthomintha ilicifolia	San Diego thorn-mint	Threatened	Endangered
Acanthomintha obovata ssp.	San Mateo thorn-mint	Endangered	Endangered
Ambrosia pumila	San Diego ambrosia	Endangered	None
Amsinckia grandiflora	large-flowered fiddleneck	Endangered	Endangered
Arctostaphylos edmundsii var.	Hanging Gardens manzanita		Rare
Arctostaphylos glandulosa ssp.	Del Mar manzanita	Endangered	None
Arctostaphylos hookeri var.	Hearst's manzanita		Rare

For range maps of listed terrestrial vertebrates that intersect with watersheds in which programmed projects occur:

District # 5 Animal Range Distribtutions

The Area occupies 28547.69 sq.km (7054287 acres). As of 2000 the population was 1327400 people and the area contained 480427 house units.

There are 25 hydrologic unit watersheds, 70 hydrologic Sub-Areas and 870 planning watershed units.

There are 0 km (0 miles) of Interstate Highways, 443.1 km (275.33 miles) of Federal Highways, 1454.58 km (903.84 miles) of State Highways, and 125.57 km (78.03 miles) of Unknown Type

There are 94 of programmed projects.

Scientific Name	Common Name	Federal List	State List
Accipiter gentilis	Northern Goshawk	BLM/FS	None
Agelaius tricolor	Tricolored Blackbird	BLM/FS	None
Ambystoma californiense	California tiger salamander	Threatened	None
Ambystoma macrodactylum	Long-toed Salamander	Endangered	Endangered….

For actual occurrences of listed terrestrial plants and animals that are in the Caltrans district five:

District # 5 Species Occurrences by Planning Watershed

The Area occupies 28547.69 sq.km (7054287 acres). As of 2000 the population was 1327400 people and the area contained 480427 house units.

There are 25 hydrologic unit watersheds, 70 hydrologic Sub-Areas and 870 planning watershed units.

There are 0 km (0 miles) of Interstate Highways, 443.1 km (275.33 miles) of Federal Highways, 1454.58 km (903.84 miles) of State Highways, and 125.57 km (78.03 miles) of Unknown Type

There are 94 of programmed projects.

Scientific Name	Common Name	Federal List	State List
Agelaius tricolor	Tricolored Blackbird	BLM/FS	None
Ambystoma californiense	California tiger salamander	Threatened	None
Ambystoma macrodactylum	Santa Cruz long-toed salamander	Endangered	Endangered
Antrozous pallidus	Pallid Bat	BLM/FS	None
Aquila chrysaetos	Golden Eagle	BLM/FS	None….

For actual occurrences of listed terrestrial plants and animals that recorded in the footprint of programmed projects:

District # 5 Species Occurrences by Programmed Project

The Area occupies 28547.69 sq.km (7054287 acres). As of 2000 the population was 1327400 people and the area contained 480427 house units.

There are 25 hydrologic unit watersheds, 70 hydrologic Sub-Areas and 870 planning watershed units.

There are 0 km (0 miles) of Interstate Highways, 443.1 km (275.33 miles) of Federal Highways, 1454.58 km (903.84 miles) of State Highways, and 125.57 km (78.03 miles) of Unknown Type

There are 94 of programmed projects.

Scientific Name	Common Name	Federal List	State List
Agelaius tricolor	Tricolored Blackbird	BLM/FS	None
Ambystoma californiense	California tiger salamander	Threatened	None
Ambystoma macrodactylum	Santa Cruz long-toed salamander	Endangered	Endangered
Ammospermophilus nelsoni	Nelson's antelope squirrel	None	Threatened
Antrozous pallidus	Pallid Bat	BLM/FS	None….

For the habitat types found in Caltrans district five. This table is presented in its entirety.

Habitat Impact Report District # 5

The Area occupies 28547.69 sq.km (7054287 acres). As of 2000 the population was 1327400 people and the area contained 480427 house units.

There are 25 hydrologic unit watersheds, 70 hydrologic Sub-Areas and 870 planning watershed units.

There are 0 km (0 miles) Interstate Highways, 443.1 km (275.33 miles) Federal Highways, 1454.58 km (903.84 miles) State Highways, and 125.57 km (78.03 miles) Unknown Type

There are 94 programmed projects.

Vegetation Type:	Total Area of state	Selected Percent (acres):	Area Protected (acres)	Area Impacted (acres):
Agriculture	1320435.68	15.30%	2693.39	651.79
Alkali Desert Scrub	32612.26	0.38%	1200.91	3.71
Annual Grassland	2747008.23	31.82%	47364.13	1174.74
Barren	30724.41	0.36%	7106.60	20.21
Blue Oak Woodland	582807.59	6.75%	20630.38	99.11
Blue Oak-Foothill Pine	160859.63	1.86%	1929.85	1.44
Chamise-Redshank Chaparral	303073.09	3.51%	55612.33	0.75
Closed-Cone Pine-Cypress	12930.74	0.15%	3595.31	3.65
Coastal Oak Woodland	710086.33	8.23%	81750.56	79.45
Coastal Scrub	608370.08	7.05%	62049.28	63.91
Desert Scrub	882.15	0.01%	0.00	0.56
Desert Succulent Shrub	286.64	0.00%	0.00	1.58
Desert Wash	953.81	0.01%	0.00	10.28
Douglas-Fir	2673.62	0.03%	397.83	0.00
Eucalyptus	1947.15	0.02%	0.00	0.88
Freshwater Emergent	242.16	0.00%	210.04	0.03
Jeffrey Pine	439.84	0.01%	410.19	0.00
Juniper	14262.61	0.17%	1000.76	0.17
Lacustrine	59.30	0.00%	0.00	0.08
Mixed Chaparral	950702.42	11.01%	298464.68	17.94
Montane Chaparral	1771.71	0.02%	1321.99	0.00
Montane Hardwood	100124.92	1.16%	41922.99	2.04
Montane Hardwood-Conifer	73230.56	0.85%	32849.47	2.41
Montane Riparian	13847.48	0.16%	657.29	2.56
Pasture	2456.17	0.03%	0.00	0.00
Pinyon-Juniper	30039.95	0.35%	3852.29	0.00
Ponderosa Pine	4428.03	0.05%	1485.07	0.00
Redwood	139166.72	1.61%	34972.06	11.10

Vegetation Type:	Total Area (acres):	Percent of	Area Protected (acres):	Area Impacted (acres)
Sagebrush	9377.45	0.11%	390.42	3.16
Saline Emergent Wetland	3135.70	0.04%	1672.87	6.63
Sierran Mixed Conifer	2616.79	0.03%	2327.68	0.00
Unknown Conifer Type	24334.41	0.28%	1848.31	0.20
Unknown Shrub Type	119670.53	1.39%	5181.69	45.10
Urban	550983.58	6.38%	3281.49	731.63
Valley Foothill Riparian	17739.31	0.21%	746.24	3.20
Valley Oak Woodland	25893.61	0.30%	1018.05	3.49
Water	31507.72	0.37%	822.84	10.92
Wet Meadow	17.30	0.00%	0.00	0.00
Total:	**8631699.67**	**100%**	**718766.95**	**2952.73**